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Piping and Instrumentation Drawing (P&ID)

CONTENTS

PREFACE

The intent of this write-up is to provide a simplistic guidelines for preparing a Piping and Instrumentation Drawing (P&ID). I felt the necessity to summarize these guidelines hoping it may assist the young engineer with a kick start in Engineering. Although P&ID's are basically meant and used by the Process, Mechanical and Instrumentation discipline, it will may also provide a guide for the others like the Electrical discipline to understand and maybe appreciate the document which is after all the "mother" document for the process plant under consideration. I call it simplistic because it may not cover all the aspects of P&ID's of more complex plants like the petrochemical or refineries, where the process requirements and variety of fluids are multifarious.

In these few pages I have tried to capture the basic philosophy, extent of detailing, instrumentation requirements and valving philosophy of a typical plant involving basically steam and water – like a power plant.

1. WHAT IS A P&ID?
    a. It is basically a drawing which is based on the Process Flow Diagram (PFD) and depicts the technical realization thereof by means of graphical symbols, lines together with symbols for process instrumentation and control functions.

2. WHAT ARE VARIOUS STAGES OF USAGE OF A P&ID (LIFE CYCLE)

    a. Preparatory Step: This step is the step of gathering and collating the information and freezing the design philosophy that maybe required to develop the P&ID. This document can be used a and example of the design philosophy. The basic document is Process Flow Diagram to start with. In this step, the nameplate, symbology, piping specification, HAZOP study (if applicable), Cause and Effect study, pre-commissioning issues, shut down issues. All the above activities initiate from the PFD and the process description.

    b. Preparation: The first cut of the P&ID shall contain the minimum the following information :-
        i. Equipment number, name and type of Equipment.
        ii. Piping and utility connections, packages identified, drains and vents and their destination.
        iii. Instrument type, tag number, control valve failure action.
        iv. Control signal lines.
        v. Battery limits identified

    c. Engineering Step: This is the step after which the P & ID is released for review to the customer. So this step is more elaborate and shall include the following:-
        i. Piping Sizes and numbering as per Piping DBR
        ii. Valving around control valves, heat exchangers
        iii. Equipment details to the extent possible
        iv. Control methods and Interlock requirements
        v. Safety and relief valves with their set points
        vi. Control Valves with air fail actions.

    d. Piping Drawing release: After the second step above and due review and approval, the P&ID needs to be supplemented with some further information so that the same can be used for starting the piping layout drawings. These requirements are as follow:-
        i. Piping class, expander/reducers
        ii. Destination of drains and vents
        iii. Instrument Process connection details
        iv. Type of instruments
        v. GA drawings for de-superheaters and control valves
        vi. Basic information and terminal point details of vendor packages.

3. WHAT ARE THE STANDARDS OF REFERENCE?
    a. ASME (American Society for Mechanical Engineers)
    b. ANSI (American National Standards Institute)
    c. ISA (International Society for Automation)

    The above standardization bodies have various standards which are followed and is listed in ANNEXURE-A. In addition to these standards, the graphical symbols maybe customized by the Company and adopted as a standard. In any case, all symbols and conventions followed should be listed as the first sheet (Legend Sheet) and this will supersede any of the afore mentioned standards.

4. UNITS

    The units used in our P & ID'd do not fall into a specific standard like Imperial, SI or MKS. The units used are more utilitarian In the sense that these units are more commonly used in the power industry and is a mixture of the conventional standards. The Table-1 below gives the units that are used:-

TABLE-1G

PARAMETERS	UNITS
LENGTH	mm
TIME	secs
GAS PRESSURE	mmwcl
STEAM PRESSURE	kg/cm2g
TEMPERATURE	Celsius
FLOW (STEAM/GAS)	Tonne/hr
VISCOSITY	2
FLOW (LIQUID)	m3/hr
SPECIFIC WEIGHT	m3/kg

5. REPRESENTATION AND LAYOUT

    The following conventions should be followed as far as practicable:-
    a. Flow of fluids/solids should be from left to right. Flow direction should be shown by arrows.
    b. Relative positions of the equipment should be representative (i.e., BFP should not be shown above the Dearator)
    c. The sizes of the equipment shall also be representative and proportional to the actual equipment. (e.g. the integral bypass MOV shall be shown as smaller than the main MOV)
    d. The symbology shall be followed as per the LEGEND sheet (Refer ANNEXURES)

e. Line thickness shall be representative of the line size and importance (e.g in the STEAM Distribution drawing, the line other than steam lines should be thinner than the steam lines. The drain/vent lines should always be thinner than the main lines).
f. Process parameter flagging and equipment details shall be covered later in this write-up.

6. GUIDELINES FOR DRAFTING

The following conventions should be followed as far as practicable for drafting:-

a. Drafting must be such quality and density that the drawing when reduced to A3 should be clearly legible.
b. The basic drawing shall be A0 (1189X849 mm), A1 (591X841 mm), A2 (420 X 594mm) or A3 (297 X 420 mm) depending on the density.
c. The sizes of the equipment shall also be representative and proportional to the actual equipment. (e.g. the integral bypass MOV shall be shown as smaller than the main MOV). BFP should be larger than the discharge MOV and smaller than the Dearator.
d. The symbology shall be followed as per the LEGEND sheet (Refer ANNEXURES)
e. Line thickness shall be representative of the line size and importance (e.g in the STEAM Distribution drawing, the line other than steam lines should be thinner than the steam lines. The drain lines should always be thinner than the main lines).

7. HOW TO DRAW THE TITLE BLOCK

Following information should be there in the Title Block

a. Company's name (Thermax Ltd. With Division) & Logo
b. End-user (Client's Name) and Logo
c. Client's Consultant's name and Logo
d. Drawing Title with Project Number
e. Drawing Number with sheet number
f. Revision Table

The Size of the Title Block shall be generally as per the following guidelines:-

TABLE-2G

Drawing Size	Size of Title Block Inc Rev Table W(mm)XH(mm)
A0	180X190
A1	130X175
A2	100X155
A3	75X120

LINE WIDTHS

Following ,line widths maybe used as guideline

Main Process Line = 0.8 mm

Secondary Process lines, utility lines = 0.5 mm

Drains/Vents = 0.4 mm

Machinery and Equipment symbols = 0.5 mm

Valves and fittings = 0.4 mm

Instrumentation/Electrical signals line = 0.3 mm

Instrumentation symbols = 0.4 mm

Process Value Boxes =0.4 mm

FONT SIZES

Drawing Title Block (All in caps)

- Drawing Number :

A0	A1	A2	A3
-	-	-	-

- Clients Name

A0	A1	A2	A3
-	-	-	-

- Consultants' Name

A0	A1	A2	A3
-	-	-	-

- Drawing Title

A0	A1	A2	A3
-	-	-	-

Process Values :

Equipment Name: 12 font in caps

Line Numbers: 10 font in caps

Instruments tags: 10 font in caps

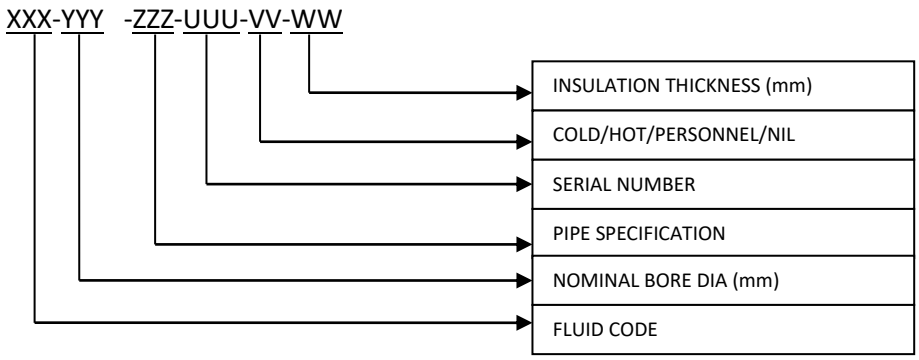
MINIMUM INFORMATION TO BE PROVIDED IN P&ID

1. P&ID's shall contain the information as detailed below. Some of the information as called for may not be available during the basic design which will be gradually filled/updated during detailed engineering phase.

2. Vendor supplied packages shall be shown boxed up in dotted lines with title and name of the package vendor. Vendor Drawing References may be added in the notes.

3. Following lines shall be shown in P&ID:-
    a. Process lines/ducts
    b. Utility lines
    c. Drains and Vent lines
    d. Instrument signal lines

4. Following equipments shall be shown in the P&ID:-
    a. Tanks, Vessels, Heaters, Coolers
    b. Instruments
    c. Valves and dampers
5. Identification:
    a. Process/Utility lines
        i. Process lines/utility lines shall be identified by a designation Following is an example of line designation/numbering. Refer ANNEXURE-iX for coding.



The information related to the process parameters shall be shown for all process and utility lines with a flag as shown below:-

	MAX	NORM	MIN
P (ata)			
T (deg C)			
F (TPH/m3/hr)			

6. Equipment Details to be shown:-

a. TANKS & VESSELS

i. Height and diameter
ii. Volume
iii. Design Pressure and Temperature
iv. All Nozzles, manholes, Safety Relief Valves, draw out and inlet, drains/vents
v. Instrument standpipes with details (wherever required)
vi. Equipment Number and Name
vii. Position of NWL (normal Working Level), LLL (low Liquid level), LLLL(Low-Low Liquid Level), HLL (High Liquid level), HHLL(High-High Liquid Level). LLLL, HHLL needs to be shown only when interlocks and alarms are involved.
viii. Water drop-out boots
ix. Bottom Elevation
x. Skirt height (if applicable)

Notes:

a) A PG and TG to be provided, in general
b) Relief valve to be provided on the top in case of pressurized vessel
c) Flame arrestor maybe required depending on the nature of the liquid.
d) Blinded nozzles also need to be shown
e) Nozzle identification number to be provided.

b. HEAT EXCHANGERS/COOLERS

i. Same as TANKS& VESSELS
ii. Spectacle-blinds for isolation if required
iii. PG and TG to provided at inlet and outlet of shell and tube side
iv. Isolation and bypass valve to be provided for maintenance.
v. Bottom Elevation
vi. Skirt height (if applicable)

a. A PG and TG to be provided, in general for the shell
b. Relief valve to be provided on the top in case of pressurized vessel
c. Flame arrestor maybe required depending on the nature of the liquid.
d. Blinded nozzles also need to be shown
e. Nozzle identification number to be provided.

c. PUMPS

i. Type of Pump, Capacity, operating head
ii. All nozzles including instrument connections
iii. Duty (1W+1S) etc.
iv. Suction valves, strainer, check valve, PG at discharge, discharge isolation valve. PG should be installed between the discharge and the check valve.
v. Auxiliary connection-cooling water, lube oils etc.
vi. Warm-up lines
vii. Pressure relief valve (is applicable)

d. COMPRESSORS/BLOWERS

i. Type of compressor/blower
ii. Capacity (Nm3/Hr), suction and discharge pressure & temperature
iii. Start-up facilities (cooling water etc.)
iv. Suction strainer
v. Suction and discharge valves
vi. Lube oil and sealing systems (if required externally)
vii. Inter-stage and after-coolers
viii. Surge Protection (if required)
ix. Inlet/Outlet nozzles
x. All non-skid instruments. (Skid mounted instruments to be shown in Compressor P&ID)

e. STEAM TURBINES

i. All nozzles and connections
ii. All Instruments mounted on the casing
iii. QCNRV in bleed lines
iv. Drain pots and condensate recovery system
v. Warm and vent lines
vi. Safety relief Valves

ANNEXURE-IV

USAGE OF BLOCK AND BLEED VALVES

Block and bypass valve arrangement is generally provided for process lines that cannot be shutdown for maintenance of a control valve or an instrument, strainer etc.

Bypass valves are not necessary in the following cases:-

1. Where it is desirable to reduce the leakages. Because more the line devices, more the chances of leakage.
2. Wherever shutting down the line will not cause safety or operability issues.
3. Pressure self-regulating valves
4. Lines used for temporary services
5. Shut off valves.
6. Around 3-way valves

Bypass valves are necessary and should be provided in the following cases:-

1. Wherever continuous operation of control valve is required.

Block valves

1. Provide inlet block valve unless the upstream line can be shutdown
2. Provide outlet block valve unless the downstream line can be shut down.
3. Provide drain/vent valve (at least ¾" gate) between inlet block and control valve.
4. Provide drain/vent valve (at least ¾" gate) between outlet block and control valve in case the fluid is corrosive/toxic or it is shut down valve.

Sizes of BLOCK and BYPASS VALVES

1. BLOCK VALVES shall be provided generally on both sides of a control valve, and the sizes shall be line size gate valves/ball valves.
2. BYPASS VALVES shall be generally globe type one size larger than the control valve or line size. For line size more than 4", gate valve maybe provided considering cost.

ANNEXURE-VIII

SPECIAL NOTES ON INSTRUMENTATION

Instruments must be provided wherever necessary and shall be avoided which cannot be justified. Existence of each instrument or a measuring point should be justifiable by either:-

i) Requirement of the operator (either in field or CCR)
ii) Requirement for performance assessment of process or equipment
iii) Required for Alarm
iv) Required for control , interlock and protection.
v) Called for by HAZOP analysis
vi) Mandated by Statutory regulations (like IBR, ASME, CPCB, EPA etc.)
vii) Recommended by accepted Industry Standards (like ASME PTC codes, etc)

Over instrumentation is as bad or worse than under-instrumentation. The extent of instrumentation should be mainly guided by the above requirements, together with cost-considerations. Since the type of instruments are also depicted in the P & ID, it is while making the P&ID these are to be decided. The following guidelines below may help in this direction.

The process connection size and type for various types of instruments are available in Table-XX

(The following covers the requirements of a power plant and should not be taken as universal guidelines)

PRESSURE

Gauges(PG) are to be used:-

i) Pump Discharges (individual-before check valves)
ii) Before and after Pressure reducing stations
iii) Pressurized vessels(Air receiver, boiler drum, dearator etc.)

Switches(PS)

i) Pump discharge(individual when there is discharge MOV)
ii) Common Pump Discharge
iii) Pressurized headers (water, steam or oil)

Transmitters

i) Common Pump Discharge header
ii) After Pressure reducing stations
iii) Controlled pressurized headers
iv) Pressurized vessels
v) Wherever Steam/Air flow compensation is required

Notes: For pressure instruments, chemical seal type instruments shall be used for fluids that are congealing type, highly viscous and corrosive in nature. Except for chemical seal type instruments, all pressure tappings shall be ½".

TEMPERATURE

For temperature instruments like gauges, switches, test pockets, thermowell shall be invariably provided in process lines and vessels. The only exempt cases are bearing/winding temperature sensors and skin temperature of vessels and tubes. In general the process connection shall be threaded (1" NPTF/M33X2) & seal-welded type for pipes and flanged for vessels. However, in special cases ALL thermowells maybe flanged type. Wherever the line size is less than 100 mm NB, a section of the pipe is to be expanded to 100 mm to accommodate insertion of thermowell. For flanged thermowell, 40 NB flange with 150 mm take-off shall be used.

Gauges (TG) are to be used:-

i) Inlet and outlet of heater and cooler for both fluids.
ii) De-superheater outlets
iii) Pressurized vessels

Switches (TS)

i) Are to be avoided as far as practicable
ii) Wherever called for TE/TT should be used

Sensors/Elements(TE)

i) RTD's to be used for below 300 deg C
ii) K-type Thermocouples to be used for > 300 deg C
iii) All sensors shall be duplex type

Transmitters (TT)

i) To be used wherever the thermocouple/RTD is used for control.
ii) RTD/TC can be directly connected to DCS/PLC for monitoring only.

FLOW

In a medium sized power plant, the sensors generally used are limited to orifice, flow nozzle, aerofoil, annubar, mass flow meter and in some cases ultrasonic and electro-magnetic flowmeters. The guidelines given below are generally satisfactory, unless the contract specifically calls for otherwise. For all flowmeters, straight run distances are critical and should be considered well while making the piping drawings.

Orifice Plate Assemblies

i) Can be used for water/steam/oil lines from 2”-24” NB line size, preferably horizontal flow.
ii) It can be used for bidirectional flow too.
iii) Flange tapping is satisfactory in most cases. For line size below 4”, D, D/2 tapping should used.
iv) Upstream PT and TE to be provided for compressible fluids flow compensation.

Flow Nozzle

i) To be used where the water/steam line pressure and temperature are high.
ii) Line size from 2”- 16” NB. Higher size possible but cost becomes prohibitive.
iii) Steam flow measurements required for performance monitoring.
iv) Upstream PT and TE to provided for compressible fluid flow compensation.

Annubar (Averaging Pitot)

i) To be used mainly for very large bore pipes > 16”
ii) Service: Water
iii) Pressure: Medium to low

Aerofoil

i) To be used for reactangular duct air flow measurement

Mass Flow meter

i) These are online meters to be mainly used for oil line (LDO/HSD)
ii) For heat-traced lines, special precautions needs to be taken.

Electromagnetic Flowmeters

I) Mainly used for water lines below 4”. Can be used for larger lines but better to opt for orifice.

Ultrasonic Flowmeters

i) To be used only when called for in larger lines for water flow measurement
ii) Can also be used for open channel flow measurement like Parshall Flue, Wedge etc.

LEVEL

Gauges

i) Reflex type gauges shall be used for all transparent fluids in pressurized vessel of heights less than 2000 mm.

ii) Each gauge shall not be more than 1200 mm c-to-c. To cover larger lengths, multiple gauges with at least 50 mm overlap (visible) shall be used.

iii) Process connection shall be 1" flanged.

iv) Tubular gauges shall be used only when the vessel in atmospheric pressure, liquid is non hazardous. Other points shall be as per Reflex gauges.

v) Float & Board type gauges shall be used for tanks higher than 2000 mm

Switches

i) Side mounted float type switches shall be used wherever there is a single setpoint. These shall always have external float chamber. Process connection 1" flanged.

ii) For multiple setpoint, vertical displacer type level switches maybe used with external float chamber or internal stilling well.

iii) RF type level switches shall be used for solids level (ash and coal)

Transmitters

i) Differential pressure type transmitters can be used for high to medium pressure application. Remote seal type to be used for services like LPFO/HFO or corrosive fluids.

ii) For low pressure vessels (condenser hotwell, LPH etc), displacer type, guided radar type shall be used. (Displacer type should be avoided because of lack of availability, cost and high maintenance).

iii) Ultrasonic LT shall be used for almost all applications except for very small (<1000 mm H), high temperature applications. (Height < 15 000 mm)

DESIGN CRITERIA FOR PREPARING P&ID

The following design criteria shall be followed in general for preparing a P&ID unless otherwise mandated by project specific Design Basis Report. In case of any conflict, the project DBR shall govern. The following is meant to be basic guidelines only.

1. EQUIPMENT ARRANGEMENT
    a. Towers, vessels, fired heaters shall be shown in the upper half of the diagram, heat exchange equipment in the upper three-quarters, and machinery equipment in the lower quarter.
    b. General flow scheme should be from right or left.
    c. The space above the title block shall be left blank for notes
2. PIPING FOR PUMPS
    a. Generally the suction pipe and the discharge pipes are different from the pump nozzles. The suction and discharge nozzles at the pump are 1 size or 2 size small than the pipe. The block valves shall be provided as per the following:-

	Pump Nozzle Size	**Size of Block valve**
Suction	1-Size smaller than pipe	Same as suction pipe
	2-size smaller than pipe	1-smaller than line
Discharge	Smaller than pipe	1-size smaller than line

    b. Suction Strainers: Generally strainers are provided at all pump suctions. Following guide lines maybe followed:-
        i. Line size 80 NB or more : “T” type strainer
        ii. Line size 50 NB and smaller : “Y” type strainer
        iii. Dual basket type strainers with three-way valves maybe provided at common suction lines for 1+1 pumps, wherever online cleaning and replacement is required.
        iv. Strainers more than 150 NB shall be provided with 25NB drains

    c. Auxiliary Piping: Auxiliary piping for pumps like cooling water, condensate, steam etc, are to be shown in a separate drawing.

    d. Vent and Drain Valves:
        i. Drain and vent hole sizes in the pipe line shall generally be ¾” size. The number of valves shall be one for pressures < 40 kg/cm2 and two for pressures above that.
        ii. Horizontal/ Vertical vessels shall have vents on top on both sides.

    e. Line Numbering: Identifying the pipelines shall be done in accordance to ANNEXURE-IX.

Following lines shall be numbered:-

i. Equipment to Equipment
ii. Equipment to line
iii. Line to atmosphere or drain
iv. All branches and headers
v. Line number shall change as the deign parameter changes.

f. Bypass valves: bypass valves maybe provided for control valves, safety valves, vessels depending on the process requirement. For Control Valves refer ANNEXURE-IV. For safety valves bypass maybe provided for toxic gases. For vessels it is mandatory to provide bypass where the process may uninterrupted when the vessel is taken for service.

g. Utility lines: for all utility lines following instrumentation shall be provided:-
   i. PG at the inlet or exit for air line.
   ii. PG,TG, FT for entry or exit of steam lines
   iii. Spectacle blind shall be provided for gas lines in addition to PG, TG and FT.
   iv. PG , TG and FT for water lines at entry and exit.

ANNEXURE-IX

PIPE TAGGING

The line numbering is done according to the following legend. The basic line number structure is as follow:

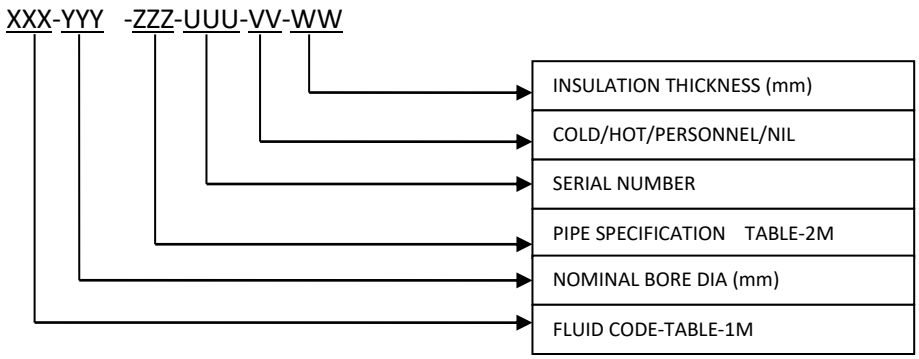


TABLE-IM

FLUID	CODE	FLUID	CODE
AUXILIARY COOLING WATER	ACW	HIGH PRESSURE STEAM DRAIN	HPD
AUXILIARY STEAM SYSTEM	ASS	INSTRUMENT AIR	IAS
BLAST FURNACE GAS	BFG	LIGHT DIESEL OIL	LDO
BASIC OXYGEN FURNACE GAS	BOG	LOW PRESSURE DOSING	DLP
CARBON DIOXIDE	CDG	LOW PRESSURE FEEDWATER	LFW
CHILLED WATER	CHW	LOW PRESSURE STEAM	LPS
CLARIFIED WATER	CLW	LOW PRESSURE STEAM DRAIN	LPD
COKE OVEN GAS	COG	LOW SULPHUR HEAVY STOCK(LSHS)	LSH
COLD REHEAT STEAM	CRH	MAIN COOLING WATER	MCW
CONDENSATE WATER	CDS	MAIN STEAM	MSS
DEARATOR PEGGING STEAM	DAS	MEDIUM PRESURE STEAM	MPS
DEMINERALISED WATER	DMW	MEDIUM PRESSURE STEAM DRAIN	MPD
DESUPERHEATING SPRAY WATER	DSW	MIXED GAS	MXD
EFFLUENT WATER	EFF	NAPHTHA	NAP
EXHAUST STEAM	ESS	NATURAL GAS	NGS
FILTERED WATER	FLW	NITROGEN	N2G
FIRE WATER	FWS	OIL WASTE WATER	OWS
FURNACE OIL	FOL	POTABLE WATER	PWS
GAS DRAIN	GAD	RAW WATER	RWS
GLAND SEALING STEAM	GSS	REFINERY GAS	RGS
GT START-UP AIR	GSA	RO PERMEATE	ROW
HIGH PRESSURE DOSING	DHP	SEA WATER	SAW
HIGH PRESSURE FEED WATER	HFW	SERVICE/PLANT AIR	SAS
HIGH SPEED DIESEL	HSD	SERVICE WATER	SWS
HOT REHEAT STEAM	HRH	SUPERIOR KEROSENE OIL	SKO

HYDROGEN	H2G	ULTRA FILTER WATER	UFW
HIGH PRESSURE STEAM	HPS	WASTE WATER	WWS

VALVE TAGGING

All mechanical valves shall be tagged with 3 alphanumeric characters according to the following Table

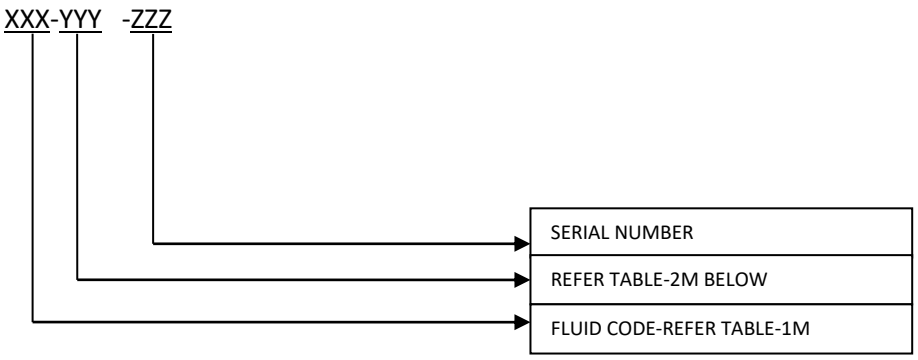


TABLE-2M

GATE VALVE	VG	NEEDLE VALVE	VN
GLOBE VALVE	VL	FLOAT VALVE	VO
CHECK VALVE	VC	ANGLE VALVE	VA
BALL VALVE	VB	RELIEF VALVE	VR
BUTTERFLY VALVE	VU	SLUICE GATE	VE
PLUG VALVE	VP	KNIFE GATE	VK
FOOT VALVE	VF	GOGGLE VALVE	VV

PIPE SPECIFICATION

The pipe specification gives the physical characteristics of the pipe material and rating by a code comprising of 4 alphanumeric characters. REFER Table-2M for the details.

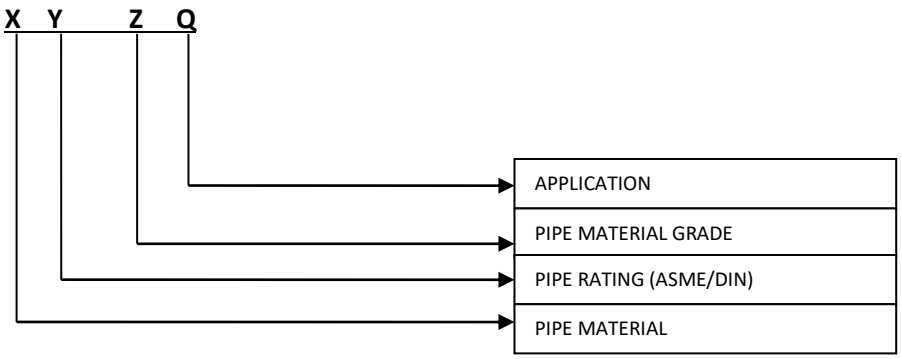


TABLE-2M

PIPE MAT'L CLASS(X)		PIPE MATERIAL(Z)		APPLICATION (Q)		PIPE RATING CLASS(Y)	
CODE	MAT'L CLASS	CODE	MATERIAL	CODE	APPLICATION	CODE	RATING
A	CAST IRON	**A**	Centrifugally cast spun CI	**C**	IBR	1	150#
		B	Vertically Cast spun CI	**F**	FIRE SAFE	2	300#
B	CARBON STEEL	**A**	IS-1239/IS-3589	**V**	VACUUM	3	600#
		B	A-106-GR-B	**E**	ELEC TRACED	5	900#
		C	A-53 GR-B	**S**	STEAM TRACED	6	1500#
		D	API 51-GR-B			8	2500#
		E	A-106 GR-C			B	PN-2.5
C	GALVANIZED CARBON STEEL	**A**	IS-1239(GALV)			C	PN-6
		B	A-106-GR-B(GALV)			D	PN-10
		C	A-53-GR-B(GALV)			E	PN-16
D	ALLOY STEEL	**A**	A-335 GR-P11			F	PN-20
		B	A-335-GR-P22				
		C	A-335-GR-P91				
E	STAINLESS STEEL	**A**	A-312-TP-304				
		B	A-312-TP-316				
		C	A-312-TP-321				
F	PLASTIC AND DERIVATIVES	**A**	GLASS REINFORCED POLYESTER				
		B	UNPLASTICISED PVC				
G	COPPER						

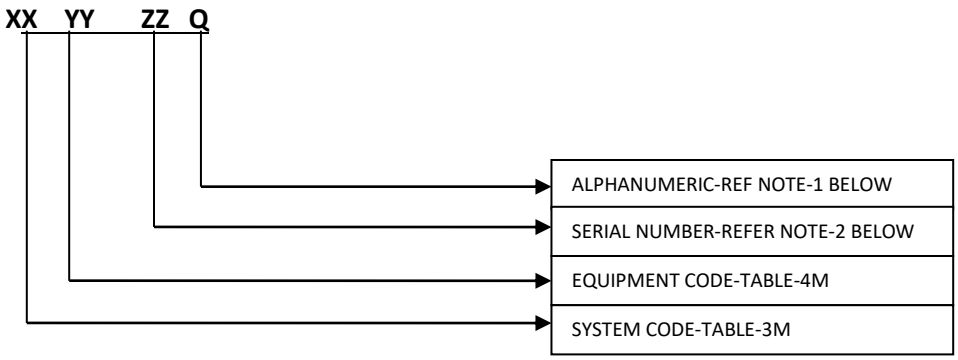
Example:-

D6BC: IBR Pipe of material A-335-Gr-P22, rating 1500#

Note: The above codification is limited and specific to Thermax Power Division and should not be construed as a general pipe naming convention.

EQUIPMENT TAGGING

All equipment in the P & ID is identified with a 4-character alpha-numeric name as per the following convention:



Note-1: One digit alphanumeric code. Starts from A when there is standby. The standby identified by B, C etc. In case there is no standby, the character is "0".

Note-2: Serial number of similar equipment under the same system code.

TABLE-3M

SYSTEM CODE

CODE	SYSTEM NAME
01	FUEL SYSTEM
02	GAS TURBINE SYSTEM
03	GAS TURBINE EXHAUST SYSTEM
04	STEAM GENERATION SYSTEM
05	STEAM TURBINE GENERATOR SYSTEM
06	WATER SYSTEM
07	FIRE WATER SYSTEM
08	COMPRESSED AIR SYSTEM
09	AIR CONDITIONING AND VENTILATION SYSTEM

TABLE-4M

NOZZLE DESIGNATIONS

Nozzles fro tanks/vessels shall be identified as per the following designations

CODE	PURPOSE		
M1	ROOF MANHOLE	N8	LEVEL GAUGE
M2	SIDE MANHOLE	N9	LEVEL SWITCH
N1	INLET	N10	VENT
N2	INLET-SPARE	N11	RECIRCULATION
N3	OUTLET	N12	SAMPLING POINT

N4	OUTLET-SPARE	N13	PRESSURE GAUGE/TRANSMITTER
N5	OVERFLOW	N14	TEMPERATURE ELEMENT/GAUGE
N6	DRAIN	N15	XXX
N7	LEVEL TRANSMITTER	N16	XXX

EQUIPMENT CODE

TABLE-5M

EQUIPMENT DESCRIPTION	CODE	EQUIPMENT DESCRIPTION	CODE
AIR CONDITINER (SPLIT)	SA	HOSE METALLIC	HM
AIR CONDITIONER SYSTEM	AC	HOSE RUBBER	HR
AIR CONDITIONER WINDOW UNIT	WA	HRSG	HB
AIR DRIER	AD	HUMIDIFIER	HU
ASH HANDLING SYSTEM	AH	HVMS SPRAY SYSTEM	HV
ASH HANDLING VACUUM TYPE	VS	INLET AIR FILTER	IF
ASH HANDLING -WET CONVEYING	WC	MECHANICAL DUST COLLECTOR	MC
BAG FILTER	BF	MVWS SPRAY SYSTEM	MV
BLOWER	BL	OIL WATER SEPARATOR	OS
BREATHER VALVE	BV	PRESSURE VESSEL	PV
CENTRIFUGE	CZ	PULLEY BLOCKS	PB
CHILLER	CH	PUMP	PP
CHLORINATOR	CL	PURIFIER	PU
CLARIFIER	CF	RADIATOR	RA
COMPRESSOR	CM	RESERVOIR	RS
CONDENSER AIR COOLED	CI	RESERVOIR-EARTHEN	RE
CONDENSER-WATER COOLED	CW	RESTRICTION ORIFICE PLATE	OR
COOLING TOWER	CT	REVERSE OSMOSIS PLANT	RO
CRANE	CR	RUBBER BELLOWS	BE
CRUSHER	CX	SCREEN-COARSE	SE
CONVEYOR	CY	SCREEN-FINE	SF
DAMPER	DM	SIDE STREAM FILTER	SS
DIVERTER DAMPER	DV	SILENCER	SL
DAMPER-GUILLOTINE TYPE	DI	SILO	SO
DEARATOR	DA	SOOT BLOWER	BS
DEGASSIFIER	DF	STACK	SK
DENSE PHASE SYSTEM	DP	STEAM GENERATOR	SG
DIESEL ENGINE	DE	STRAINER-BASKET TYPE	SB
D.M.PLANT	DP	STRAINER-CONICAL TYPE	SC
ELECTROSTAIC PRECIPITATOR	ES	STRAINER-TEE TYPE	ST
EXPANSION JOINT	EJ	STRAINER-Y-TYPE	SY
FAN	FN	TANK	TK
FIRE FIGHTING EQUIPMENT	FE	TRAP-BALL & FLOAT	TB
FIRE HYDRANT	FH	TRAP-INVERTED BUSCKET	TI
FIRE PROTECTION EQUIPMENT	FP	TRAP-THERMOSTATIC	TS

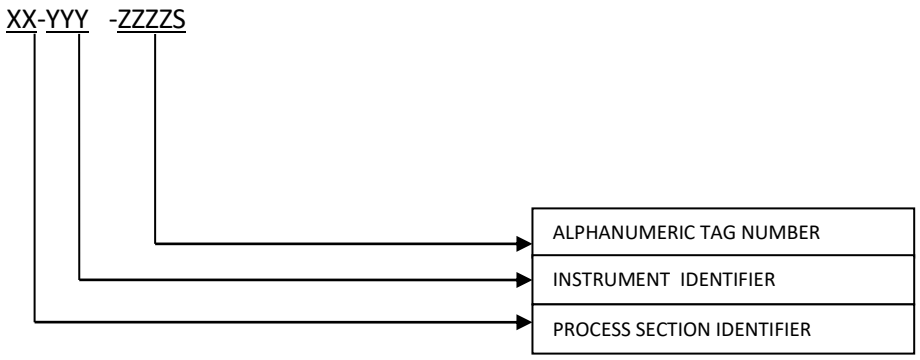
FLAME ARRESTOR	FA	TRAP-THERMODYNAMIC	TD
FLEXIBLE JOINT	FJ	TRAVAGRATE BOILER	MB
FLOW GLASS	FG	TURBINE GAS DRIVEN	GT
FOAM SYSTEM	FM	TURBINE-STEAM DRIVEN	TG
FUEL HANDLING SYSTEM	FS	ULTRA FILTER PLANT	UF
GAS CONDITIONING SKID	GS	VENTILATION SYSTEM	VT
HEAT EXCAHNGER	HE	VENTURI SCRUBBER	SV
HOIST	HO	WASTE HEAT RECOVERY BOILER	WB
HOSE BOX	HB	WATER TREATMENT PLANT	WT
HOSE CANVAS	HC	WEIGHING SCALE	WS

ANNEXURE-III

INSTRUMENT TAGGING

All instruments in a plant shall have unique tag number which propagates through all other following drawings/documents like Instrument Index, DCS/PLC IO list, Specification and data sheets , hook up drawings etc. There are various conventions of tag numbering followed which are regionally, process wise or company wise followed like ISA, KKS, GOST, NORSOK etc. Each of these methods have the pros and cons when analysed against some concept or other. In power plants KKS system of tagging is widely followed in Europe since it originated from Germany, whereas ISA is followed in US. In Thermax, we have found ISA system of tag numbering more convenient and have adopted with minor adjustment.

Instruments, control and shut-off valves and drives are numbered according to the following legend



PROCESS SECTION-XXX

01	ELECTRICAL PARAMETRS-33KV	60	WATER TREATMENT PLANT
02	ELECTRICAL PARAMETERS-11KV	70	GAS TURBINE COMMON SYSTEMS
03	ELECTRICAL PARAMETERS-6.6 KV	71	GAS TURBINE-1
04	ELECTRICAL PARAMETERS-415/690 V	72	GAS TURBINE-2
05	UPS PARAMETERS	80	FIRE ALARM SYSTEM
06	DG SET PARAMETERS	90	COAL HANDLING PLANT
10	BOILER COMMON	91	LIMESTONE HANDLING PLANT
11	BOILER-1		
12	BOILER-2		
20	STEAM TURBINE COMMON		
21	STEAM TURBINE-1		
22	STEAM TURBINE-2		
30	ASH HANDLING-COMMON SERVICES		
31	ASH HANDLING-BOILER-1		
32	ASH HANDLING-BOILER-2		
40	BALANCE OF PLANT		
41	AIR COMPRESSOR-1		

42	AIR COMPRESSOR-2		The numbering system as given in this Table is a typical and may be re-created depending on the configuration of the plant
43	AIR DRIER		
50	ESP COMMON		
51	ESP-BOILER-1		
52	ESP-BOILER-2		

INSTRUMENT FUNCTION IDENTIFIER-YYYY

Function	Indicator		Sensor	Transmitter	Controller	Switch	Alarm-HH,H,L,LL	Function	Totalizer
	Local	Remote							
Pressure	PG	PI		PT	PIC				
Temperature	TG	TI		TT	TIC				
Flow	FG	FI	FE	FT	FIC				
Level	LG	LI	LE	LT	LIC				
Diff Pressure	DPG	DPI		DPT	DPIC				
pH	*	ApHI	ApHE	ApHT	ApHIC				
Conductivity	*	ACI	ACE	ACT					
Oxygen-Gas	*	AOXI	AOXE	AOXT					
Dissolved Oxygen	*	ADOI	ADOE	ADOT					
Particulate	*	APMI	APME	APMT					
Sox	*	ASOXI	ASOXE	ASOXT					
NOx	*	ANOXI	ANOXE	ANOXT					
Current	A	II		IT					
Voltage	V	EI		ET					
Power	P	JI		JT					
Position		ZI		ZT					
Torque		WI		WT					
Energy	w	WQI							

Note: All transmitters are with integral indicators and hence these indicators are specifically spelt out with a distinctive tag. (*)