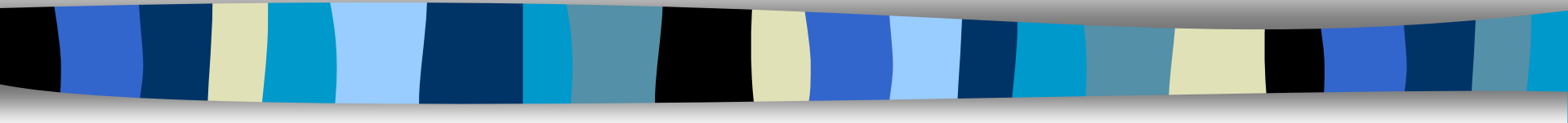
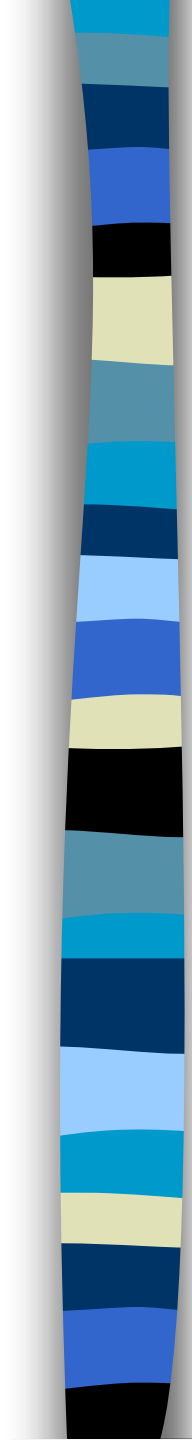


PFD & P&ID



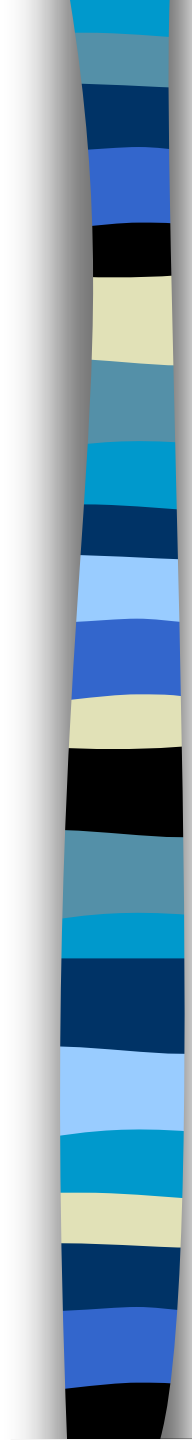
Anjum Naveed



GOALS

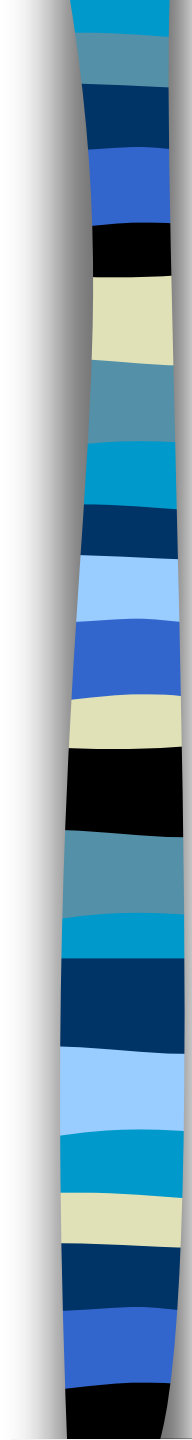
BE able to

- Grab Concept of PFD and P&ID
- Extract Information
- Describes the PFD and P&ID system of line, valve and flow symbols.
- Explains PFD and P&ID symbols used for instrument and measuring devices.

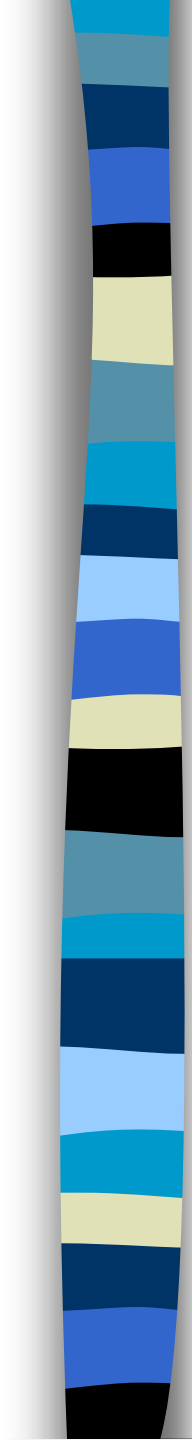


Outline

- INTRODUCTION
- PFD
- P&ID

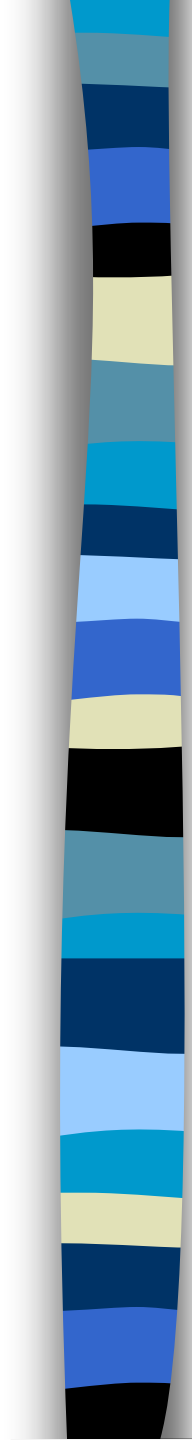


INTRODUCTION



TYPES OF FLOW DIAGRAM

- BFD (Block Flow Diagram)
- PFD (Process Flow Diagram)
- UFD (Utility Flow Diagram)
- MFD (Mechanical Flow Diagram)
- P&ID (Piping and Instrumentation Diagram)



PFD

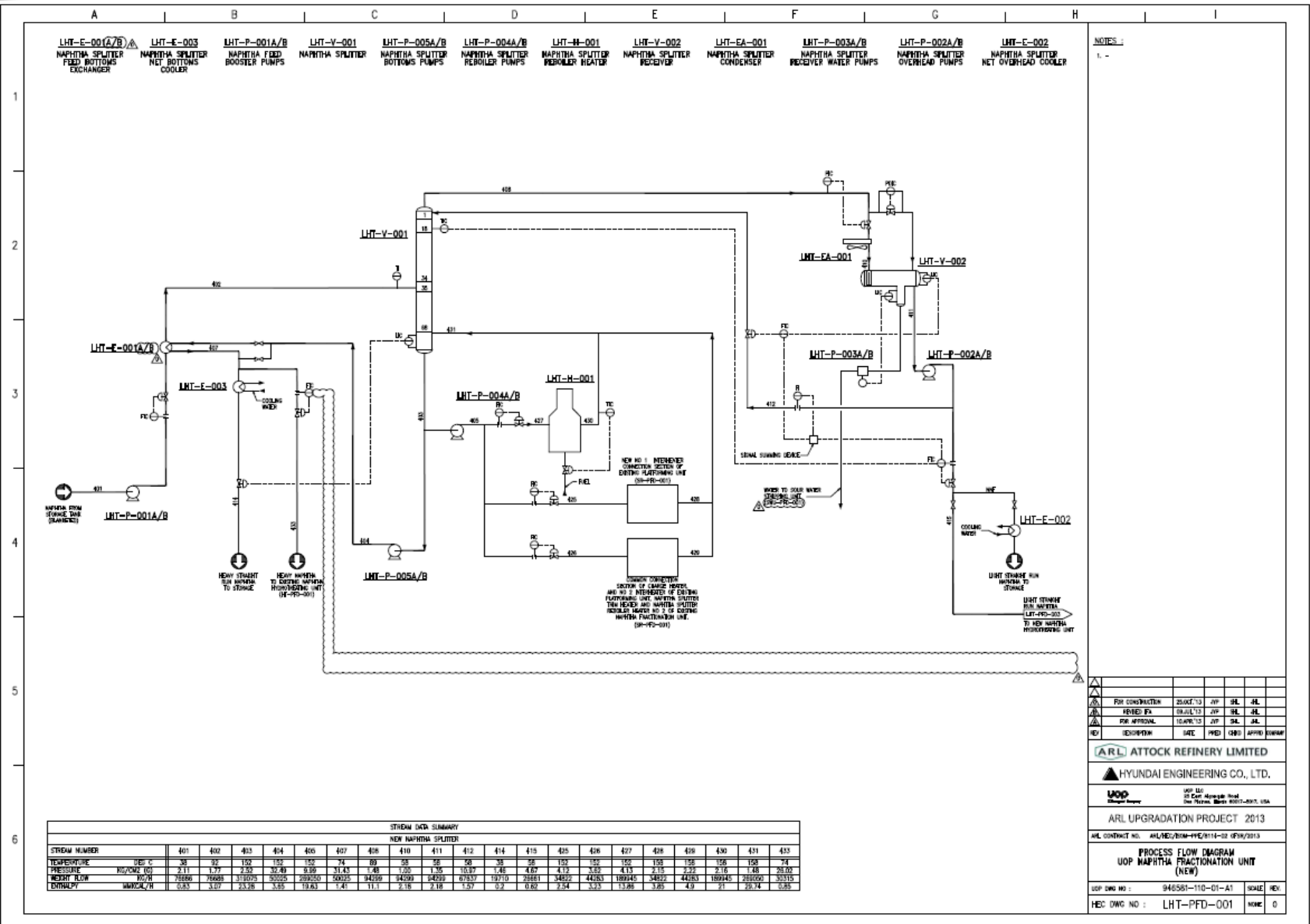
A **process flow diagram** (PFD) is a **diagram** commonly used in chemical and **process** engineering to indicate the general **flow** of plant **processes** and equipment.

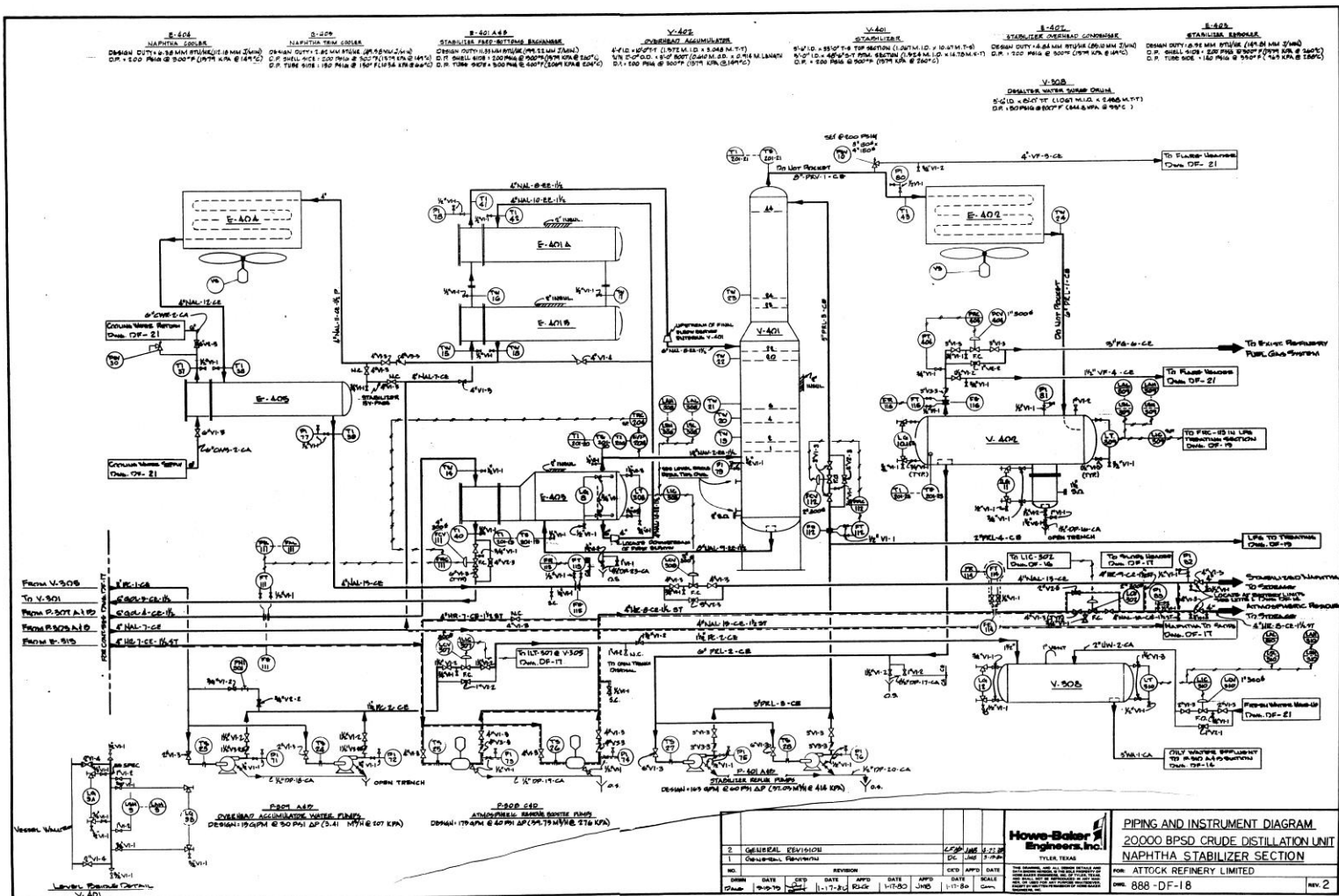
P&ID

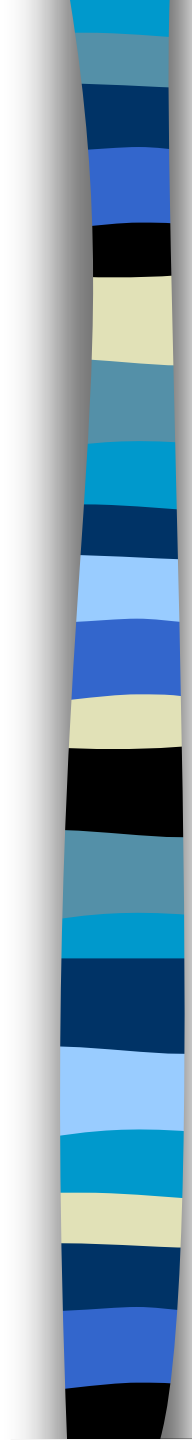
A **Piping and Instrumentation Diagram** - P&ID, is a schematic illustration of functional relationship of piping, instrumentation and system equipment components

Instrumentation, Systems, and Automation Society (ISA)

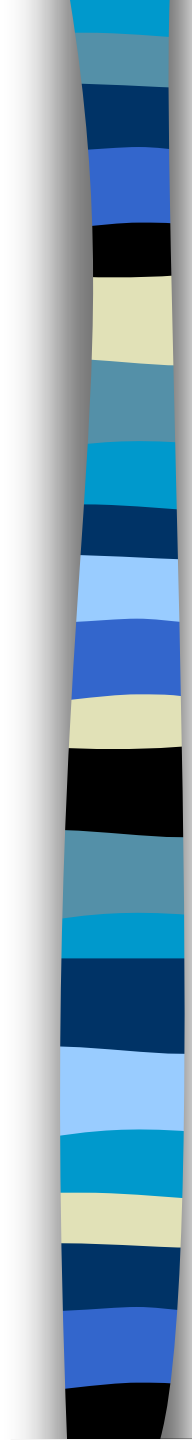








PFD



Uses

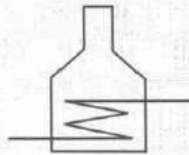
- Use to know topolog of Process
- Useful for conveying the heat and material balances
- Useful for conveying major pieces of equipment
- Useful for conveying processing conditions
- Useful for conveying utilities

PFD Shows

All major equipment



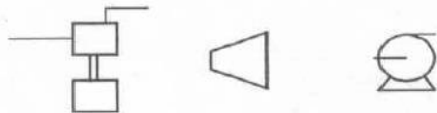
HEAT EXCHANGERS



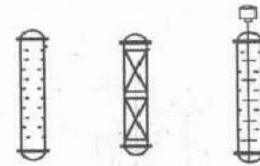
FIRED HEATER



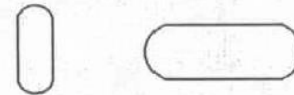
STORAGE TANKS



PUMPS, TURBINES,
COMPRESSORS



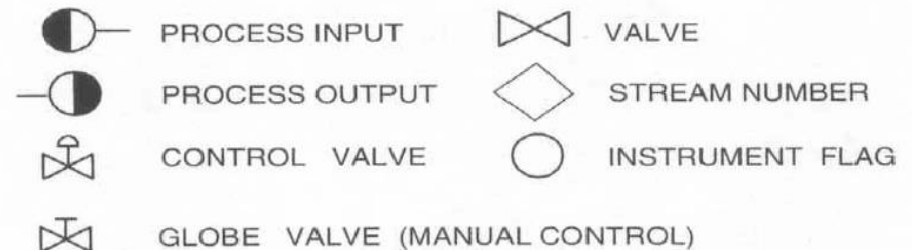
TOWERS



VESSELS



REACTORS



PFD Shows

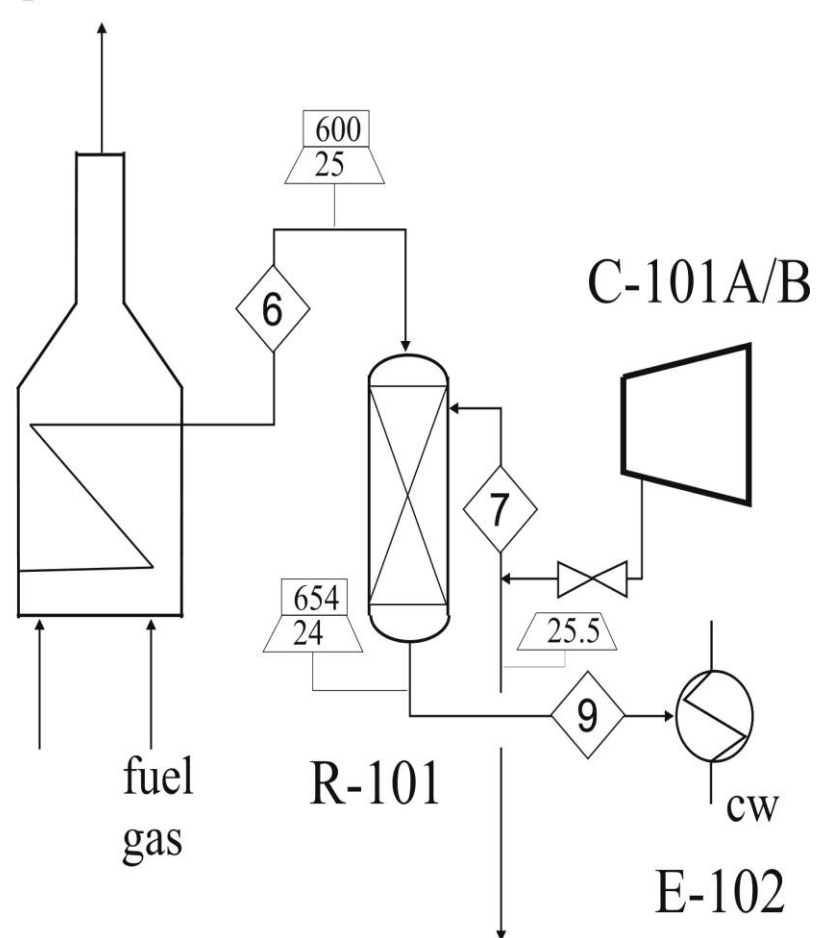
All major process and utility lines

NO

NO

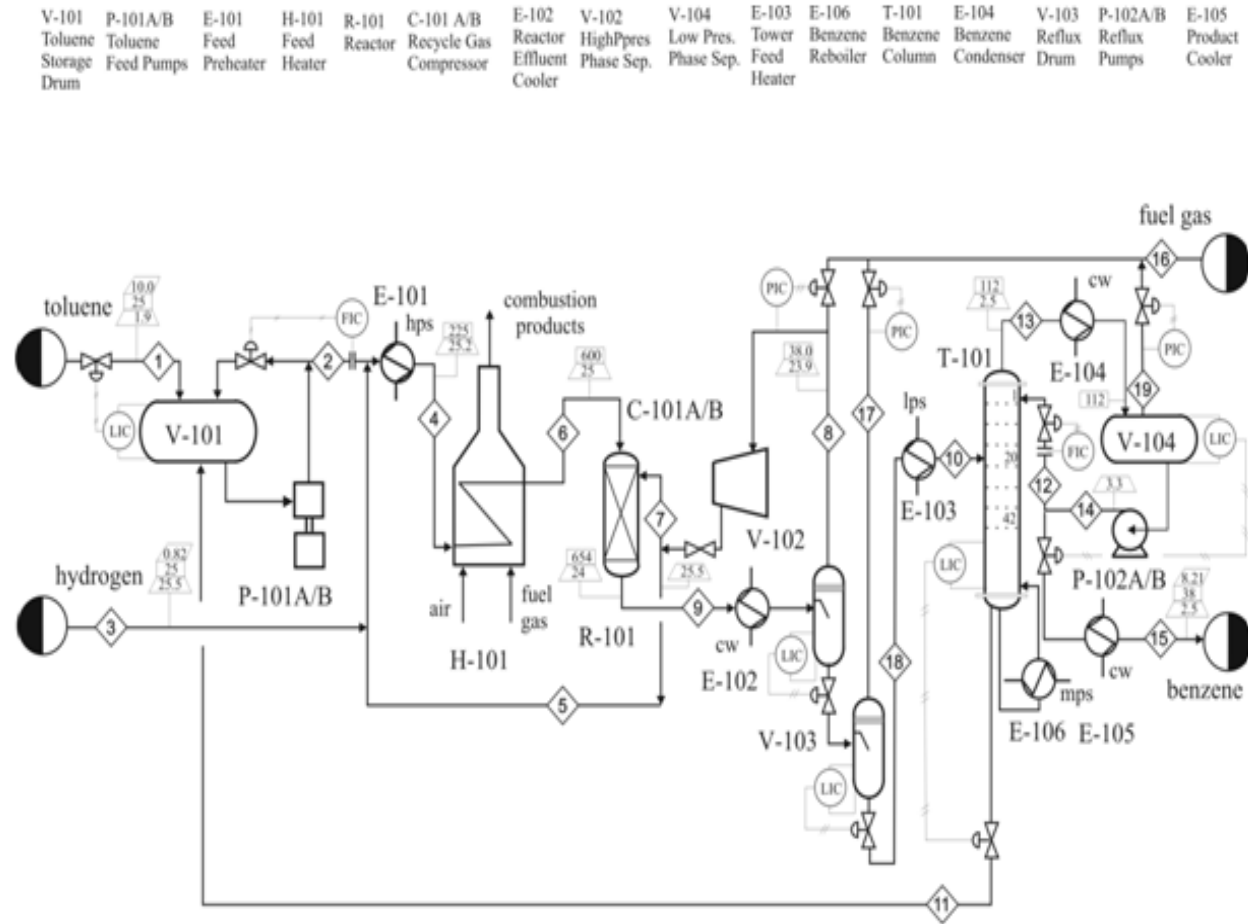
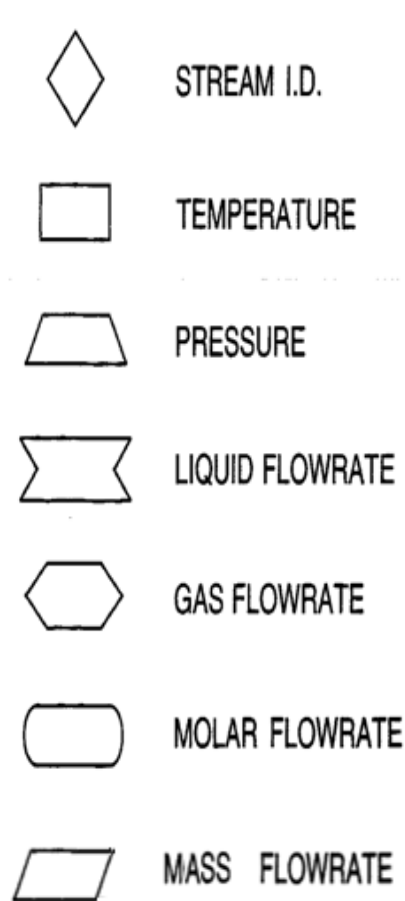
YES

combustion
products



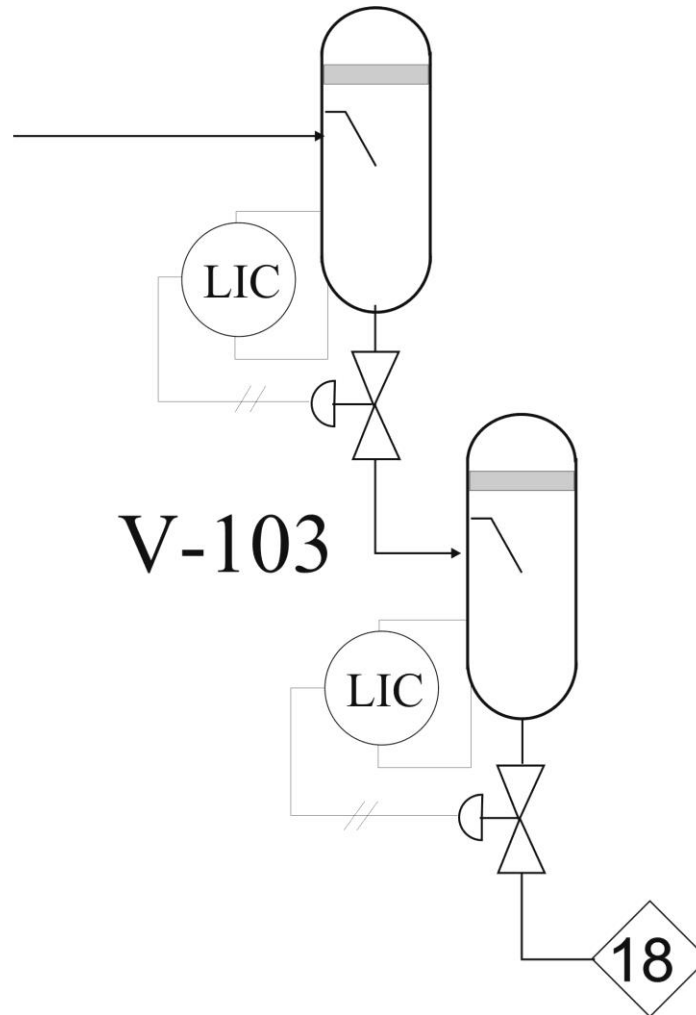
PFD Shows

All stream numbers, temperatures, pressures, flows



PFD Shows

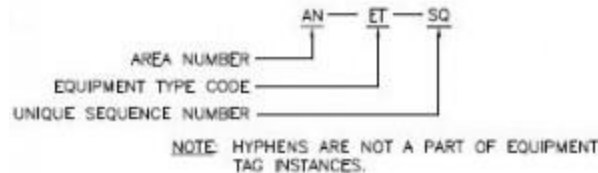
All major process controls and valves



PFD Shows

All equipment names and numbers

EQUIPMENT TAG FORMAT



AREA NUMBERS

(PROJECT SPECIFIC)

- 1—TANK FARM
- 2—TRAIN 1
- 3—SOLIDS DEWATERING
- 4—TRAIN 2
- 5—VAPOR HANDLING SYSTEM

EQUIPMENT TYPE CODES

- 1—FLUID TRANSPORT (BLOWERS, COMPRESSORS AND ALL TYPES OF PUMPS)
- 2—SOLIDS TRANSPORT (BELT AND SCREW CONVEYORS, FEEDERS, ETC.)
- 3—PHYSICAL SEPARATION (PHASE SEPARATION EQUIPMENT, FILTERS, SCREENS, GRAVITY SEPARATORS, CENTRIFUGES, MICRO/ULTRAFILTERS, ETC.)
- 4—MIXERS (AGITATORS, IN-LINE MIXERS, SHREDDERS, BLENDEERS, ETC.)
- 5—HEAT TRANSFER (HEAT EXCHANGERS, HEATERS, COOLING TOWERS, BURNERS, ETC.)
- 6—MASS TRANSFER (ADSORBERS, ION EXCHANGE, SCRUBBERS, STRIPPERS, COLUMNS, EVAPORATORS, ETC.)
- 7—CONTAINMENT (TANKS, VESSELS, PITS, SUMPS, SILOS, ETC.)
- 8—REACTORS (CHEMICAL REACTORS OR PRECIPITATORS, CRYSTALLIZERS, ETC.)
- 9—VENDOR PACKAGES & MISC. (PREFABRICATED SYSTEMS FROM 3RD PARTY SUPPLIERS, SPECIALTY EQUIPMENT UNCLASSIFIED ELSEWHERE)

1101 – The first pump in the tank farm area.

1701 – The first tank in the tank farm area.

1405 – The fifth mixer in the tank farm area.

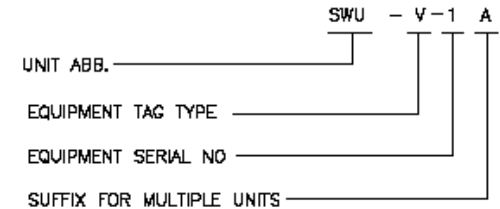
2901 – A vendor package in the Train 1 area.

HYU-P-001 – The first pump Hydrogen unit .

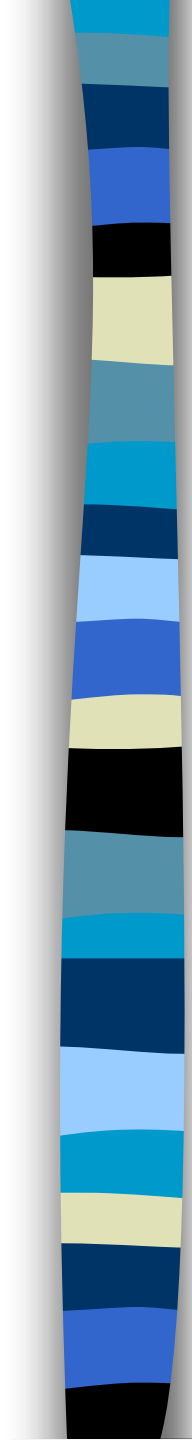
HDS-R-001 – The first reactor in DHDS Unit.

ISM-PU-001– A vendor package isom unit

EQUIPMENT TAG NUMBERING LEGEND

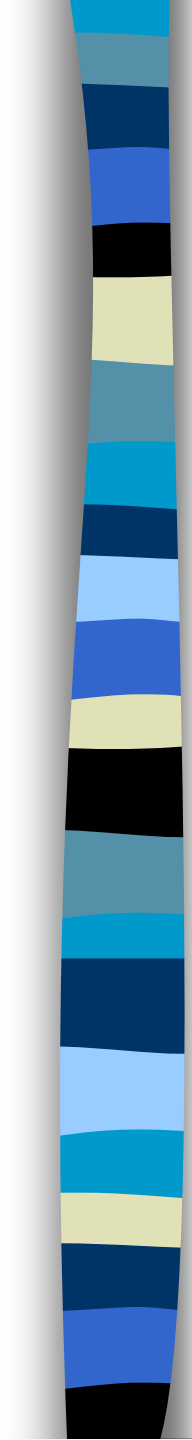


TAG TYPE	TAG DESCRIPTION	UNIT ABB.	DESCRIPTION
A	AERATOR/MIXER/AGITATOR	SWU	SOUR WATER UNIT
B	BLOWER	AMU	AMINE UNIT
C	COMPRESSOR	CWS	COOLING WATER SYSTEM
CT	COOLING TOWER	SRU	SULFUR RECOVERY UNIT
E	HEAT EXCHANGER	HYU	HYDROGEN UNIT
EA	AIR COOLER	SGS	STEAM GENERATION SYSTEM
F	FILTER/BELT FILTER	FLS	FLARE SYSTEM
H	FIRE HEATER/BOILER	FGS	FUEL GAS SYSTEM
M	MEMBRANES	FOG	FUEL OIL SYSTEM
MS	METERING SKID	CAS	COMPRESSED AIR SYSTEM
P	PUMP	PWS	PLANT WATER SYSTEM
PU	PACKAGE UNIT	HDS	DHDS UNIT
R	REACTOR	UGS	UTILITY GAS SYSTEM
SL	SCRAPER LAUNCHER	ISM	ISOMERIZATION UNIT
SR	SCRAPER RECEIVER	LHT	NEW NAPHTHA SPLITTER & NHT UNIT
ST	VENT/FLARE STACK	HT	EXISTING NAPHTHA SPLITTER & NHT UNIT
TK	TANK	HBU-I	HOWE BAKER UNIT I
U	MISCELLANEOUS	HBU-II	HOWE BAKER UNIT II
V	VESSELS	HCU	HEAVY CRUDE UNIT

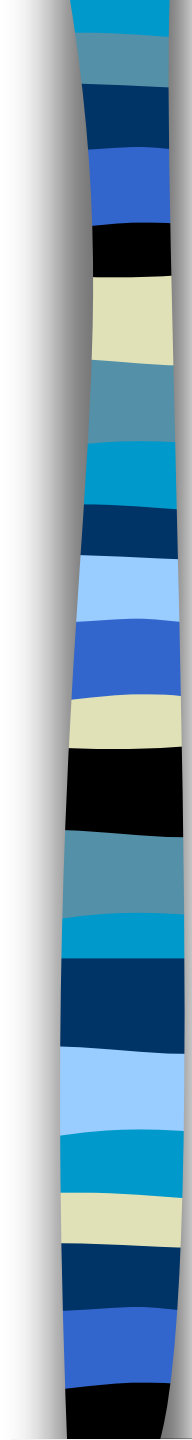


PFD Good Practices

- The flowsheet should generally flow from left to right.
- The flowsheet should not be cluttered - use multiple sheets.
- The flowsheet should be in landscape with the bound edge at top.
- The equipment should be drawn in approximately relative size, e.g. towers larger than drums, exchangers larger than pumps etc.
- The major towers and reactors are generally on one, or nearly one, level.
- The reader should be able to follow it with his or her eye.
- The streams should have the minimum of direction changes.
- The streams that enter across the battery limits should be on the left.
- The streams that leave across the battery limits should be on the right.
- The streams that move to the next sheet should leave on the right.
- The streams that recycle to earlier sheets should leave on the left.

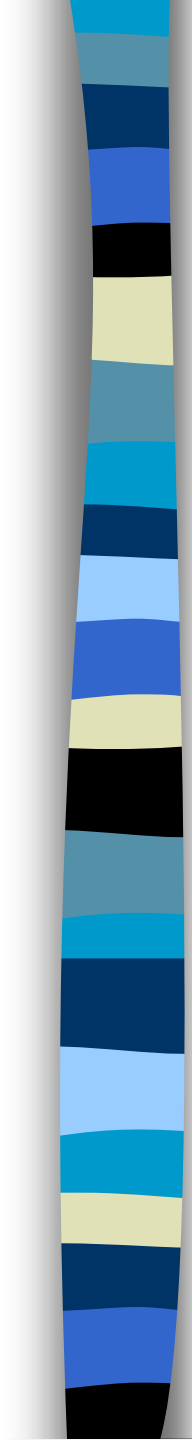


P&ID



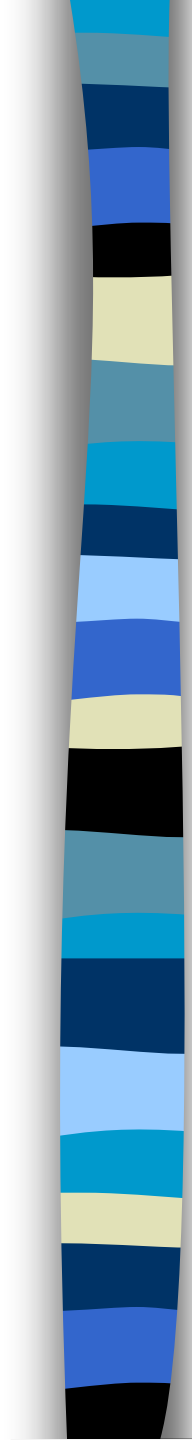
Uses

- Act as the definition of the process from which all engineering, fabrication, construction and operation is based.
- Serve as reference for Process Safety Information (PSI) in Process Safety Management (PSM).
- **BIBLE OF PLANT**



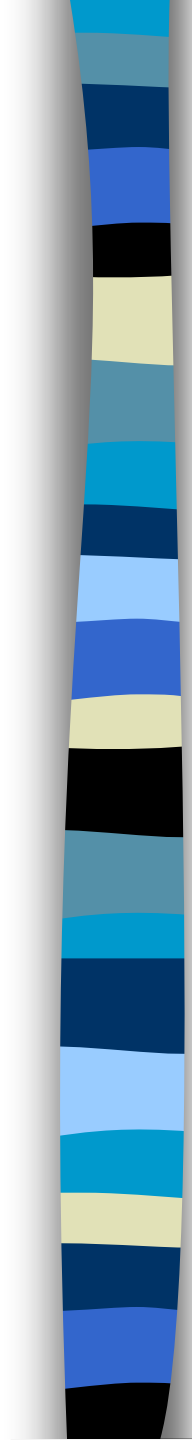
Content

- Major and minor equipment
- Valves
- Instrumentation
- Stand-alone controllers
- Buttons used to control motors and devices
- Motors and drives
- Limit and point devices
- Piping
- Virtual devices



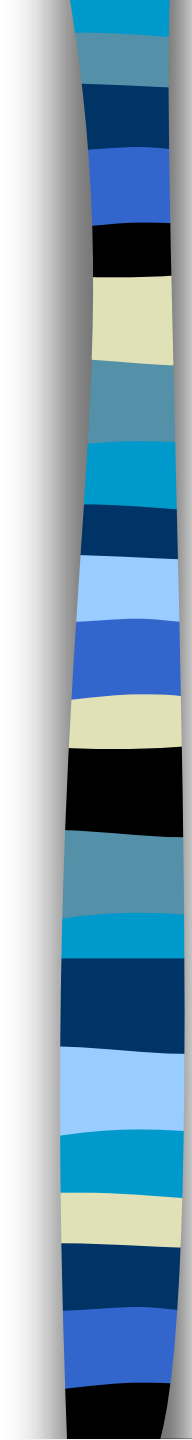
Limitation

- Not to Scale
- Not Geometrically Accurate
- Color Blind
- Not Definitive
- Not Drawn Consistently
- Don't Show Pipe fitting type



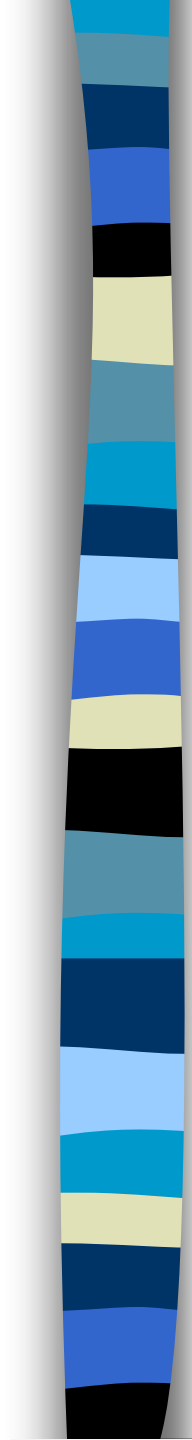
Supporting Documents

- Process Flow Drawings (PFDs)
- Piping specifications.
- Equipment and instrumentation specifications.
- Functional/process control documents
- Equipment Tag Numbering Procedure
- Line Numbering Procedure
- Material Specifications



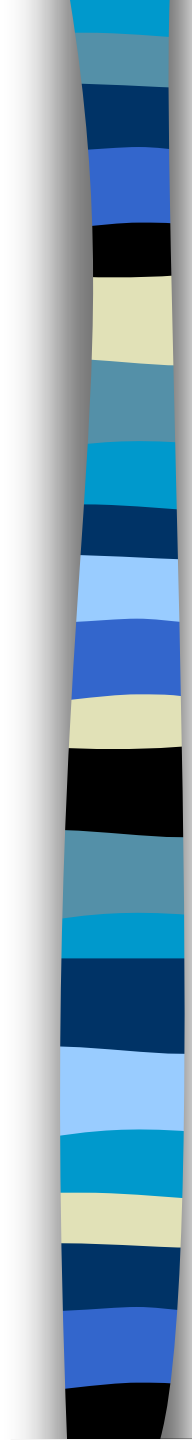
Reading P&ID

- The first step in reading a P&ID is to find the correct diagram.
- Each P&ID is numbered according to the section of pipeline that the P&ID displays.
- The P&ID number is located in the bottom right corner of the diagram, along with a brief description of the pipeline section it represents.



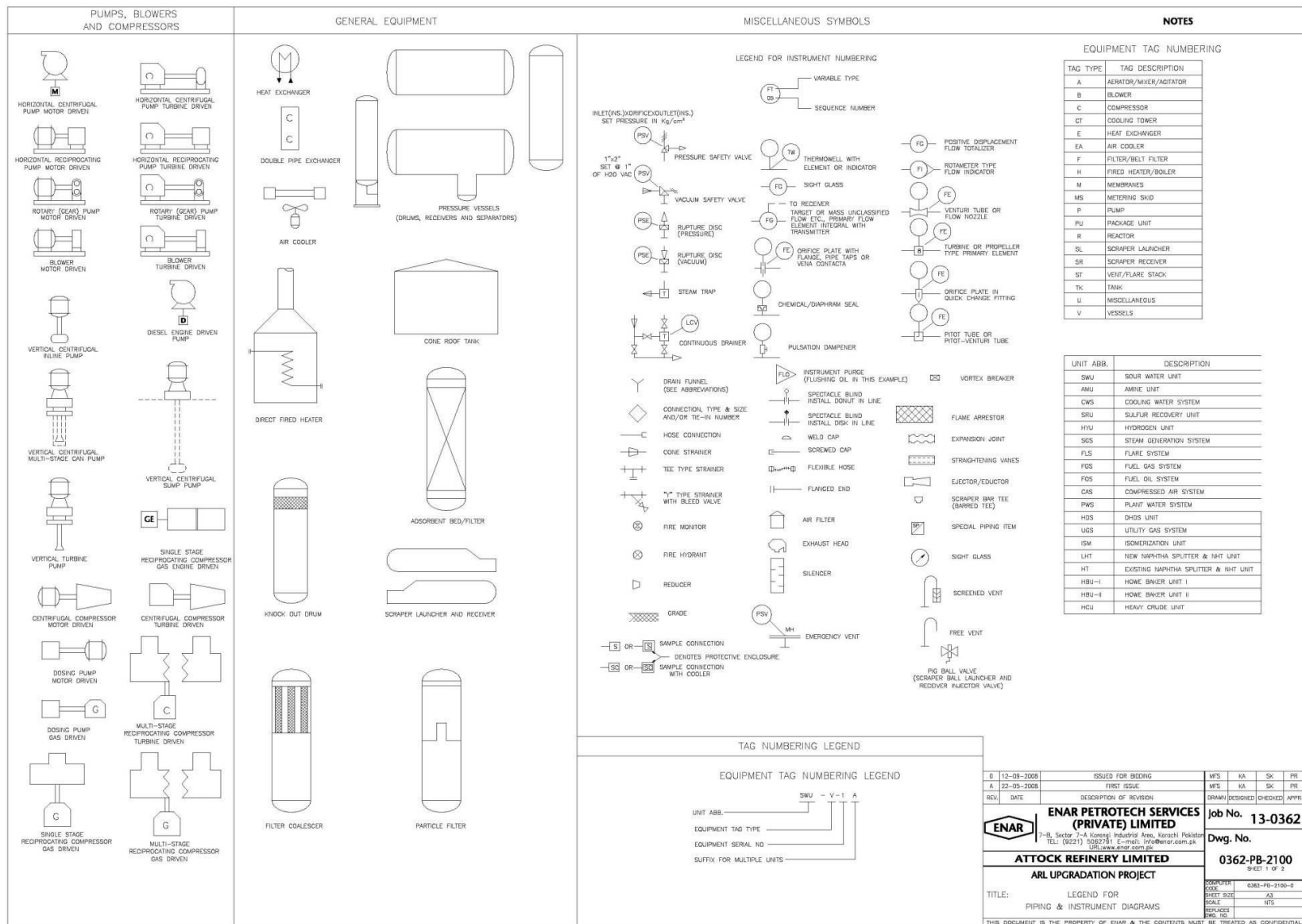
Template

- Size (A0 according to ISA)
- Title Block
 1. P&ID Number
 2. Client Name
 3. Unit Name
 4. Section Name
 5. Project Name
 6. Revision
- Note Column
- Reference document list Space.
- Soft File Address



Legend Sheet or Lead Sheet

- Two (2) to three (3) sheets
- Most Important Sheets (secret Decoder)
- meanings of the various symbols used on P&IDs
- About 90% information



B 12-09-2008	ISSUED FOR BIDDING	WFS	KA	SK	PR
A 22-05-2008	REVISED	WFS	KA	SK	PR
REV	DATE	DESCRIPTION OF REVISION		DRAWN [DESIGNED] CHECKED [APPR.]	

ENAR PETROTECH SERVICES (PRIVATE) LIMITED
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 TEL: (0221) 5062781 E-mail: info@enar.com.pk
 U.S. www.enar.com.pk

ATTOCK REFINERY LIMITED
ARL UPGRADATION PROJECT

TITLE: LEGEND FOR PIPING & INSTRUMENT DIAGRAMS

Job No. 13-0362

Dwg. No. 0362-PB-2100

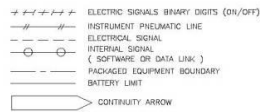
SHEET 1 OF 2

COMPUTER	0362-PB-2100-0
COLL.	AS
PLT. SIZE	NTS
SCALE	
REVISIONS	
PAGE NO.	

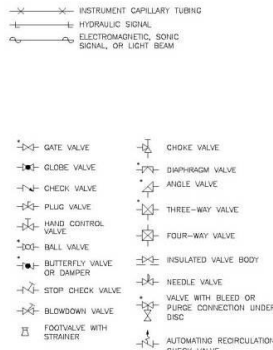
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FLOW DIAGRAM IDENTIFICATION LETTERS

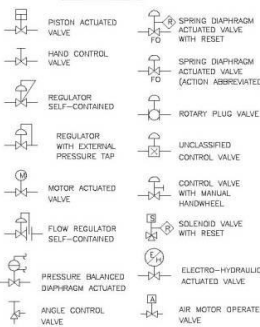
LETTER	FIRST LETTER	SUBSEQUENT LETTER
A	ANALYSIS	ALARM
B	BURNER FLAME	BLOCK/BYPASS
C	CONDUCTIVITY (ELECTRICAL)	CONTROLLER
D	DENSITY (SP, GR.)	DIFFERENTIAL
E	VOLTAGE (DMF/ELECTRICAL)	ELEMENT (PRIMARY)
F	FLOW	RATIO (FRACTION)
G	GAGING (DIMENSIONAL)	GLASS/GAGE
H	HAND ACTUATED (MANUAL)	HIGH
I	CURRENT (AMPS)	INDICATOR
J	POWER (WATTS)	MULTIPOINT (SCAN)
K	TIME	CONTROL STATION
L	LEVEL	LIGHT/LDW
M	MOISTURE (HUMIDITY)	MIDDLE
N	(UNCLASSIFIED)	(UNCLASSIFIED)
O	(UNCLASSIFIED)	(UNCLASSIFIED)
P	PRESSURE/VACUUM	POINT
Q	QUANTITY/NUMBER	TOTALIZER/INTEGRATOR
R	RUN/RADIOACTIVITY	RECORDER
S	SPEED/FREQUENCY	SAFETY/SWITCH
T	TEMPERATURE	TRANSMITTER
U	MULTIVARIABLE	MAJUNCTION
V	VIBRATION/VISCOSITY	VALVE
W	WEIGHT/FORCE	WELL/PROBE
X	(UNCLASSIFIED)	SHUTDOWN/INTERLOCK
Y	(UNCLASSIFIED)	RELAY
Z	POSITION	DRIVE/ACTUATE
EP		ELEMENT PROBE
EC		SAMPLE HANDLING SYSTEM
EN		LOCAL SAMPLE HANDLING SYSTEM
CH		TELEVISION CAMERA



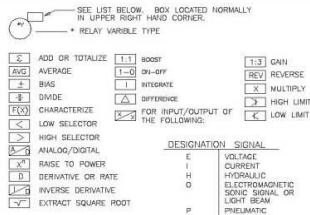
MANUALLY OPERATED VALVES
BY ADDING AN ACTUATOR TO THE BASIC VALVE SYMBOL, THE VALVE BECOMES A CONTROL VALVE



CONTROL VALVES



RELAY FUNCTION IDENTIFICATION



INSTRUMENT DESCRIPTION ABBREVIATIONS

ST - START
 SB - STOP
 PV - PROCESS VARIABLE
 OP - OPEN
 CDF - CENTRE OF FLOAT
 VB - VIBRATION
 RW - RUNNING
 RT - RESISTANCE THERMOMETER
 RTD - TEMPERATURE DETECTOR
 CL - CLOSED

CONTROL VALVE ACTION

FC - FAILS CLOSED
 FO - FAILS OPENED
 FLO - FAILS STATIONARY-TENDS TO OPEN
 FLC - FAILS STATIONARY-TENDS TO CLOSE

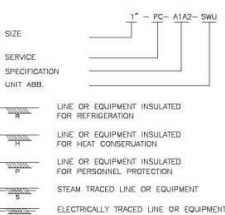
LOGIC SYMBOLS

OR - OUTPUT EXISTS IF ONE OR MORE OF THE INPUTS EXIST
 AND - AND - OUTPUT EXISTS IF, AND ONLY IF, ALL INPUTS EXIST
 EXCLUSIVE OR - OUTPUT EXISTS IF ONE, AND ONLY ONE, INPUT EXISTS
 NOT - NO OUTPUT EXISTS IF AN INPUT EXISTS
 SHUTDOWN/INTERLOCK

ABBREVIATIONS

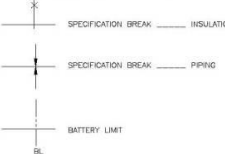
AG - ABOVE GROUND
 ATM - ATMOSPHERE
 BF - BLEND FLANGE
 BL - BATTERY LIMIT
 BW - BACKWASH
 CC - CORROSION COUPLER
 CO - COIL OPERATED
 CP - CORROSION PROBE
 CSC - CARBON SEAL CLOSED
 CSO - CARBON SEAL OPEN
 DR - DRAIN
 DE - DEENERGIZED
 DPH - PRESSURE DROP INDICATOR
 E - ENERGIZED
 EX - EXISTING
 F - FURNISHED
 F & P - FURNISHED & PIPED
 FB - FULL BORE
 FC - FAIL CLOSED
 FCC - FULL COLD CONSERVATION
 FHC - FULL HEAT CONSERVATION
 FI - FAIL INTERMEDIATE
 FL - FAIL LOCKED (LAST POSITION)
 FO - FAIL OPEN, OR FIRST OUT
 FOB - FLAT ON BOTTOM
 FOT - FLAT ON TOP
 FP - FULL PORT
 GO - GEAR OPERATED
 HP - HORSE POWER OR HIGH PRESSURE
 HPT - HIGH POINT
 IAC - INSULATION ACOUSTIC
 IS - INSTRUMENT AIR SUPPLY
 IS - INSTRUMENT GAS SUPPLY
 IC# - ITEM CODE NUMBER
 IC - INSULATION COLD
 IS - INSULATION HOT
 U - INSULATING JACKET
 FL - FILTER
 CONN - CONNECTION
 FLG - FLANGE
 HC - HOSE CONNECTION
 FB - FULL BORE
 SDP - SPENDING POINT
 OS - OIL WATER SWEET
 M - MOIST TRIM
 ST - STELLITE TRIM
 UC - UTILITY CONNECTION
 CD - CLOSED DRAIN
 IS - INSULATION SAFETY
 KP - KILOMETER POST OF P/L SURVEY
 LC - LOCK CLOSED
 LO - LOCK OPEN
 LP - LOW PRESSURE
 LPT - LOW POINT
 MOV - MOTOR OPERATED VALVE
 NC - NORMALLY CLOSED
 NDE - NORMALLY DEENERGIZED
 NE - NORMALLY ENERGIZED
 NI - NO INSULATION
 NIF - NORMALLY NO FLOW
 NO - NORMALLY OPEN
 PHC - PARTIAL HEAT CONSERVATION
 PF - INSULATION FOR PERSONAL PROTECTION
 RF - RANGED FACE FLANGE
 RJT - RING TYPE JOINT FLANGE
 SC - SAMPLE CONNECTION
 SO - STEAM OUT
 SP - SET POINT
 SG - SPECIFIC GRAVITY
 SR - STRESS RELIEF
 SS - SOFT SEAT VALVE
 S-S - SEAM TO SEAM
 STW - STEAM WATER SEWER
 LP STEAM
 HP STEAM
 ST - STEAM
 PC - PROCESS CONDENSATE
 BFW - BOILER FEED WATER

LINE NUMBER AND HEAT TRACING IDENTIFICATION

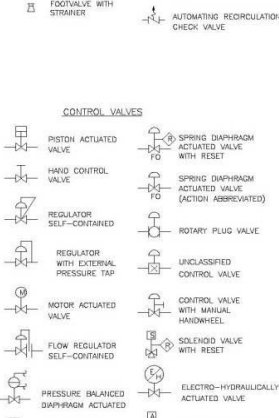
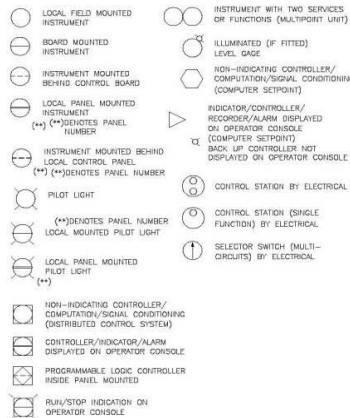


LINE SERVICE SYMBOLS

AIR SYSTEMS
 REFRIGERANT AIR
 PLANT AIR
 PUMPOUT SYSTEMS
 SLOP OIL
 DRAIN SYSTEM
 CHEMICAL DRAIN
 OILY WATER
 SANITARY WASTE SOWER
 CLEAN WATER SOWER
 PROCESS DRAIN
 FLARE & BLOWDOWN
 SYSTEM
 VENT FLAMMABLE
 CLOSED DRAIN HEADER
 BLOW DOWN
 FLAME FRONT
 GAS SYSTEMS
 FUEL GAS
 NITROGEN
 SPECIAL LIQUIDS
 FOGAM SOLUTION
 MULTIFUNCTION RABBITOR
 BIOGAS
 SODIUM HYDROCHLORIDE
 CORROSION INHIBITOR, ETC.
 CHEMICAL FIRE SOLUTIONS
 CAUSTIC SOLUTION
 OIL UTILITY SYSTEMS
 LUBRICATING OIL
 SEAL OIL
 HEATING OIL
 FUEL OIL
 PROCESS SERVICE
 PROCESS GAS
 PROCESS LIQUID
 SOLAR GAS
 HYDROCARBON
 EFFLUENT
 GAS OIL LIGHT
 GAS OIL HEAVY
 NAPHTHA
 CAUSTIC
 VEIL SYSTEMS
 ATMOSPHERIC VENTS
 WATER/STEAM SYSTEMS
 FIRE WATER
 RECIRCULATING COOLING WATER
 SERVICE WATER
 INDUSTRIAL WATER
 POTABLE WATER
 WASTE WATER
 TREATED WATER
 RAW WATER
 STEAM CONDENSATE
 LP STEAM
 HP STEAM
 PROCESS CONDENSATE
 BOILER FEED WATER

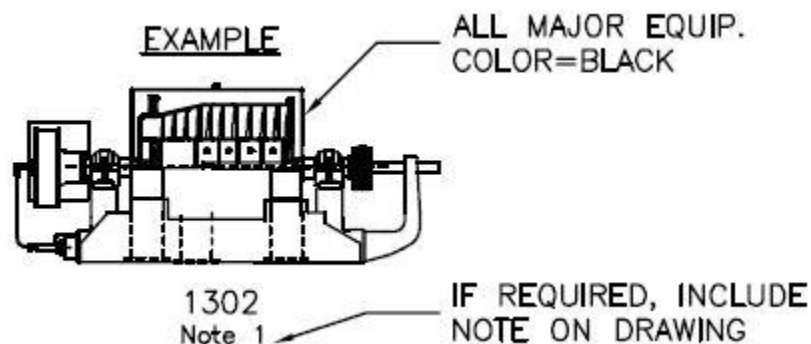


NOTES



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A 22-05-2008		FIRST ISSUE		MPS	KA	SK	PR
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ENAR PETROTECH SERVICES (PRIVATE) LIMITED 7-B, Sector 7-A, Kanyola Industrial Area, Kanyola, Pakistan TEL: (0221) 1052731 E-mail: info@enar.com.pk www.enar.com.pk				ATTOCK REFINERY LIMITED ARL UPGRADATION PROJECT			
TITLE: LEGEND FOR PIPING & INSTRUMENT DIAGRAMS				Job No. 13-0362 Dwg. No. 0362-PB-210 Sheet 7 of 8			
SUPERVISOR CODE: 0362-PB-210-0 SHEET SIZE: A3 SCALE: NTS REVISIONS: PWT: 10				THIS DOCUMENT IS THE PROPERTY OF ENAR & THE CONTENTS MUST BE TREATED AS CONFIDENTIAL			

Equipment Tag and Label



Air Cooled Heat Exchangers:

- (1) Item No.
- (2) Service Name
- (3) Duty
- (4) Design Press. / Temp.

Compressor:

- (1) Item No.
- (2) Service Name
- (3) Design Capacity
- (4) Differential Press.
- (5) Driver Power

Furnaces:

- (1) Item No.
- (2) Service Name
- (3) Design Duty
- (4) Normal Duty
- (5) Design Press./Temp.

Pumps:

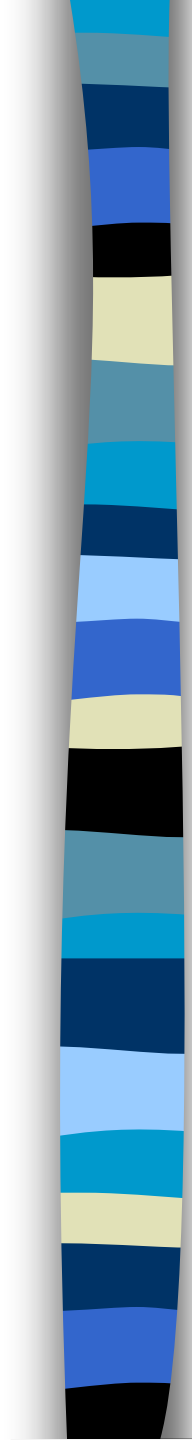
- (1) Item No.
- (2) Service Name
- (3) Design Capacity
- (4) Differential Press.
- (5) Driver Power

Vessels:

- (1) Item No.
- (2) Service Name
- (3) Diameter $\times$ Length
- (4) Design Press. / Temp.
- (5) Operating Press. / Temp.
- (6) Insulation Thickness

S/T Heat Exchangers:

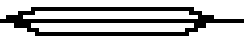
- (1) Item No.
- (2) Service Name
- (3) TEMA Type
- (4) Diameter $\times$ Tube Length
- (5) Duty
- (6) Shell Design Press. / Temp.
- (7) Tube Design Press. / Temp.
- (8) Insulation Thickness, Shell / Tube



LINE SYMBOLS

- P&IDs use symbols that represent the various types of lines in the pipeline system.
- These line symbols assist the operator in tracing the connections between process and instrumentation equipment.
- The direction of liquid flow through the process lines, is shown by arrows on top of the line.

LINE SYMBOLS

Future Equipment	-----
Major Process	—————
Minor Process	—————
Pneumatic	—#—#—#—#—
Hydraulic	—L—L—L—
Capillary Tubing	—X—X—X—X—
Mechanical Link	—●—●—●—●—
Electromagnetic, Sonic	
Optical, Nuclear	—⌒—⌒—⌒—
Electric	— — — — —
Connecting Line	——— ———
Non-Connecting Line	——— ———
Non-Connecting Line	——— ———
Jacketed or Double Containment	———  ———
Software or Data Link	—○—○—○—

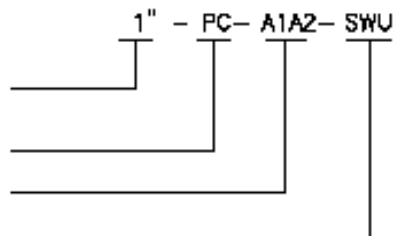
Line Number

SIZE

SERVICE

SPECIFICATION

UNIT ABB.



LINE SERVICE SYMBOLS

AIR SYSTEMS

INSTRUMENT AIR
PLANT AIR

SYMBOL

IA
A

PUMPOUT SYSTEMS

SLOP OIL

SL

DRAIN SYSTEM

CHEMICAL DRAIN
OILY WATER
SANITARY WASTE SEWER
CLEAN WATER SEWER
PROCESS DRAIN

DC
OW
WS
CS
DP

FLARE & BLOWDOWN SYSTEM

VENT FLAMMABLE
CLOSED DRAIN HEADER
BLOW DOWN
FLAME FRONT

VF
CD
BD
FF

GAS SYSTEMS

FUEL GAS
NITROGEN

FG
IG

SPECIAL LIQUIDS

FOAM SOLUTION

MULTIFUNCTION INHIBITOR
BIOCIDE
SODIUM HYPOCHLORITE
CORROSION INHIBITOR, ETC }
CHEMICAL FIRE SOLUTIONS
CAUSTIC SOLUTION

FLW
CF

FL
CS

OIL UTILITY SYSTEMS

LUBRICATING OIL
SEAL OIL
HEATING OIL
FUEL OIL

LO
SO
HO
FO

PROCESS SERVICE

PROCESS GAS
PROCESS LIQUID
SOUR GAS
HYDROCARBON
EFFLUENT
GAS OIL LIGHT
GAS OIL HEAVY
NAPHTHA
CAUSTIC

PG
PL
SG
HC
EF
GOL
GOH
NA
KA

VENT SYSTEMS

ATMOSPHERIC VENTS

AV

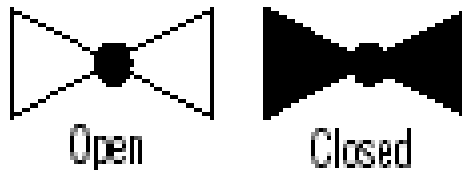
WATER/STEAM SYSTEMS

FIRE WATER
RECIRCULATING COOLING WATER
SERVICE WATER
INDUSTRIAL WATER
POTABLE WATER
WASTE WATER
TREATED WATER
RAW WATER
STEAM CONDENSATE
LP STEAM
HP STEAM
PROCESS CONDENSATE
BOILER FEED WATER

FW
CW
SW
IW
PW
WW
TW
RW
SC
LS
ST
PC
BW

Valve Symbol

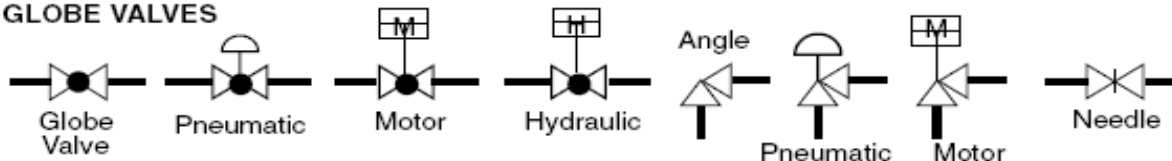
- P&IDs also have symbols that represent various types of valves on the system. These valve symbols indicate whether the valve is normally open or closed.
- By recognizing the various valve symbols on a P&ID, the operator can trace liquid flow through a line, and identify the necessary valves to open or close when altering the liquid's route through the pipeline.
- If the Valve Symbol is filled in, the valve is normally closed.



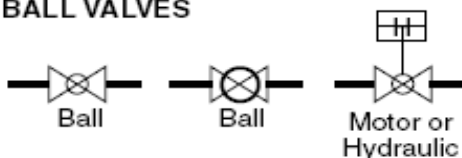
GATE VALVES



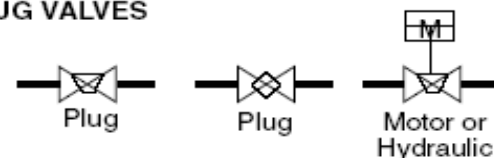
GLOBE VALVES



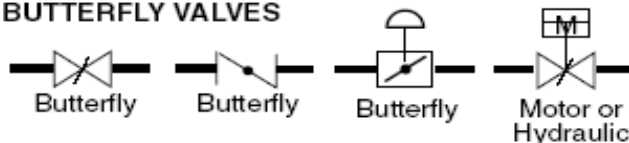
BALL VALVES



PLUG VALVES



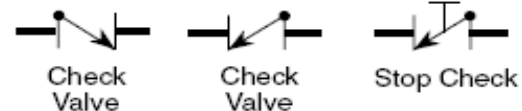
BUTTERFLY VALVES



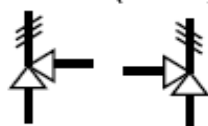
DIAPHRAGM VALVES



CHECK VALVES



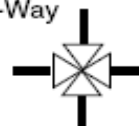
SAFETY (Gases)



RELIEF (Liquids)



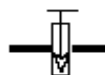
Four-Way



Three-Way Valve

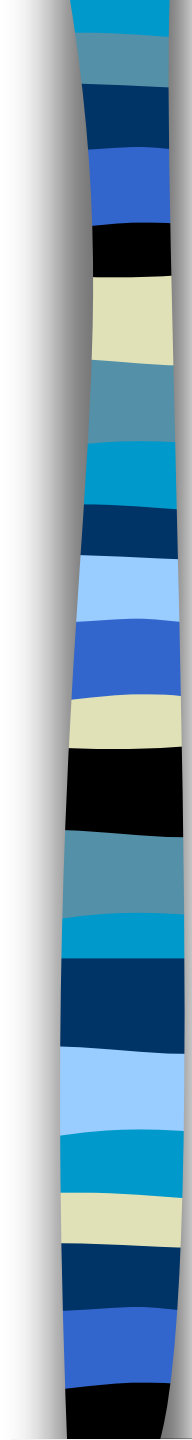


Knife Valve



Pinch Valve





PRESSURE/VACUUM RELIEF VALVES

- Devices open if line pressure overcomes valve spring tension.
- Pipelines and storage tanks are equipped with pressure relief valves to relieve excess pressure from tanks overfilling, liquid expansion, or high pump discharge pressure.



FLOW ELEMENT SYMBOLS

- The flow element (FE) measures flow.
- The measured flow must be converted to a process signal suitable for use in the control system.
- The conversion is performed by a flow transmitter (FT).



PRIMARY FLOW ELEMENTS



ORIFICE PLATE WITH
FLANGE PIPE TAPS
OR VENA CONTRACTA



ORIFICE PLATE IN
QUICK-CHANGE
FITTING



AVERAGING
PITOT TUBE



TURBINE OR
PROPELLER TYPE



PITOT TUBE



POSITIVE
DISPLACEMENT



VENTURI TUBE



ROTAMETER



VORTEX SENSOR



FLOW NOZZLE



MAGNETIC



WEIR (V-NOTCH SHOWN)



ULTRASONIC (DOPPLER)



CORIOLIS

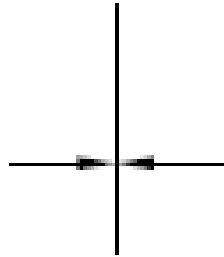


FLUME



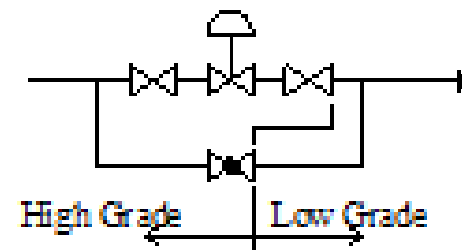
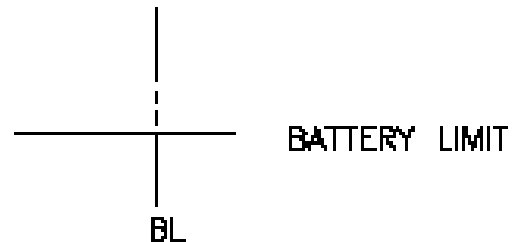
TRANSIT TIME

Spec Break



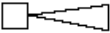
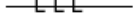
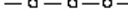
To elaborate change in

- Piping class (mainly)
- Material Specification
- Pressure
- Composition
- Temperature
- Battery limit
- Custody Transfer
- Grade Level
- Insulation



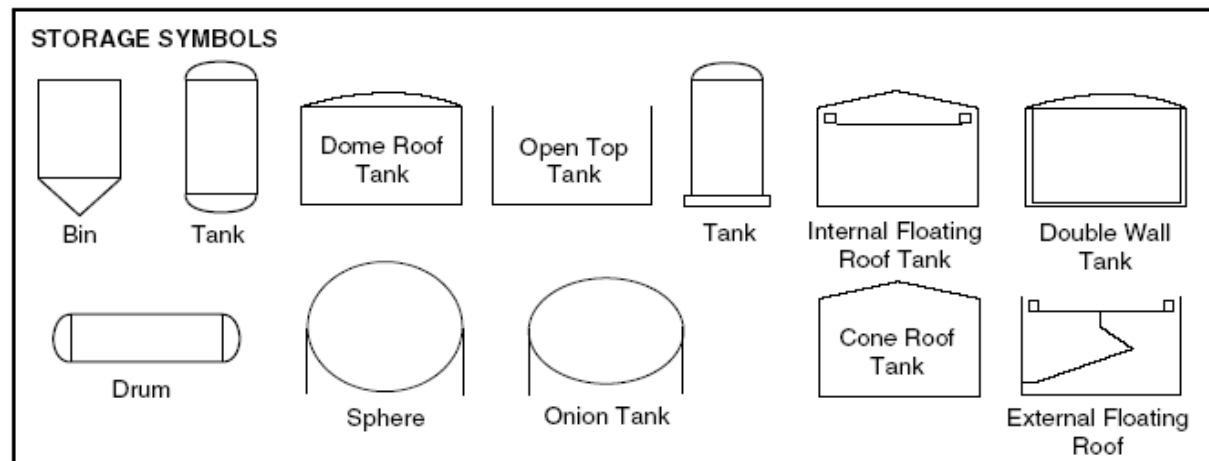
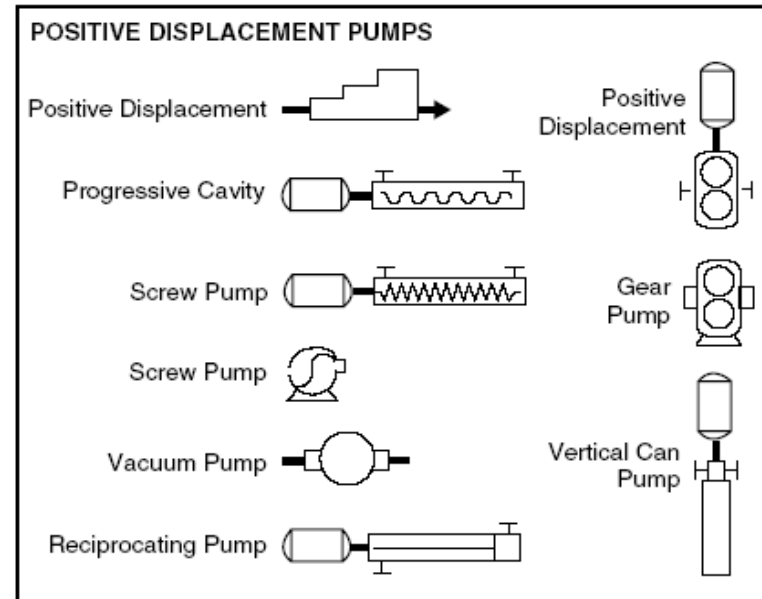
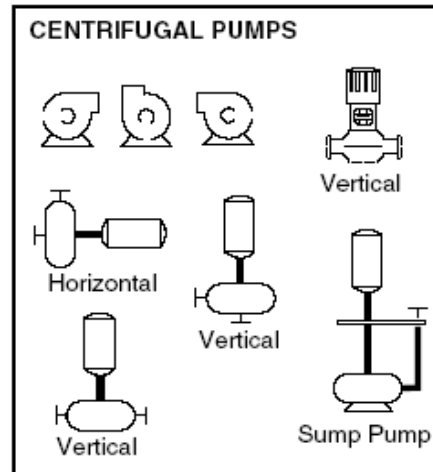
Some Common Symbols

Piping Symbols

	Y-type Strainer		Removable Spool
	Duplex Strainer		Flexible Hose
	Basket Strainer		Expansion Joint
	Detonation Arrestor		Breather
	Flame Arrestor		Vent Cover
	In-Line Silencer		In-Line Mixer
	Steam Trap		Vent Silencer
	Desuperheater		Diverter Valve
	Ejector / Eductor		Rotary Valve
	Exhaust Head		Pulsation Dampener
	Future Equipment		Flange
	Major Process		Electromagnetic, Sonic Optical, Nuclear
	Minor Process		Electric
	Pneumatic		Connecting Line
	Hydraulic		Non-Connecting Line
	Capillary Tubing		Non-Connecting Line
	Mechanical Link		Jacketed or Double Containment
			Software or Data Link

Some Common Symbols (Cont.)

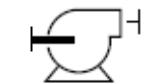
Pumps and Tanks



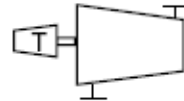
Some Common Symbols (Cont.)

Compressors, Steam Turbines, and Motors

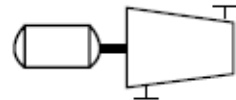
CENTRIFUGAL COMPRESSORS



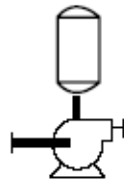
Centrifugal Compressor



Centrifugal Compressor (Turbine Driven)



Centrifugal Compressor

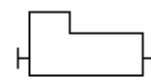


Centrifugal Blower

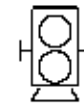


Axial Compressor

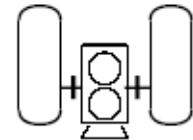
PD COMPRESSORS



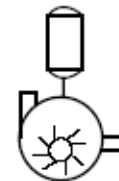
Reciprocating Compressor



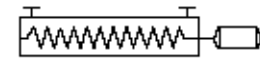
Rotary Compressor



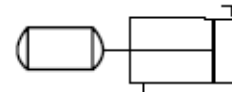
Rotary Compressor & Silencers



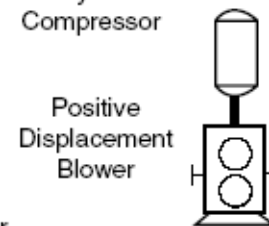
Liquid Ring Vacuum



Rotary Screw Compressor



Reciprocating Compressor

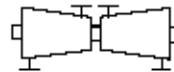


Positive Displacement Blower

STEAM TURBINE



Turbine Driver



Doubleflow Turbine

MOTORS



Motor



Agitator or Mixer



Diesel Motor

Some Common Symbols (Cont.)

Heat Exchangers

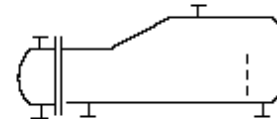
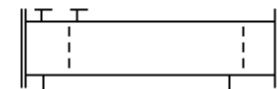
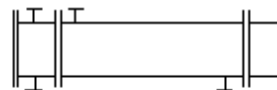
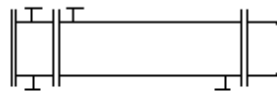
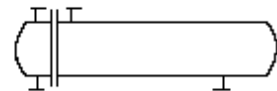
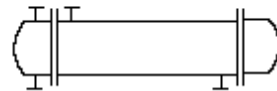
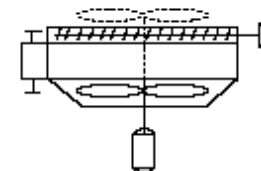
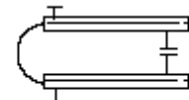


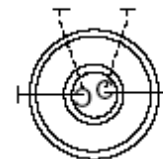
Plate and Frame Heat Exchanger



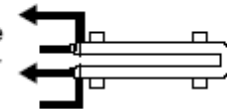
Air Cooled Exchanger
(Louvers Optional)



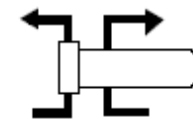
Double-Pipe Heat Exchanger



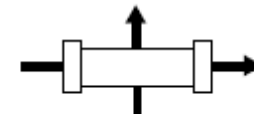
Spiral Heat Exchanger



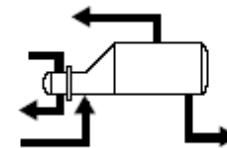
Hairpin Exchanger



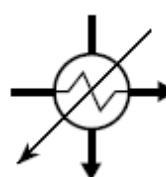
U-Tube Heat Exchanger



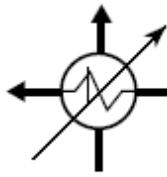
Single Pass Heat Exchanger



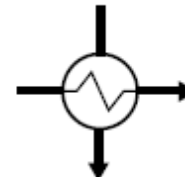
Reboiler



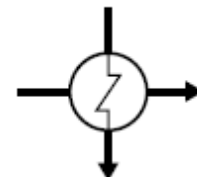
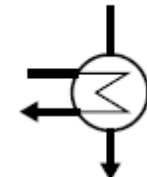
Heater



Condenser

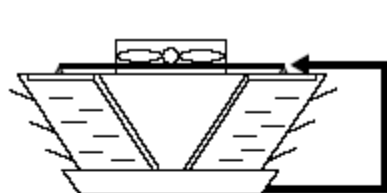


Shell and Tube Heat Exchanger

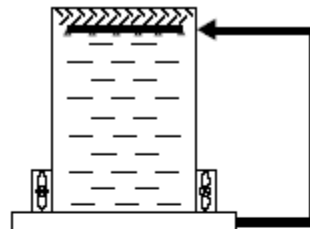


Some Common Symbols (Cont.)

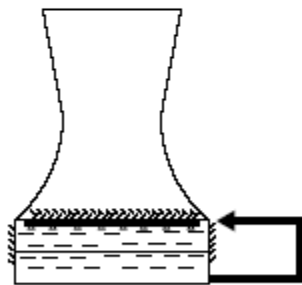
Cooling Towers



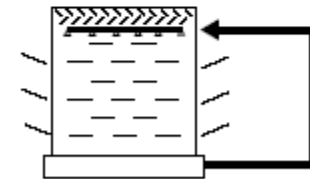
INDUCED DRAFT
Crossflow



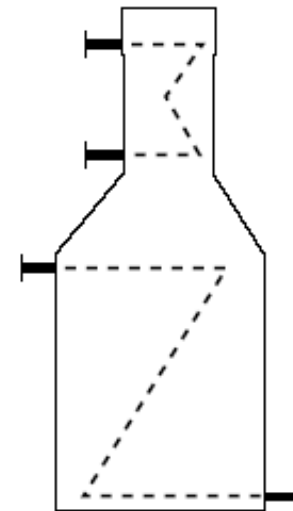
FORCED DRAFT
Counterflow



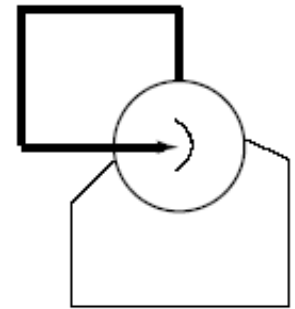
HYPERBOLIC
Chimney Tower



NATURAL DRAFT
Counterflow



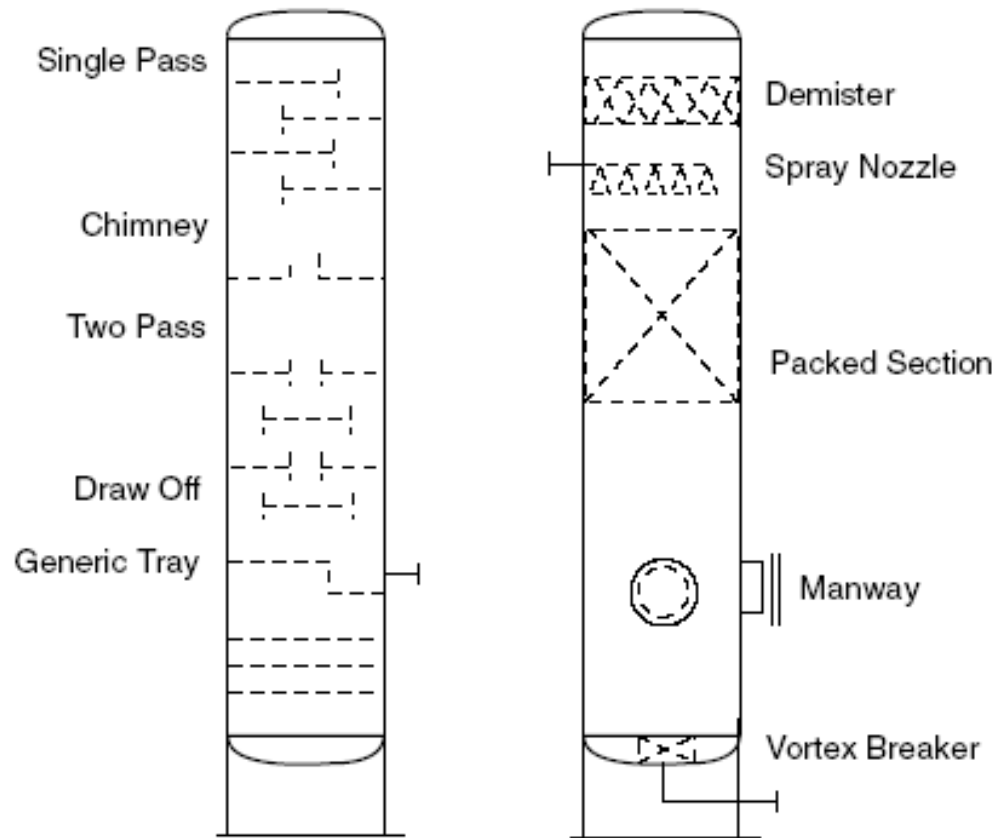
Furnace



Boiler

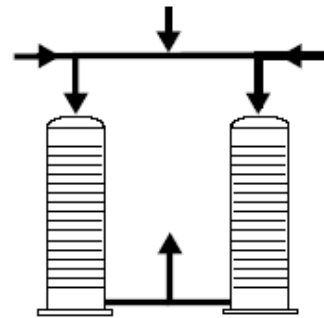
Some Common Symbols (Cont.)

Distillation Symbols

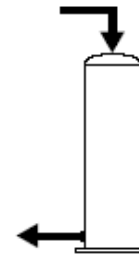


Some Common Symbols (Cont.)

Reactor Symbols



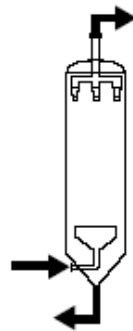
Hydrocracking



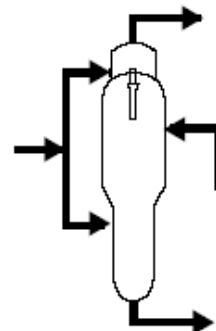
Hydrodesulfurization



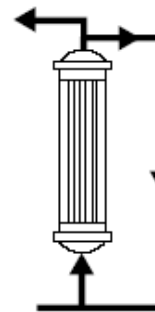
Reformer



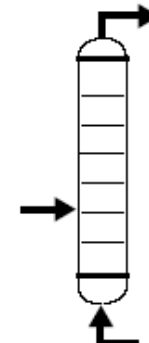
Fluid Catalytic Cracking



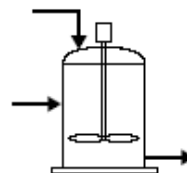
Fluid Coking



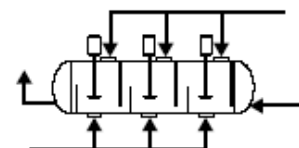
Tubular Reactor



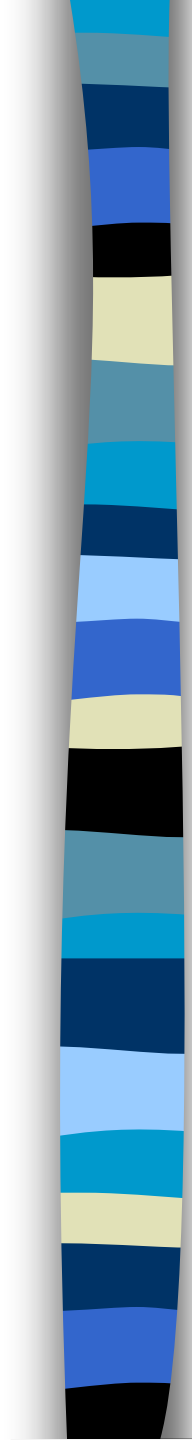
Fluidized Reactor



Mixing Reactor



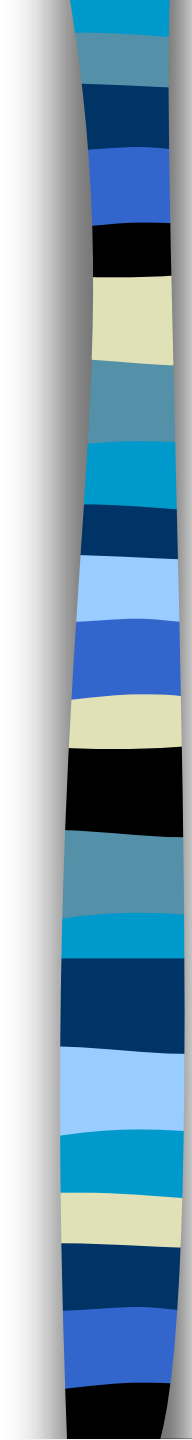
Alkylation



Instrumentation

Identify the following instruments and measurement symbols used on a P&ID.

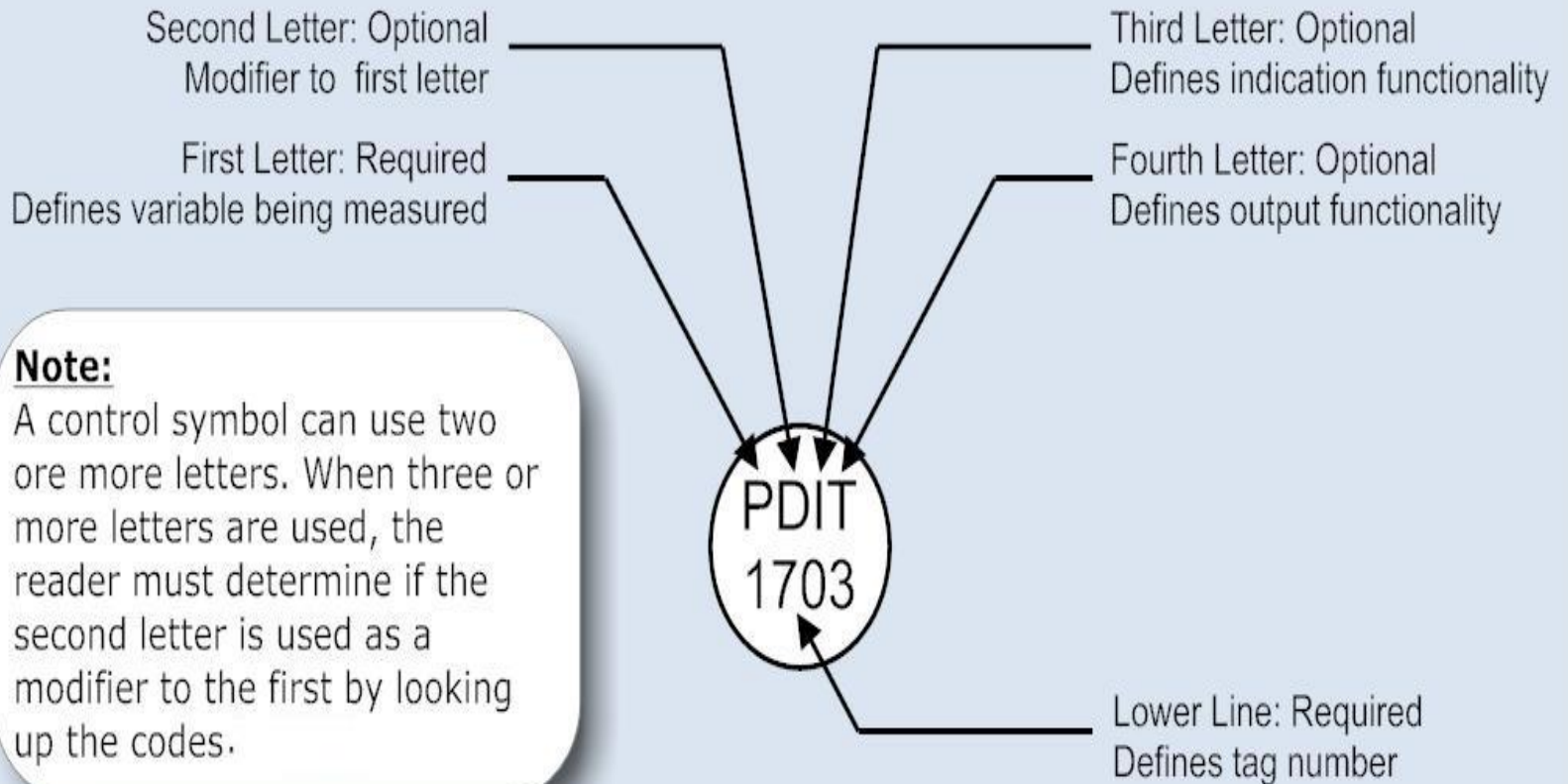
- field-mounted instruments
- primary location front-mounted instruments and primary location rear-mounted instruments
- auxiliary front-mounted instruments and auxiliary rear-mounted instruments
- instruments in a shared housing
- instruments sharing a single display
- thermowell
- resistance temperature detectors (RTDs) and thermocouples
- gauge glass
- pressure indicator (PI)
- pressure indicator with transmitter (PT), and
- pressure alarms (PA).



INSTRUMENT SYMBOLS

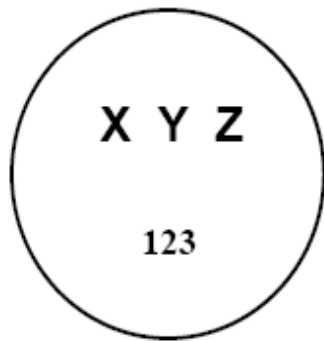
- Instruments on the P&ID are represented as circles or balloons.
- A code in the top half of the circle identifies the type of instrument shown, and the code in the bottom half of the balloon gives the instrument number and the specific measurement taken by the instrument

Instrument Symbol Tag Identification



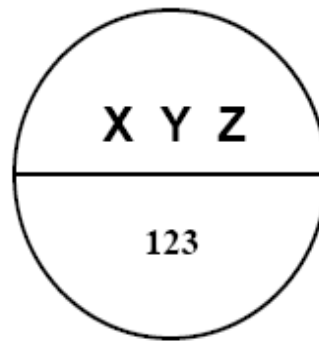
	First-letter		Succeeding- Letters		
	Measured or Initiating variable	Modifier	Readout function	Output function	Modifier
A	Analysis				
C				Control	
D		Differential			
F	Flow Rate	Ratio			
H	Hand				High
I	Current		Indicate		
L	Level				Low
P	Pressure, vacuum				
Q	Quantity	Totalizer			
S		Safety		Switch	
T	Temperature			Transmit	
V	Vibration			Valve, Damper	
Z	Position			Actuator	

*The presence or absence of a line determines the location of the physical device. For example **no line** means the instrument is installed in the field near the process.*



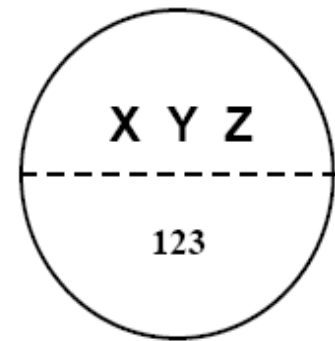
No Line

The instrument is mounted in the field near the process, (close to the operator)



Solid Line

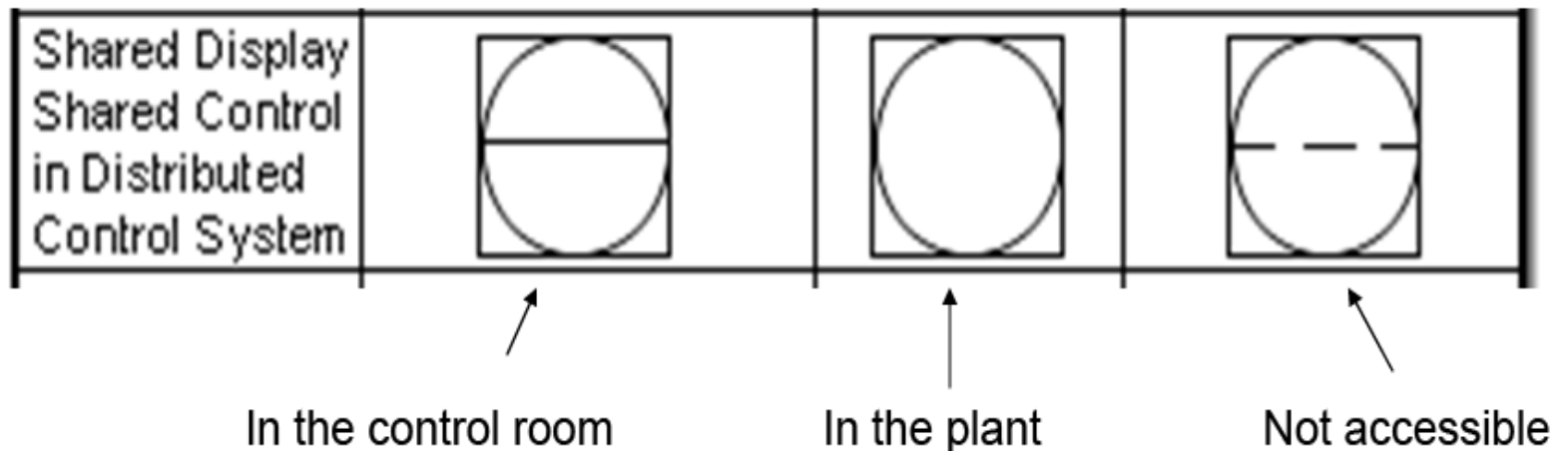
The instrument is mounted in the control room (accessible to the operator)

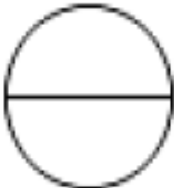
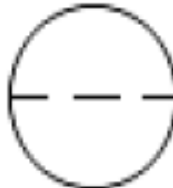
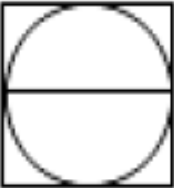
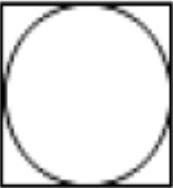
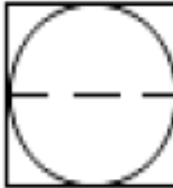
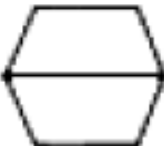
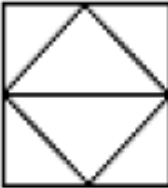
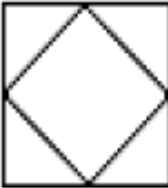
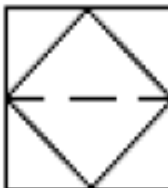


No Line

The instrument is mounted out of sight (not accessible to the operator)

Some instruments are part of a Distributed Control System (DCS) where a specific controller or indicator can be selected from many others but shown in one location (like a terminal screen)



	Accessible to the Operator; Primary Location on the Main Control Panel	Mounted in the Field	Not Normally Accessible to Operator, Behind the Panel
Distinct Elements			
Shared Display Shared Control in Distributed Control System			
Computer Logic Function			
Programmable Logic Control			

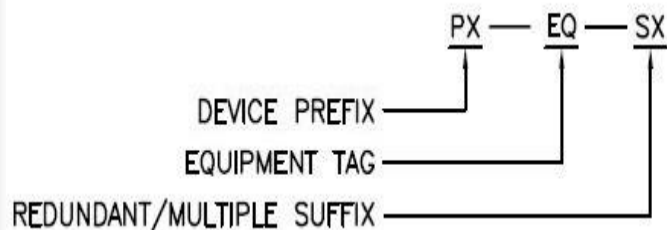
Common Primary Device Symbols

Analyzer	Level	Temperature	Pressure	What does it mean?
AI 1234	LI 1234	TI 1234	PI 1234	Indicates only
AT 1234	LT 1234	TT 1234	PT 1234	Transmits only
AIT 1234	LIT 1234	TIT 1234	PIT 1234	Indicates and transmits
ADIT 1234	LDIT 1234	TDIT 1234	PDIT 1234	Indicates and transmits (Includes first letter modifier D for Differential)

Other Common Examples

XV 1234	Actuated Valve	ZSC 1234	Limit Switch (close)
SV 1234	Solenoid Valve	ZSO 1234	Limit Switch (open)
SC 1234	Speed Controller	VS 1234	Vibration Switch
HS 1234	Hand Switch	PS 1234	Pressure Switch

INSTRUMENT/DEVICE TAGS



NOTE: HYPHENS ARE NOT REQD BETWEEN PX AND EQ.

REDUNDANT/MULTIPLE SUFFIX RULES:

1. UTILIZE SEQUENTIAL NON-HYPHENATED ALPHABETIC SUFFIXES FOR REDUNDANT DEVICES.
2. FOR MULTIPLE ITEMS OF SAME TYPE, EMPLOY A SEQUENTIAL, HYPHENATED NUMERIC SUFFIX.

PX – device type prefix (as per [ISA 5.1](#))

EQ – the associated equipment tag

SX – duplicate or redundant device suffix

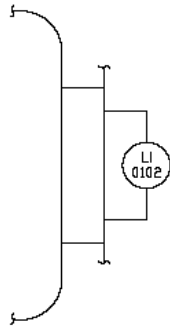
If a piece of equipment has redundant devices associated with it, an alphabetic suffix may be appended to the loop number, e.g., FV1101A, FV1101B, FV1101C, etc. (Note: Redundant means serving the same purpose as another device in a backup fashion.)

PI1101 – A pressure indicator on the discharge of the first pump in the tank farm area.

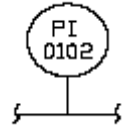
LT1701 – A level transmitter on the first tank in the tank farm area.

IT1405 – A current transmitter (for the motor) on the fifth agitator in the tank farm area.

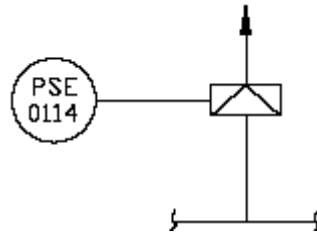
Standalone Instruments



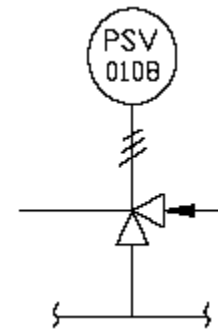
LEVEL



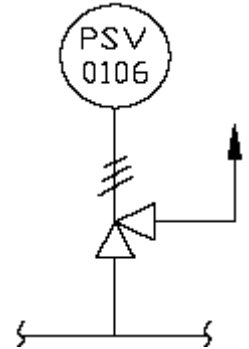
PRESSURE



RUPTURE DISC



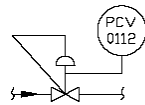
VACUUM RELIEF VALVE



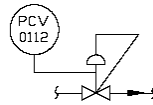
PRESSURE RELIEF VALVE



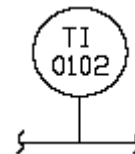
FLOW



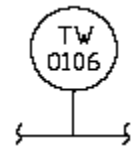
PRESSURE REGULATOR

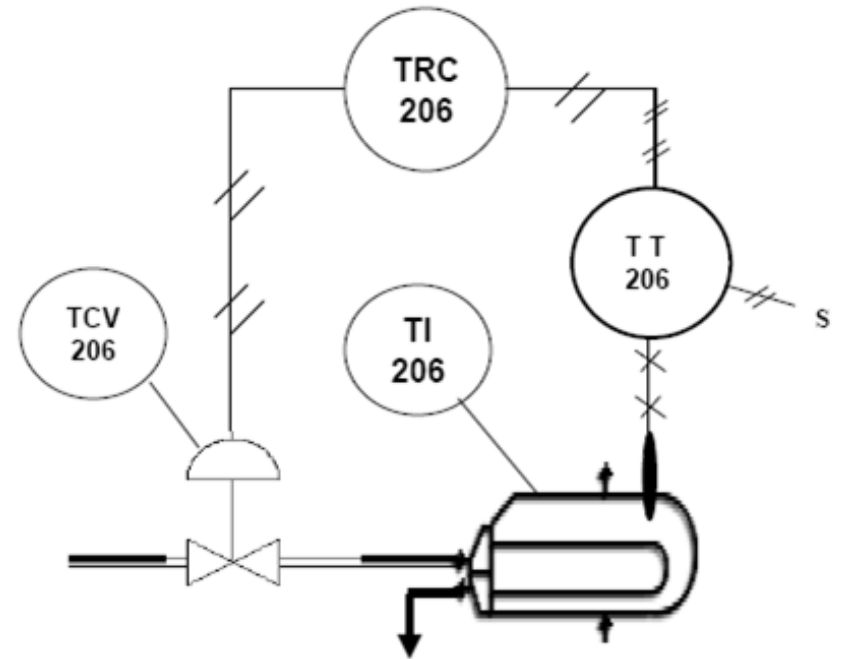


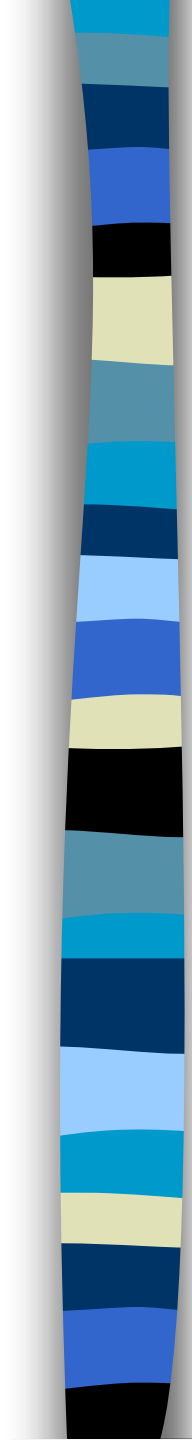
TEMPERATURE INDICATING



TEMPERATURE POINT







Alarm

Alarms are represented
by:

- XAHH (X Alarm High High)
- XAH (X Alarm High)
- XAL (X Alarm Low)
- XALL (X Alarm Low Low)

Where

X is P, L or T

P = Pressure

L = Level

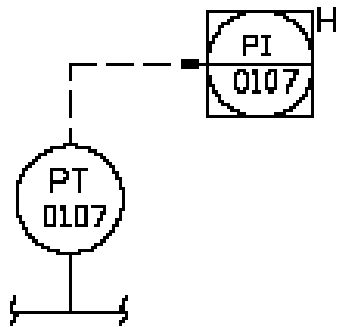
T = Temperature

PAHH = Pressure Alarm High High

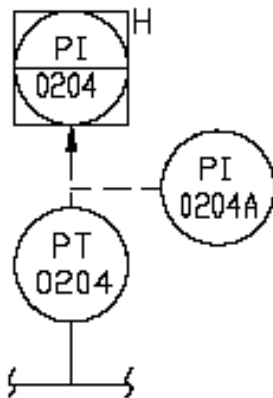
TAH = Temperature Alarm High

LALL = Level Alarm Low Low

Loop Instruments

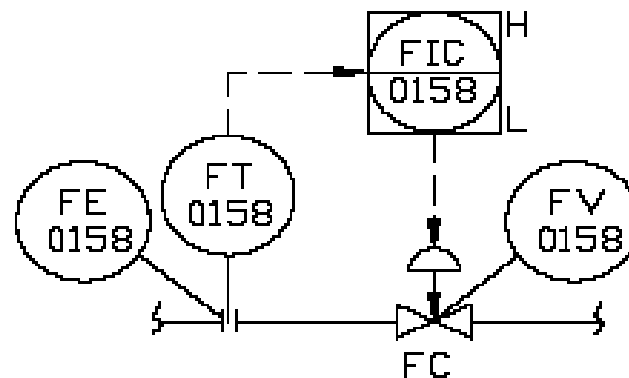


TAG NUMBER	COMPONENT/- FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION
PT-0107	PRESSURE TX		AI	FIELD	DCS	FIELD
PI-0107	DCS INDICATOR	H	SW			DCS
PAH-0107	HIGH ALARM					DCS



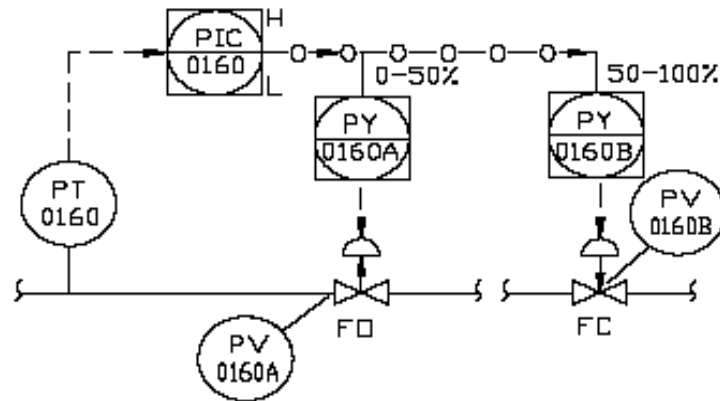
TAG NUMBER	COMPONENT/- FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION
PT-0204	PRESSURE TX		AI	FIELD	DCS	FIELD
PI-0204	DCS INDICATOR	H	SW			DCS
PI-0204A	LOCAL INDICATOR - LOOP POWERED					FIELD
PAH-0204	HIGH ALARM					DCS

CONTROL LOOP



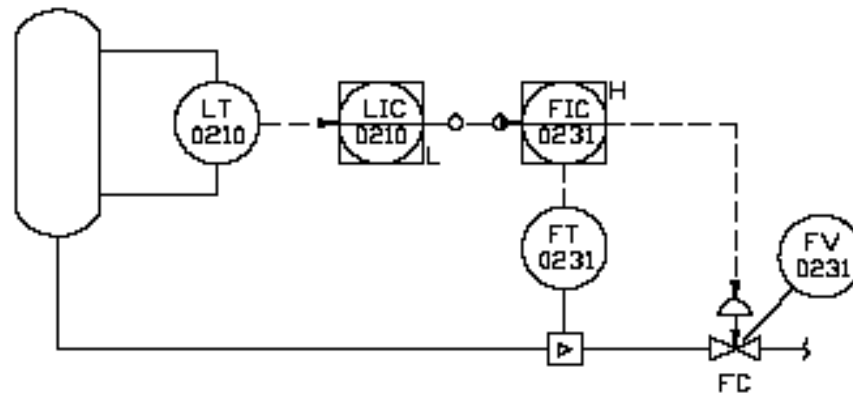
TAG NUMBER	COMPONENT-FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION	COMMENTS
FE-0158	FLOW ELEMENT ORIFICE					FIELD	
FT-0158	D/P TX FLOW		AI	FIELD	DCS	FIELD	
FIC-0158	FLOW IND CONTROLLER	H,L	SW			DCS	
FAH-0158	HIGH ALARM					DCS	
FAL-0158	LOW ALARM					DCS	
FV-0158	GLOBE CONTROL VALVE		AO	DCS	FIELD	FIELD	

SPLIT RANGE CONTROL



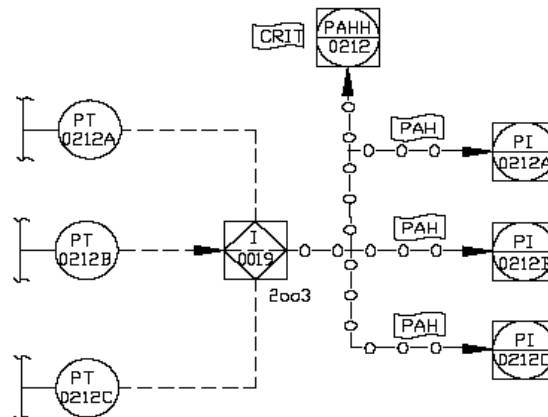
TAG NUMBER	COMPONENT/-FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION	COMMENTS
PT-0160	PRESSURE TX		AI	FIELD	DCS	FIELD	SPLIT RANGE
PIC-0160	PRESSURE IND CONTROLLER	H,L	SW			DCS	
PAH-0160	HIGH ALARM	H				DCS	
PAL-0160	LOW ALARM	L				DCS	
PV-0160A	GLOBE CONTROL VALVE		AO	DCS	FIELD	FIELD	
PV-0160B	GLOBE CONTROL VALVE		AO	DCS	FIELD	FIELD	
PY-0160A	FUNCTION BLOCK		SW			DCS	
PY-0160B	FUNCTION BLOCK		SW			DCS	

CASCADE CONTROL LOOP



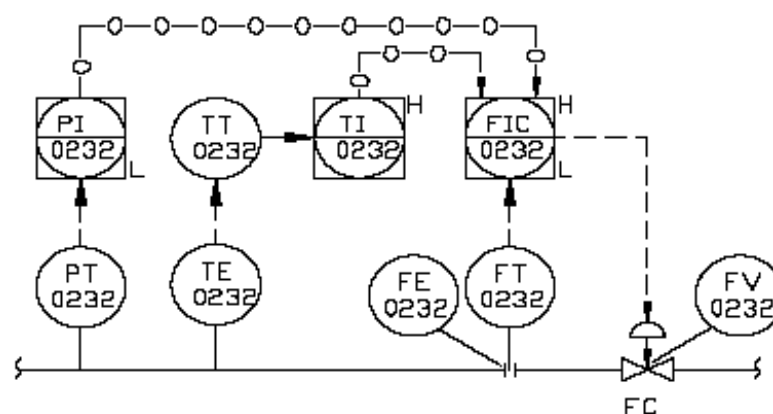
TAG NUMBER	COMPONENT/-FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION	COMMENTS
FT-0231	VORTEX FLOW METER		AI	FIELD	DCS	FIELD	CASCADE CONTROL WITH LIC-0210
FIC-0231	FLOW IND CONTROLLER	H	SW			DCS	
FAH-0231	HIGH ALARM					DCS	
FV-0231	GLOBE CONTROL VALVE		AO	DCS	FIELD	FIELD	CASCADE CONTROL WITH FIC-0231
LT-0210	D/P TX LEVEL		AI	FIELD	DCS	FIELD	
LIC-0210	LEVEL IND CONTROLLER	L	SW			DCS	
LAL-0210	LOW ALARM					DCS	

TWO-OUT-OF-THREE VOTING (2003)



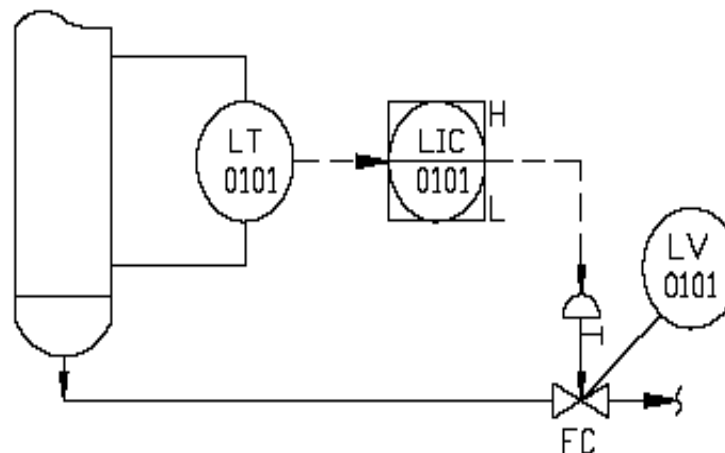
TAG NUMBER	COMPONENT/- FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION	COMMENTS
PT-0212A	PRESSURE TX	HH	AI	FIELD	ESD	FIELD	
PT-0212B	PRESSURE TX	HH	AI	FIELD	ESD	FIELD	
PT-0212C	PRESSURE TX	HH	AI	FIELD	ESD	FIELD	
PI-0212A	DCS INDICATOR	H	SI	ESD	DCS	DCS	
PI-0212B	DCS INDICATOR	H	SI	ESD	DCS	DCS	
PI-0212C	DCS INDICATOR	H	SI	ESD	DCS	DCS	
PAH-0212A	HIGH ALARM					DCS	
PAH-0212B	HIGH ALARM					DCS	
PAH-0212C	HIGH ALARM					DCS	
PAHH-0212	HIGH HIGH ALARM		SI	ESD	DCS	DCS	VOTED TRIP ALARM

FLOW CONTROL, PRESSURE AND TEMPERATURE COMPENSATED

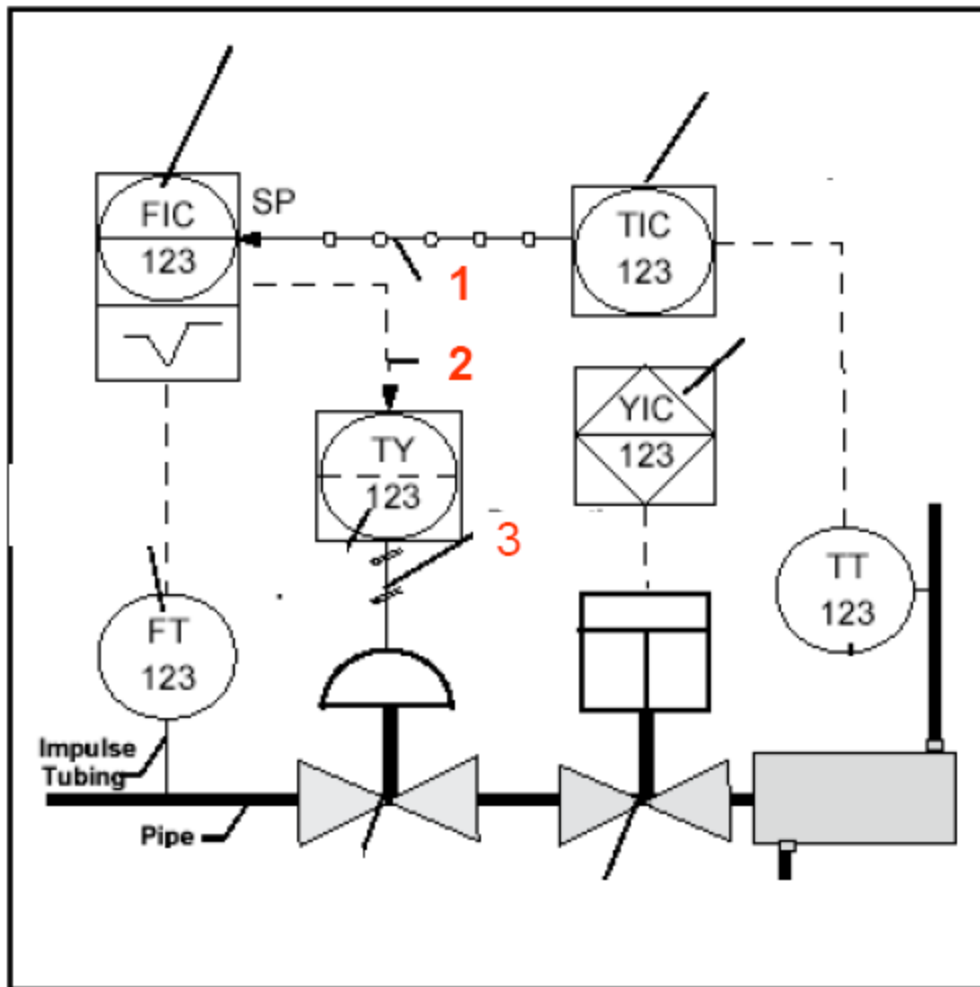


TAG NUMBER	COMPONENT/FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATION	COMMENTS
FE-0232	FLOW ELEMENT ORIFICE	H,L	AI	FIELD	DCS	FIELD	PI 0232 & TI 0232 COMPENSATION
FT-0232	D/P TX FLOW					FIELD	
FIC-0232	FLOW IND CONTROLLER					DCS	
FAL-0232	LOW ALARM					DCS	
FAH-0232	HIGH ALARM					DCS	
FV-0232	GLOBE CONTROL VALVE		AO	DCS	FIELD	FIELD	
TE-0232	RTD					FIELD	
TT-0232	TEMP. TRANSMITTER	H	AI	FIELD	DCS	FIELD	
TI-0232	DCS INDICATOR		SW			DCS	
TAH-0232	HIGH ALARM					DCS	
PT-0232	PRESSURE TX	L	AI	FIELD	DCS	FIELD	
PI-0232	DCS INDICATOR		SW			DCS	
PAL-0232	LOW ALARM					DCS	

LEVEL CONTROL



TAG NUMBER	COMPONENT/- FUNCTION	SOFTWARE FUNCTION / ALARM	I/O TYPE	SIGNAL FROM	SIGNAL TO	LOCATI ON	COMMENTS
LT-0101	D/P TX LEVEL	H,L	AI	FIELD	DCS	FIELD	
LIC-0101	LEVEL IND CONTROLLER		SW			DCS	
LAL-0101	LOW ALARM					DCS	
LAH-0101	HIGH ALARM					DCS	
LV-0101	GLOBE CONTROL VALVE		AO	DCS	FIELD	FIELD	



FIC

TIC

YIC

TY

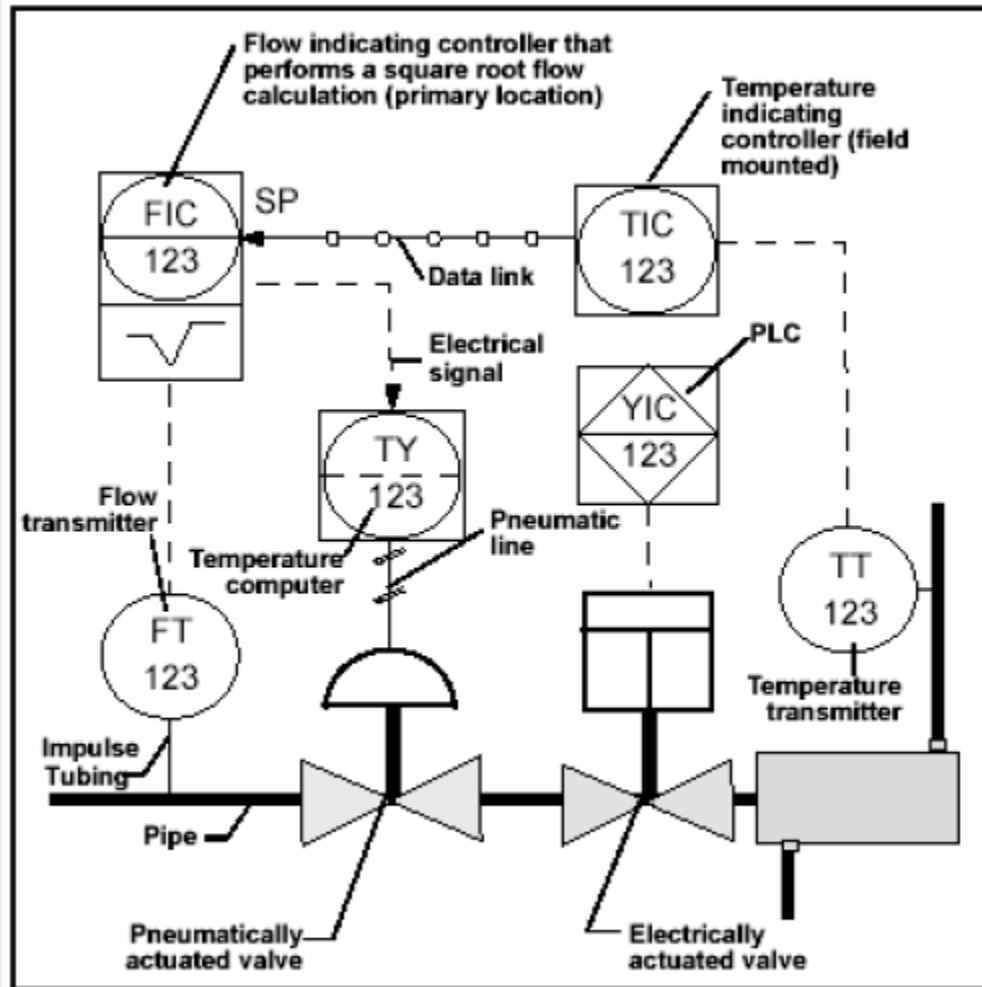
FT

TT

1

2

3



FIC –
Flow Indicating Controller

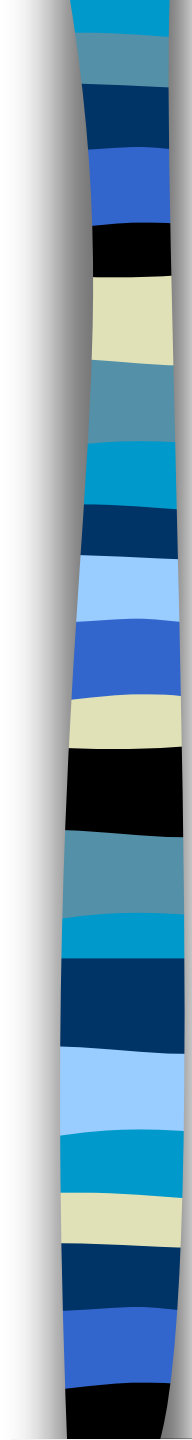
TIC
Temperature Indicating Cont.

YIC
PLC Indicating Controller

TY
Temperature Computer Output

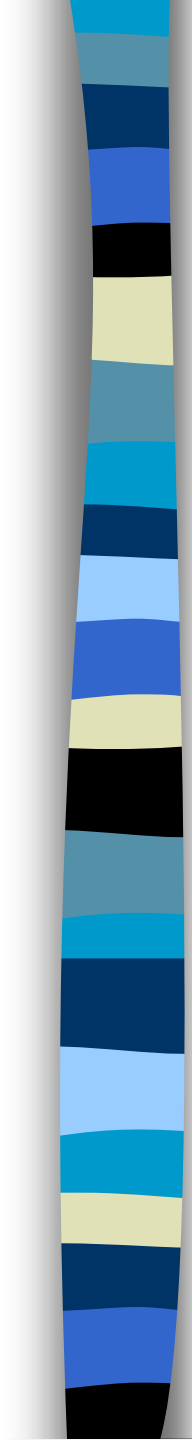
FT
Flow Transmitter

TT
Temperature Transmitter



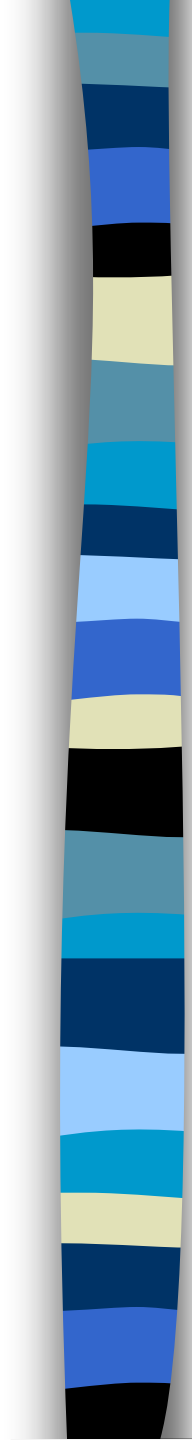
SUMMARY

- P&ID is primary document for any process industry
- Each P&ID is numbered according to the section of pipeline the P&ID displays
- The symbols used in P&IDs are standard and established by the Instrument Society of America (ISA).
- The P&ID shows the sequence of valves and instruments on the pipeline
- There are standard to show lines, valves and instrumentation
- P&ID provides 90% of process information



Check List

- **Instrumentation and designations**
- **Mechanical equipment with names and numbers**
- **All valves and their identifications**
- **Process piping, sizes and identification**
- **Miscellaneous - vents, drains, special fittings, sampling lines, reducers, increasers and swagers**
- **Permanent start-up and flush lines**
- **Flow directions**
- **Interconnections references**
- **Control inputs and outputs, interlocks**
- **Interfaces for class changes**
- **Seismic category**
- **Quality level**
- **Annunciation inputs**
- **Computer control system input**
- **Vendor and contractor interfaces**
- **Identification of components and subsystems delivered by others**
- **Intended physical sequence of the equipment**



THANK YOU