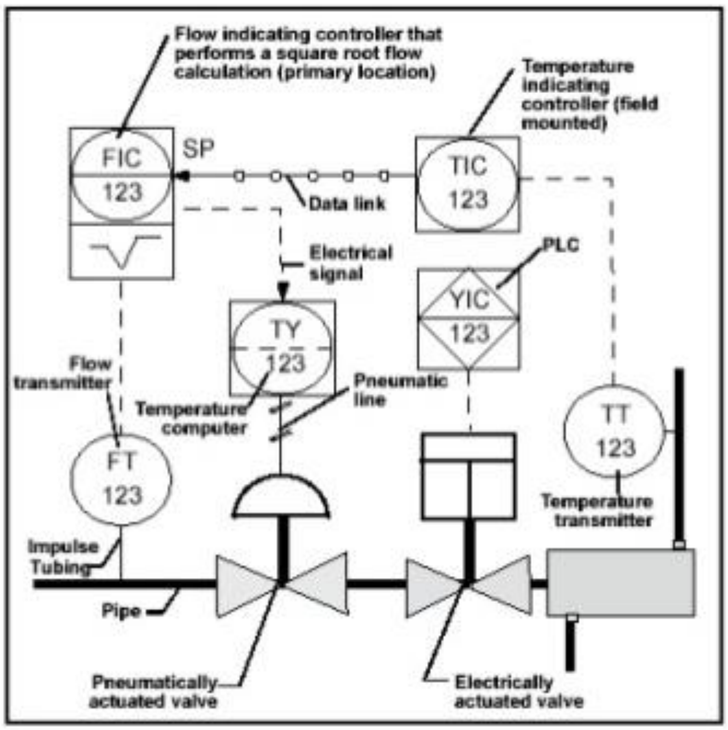
P&ID symbols with examples



FIC –
Flow Indicating Controller

TIC
Temperature Indicating Cont.

YIC
PLC Indicating Controller

TY
Temperature Computer Output

FT
Flow Transmitter

TT
Temperature Transmitter

INSTRUCTOR

Ahmed Yehia Mohamed

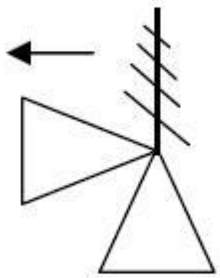
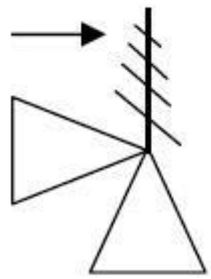
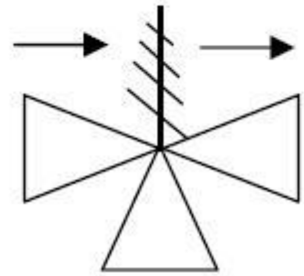
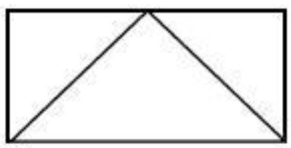
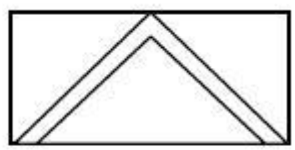
Process engineer, Suez Oil Processing Company (SOPC)

Che.yehia@gmail.com

+20 1008907390

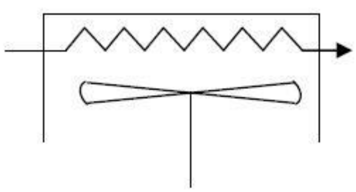
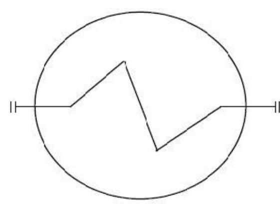
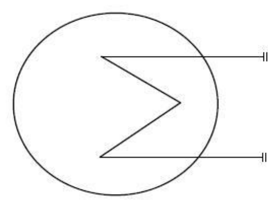
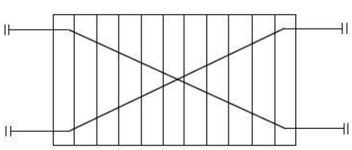
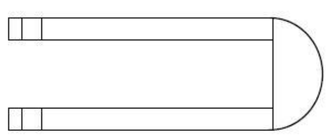
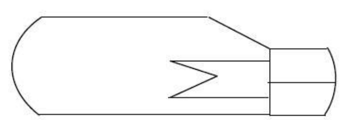
Safety Valves P&ID Symbols

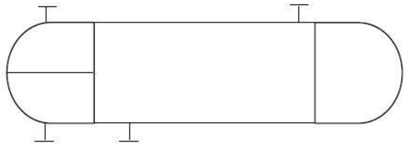
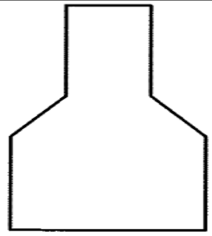
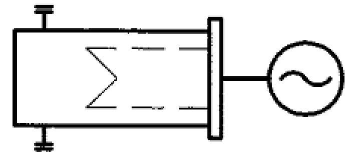
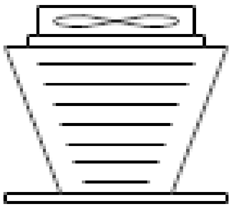
Commonly used P&ID symbols (Piping and Instrumentation Diagram symbols) for safety valves. Note that they may differ slightly from one project to another.

 Pressure Relief Valve	 Vacuum Relief Valve	 Breathing Valve or Pressure / Vacuum Relief Valve
 Pressure Rupture Disc	 Vacuum Rupture Disc	

Heat exchanger P&ID symbols

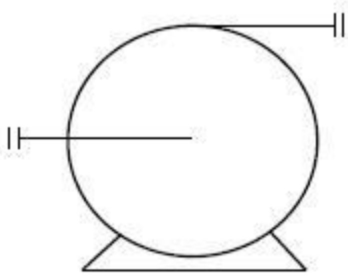
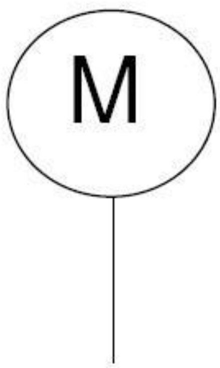
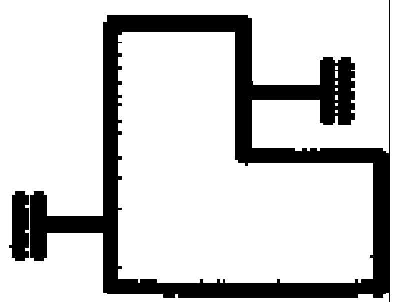
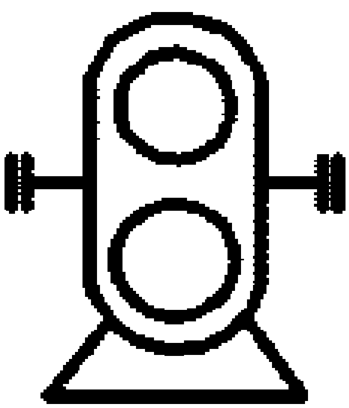
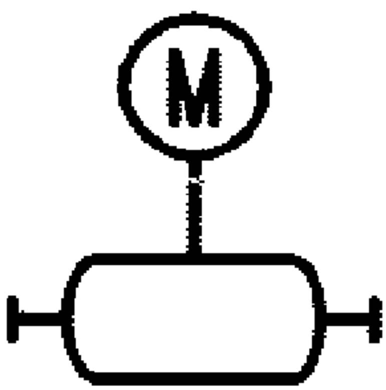
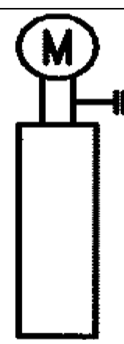
Commonly used P&ID (Piping and Instrumentation Diagram) symbols for heat transfer equipment. Note that they may differ slightly from one project to another.

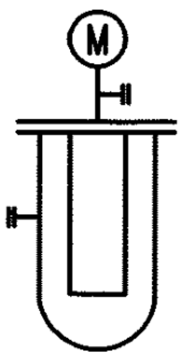
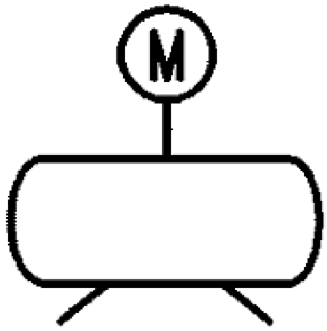
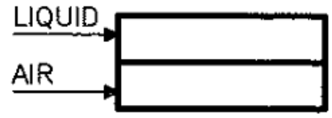
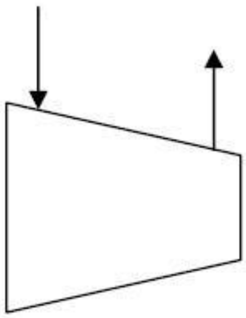
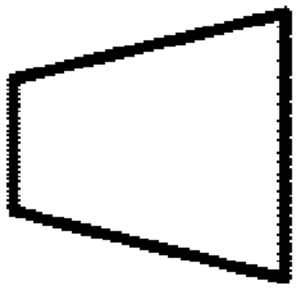
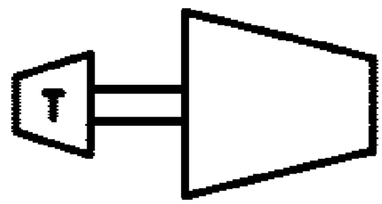
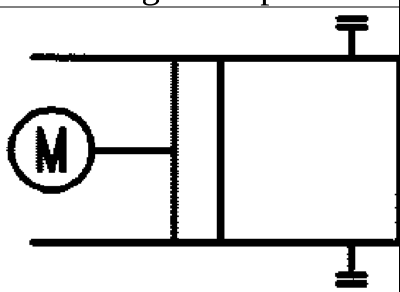
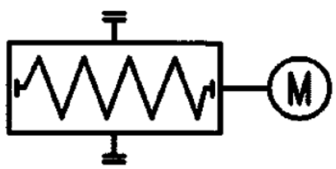
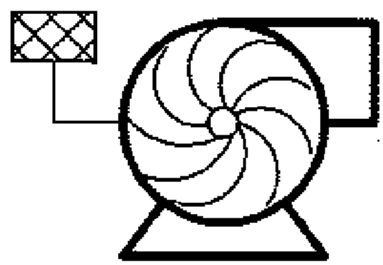
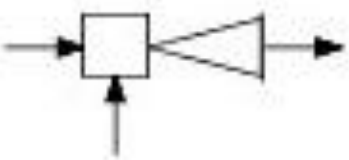
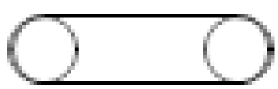
 Air cooler	 Generic heat exchanger	 Generic heat exchanger
 Plate and frame heat exchanger	 Double pipe U tube heat exchanger	 Kettle type heat exchanger

 Shell & Tube Heat Exchanger	 Fired heater	 Electrical heater
 Cooling Tower		

Pumps / compressors P&ID symbols

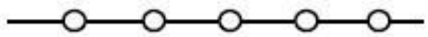
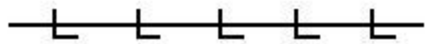
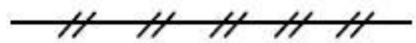
Commonly used P&ID (Piping and Instrumentation Diagram) symbols for pumps / compressors. Note that they may differ slightly from one project to another.

 Centrifugal pump	 Motor	 Reciprocating pump / compressor
 Rotary / Gear pump	 Vertical / Inline pump	 Vertical centrifugal pump with external motor

 Vertical can pump	 Submersible pump with submersed motor	 Air driven double diaphragm pump
 Centrifugal compressor	 Expander / turbine	 Turbine driven compressor
 Reciprocating pump / compressor	 Screw pump or compressor	 Centrifugal blower
 EJECTOR	 Conveyor Belt	

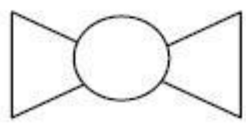
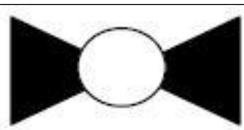
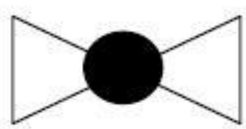
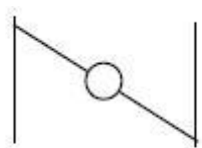
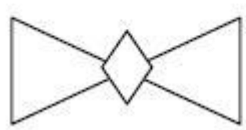
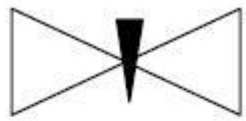
Instrument Signal P&ID symbols

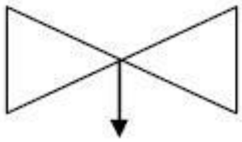
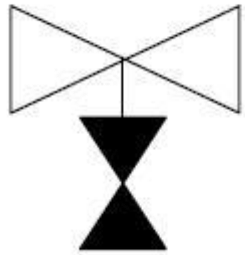
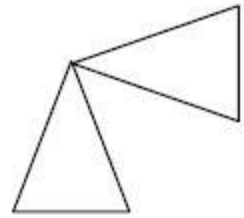
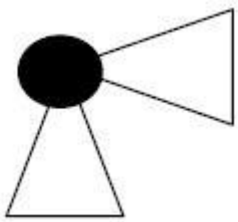
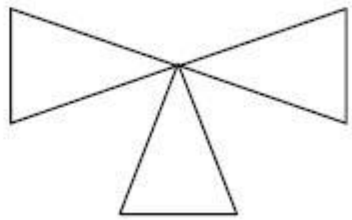
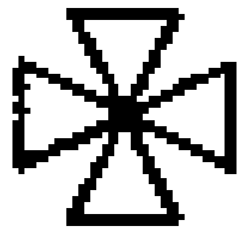
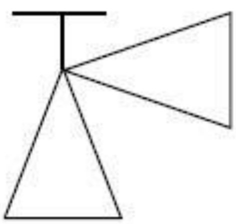
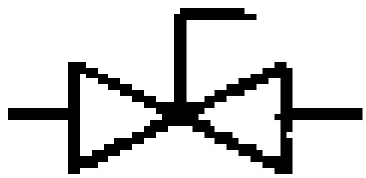
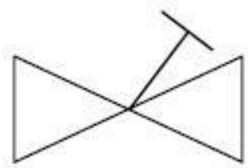
Commonly used P&ID symbols (Piping and Instrumentation Diagram symbols) for instrument signals. Note that they may differ slightly from one project to another.

Process Connection	Electric signal
 Software signal	 Mechanical link
 Hydraulic signal	 Pneumatic signal

Valve P&ID symbols

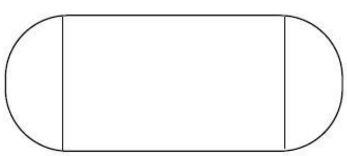
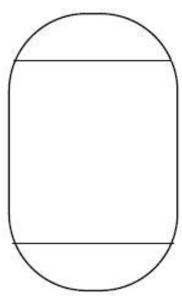
Commonly used P&ID symbols (Piping and Instrumentation Diagram symbols) for manual valves. Note that they may differ slightly from one project to another.

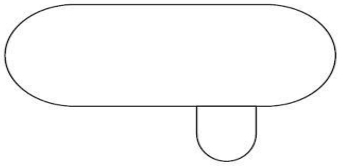
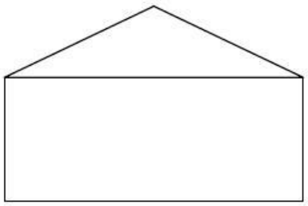
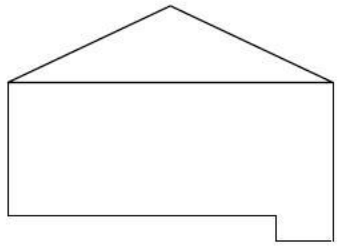
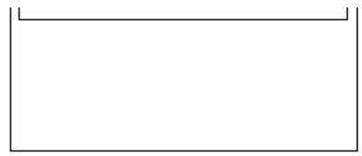
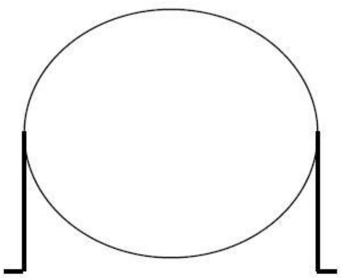
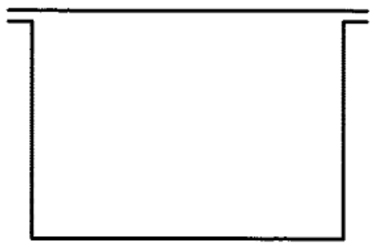
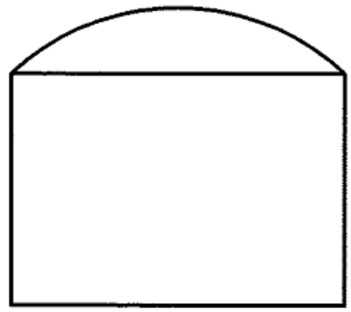
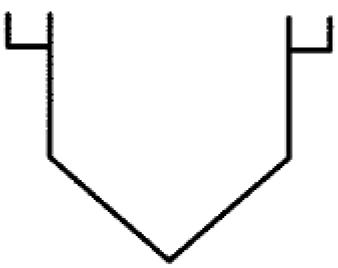
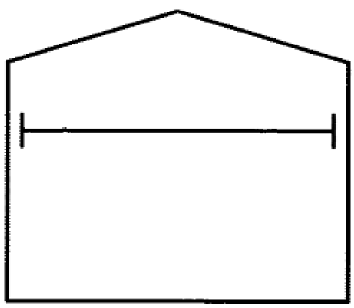
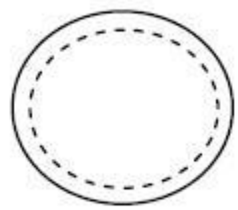
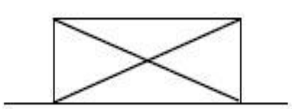
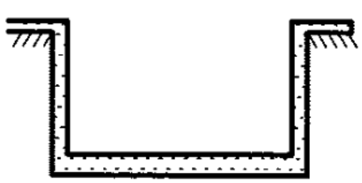
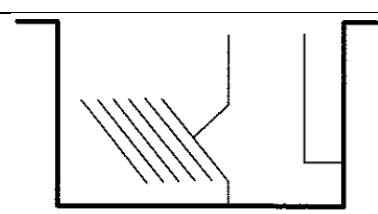
 Gate Valve	 Normally Closed Gate Valve	 Ball Valve
 Normally Closed Ball Valve	 Globe Valve	 Butterfly Valve
 Check Valve	 Plug Valve	 Needle Valve

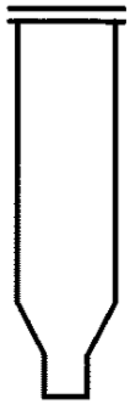
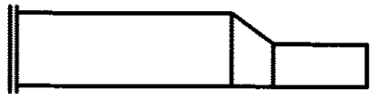
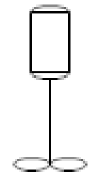
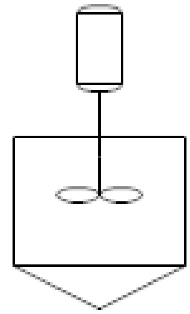
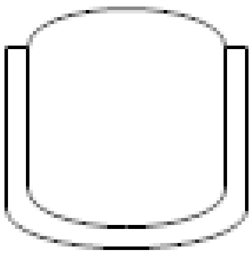
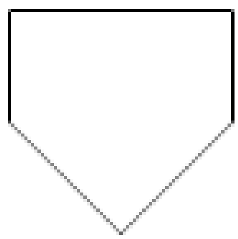
 Self-Draining Valve	 Integrated Block and Bleed Valve	 Angle Valve
 Angle Globe Valve	 3-way Valve	 4- way valve
 Angle Blowdown Valve	 Plug valve	 Y Valve

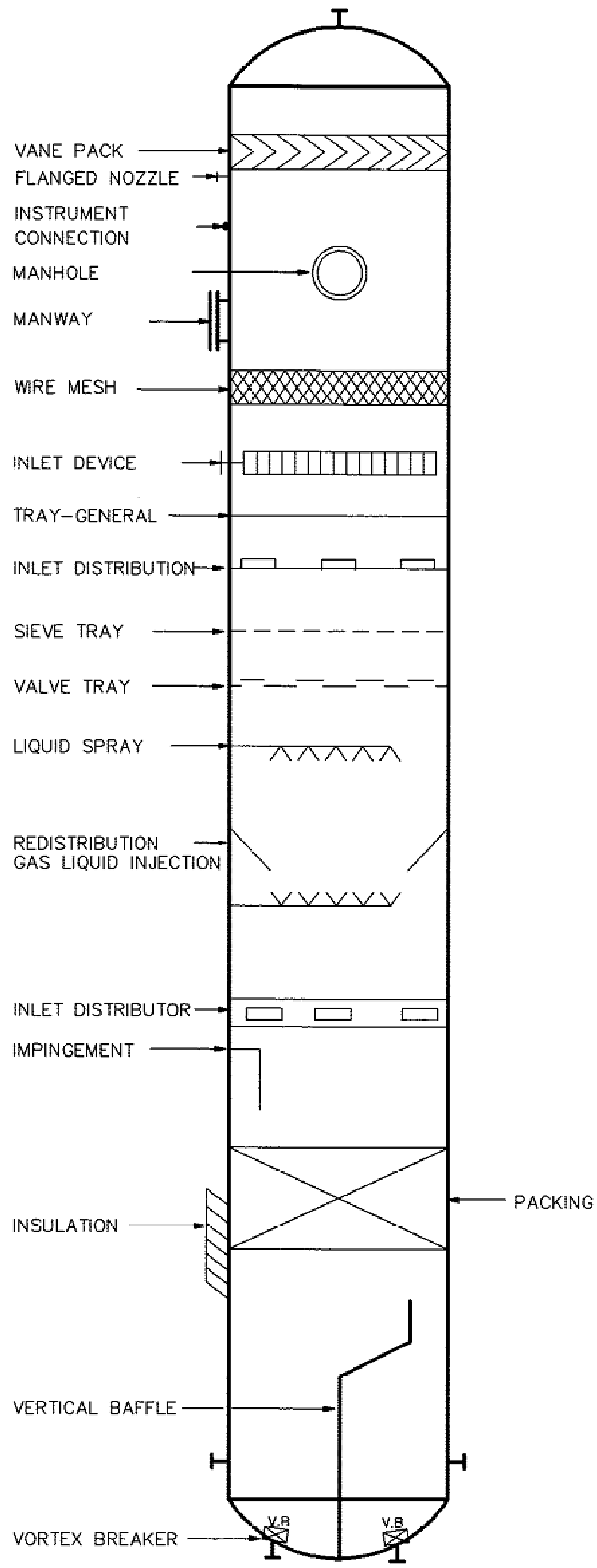
Storage tanks / vessels P&ID symbols

Commonly used P&ID (Piping and Instrumentation Diagram) symbols for storage tanks and process vessels or drums. Note that they may differ slightly from one project to another.

 Horizontal Vessel / drum	 Vertical vessel / drum	 Vertical vessel with mesh pad

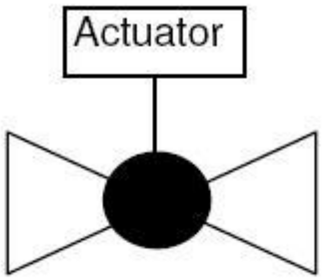
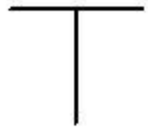
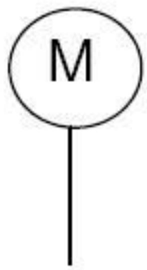
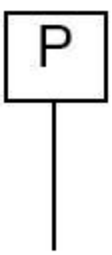
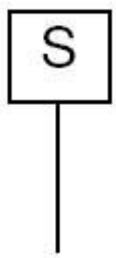
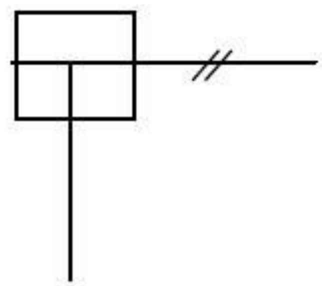
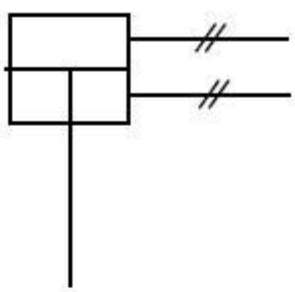
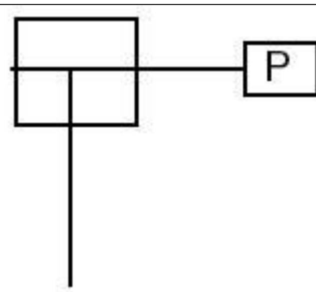
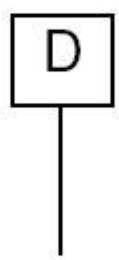
 Horizontal vessel with boot	 Horizontal vessel with weir	 Horizontal vessel with coalescer
 Conical roof tank	 Conical roof tank with boot	 Floating roof tank
 Spherical storage tank	 Flat roof tank	 Dome roof tank
 Sedimentation tank	 Fixed internal floating roof tank	 Man way
 Vortex breaker	 Concrete sump	 Oil skimmer

 Vertical pig trap	 Horizontal pig trap	 Mixer  Mixing Reactor
 Jacketed Tank	 Centrifuge	


VANE PACK
FLANGED NOZZLE
INSTRUMENT CONNECTION
MANHOLE
MANWAY
WIRE MESH
INLET DEVICE
TRAY-GENERAL
INLET DISTRIBUTION
SIEVE TRAY
VALVE TRAY
LIQUID SPRAY
REDISTRIBUTION GAS LIQUID INJECTION
INLET DISTRIBUTOR
IMPINGEMENT
INSULATION
PACKING
VERTICAL BAFFLE
VORTEX BREAKER
V.B
V.B

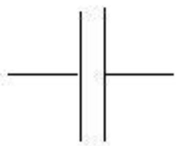
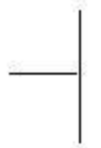
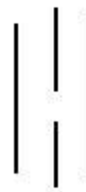
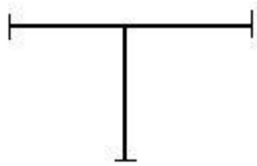
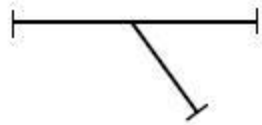
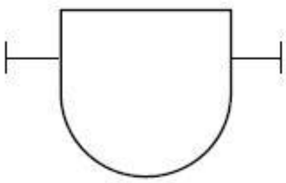
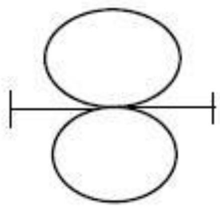
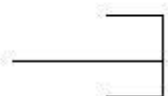
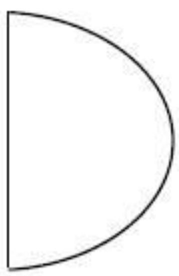
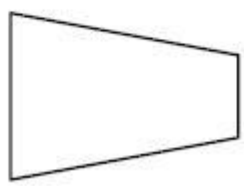
P&ID symbols for control valve and actuators

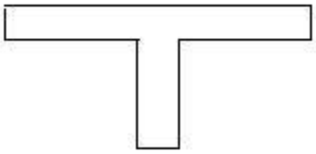
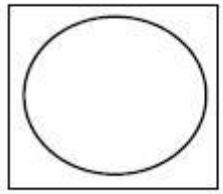
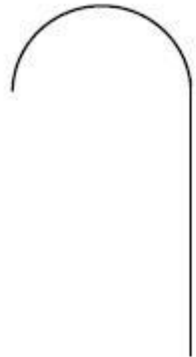
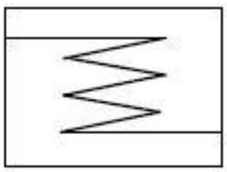
Commonly used P&ID symbols (Piping and Instrumentation Diagram symbols) for control valve actuators. Note that they may differ slightly from one project to another.

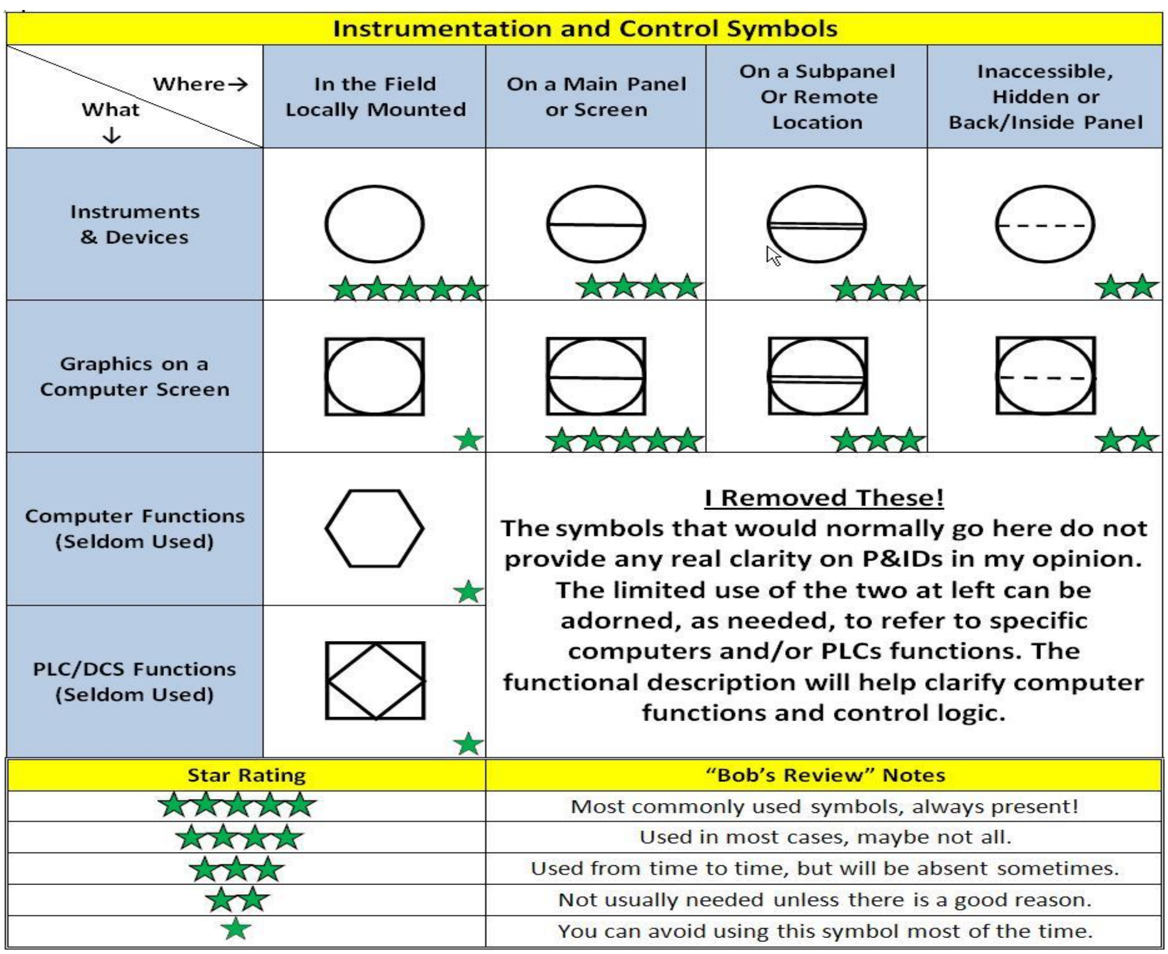
 Control valve assembly	 Manual (hand wheel)	 Diaphragm actuator
 Balanced diaphragm actuator	 Motor actuator	 Spring actuator
 Pilot actuator	 Solenoid actuator	 1 Acting cylinder actuator
 2 Acting cylinder actuator	 Pilot operated cylinder actuator	 Digital actuator

Fittings P&ID symbol

Commonly used P&ID symbols (Piping and Instrumentation Diagram symbols) for piping fittings. Note that they may differ slightly from one project to another.

 Flange set	 Blind Flange	 Flow orifice
 Removable pipe spool	 Tee type strainer	 Y type strainer
 Basket type strainer	 2 basket type strainer	 End plug
 End cap	 Reducer / Expander	 Open spacer
 Closed spacer	 Open spectacle blind	 Closed spectacle blind

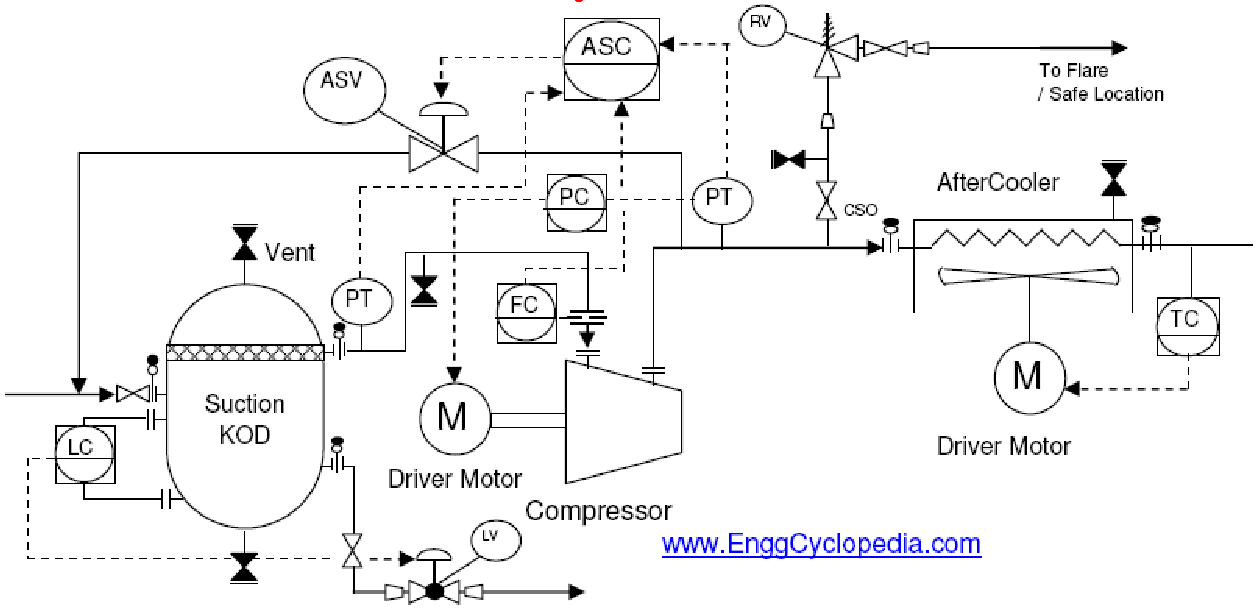
 Mixing Tee	 Sight glass	 Gooseneck vent
 Sample cooler		



Instrumentation and Control Symbols				
What ↓ / Where→	In the Field Locally Mounted	On a Main Panel or Screen	On a Subpanel Or Remote Location	Inaccessible, Hidden or Back/Inside Panel
Instruments & Devices	★★★★★	★★★★	★★★	★★
Graphics on a Computer Screen	★	★★★★★	★★★	★★
Computer Functions (Seldom Used)	★	**I Removed These!** The symbols that would normally go here do not provide any real clarity on P&IDs in my opinion. The limited use of the two at left can be adorned, as needed, to refer to specific computers and/or PLCs functions. The functional description will help clarify computer functions and control logic.		
PLC/DCS Functions (Seldom Used)	★			

Star Rating	"Bob's Review" Notes
★★★★★	Most commonly used symbols, always present!
★★★★	Used in most cases, maybe not all.
★★★	Used from time to time, but will be absent sometimes.
★★	Not usually needed unless there is a good reason.
★	You can avoid using this symbol most of the time.

Typical P&ID arrangement for Centrifugal Compressor Systems



ASC : Anti Surge Controller
ASV : Anti Surge Valve

TC : Temperature Controller
PC : Pressure Controller

FC : Flow Controller
LC : Level Controller

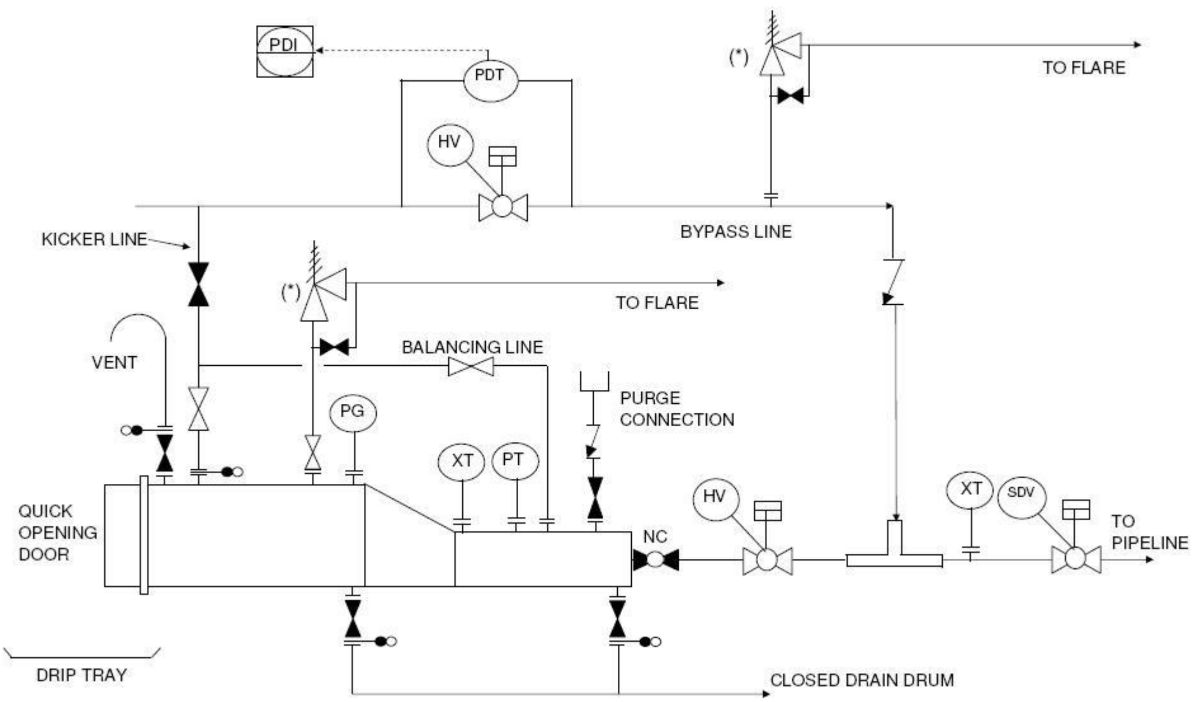
1. Normally, a centrifugal compressor is accompanied by a Knock Out Drum (KOD) at the compressor suction and an after cooler at the compressor discharge, as per a typical compressor PFD. Symbols for these equipment should also be placed on the P&ID before proceeding a head. All the equipment symbols should be selected from the legend sheets of a particular project.
2. All the nozzles on the compressor, suction drums and after cooler should then be correctly represented with size and flanges. This includes inlet and outlet nozzles and equipment drains / vents.
3. Centrifugal compressor suction KOD is intended for removing the entrained liquids before sending gas to the compressor. Demister, mesh pad etc. are used in the knock out drum to efficiently remove the liquid droplets.
4. Compressor after coolers are generally air coolers and the related fan, motor etc. should be clearly indicated on the P&ID. If cooling water is used, proper symbol for a heat exchanger should be used.
5. Inlet, outlet lines for each equipment, anti-surge line, drain/vent lines, line to the relief valve etc. are the next to be drawn up. Line number, material class, size etc. is to be correctly assigned to each of the lines.
6. Isolation valves, spectacle blinds, spacers etc. to be used for maintenance should be drawn up next on various lines between the equipment. Requirement for isolation valves, spectacle blind, spaces etc. depend on the project standards,

which should be followed while indicating these on the P&ID. Sometimes, to minimize the number of isolation valves between the equipment, they can be placed only at the suction KOD inlet which is inlet of the centrifugal compressor system and discharge of the after cooler which turns out to be the outlet of the centrifugal compressor system. Spectacle blinds or spacers can be used for isolation between individual equipment for quick maintenance. This is simply a guideline and project standards need to be followed when indicating the isolation requirements.

7. A check valve should be normally provided on the compressor discharge to avoid reverse flow when the pump is not in operation.
8. Pressure relief valves can be provided on the compressor discharge line, downstream to the check valve, to protect the equipment downstream of compressor.
9. Pressure gauges should be provided on suction and discharge of the compressor. Level gauges need to be located on the compressor suction knock out drum and temperature gauges on inlet, outlet lines for the after cooler.
10. Pressure transmitters should be provided on compressor suction and discharge line. A flow transmitter should be provided on compressor suction line. Signals from these transmitters are sent to an ‘Anti-Surge Controller’. Based on the gas flow and differential pressure head developed by the compressor, the anti-surge controller operates the anti-surge valves to prevent compressor surge condition.
11. An anti-surge line from the after cooler discharge to the suction KOD inlet should be provided for anti-surge control. When the compressor approaches surge condition (low flow, high differential head), the anti-surge valves open up to lower the pressure differential and circulate higher gas flow.
12. Sometimes, a performance controller can be included in the centrifugal compressor system to control the rotating speed (RPM) of the compressor based on inlet pressure, flow etc. in order to achieve optimum performance. Performance controller will typically adjust the motor/turbine speed.
13. Level transmitters provided on the suction knock out drum are responsible for liquid level control in the drum. Alarms are usually provided for high and high high liquid level conditions.
14. Temperature transmitter can be provided on after cooler for temperature control by sending a signal to adjust the fan speed of the air cooler.
15. Emergency Shutdown (ESD) valves can be provided on inlet / outlet lines of the compressors system to isolate whole system in case of a shutdown. The inlet line of the suction KOD corresponds to inlet of the compressor system. After cooler discharge and liquid outlet of suction knock out drum correspond to the outlet lines of the compressor system. Shutdown valves can be located on these lines.

16. Drains and vents to be provided on the suction / discharge lines, compressor casing, suction Knock Out Drum, air cooler body etc. for completely draining/venting compressor and associated piping, for maintenance.
17. For purging the compressor system, a nitrogen connection can be provided right after the first isolation valve on the suction KOD inlet line.
18. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

Typical P&ID arrangement for Pig Launchers / Pig Receivers



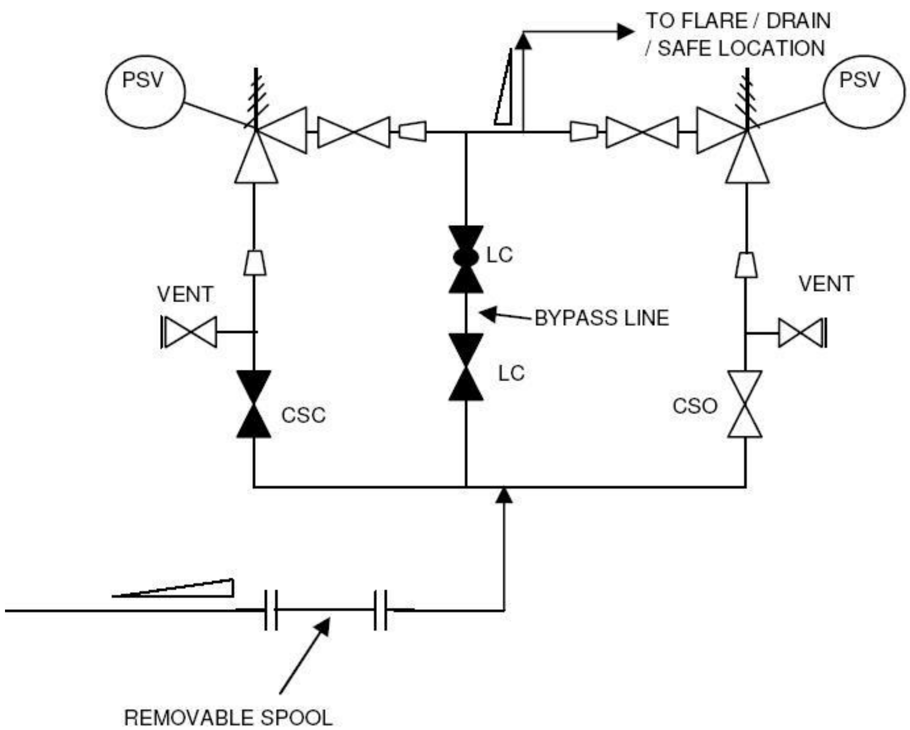
Pig launchers and receivers are commonly used in upstream oil and gas industry for periodic cleaning of pipelines carrying crude oil, natural gas and water from oil wells. A pig is a bullet shaped object which fits the pipeline from inside. The pig launcher launches the pig into pipeline and the upstream pressure pushes the pig to other end of the pipeline where it is received by the pig launcher. Hence generally arrangement for pig launchers and receivers are essentially the same, except for the difference between 'Kicker line' position for launchers and receivers. The sample drawing presents this general arrangement common to pig launchers and receivers.

1. Proper equipment symbol for pig launcher (vertical or horizontal) should be selected first of all, as shown in the presented drawing. This should be selected from the list of equipment symbols on the legend sheets of a particular project.
2. The major and minor barrels of the pig trap should be indicated as shown in the sample drawing. Minor barrel size is equal to pipeline size and the major barrel size is slightly larger.
3. All the nozzles on the pig launcher should then be correctly represented with size and flanges. This includes door on the launcher, pig outlet to pipeline, kicker line, balancing line, PSV connection, purge, vent, drain and instrument nozzles, as shown in the sample drawing presented here. Typical instrumentation on the pig launcher would be pressure gauges and transmitters and pig indicators to know if the pig has been launched (or arrived in the case of pig receivers).
4. Different lines connected to the pig launcher are the next to be drawn up. Line number, material class, size etc. is to be correctly assigned to each of the lines.
5. Kicker line is used to pressurize the upstream side of pig so it can be launched. In case of receiver, kicker line provides an outlet for fluids arriving in the pig trap. Normally when pigging is not being performed, kicker line is closed using normally closed valve.
6. Balancing line connecting the kicker line to minor barrel of the pig launcher, helps lower the pressure differential so that sudden shooting of the pig will not damage downstream automatic valves.
7. A bypass line of the pig launcher is the normal route for the fluids when pigging is not taking place. This section upstream to the shutdown valve at beginning of pipeline can be protected against overpressure as indicated in the sample drawing.
8. The hand operated valve (HV) on the bypass line is used to create a pressure differential for launching the pig (also for receiving the pig). A pressure differential indicator (PDI) has to be available to the HV operator to monitor the pressure differential.
9. On the outlet of the pig launcher, another hand operated automatic valve is provided to open up the launcher upon pressurization.
10. The pig launcher (and receiver) are also protected against overpressure with a PSV which discharges to flare. Typical representation of PSVs can be referred to in another article.
11. Isolation valves, spectacle blinds, spacers etc. to be used for maintenance should be drawn up next, on various lines to and from the pig trap. The spectacle blinds, spacers etc. are usually connected right next to the isolation valves and equipment nozzles, as indicated in the sample drawing presented here.
12. Drains should be provided either on major or minor barrel or on both for complete draining of the pig trap after the pig is launched or received. Sample drawing has

indicated drains on both the barrels. These drains are connected to the closed drain system.

13. Vents to flare and to atmosphere are required on pig launchers. Venting to flare for depressurization of the pig launcher can be achieved using bypass on the relief valve. For maintenance, when pig is not in operation it can be vented to atmosphere.
14. A utility connection is required to purge the pig launcher / receiver after the pigging is done and the pig trap is depressurized and drained. A nitrogen connection should normally be provided as indicated in the sample drawing.
15. Most of the guidelines mentioned for pig launchers also hold good for pig receivers.
16. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

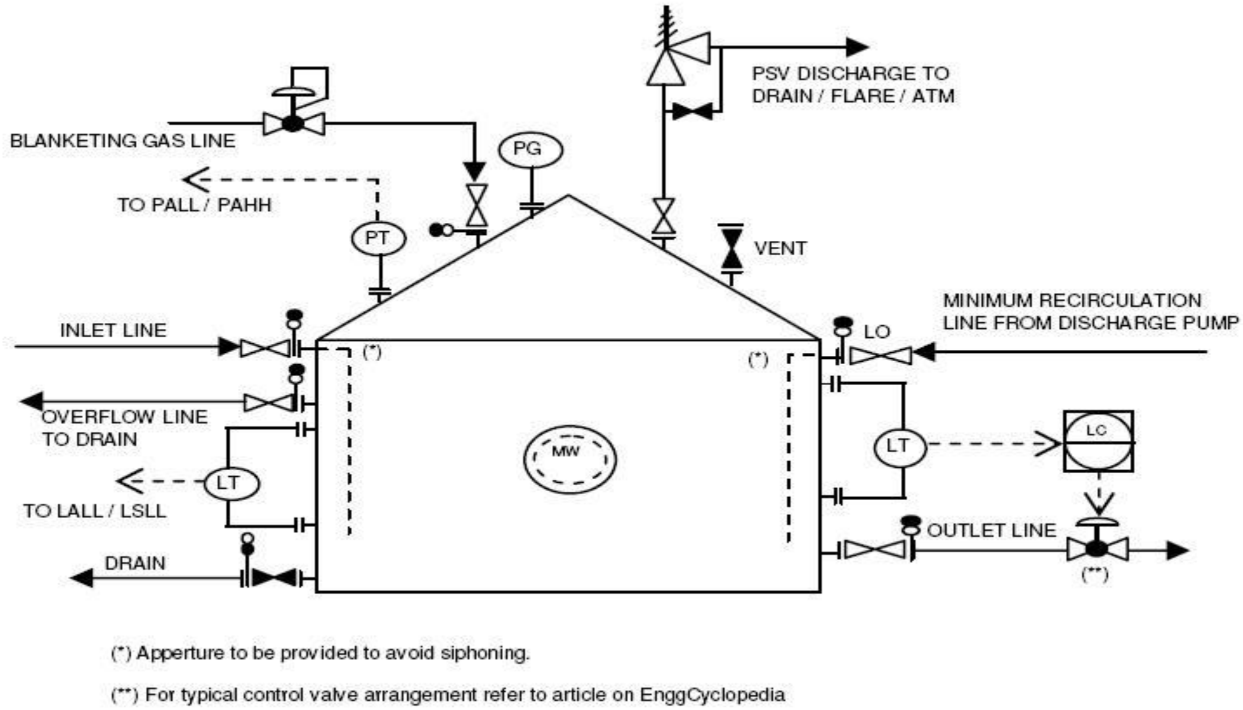
Pressure Safety Valves – Typical P&ID arrangement



1. The sample drawing presented here represents a typical arrangement generally used to represent safety valves or relief valves on P&ID. First of all a proper safety valve symbol should be selected to represent the control valve as per the project standards.

2. For protecting equipment that are not spared and equipment that cannot be isolated without disrupting the plant / unit a spare safety valve is recommended to be provided as shown in the sample drawing.
3. Generally, the safety valve inlet / outlet nozzles are smaller than the corresponding line sizes. This change in diameter should be clearly indicated in the P&ID with reducer and expander.
4. Block valves should be provided upstream and downstream of the safety valves in case of shutdown and maintenance. Normally provision is made to keep these valves locked or sealed open. The spare safety valve is kept locked or sealed closed, as indicated in the sample drawing.
5. A vent valve is normally provided between the safety valve and upstream block valve.
6. Normally, bypass should provided for safety valves for process or start-up requirements. Type, number and size of bypass valves will depend on the project standards.
7. Depending on the service handled, the discharge from PSV can be either routed to flare system for hydrocarbon service, for closed/open drain systems or to atmosphere at a safe location for non-hazardous service.
8. The inlet lines to the safety valves are always sloped toward to protected equipment and the outlet lines from the safety valves are always sloped towards the flare header / the knock out drum or the safe location.
9. When a PSV is connected to the flare system, the inlet line piping should be equipped with a spool piece to facilitate dismantling, as indicated in the sample drawing. For PSVs discharging to atmosphere, this is not required.
10. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

Typical P&ID arrangement for Storage Tanks



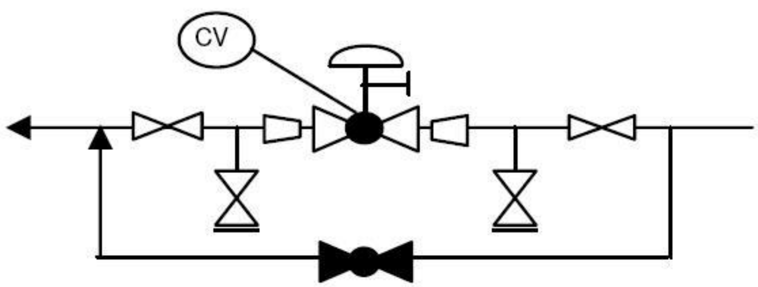
Storage tanks of various kinds are used to store process fluids of various types, under different process conditions. But the basic arrangement remains roughly the same for different types of storage tanks.

1. Proper tank symbol should be selected first of all, as shown in the presented drawing. This should be selected from the list of equipment symbols on the legend sheets of a particular project.
2. Tank internals should then be indicated as per proper symbols on the legend sheets. These internals can be inlet pipe, vortex breaker on the outlet lines etc.
3. All the nozzles on the storage tank should then be correctly represented with size and flanges. This includes inlet and outlet nozzles, overflow line, minimum recirculation line, blanketing gas line, drains, vents, PSV connection and instrument nozzles, as shown in the sample drawing presented here. Normally for large enough tanks a manway has to be provided as indicated in the sample drawing for maintenance access.
4. Inlet and outlet lines are the next to be drawn up. Line number, material class, size etc. is to be correctly assigned to each of the lines.
5. Typical instrumentation on the tank would be level gauges and transmitters plus pressure gauge and transmitters. For tank under continuous operation a level control valve has to be provided as indicated in the sample drawing. For tank with blanketing gas a self regulating pressure valve has to be provided on the

blanketing gas inlet line. Normally alarms / trips are provided for High High Pressure, High High Level, Low Low Pressure and Low Low Level.

6. Isolation valves, spectacle blinds, spacers etc. to be used for maintenance should be drawn up next on the inlet / outlet lines. The spectacle blinds, spacers etc. can be connected right next to the isolation valves and equipment nozzles, as indicated in the sample drawing presented here.
7. Drains should be provided on the tank bottom and on the bottom outlet lines for complete draining of the tank and associated piping for maintenance purpose.
8. Vent has to be provided on top of the tank for complete venting of the tank for maintenance purpose. In some cases the tank may be open to atmosphere through vent during normal operation. In such cases a bird screen has to be provided on the vent line.
9. For purging the tank with nitrogen or steam, a utility connection can be provided directly on the tank.
10. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

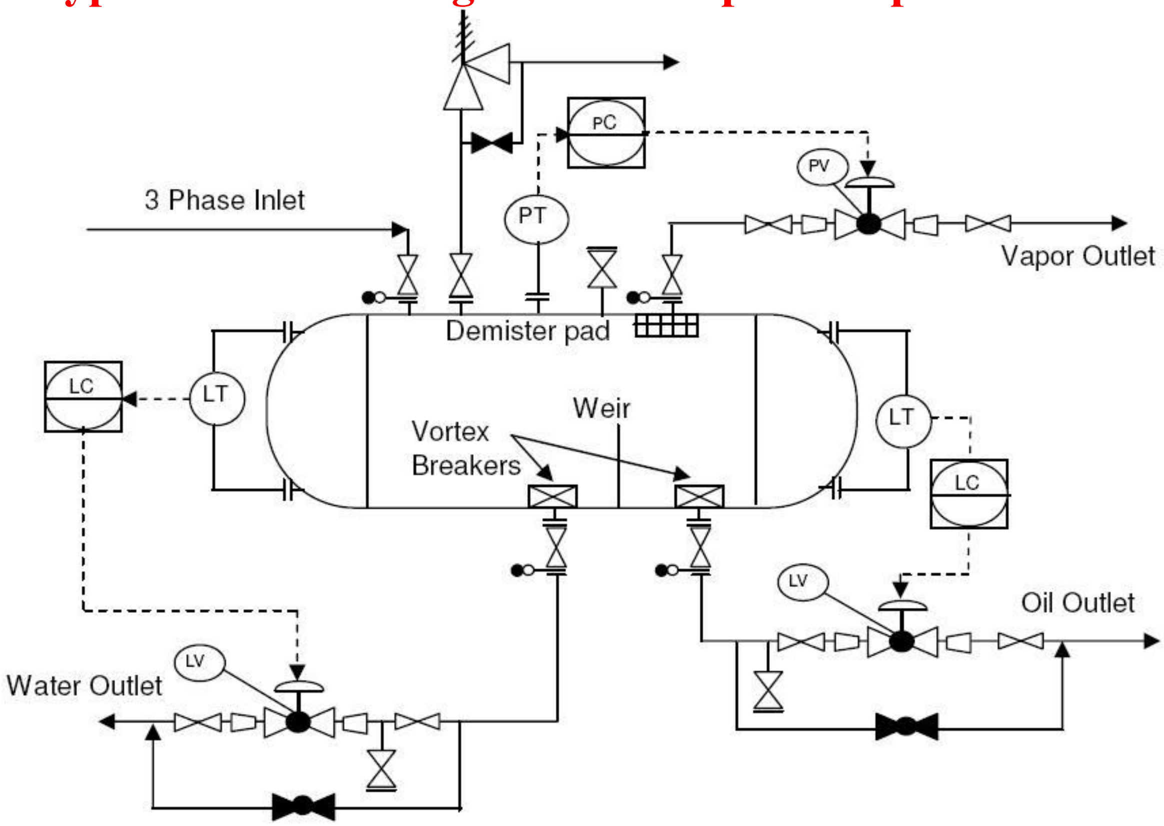
Control Valves – Typical P&ID arrangement



1. The sample drawing presented here represents a typical arrangement generally used to represent control valves on P&ID. Depending on the projects legend sheets, control valves may be represented by globe or gate valves. Here a globe valve symbol is used. First of all a proper valve symbol should be selected to represent the control valve as per the project standards.
2. Generally, the control valve size is smaller than the corresponding line size. This change in diameter should be clearly indicated in the P&ID with reducer and expander.
3. Block valves should be provided upstream and downstream of the control valves in case of shutdown and maintenance.

4. A drain valve is normally provided between the control valve and upstream block valve. If the control valve is of 'Fail Open' type, this drain valve is sufficient to drain the piping segment. If the control valve is of 'Fail Close' or 'Fail in Position' type, then additional drain valve is required between the control valve and downstream block valve as shown in the sample drawing.
5. Normally, either a bypass or a hand wheel is provided for control valves which are under continuous service. If two or more control valves are installed in parallel, bypass or hand wheel is not required.
6. The choice between providing either a bypass or a hand wheel for the control valve is made based on the size of the control valve. For control valves bigger than a certain size, provision of hand wheel is preferred. For control valves smaller than certain size, provision of bypass with block valves is preferred. For control valves on certain critical services, a spare control valve may be installed on the bypass of main control valve. This limiting control valve size between hand wheel and bypass is specific for a project and may vary from one project to another.
7. If the control valve is equipped with a hand wheel, then only the drain between control valve and upstream block valve is sufficient for draining by opening the control valve using hand wheel.
8. Normally globe valve is selected as the bypass valve on the control valve as it allows better control with opening.
9. Additional details such as failure position, tightness class, # rating etc. are also indicated on the P&ID for control valves, as per the project standards.
10. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

Typical P&ID arrangement for 3 phase separator vessels

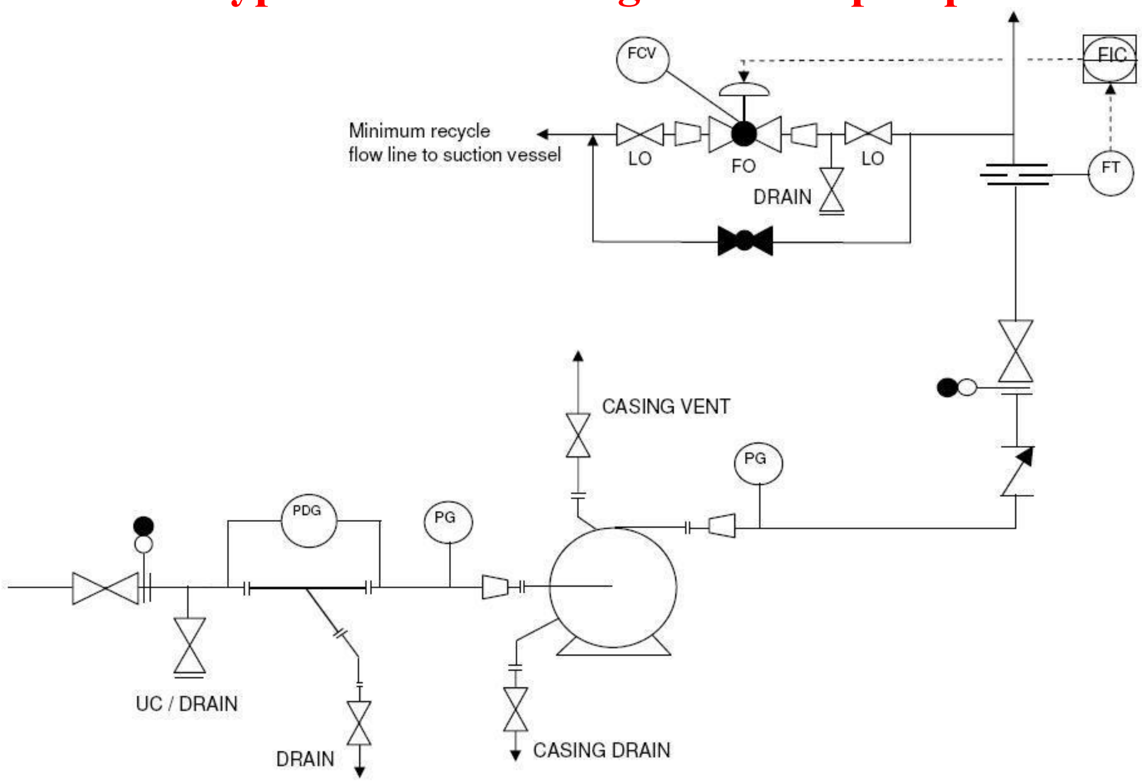


3 phase separators are commonly used in upstream oil and gas industry to separate oil, gas and water stream coming from the oil wells. This typical P&ID arrangement can be modified and used for other separator vessels as well.

1. Proper vessel symbol should be selected first of all, as shown in the presented drawing. This should be selected from the list of equipment symbols on the legend sheets of a particular project.
2. Separator vessel internals should then be indicated as per proper symbols on the legend sheets. These internals can be inlet vane, vortex breaker on the outlet lines, demister pads on gas outlets, weir plate separating the oil and water compartments etc.
3. All the nozzles on the separator vessel should then be correctly represented with size and flanges. This includes inlet and outlet nozzles, drains, vents, PSV connection and instrument nozzles, as shown in the sample drawing presented here. Typical instrumentation on the vessel would be level gauges and transmitters on oil and water compartments of the vessel plus pressure gauge and transmitters linked to pressure control or alarms as applicable.

4. Inlet and outlet lines are the next to be drawn up. Line number, material class, size etc. is to be correctly assigned to each of the lines.
5. Isolation valves, spectacle blinds, spacers etc. to be used for maintenance should be drawn up next on the inlet / outlet lines. The spectacle blinds, spacers etc. are usually connected right next to the isolation valves and equipment nozzles, as indicated in the sample drawing presented here.
6. Instrumentation on the vessel should be drawn up next. Typically this would include level gauges, level transmitters, pressure gauges, pressure transmitters as per requirement for control, alarm and trip if applicable. The sample drawing presented here only indicates transmitters, but generally they are accompanied by gauges for local indication and also transmitters for alarms and trips.
7. Various control valves should be drawn up next wherever applicable. Sample drawing indicates level control on oil and water outlet lines. Plus pressure control is indicated on the vapor outlet to flare. These control valves should be equipped with either a bypass or hand wheel as per project standards, to continue vessel operation in case of control valve maintenance.
8. Drains should be provided either on the vessel or on the bottom outlet lines for complete draining of the vessel and associated piping for maintenance purpose. Sample drawing has indicated drains on the outlet lines through which the vessel and piping can be completely drained. Usually the vessel also has nozzles connecting it directly to the draining system.
9. Vents can be present either on the vessel itself or on the vapor outlet line, so that the vessel and associated piping can be completely vented for maintenance. Vent connected directly to vessel is indicated in the sample drawing.
10. In most cases the vessel is provided with a blanketing gas connection. This blanketing connection can be with or without pressure control. Although not indicated in the sample drawing, it is important to consider the blanketing gas connection to the vessel.
11. For purging the vessel with nitrogen, a connection can be provided directly on the vessel. In some cases purging can be done with steam.
12. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

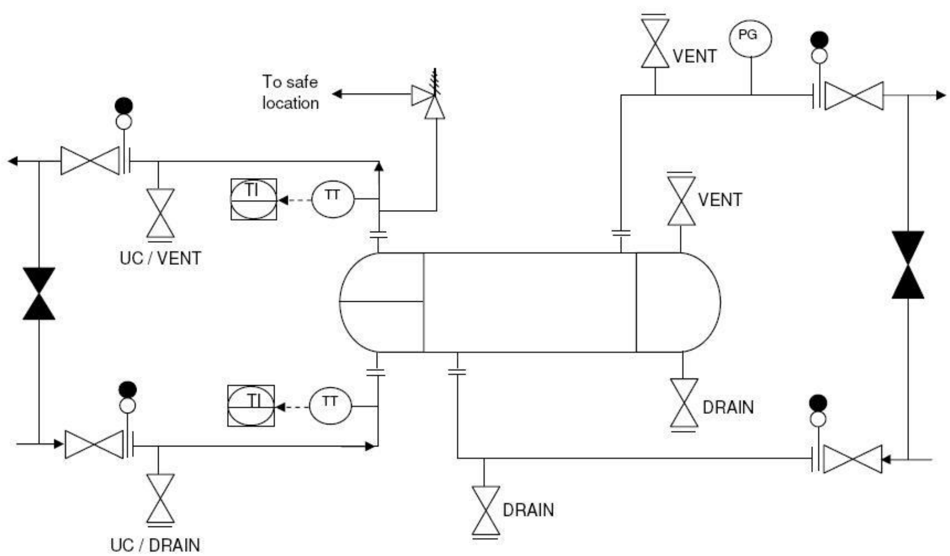
Typical P&ID arrangement for pumps



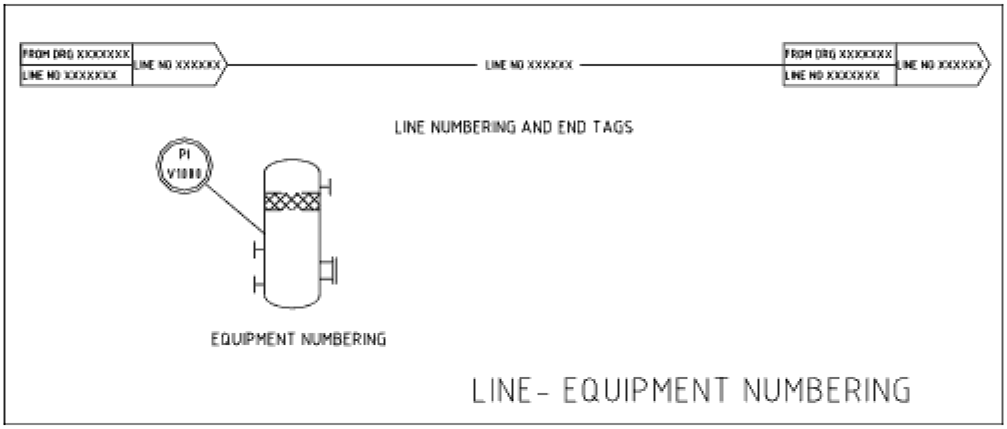
1. Proper pump symbol should be selected first of all, as shown in the presented drawing. This should be selected from the list of equipment symbols on the legend sheets of a particular project.
2. All the nozzles on the pump should then be correctly represented with size and flanges. This includes inlet and outlet nozzles and casing drains and vents as shown in the sample drawing presented here. Generally, the suction and discharge nozzles on the pump are smaller than suction and discharge line sizes. Appropriate reducer / expander to be clearly indicated in such cases.
3. Inlet and outlet lines are the next to be drawn up. Line number, material class, size etc. is to be correctly assigned to each of the lines.
4. Isolation valves, spectacle blinds, spacers etc. to be used for maintenance should be drawn up next on the inlet / outlet lines. The isolation valves on suction and discharge lines should be 'Locked Open' in case of automatic pump start-up. Inlet line to the pump is to be fitted with a strainer for pump protection. This strainer can be equipped with a pressure differential gauge to monitor blockage in the strainer.
5. Pressure gauges are normally to be provided on suction and discharge of the pump. In addition, pressure transmitters connected to Emergency Shutdown (ESD) system can also be provided as per requirements.

6. A check valve should be normally provided on the pump discharge to avoid reverse flow when the pump is not in operation.
7. Downstream to the check valve on the pump discharge, minimum flow recirculation line for the pump needs to be provided. A flowmeter should be provided before the minimum flow line, as shown on the presented sample drawing.
8. A flow control valve with or without bypass is then to be provided on the minimum flow recirculation line. The isolation valves for this control valve need to be locked open or sealed open and the FCV should be of 'Fail Open' type. The minimum recirculation line is normally routed back to the suction vessel of the pump.
9. Drains and vents to be provided on the suction / discharge lines, minimum flow line and on pump casing, so that the pump and associated piping can be completely drained for maintenance.
10. For purging the pump with nitrogen, a connection should be provided right after isolation valve on the suction line. This connection can also be used as a drain.
11. Temperature gauges and transmitters to be provided as per requirements for operating and controlling the equipment.
12. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.

Typical P&ID arrangement for Heat Exchangers

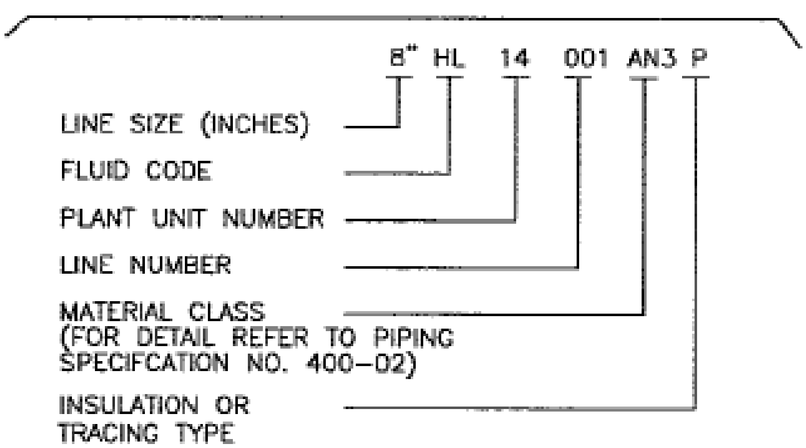


1. Proper equipment symbol should be selected first of all, as shown in the presented drawing. This should be selected from the list of equipment symbols on the legend sheets of a particular project.
2. All the nozzles on the exchanger should then be correctly represented with size and flanges. This includes inlet and outlet nozzles, drains, vents, utility connections etc.
3. Inlet and outlet lines are the next to be drawn up. Line number, material class, size etc. is to be correctly assigned to each of the lines. If the unit is envisaged to be in operation while the exchanger is under maintenance, then bypass lines should be drawn up on shell side, tube side or on both sides as shown in the drawing presented here.
4. Isolation valves, spectacle blinds, spacers etc. to be used for maintenance should be drawn up next on the inlet / outlet lines. Bypass lines to be fitted with normally closed isolation valves.
5. Thermal relief valve should be provided where required. Generally thermal relief valves are required on the cold liquid streams, when there is a possibility of blockage in the heating medium on the other side of exchanger. In case of such blockage, there is possibility of overheating the cold stream and hence requirement for thermal relief valve. Discharge of a relief valve to be routed to an appropriate, safe location.
6. Drains and vents to be provided on both sides of the exchanger (hot and cold sides), either on the exchanger itself or inlet / outlet piping, so that the equipment can be completely drained for maintenance.
7. For fouling service on the tube side, utility connections should be provided as indicated in the presented drawing, for cleaning purpose.
8. Temperature and pressure gauges and transmitters to be provided as per requirements for operating and controlling the equipment. Normally temperature monitoring is required for the process side of the heat exchanger. Also generally temperature control is implemented on the process side of the exchanger.
9. All the guidelines given here are very general and may be modified as per specific requirements of any particular project.



Measured Variable	Type of Conditioner	Type of Component
F = Flow	R = Recorder	T = Transmitter
L = Level	I = Indicator	M = Modifier
P = Pressure	C = Controller	E = Element
Q = Quantity	A = Alarm	
T = Temperature		Connexion Solenoid Valve symbols from the UK's premier solenoid valve suppliers

LINE NUMBERING SYSTEM



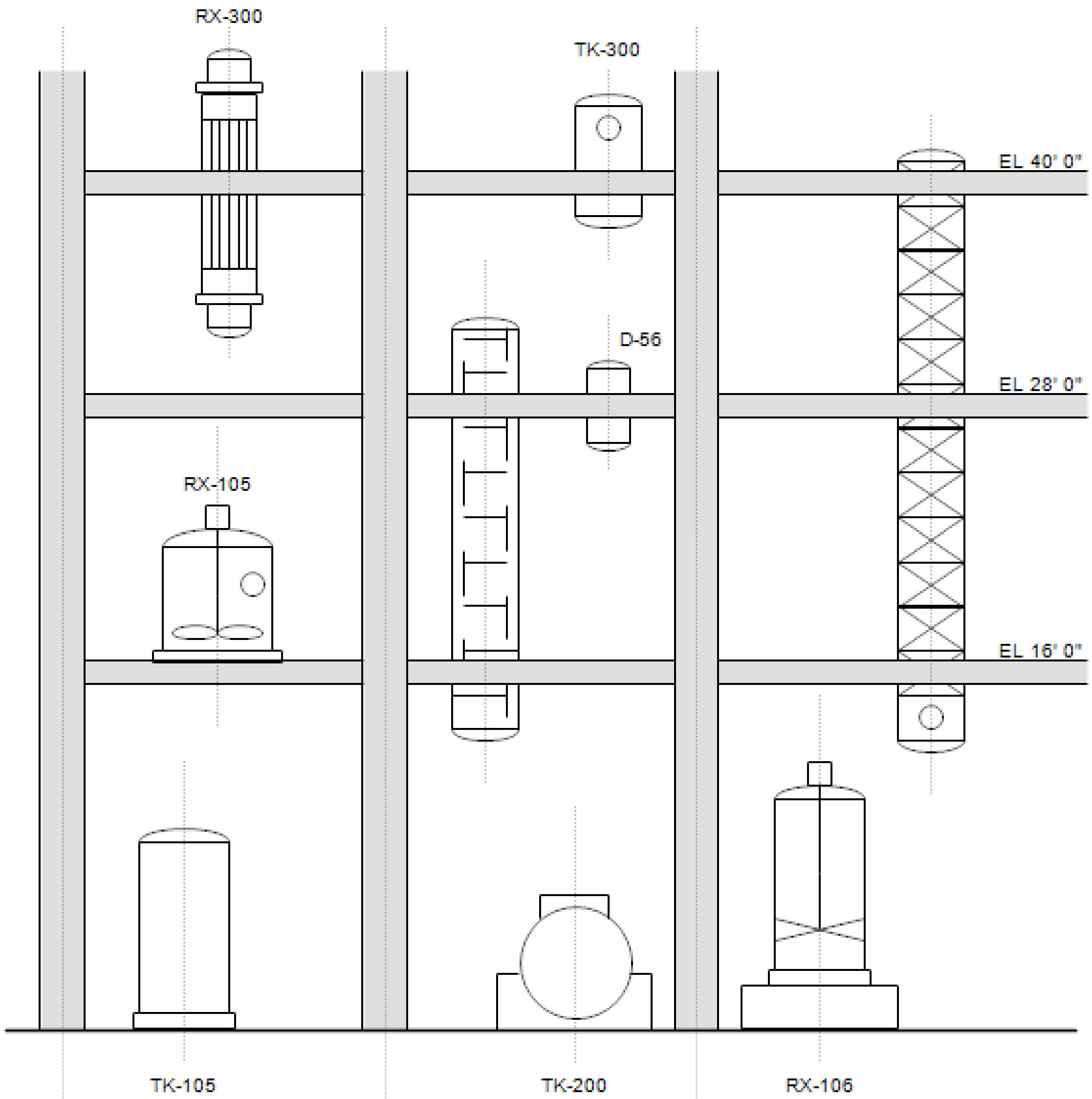
INSULATION AND TRACING	
SYMBOL	DESCRIPTION
A	ACOUSTIC INSULATION
C	COLD INSULATION
H	HOT INSULATION
P	PERSONAL INSULATION
CA	COLD ACOUSTIC INSULATION
HA	HEAT ACOUSTIC INSULATION
PP	POLYPROPYLENE INSULATION
FP	FREEZE PROTECTION INSULATION
PE	POLYETHYLENE INSULATION
FB	FUSION BONDED EPOXY INSULATION
N	NORMAL (NORMAL LINE PAINTED)
ET	ELECTIRECAL TRACING
ST	STEAM TRACING
CJ	CHILLED FLUID JACKET
HJ	HOT FLUID JACKET
SST	STEAM TRACE WITH HEAT TRANSFER CEMENT
G	GALVANIZED C.S

MATERIAL CLASS	C.A	RATING	MATERIAL	SERVICE
A3	3.2	150	C.S 13%CR	OD
AN3	3.2	150	C.S NACE 13%CR TRIM	PROCESS, FLARE, CD
B3	3.2	300	C.S 13%CR TRIM	PROCESS
BN3	3.2	300	C.S NACE 13%CR TRIM	PROCESS
AB3	1.6	150	C.S NACE 13%CR TRIM	GN,GF,UA
AE3	1.6	150	EPOXY LINED C.S SUPER DUPLEX S.S,TRIM	SEA WATER COOLING / 8" AND ABOVE
AS3	0	150	SUPER DUPLEX S.S	SEA WATER LESS THAN 8 INCH
AX3	0	150	316 L S.S	STEAM CONDENSATE
DB3	1.6	600	C.S, 13%CR TRIM	HP STEAM
LD3	1.6	150	GALV. C.S, 13%CR	FIRE WATER UA,IA
LP3	–	150	HDPE	POTABLE WATER, U/G, FIRE WATER, UW

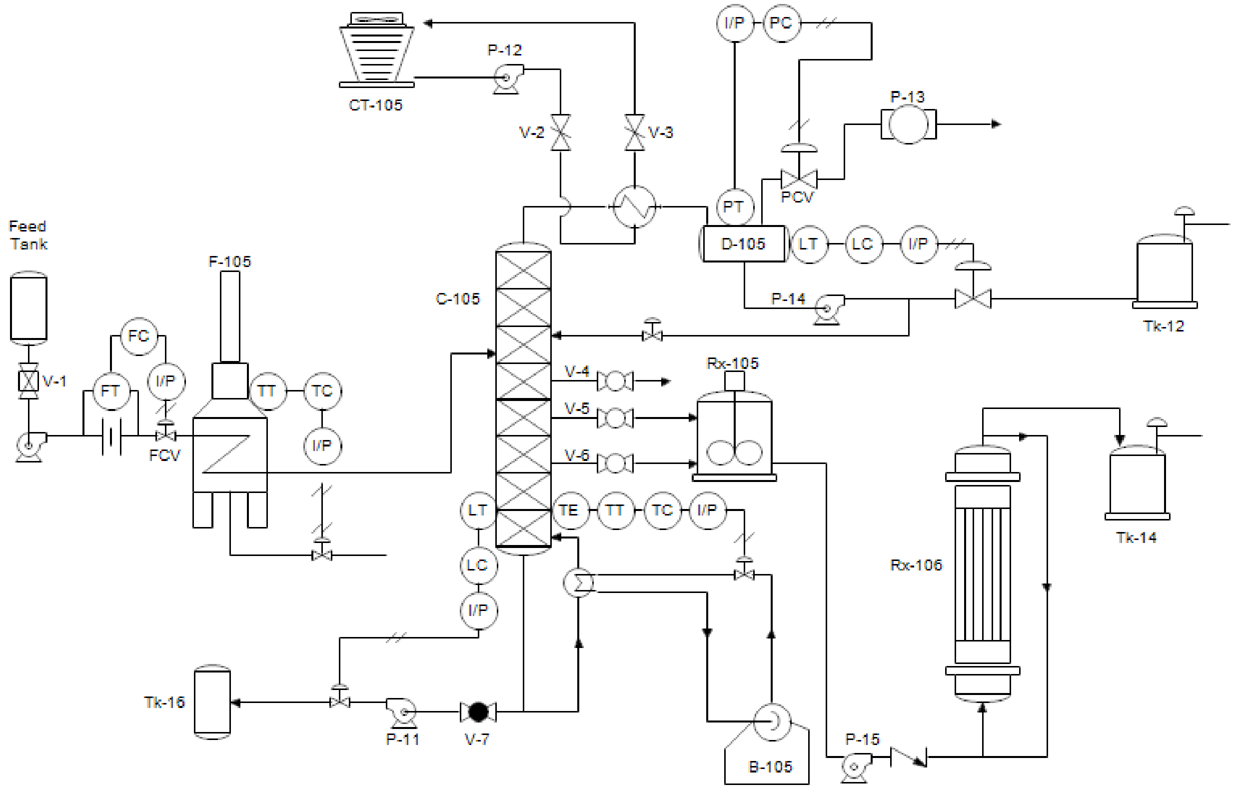
FLUID SYMBOLS / SERVICES	
CODE	SERVICE
AF	ANTI-FOAM
AM	AMMONIA
AN	AMINE
AT	ANTIFOULANT
BD	BLOWDOWN
BO	BLOWOFF
BU	BUFFER
CD	CLOSED DRAIN
CI	CORROSION INHIBITOR
CL	CHLORINE
DM	DEMULSIFIRE
DO	DIESEL OIL
F	FLARE AND RELIEF
FC	COLD FLARE
GA	GASOLINE
GF	FUEL GAS
GI	INERT GAS (GENERATOR)
GL	LPG
GN	NITROGEN GAS
GR	RECYCLE GAS
HO	HOT OIL CLOSED DRAIN
H	HYDROGEN
HL	HYDROCARBON LIQUID
HV	HYDROCARBON VAPOR
IA	INSTRUMENT AIR
IN	INHIBITOR
IO	ODORANT INJECTION
K	KEROSENE
KC	CAUSTIC
KN	ANTIFOULANT
LG	GLYCOL
LN	NITROGEN LIQUID
ME	METHANOL
NA	NAPHTHA
NH	HEAVY NEUTRAL OIL
NL	LIGHT NEUTRAL OIL
NM	MEDIUM NEUTRAL OIL
O	OXYGEN
OC	CRUDE OIL
OD	OPEN DRAIN
OF	FUEL OIL
OG	GAS OIL
OH	HOT OIL
OL	LUBE OIL & SEAL OIL
OP	FLUSHING OIL

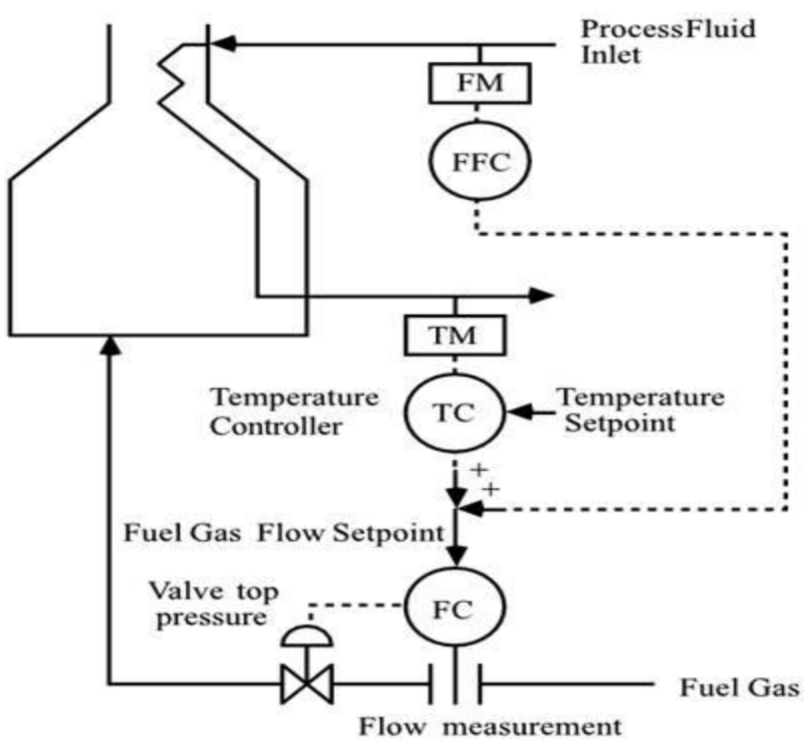
OP	FLUSHING OIL
OR	RECOVERED OIL
P	PROCESS PIPING
PA	PLANT AIR
PG	PILOT GAS
PW	POTABLE WATER
R	RESIDUE
RD	REFRIGERATED DRAIN
RF	REFREGERANT
RW	RAW WATER
S	SLOPS
SC	STEAM CONDENSATE
SH	HIGH PRESSURE STEAM
SL	LOW PRESSURE STEAM
SM	MEDIUM PRESSURE STEAM
SS	SUPERHEATED STEAM
SI	SCALE INHIBITOR
SU	SLURRY
SV	SOLVENT
SW	SALINE DISPOSAL WATER
UA	UTILITY AIR
UW	UTILITY WATER
VA	VENT TO ATMOSPHERE
VT	VESSEL TRIM
WB	BOILER FEED WATER
WD	DOMESTIC WATER
WF	FIRE WATER
WH	HOT WATER
WI	WATER INJECTION
WM	DEMINERALIZED WATER
WO	OILY WATER
WP	PROCESS WATER
WR	COOLING WATER RETURN
WS	COOLING WATER SUPPLY
WW	WASTE WATER
RW	RAW WATER

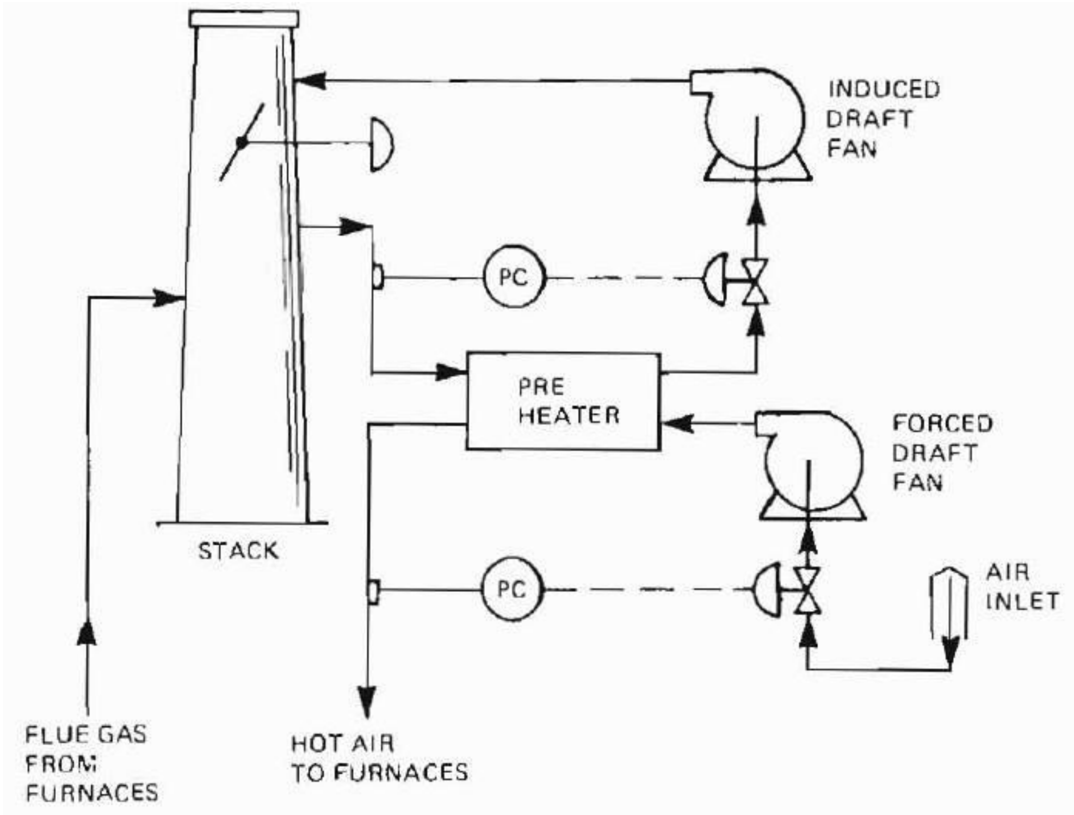
Elevation Drawing

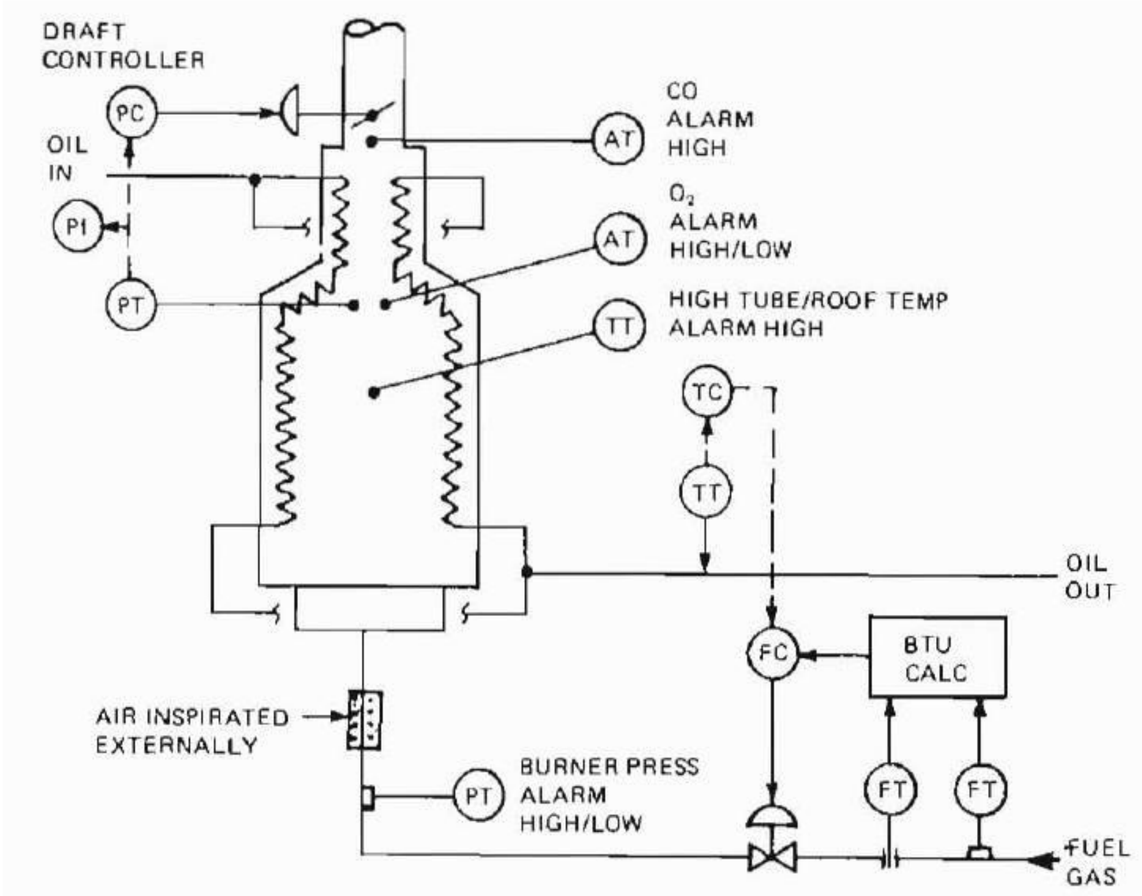


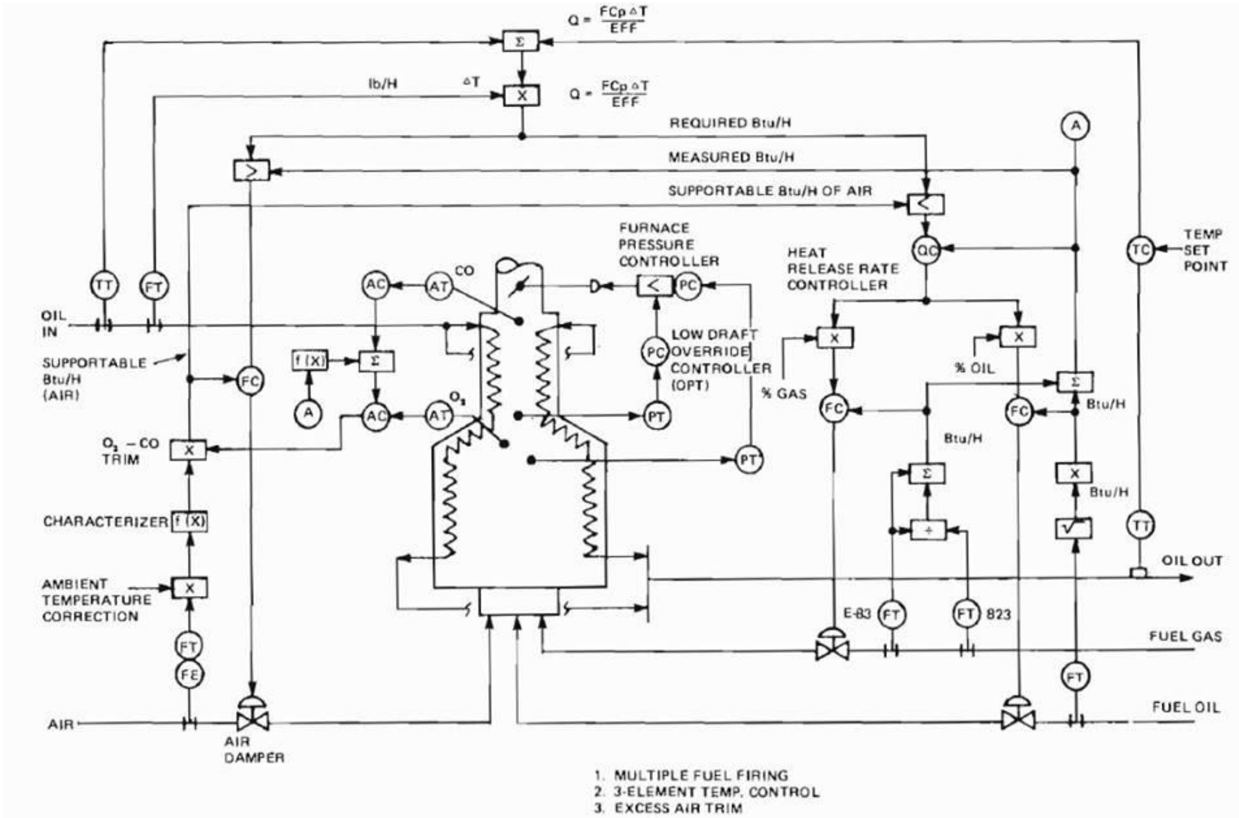
Process and Instrument Diagram (P&ID)






INDUCED
DRAFT
FAN
PC
PRE
HEATER
FORCED
DRAFT
FAN
STACK
PC
AIR
INLET
FLUE GAS
FROM
FURNACES
HOT AIR
TO FURNACES


DRAFT
CONTROLLER
PC
OIL
IN
PI
PT
CO
ALARM
HIGH
AT
O_2
ALARM
HIGH/LOW
AT
HIGH TUBE/ROOF TEMP
ALARM HIGH
TT
TC
TT
OIL
OUT
FC
BTU
CALC
AIR INSPIRATED
EXTERNALLY
BURNER PRESS
ALARM
HIGH/LOW
PT
FT
FT
FUEL
GAS



THANK YOU FOR YOUR TIME

INSTRUCTOR

Ahmed Yehia Mohamed

Process engineer, Suez Oil Processing Company (SOPC)

Che.yehia@gmail.com

+20 1008907390