BASIC ENGINEERING DESIGN QUESTIONNAIRE (BEDQ)

CUSTOMER REFERENCES:

- COMPANY LAVAN OIL REFINING COMPANY.....
- ADDRESS LAVAN REFINERY .....
  P.O. BOX 71365-568 .....
  SHIRAZ, I.R. IRAN.....
- NAME FOR CONTACT SIROUS PEYKAR .....
- TITLE/POSITION DIRECTOR OF PROJECT ENGINEERING .....
- TELEPHONE +98-711 2249925-8..... FAX +98-711 2300952 .....
- E-MAIL S.PEYKAR@LORC.IR .....

Rev.	Date	Prepared by
0	28/11/2006	Axens / LORC
1	13/12/2006	LORC

CONTENTS

INTRODUCTION

This Basic Engineering Design Questionnaire lists information that Axens requires to proceed with design work defined in the scope of work.

The questionnaire should be carefully completed, preferably by the date of the kick-off meeting and must be finalized before the start of Axens design work ; any significant modifications in the Basic Engineering Design Questionnaire requested by the Client or the Engineering Contractor or Consultant, received by Axens after the start of the project, will be subject to a mutual agreement and may result in changes to schedules and additional engineering charges.

For the matters related to feedstocks and products, a Process Design Questionnaire will be added to this document.

The information shown in the chapters "Equipment Design Basis" and "Climatic Data" is for general purposes. Each process may have specific equipment design criteria.

SECTION I

PROJECT COORDINATION PROCEDURE

This Coordination Procedure establishes the organizational relationship, functions and procedures between the Client, the Engineering Contractor or Consultant (hereinafter called Contractor) and Axens.

1. GENERAL

1.1 Client: National Iranian Oil Refining & Distribution Company

Lavan Oil Refining Company

1.2 Official Project Name: Basic Design and Preparation of EPC Tender Documents for Lavan Refinery Revamping and Upgrading

1.3 Plant Location: Lavan Refinery, IRAN

1.4 Type and capacity of plant:

LNHT UNIT– BPSD
ISOMERIZATION UNIT - BPSD
HNHT UNIT - BPSD
SEMI-REGENERATIVE CATALYTIC REFORMING UNIT – BPSD
MIDDLE DISTILLATE HDS UNIT – PRIME D - BPSD

~~**1.5 Contractor:**~~

Consultant: Namvaran

2. Axens BASIC PROCESS DESIGN

The Basic Process Design shall be as defined in the agreement (see Appendix).

3. ORGANIZATION AND PERSONNEL

3.1 Project Manager for Client:

Mr Peykar

3.2 Project Manager for Master plant Basic design consultant:

Mr Boghoz

3.3 Project Manager for Axens:

Mrs Bassir

4. CORRESPONDENCE AND COMMUNICATIONS

4.1 Language

All communication, both written and oral, will be in English.

4.2 Heading and job numbers

All documents for the project shall contain the following identification:

- Client name,
- Project name,
- Plant location,
- Job number
- Etc…

4.3 Correspondence

In general, correspondence should be limited to one topic, so it can be readily treated.

The Axens Project Manager will address all letters, facsimiles, telephone notes, and e-mails between Axens and Client with copies to the Master plan Basic design consultant 's Project Manager.

Similarly, the Client's Project Manager will address all such correspondence to the Axens Process Manager with copies to the Master plan Basic design consultant 's Project Manager.

The Axens Project Manager will address all letters, facsimiles, telephone notes, and e-mails between Axens and Master plan Basic design consultant with copies to the Client's Project Manager.

Similarly, the Master plan Basic design consultant 's Project Manager will address all such correspondence to the Axens Process Manager with copies to the Client's Project Manager.

The names, addresses, and the telephone, facsimile and e-mails for the Client, Contractor and Axens are :

Client's address
Lavan Refinery
P.O. Box 71365/568
Shiraz,I.R. Iran

Telephone:+98-711 2249925-8

Facsimile:+98-711 2300952

E-mail: s.peykar@lorc.ir

Attention: Mr Serous Peykar

Consultant's address
No.10/1 Shabafrooz Alley
North Gheitarieh Ave.
P.O. Box 14155-1766 Tehran-Iran

Telephone: +98 21 2231620 *Direct*: +98 21 2238772

Facsimile:+98 21 2231597

E-mail: A.Boghoz@Namvaran.com

Attention: Mr Armond Boghoz

Axens

89 boulevard Franklin Roosevelt – BP 50802

92508 RUEIL-MALMAISON Cedex - FRANCE

Telephone: 33.1.47.14.21.00 (switchboard), 33.1.47.14. . (direct)

Facsimile: 33.1.47.14.25.00

E-mail: Attention: address:

christine.bassir@axens.net (Project Manager)

pierre-yves.martin@axens.net (Axens Group Leader ~~or others~~)

xavier.decoodt@axens.net

olivier.martin@axens.net

4.4 Numbering/Identification

From	*To*	*Type of document*	*Serial number*
1 letter	1 letter	1 letter	3 digits
(X)	A	F	001

written: XA-F-001

(means fax number 1 sent by Client to Axens)

(L) : Client

(N) : Consultant

A : Axens

L : Letter and document transmission

F : Fax

M : E-mail

Numbering will be consecutive regardless of correspondence type (fax or e-mail).

4.5 Number of document copies to be issued

- Letter, fax: one original.
- Documents:
  - Piecemeal isolated or single-purpose documents: by e-mail + 1 hard copy for client + 1 hard copy for consultant
  - Final bound copies of the Process Book:

    Client: .....5 copies with 1 CD for the Process Book

    Consltant: .....1 copy with 1 CD for the Process Book

    (See Appendix: Axens computerized files supply)
  - Electronic mailing

  Please give any additional or different instructions.

4.6 Minutes of meetings - Phone conversation reports

All minutes of meetings shall be approved and signed by the parties at the end of the meetings.

The minutes of meetings will be prepared by Axens during the period from the kick-off meeting till the Process Book delivery.

All phone conversations will be summarized in a facsimile sent by the phone call initiator.

4.7 Document issue numbering

The piecemeal isolated documents will be issued first as Revision A, then as B for the second issue if any, etc.

The Process Book will be first issued as Revision 0.

For main equipment with long delivery times, such as reactors, compressors and high pressure exchangers, the specification sheet in Revision A may be used for consultation by the manufacturer; the main equipment characteristics, necessary for the vendor consultation, are fixed in this document; only some details may be more precisely defined or corrected later in the following issues. In the case of detail correction in the revision 0, these corrections will be clearly identified.

4.8 Document approval

The following preliminary documents are sent to the licensee during the project:

- Material and Heat Balance ;
- Process Flow Diagram ;
- Piping and Instrument Diagram ;
- Main equipment.

These documents are submitted during the basic engineering and before the final issue of the Process Book for review and approval of the licensee.

A maximum of two weeks is requested to receive the Licensee's approval / comments.

After this delay and without comments from the Licensee, Axens considers that the documents are approved.

4.9 Change order

If Licensee requires a change which is considered to be a modification or addition to Axens scope of works or design basis, within two weeks of occurrence of the change, Axens shall:

a) Prepare and submit a detailed description of the request of the change with the schedule impact and a detailed cost build up.

b) Receive the approved change order from the licensee before starting the implementation of the change.

SECTION II

DESIGN BASIS

1. UNITS OF MEASURE

There are now three systems of measurement in common use in the industrial world: English/American, MKS (Old Metric), and SI (New Metric). Unless care is taken, this can lead to confusion.

Please circle the specific units to be used on this project for each type of measurement listed below.

	MkS (Old Metric)
Temperature	Degree C
Pressure	kg/cm^2G
Vacuum	mmHg
Weight	kg
Volume	m^3
Flow of Process fluid	
• Liquid	
- Mass flow	kg/h
- Volume flow	m^3/h
• Gas	
- Mass flow	kg/h
- Volume flow	m^3/h
Flow of steam	kg/h
Enthalpy	kcal/hr
Heat duty/Power	MKcal/h / kW
Transfer rate	$kcal/m^2 \cdot$ Degree C·h
Fouling resistance	$m^2 \cdot$ Degree C·h/kcal
Viscosity	cP
Equipment size	mm
Pipe length	km
Pipe diameter	in
Vessel nozzle sizes	in

The normalized conditions for gas measurement are:

Standard	:	760 mmHg, 15.5 Degree C (60 Degree F)	(Sft^3/mn or SCFM)
Normal	:	760 mmHg, 0 Degree C	(Nm^3/h)

2. CLIMATIC DATA

These data are required for reference only to indicate if a need exists for tracing or winterizing.

* Maximum temperature: **45 °C**

* Design maximum ambient temperature: **50 °C (48°C Air Cooler design)**

* Minimum temperature: **10 °C**

* Winterizing temperature:

* Design minimum temperature: **0 °C**

* Relative humidity
  - Average: **60%**
  - Maximum: **95%**

* Dry bulb temperature: Not applicable

* Barometric pressure
  - Minimum:
  - Maximum:
  - Average: **1.01 bar (Sea Level)**

3. UTILITIES AND FLARE

3.1 Steam and condensate

	Pressure		Temperature	
	Consumer	Producer	Consumer	Producer
• High pressure				
Minimum (for thermal design):				
Normal:		**42.2 Kg/Cm2(g)**		**385 °C**
Maximum:		**45.2 Kg/Cm2(g)**		**398 °C**
Mechanical design:		**54 Kg/Cm2(g)**		**425 °C**
• Medium pressure				
Minimum (for thermal design):		**10.6 Kg/Cm2(g)**		**185 °C**
Normal:		**13.3 Kg/Cm2(g)**		**195 °C**
Maximum:		**14.2 Kg/Cm2(g)**		**198 °C**
Mechanical design:		**16 Kg/Cm2(g)**		**225 °C**
• Low pressure*				
Minimum (for thermal design):		**4 Kg/Cm2(g)**		**150 °C**
Normal:		**5.0 Kg/Cm2(g)**		**159 °C**
Maximum:		**5.6 Kg/Cm2(g)**		**162°C**
Mechanical design:		**7.8 Kg/Cm2(g)**		**190°C**
• Steam condensate		**Cold Condensate from Surface Condenser**		**50 °C**
MP CONDENSATE*		**10.6**		**185**
LP CONDENSATE*		**3**		**144**

(Give for each level required)

*** THESE STEAMS ARE NOT AVAILABLE NOW AND ARE PLANNED TO BE INCLUDED IN BDP OF WHOLE REFINERY.**

3.2 Water

• **Cooling water** - Supply	**Pressure (Barg)**	**Temperature (°C)**
Source: (SEA WATER)		
Minimum:	**2.5**	**27**
NORMAL	**3.0**	**33**
Maximum:	**4**	**38**
Mechanical design:	**5.8**	**65**

• **Cooling water** - Return		
Return to: * returned to sea	**Atm**	**43**
Minimum pressure required for return:	**Atm**	
Maximum temperature for return:		**45**

• **Boiler feed water**	**Pressure (Barg)**	**Temperature (°C)**
Minimum (for thermal design):	**50**	**100**
Normal:	**60**	**120**
Maximum:	**65**	**159**
Mechanical design:	**71.5**	**185**

Quality: provide detailed analysis

• **Process water** (catalyst wash, chemicals)	**Pressure**	**Temperature**
Minimum:		
Normal:	**2.28 Bar**	**Ambient**
Maximum:		**50 ^{O}C**
Mechanical design:		

Source: **Industrial Water from Desalination Units** *

Quality: provide detailed analysis

REFER TO NEXT TABLE (FOR PROCESS WATER)

*** LORC USES CONDENSATE AS PROCESS WATER WITH DIFFERENT CONDITION BY CASE.**

- **Process water** (water wash)

	Pressure	Temperature
Minimum:		
Normal:	**2.28 Bar**	**Ambient**
Maximum:		**50 ^{O}C**
Mechanical design:		
Source: **Industrial Water from Desalination Units**		
Quality: deaerated, provide detailed analysis		
T H, ppm	0.36	
O_2, ppb	50	
H_2S,	NEGATIVE	
CYANIDE, ppm	0.006	
PH	8.9	
SO_3, ppm	TRACE	
Cl, As, NaCl, ppm	NIL	
PO_4 , ppm	TRACE	
NH_3 , ppm	0.02	
TOTAL Fe, ppm	0.12	
TSS, ppm	TRACE	

3.3 Air

- **Plant air**
  (oil-free for catalyst regeneration)

	Pressure (Barg)	Temperature (°C)
Minimum:	**4.5**	**40**
Normal:	**5**	**45**
MAXIMUM	**7**	**45**
Mechanical design:	**11.77**	**100**

- **Instrument air**

Minimum:	**4**	**40**
Normal:	**5**	**45**
MAXIMUM	**7**	**45**
Mechanical design:	**11.77**	**100**
DEW POINT		**-40**

3.4 Nitrogen

Availability:	**1 PSA N2 Package Q : 100 Nm3/H (99.5%N2)**	
Quality: provide detailed analysis	**N2 99.5 vol%**	**Dew Point @ 1 Bar(a)**
	O2 Balance	**- 40 ^{O}C**
	CO2 20 vol ppm max	
	CO 20 vol ppm max	
	HC 5 vol ppm max	
	Water 5 vol ppm max	
Temperature:		**40 ^{O}C**
Minimum pressure:	**7 Bar(g)**	
Mechanical design:	**10.3 Bar(g)**	**65 ^{O}C**

3.5 Fuel

- **Fuel gas**

	Pressure(Barg)	Temperature(°C)
Minimum:	**4**	**30**
Normal:	**4.3**	**35**
Maximum:	**5.3**	**40**
Mechanical design:	**7**	**65**
Quality: provide typical analysis	*	

- **Fuel oil** **11.7** **120**

*** Fuel Gas Analysis:**

H2	C1	C2	C3	IC4	NC4	HEAVIER
31	38.0	19.4	8.0	1.8	1.7	0.1

Sulfur specification : 50 ppm vol max (H2S)

3.6 Flare header pressure

Indicate flare header normal and design pressure.

KNOCK OUT DRUM CONDITION:

Design pressure: 3.5 kg/cm2g , Operating pressure: 0.2 ~ 3 kg/cm2g

4. SAFETY AND ENVIRONMENTAL REQUIREMENTS

4.1 SIS (Safety Instrumentated Systems) related to chemistry

In case of risk to the chemistry of the reaction, Axens specifies the SIL (Safety Integrity Level) in order to fit the corresponding SIS. The SIL number will be indicated on Axens Piping and Instrumentation Diagrams (P&ID) and instrument Data Sheet "SHUTDOWN LOGIC IS" (IS = Interlock Safety).

If Axens specifies a SIL, a typical SIS configuration will be represented **only for concerned loop(s)** and close to the safety interlock (IS) or instrument(s) corresponding to the loop, the following note will be indicated :

"This Safety Instrumented System (SIS) has to be in accordance with safety Integrity Level (SIL ×) for this instrumented loop.

The Engineering Contractor and Owner shall make sure that the type and quality of the instrumentation supplied for the SIS, the redundancies which are possibly necessary for sensors and final elements, the logic system, and the on site test frequency will be compatible with the SIL level which is specified."

These SIL numbers shall be indicated on final Piping and Instrumentation Diagrams (P&ID) issued by EPC contractor.

4.2 SIS not related to chemistry

The SIL and the corresponding SIS connected to equipment protection will be the responsibility of the Engineering Contractor and Owner. Axens will show on the PIDs a simple configuration of the SIS.

4.3 Fast depressurization

- Fire case : Normally considered for the reaction sections operating at a pressure higher than or equal 17 barg, the depressurization to normaly 7 barg or 50 per cent of the vessel design pressure shall be done manually from a push button, duration : 15 minutes.
- Runaway case : Considered for the possibility of runaway in the reactor, Axens will specify depressurization device and the activation in accordance with the SIL level. The SIS corresponding to this depressurization shall be in accordance with the SIL level already specified for the risk of runaway.

4.4 Shutdown of pumps by low level in upstream vessel

Axens will specify automatic shutdown of the pumps by low level in upstream vessel for :

- feed pumps with high delta P higher than or equal 70 bar
- Sealless pumps

For all other cases, Engineering Contractor will check with the pump's vendor if automatic shutdown is required. A note shall be notified on the PID.

4.5 Minimum flow bypass on centrifugal pumps with flow control

Axens will indicate a minimum flow bypass with flow control for centrifugal pumps for the following cases:

- differential pressure multistage pumps higher than or equal 35 bar ;
- large pumps with driver power higher than 160 kW ;
- for process reason (turndown), flowrate lower than or equal 30 per cent of max flowrate ;

The pump data sheet will specify the process flow without provision for the minimum flow which will be specified by the pump's vendor.

4.6 Automatic isolation valves between process vessel and pumps

Axens will consider automatic isolation valves for:

- an inventory of the process vessel over 8 m^3 of light ends (LPG) ;
- an inventory of the process vessel over 8 m^3 and with a product above its autoignition temperature or at a temperature above 250 degree C ;
- an inventory of the process vessel above 16 m^3 and a flammable product.

The closure of these valves shall result in the automatic shutdown of the corresponding pumps.

4.7 Spare pump driver for critical service

In case of steam turbine driver selection for pump with critical service the steam turbine will be specified for the normal operation, the electric motor for the spare pump.

4.8 High High level in feed drum or reaction section separator drum (if necessary)

To avoid overfilling, an independant High High Level alarm (LSHH) via a Level Transmitter (LT) will be specified and connected to ESD.

The level transmitter will be connected to the drum with independent nozzles (not shown on Axens PID) of the others LT/LG nozzles.

4.9 Isolation of compressor

To reduce the consequences of a fire in compressor area, remote activated isolation valves will be installed in the suction and discharge of any compressor with a power higher than or equal 150 kW and handling flammable or toxic gases.

4.10 Prevention of back flow overpressure

Following devices will be considered at the pump discharge:

- P lower than or equal 40 barg: one check valve
- P higher than 40 barg and smaller than 80 barg: two check valves of different type (stem or shaft blow out resistant, preferably of the non slamming type).
- P higher than or equal 80 barg: two check valves of different type (stem or shaft blow out resistant, preferably of the non slamming type) plus an automatic shut-off valve in case of low flow.

4.11 Isolation of a fired heater

In case of tube rupture in a fired heater and to minimize the consequences of a fire:

- a motor operated isolation valve will be installed at the inlet of the fired heater, if no possibility to shut down the feed flow.
- a check valve or motor operated isolation valve will be installed at the outlet of a fired heater in the following cases:
  - heater operation at high pressure higher than or equal 70 barg
  - reboiling heater of a column with high gas inventory

4.12 Seals on pumps

Dual mechanical seals (pressurized or unpressurized according to process considerations) or sealless pumps shall be considered in the following cases :

- LPG
- Hydrocarbons above their auto ignition temperature or at a temperature higher than 250 degree C
- Toxic or carcinogenic fluid
- Pump operating at high pressure higher than or equal 50 barg

4.13 Constraints due to handling of benzene

Due to the known carcinogenity of benzene, the following provisions shall be taken when applicable :

- For all streams containing 0.5 per cent weight or more of benzene and 25 per cent weight or more of C_7 through C_9 aromatics, the following shall apply :
  - closed sampling
  - closed aromatics collection system with an below grade drum in an open pit receiving all drains of the corresponding process part
  - pumps will be equipped with dual mechanical seals or pumps will be sealless if operating conditions allow it
  - detailed engineering of valves, flanges and joints shall be such as to satisfy the requirements of TWA (Time-Weighted Average) exposure limit of 1 ppm for an 8 hour workday (OSHA's requirement)
- All water streams saturated with aromatics shall be sent to a suitable processing or treating facility in order to minimize aromatic emissions to the environment.

4.14 Constraint due to streams containing H_2S

When a process unit contains streams with H_2S content higher than or equal 10 ppm wt, the following precautions shall be taken into account to avoid release of H_2S to atmosphere :

- Sample connections will be with a closed loop.
- Draining of pressurized liquids which could release H_2S after expansion shall be sent to a dedicated system to be defined by Engineering Contractor :
  - Below grade drum in an open pit for hydrocarbons,
  - sour water treatment system for acid waters.

Engineering Contractor shall provide adequate H_2S detection system in the process unit.

4.15 Other requirements

SECTION III

PREPARATION OF PROCESS BOOK

TYPICAL P&IDs OF CDU NO2 AND P&ID LEGEND AND SYMBOLS HAS BEEN HANDED TO AXENS DURING KOM. PREPARATION OF PROCESS BOOK BY AXENS FOR LICENSE UNITS SHALL COMPLY WITH THESE DOCUMENTS.

1. EQUIPMENT DESIGNATION AND NUMBERING

1.1 Unit numbering

Unit name	*Number*

1.2 Equipment numbering and identification

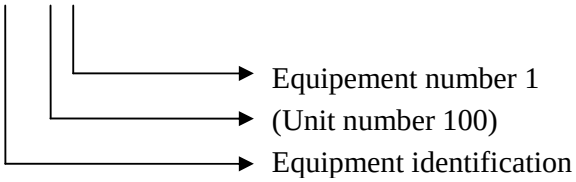
1.2.1 Equipment symbols and identification

Axens standard is used for equipment symbols

Identification	*Equipment*
H	Heaters
R	Reactors
C	Towers and Columns
D	Drums, Separators
E	Heat Exchangers
A	Air coolers
F	Filters
P	Pumps
K	Compressors
T	Storage Tanks
J	Ejectors
M	Miscellaneous
DR	Dryer
FA	Fan

1.2.2 Equipment numbering

Exemple : P –101 – A/B



1.3 Line numbering and identification system

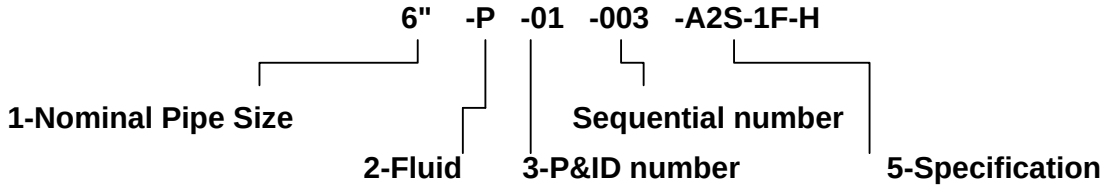
- Example of line numbering (see following pages)
- The utility lines have a simplified identification system. Size and piping class are not shown.

Notes:

- Numbering will start at 001.
- The number changes after control valves and main equipment.
- The number is different for the lines connected to equipment in parallel.
- Each type of fluid will have a separate numbering sequence.
- Drains and vents without permanent flows are neither identified nor listed.
- Design pressures and temperatures are shown on piping specification sheets.

LINE NUMBERING SYSTEM	Specification reference :	3PS001	Sheet	1	of	3

Example of line numbering:



1- Nominal Pipe Size (NPS)

2- Fluid

Heating / Cooling

HO	Heat transfer fluid		
LS	Low pressure steam	**LC**	Low pressure steam condensate
MS	Medium pressure steam	**MC**	Medium pressure steam condensate
HS	High pressure steam	**HC**	High pressure steam condensate
LSS	Low pressure superheated steam		
MSS	Medium pressure superheated steam		
HSS	High pressure superheated steam		
CWS	Cooling water supply	**CWR**	Cooling water return
FR	Refrigerant		
FG	Fuel gas	**FO**	Fuel oil

Chemicals

IG	Inert gas	**ZS**	Caustic soda
NG	Nitrogen	**ZA**	Ammonia
CA	Catalyst	**ZC**	Chemicals
IA	Instrument air	**PA**	Process air (oil free)
UA	Utility air		
RW	Raw water	**PW**	Process water
DW	Demineralized water	**TW**	Tempered water
BFW	Boiler feed water		

Effluents disposal

BD	Blowdown	**CS**	Chemical sewer
SWS	Sour water sewer	**OS**	Oily sewer
ATM	Vent to atmosphere	**FL**	Flare
SL	Slops		

Process fluids

P	Process		

3- P&ID number

Identification number of the P&ID (last two digits)

4- Sequential number

Sequential number in the P&ID for identification of the line

5- Specification

5.1- Material for pipe (1 digit - letter)

Type	Material	ASTM spec. used by Axens	
		For schedule or thickness calculation	For flange ratings
A	CS (MDMT* higher than or equal minus 5 degree C)	A106 – GrB	A105
B	CS (MDMT* higher or equal minus 45 degree C and lower than minus 5 degree C)	A333 - Gr6	A350 Gr LF 2
C			
D			
E	1 1/4Cr - 1/2 Mo	A335 - P11	A182 – F11
F	2 1/4Cr - 1 Mo	A335 - P22	A182 – F22
G			
H	5Cr - 1/2 Mo	A335 - P5	A182 – F5
I	9Cr - 1 Mo	A335 - P9	A182 – F9
J	SS - TP316	A312 – TP316	A182 – F316
K	SS - TP316L	A312 – TP316L	A182 – F316L
L	SS - TP304	A312 – TP304	A182 – F304
M	SS-TP304L	A312 – TP304L	A182 – F304L
N	SS - TP321	A312 – TP321	A182 – F321
O	SS – TP317L	A312 – TP317L	A182 – F317L
P	SS - TP347	A312 – TP347	A182 – F347
R	Alloy 800 (INCOLLOY 800™)	B407 – N08800	B564 – GrN08800
S_1	Alloy 400 (MONEL 400 ™) D lower than or equal 5"	B165 – N04400	B564 – GrN04400 Annealed
S_2	Alloy 400 (MONEL 400™) D higher than 5"	B165 – N04400	B564 – GrN04400 Annealed
U	Duplex S31803 (URANUS 45 N™)	A789 – S31803	A182 – Gr F51
X	Hastelloy™ C276	B619 – N10276	B462 – N10276

* MDMT: Minimum Design Metal Temperature

5.2- Corrosion allowance (1 digit - number)

0	0.25 mm
1	1.0 mm
2	1.5 mm
3	3.0 mm
6	6.0 mm

5.3- Special requirement (1 digit - letter)

S	Killed carbon steel (KCS) wet H_2S résistant*
R	Internal lining
H	HIC corrosion resistant**
C	PWHT*** mandatory for corrosion reason

* Seamless pipe sulfide stress corrosion cracking resistant as per NACE standard MR01-75 latest edition.
** Only for large diameter welded pipes (Ø > 24")
*** PWHT : Post Weld Heat Treatment

5.4- Flange rating (1 or 2 digits - number)

Item	ASME Class	ISO (EN 1759-1)
1	150	ISO PN 20
3	300	ISO PN 50
6	600	ISO PN 100

Item	ASME Class	ISO (EN 1759-1)
9	900	ISO PN 150
15	1500	ISO PN 250
25	2500	ISO PN 420

Upon request: Rating according to EN 1092-1 (PN 2.5 to PN 100)

5.5 Flange facing (1 digit - letter)

F	Raised face
J	Ring Type Joint

5.6- Insulation (1 digit - letter)

Item	Designation
H	Heat conservation
P	Personal protection
C	Refrigeration conservation

Item	Designation
T	Tracing
J	Jacketing

1.4 Instrument numbering

1.4.1 Symbols

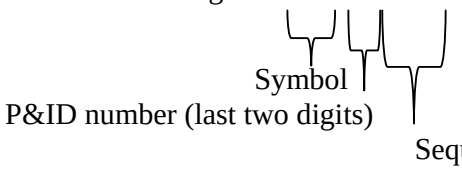
- The symbols for instrumentation will be represented on the Axens Piping and Instrumentation Diagrams (P&ID) by a **simplified form** of ISA. This simplified form will provide all the information required by the process, thereby allowing a better interpretation of the lines and equipments related to the process (see Appendix).

- This level of representation for instrumentation loops provides all required information of Process Control / Command and Safety without specifying particular details of completion which remains under the final customer selection.

- This basic representation of symbols for instrumentation shall be accommodated by the detail engineering following final customer specifications and recommendations.

1.4.2 Numbering

Example of instrument numbering: TI – 01001

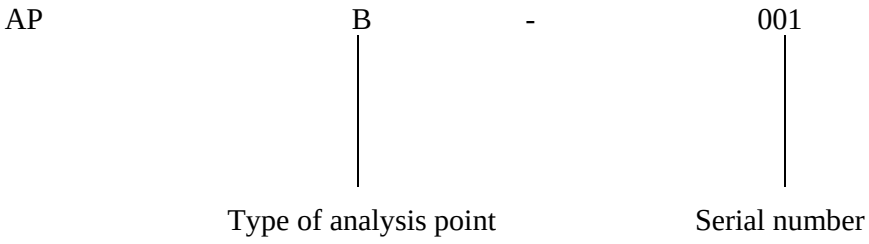


Operating and design pressures and temperatures are given in the instrument specification sheets.

1.5 Analysis point numbering

The analysis points will be listed with their type (A, B, C…). The type conforms to the typical analysis point schemes (see Appendix).

Example:



1.6 Pressure relief valve numbering

Example : PSV 001

2. AXENS STANDARD DRAWINGS AND SPECIFICATIONS FOR REVAMPING (IF REQUIRED)

2.1 Generalities

2.1.1 Revamp philosophy for P&ID's (see attached example)

- Existing P&ID's shall be used to identify area of dismantling and area of modification of existing equipment or circuit. In order to avoid difficulty in representation of modifications, existing P&ID's shall not be used for this purpose.
- New P&ID's shall be used to describe new equipments, modifications of existing equipment and new circuits through witness marker revamping. Existing area reused without modification will not be shown. The complete set of clear revamped P&ID's is within EPC contractor scope.

2.1.2 Revamp symbology for equipment

2.1.2.1 For existing P&ID's (see attached standards)

2.1.2.2 For new P&ID's

New items, modification of existing equipment or circuit and reusing of existing equipment to be modified, line, valve, instrument, shall be identified using the standard symbols presented on Axens standard drawings and specifications symbols and legends.

2.1.2.3 The letter R (for revamping) will identify the drawings of existing and new PID's (see attached examples).

2.1.3 Revamp numbering system for equipment

- Line, instrument, valve and equipment numbers, once deleted, shall not be re-used.
- The symbol (N) : new or (M) : modified put beside a tag number, is an identification for new or modified line, instrument, valve, PSV and equipment.
- This will appear as such one corresponding lists and drawings.

Example : Equipment : P-201 (N), T-304 (M)

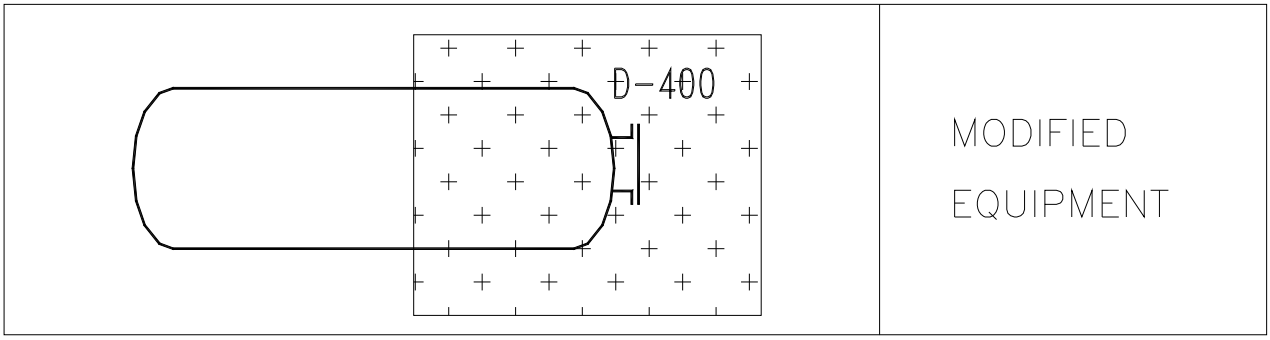
Line : 6"-P-111-G1 (N)

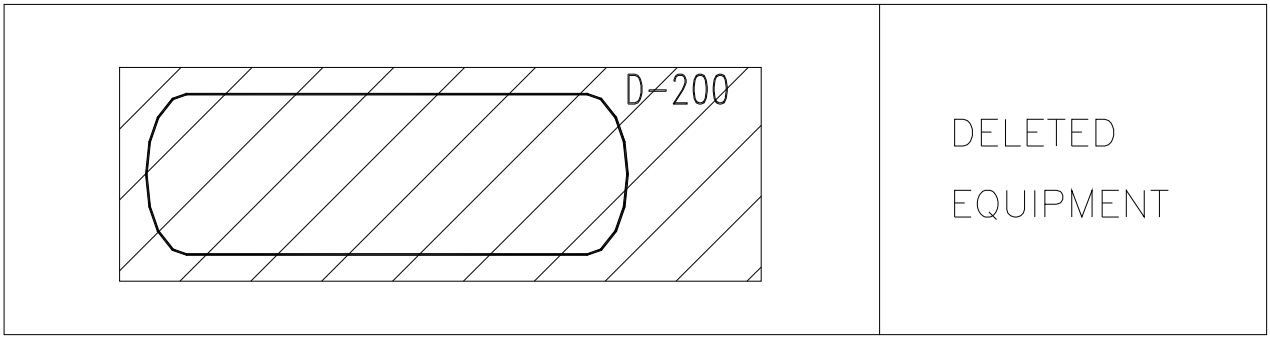
Instrument : TV-105 (N)

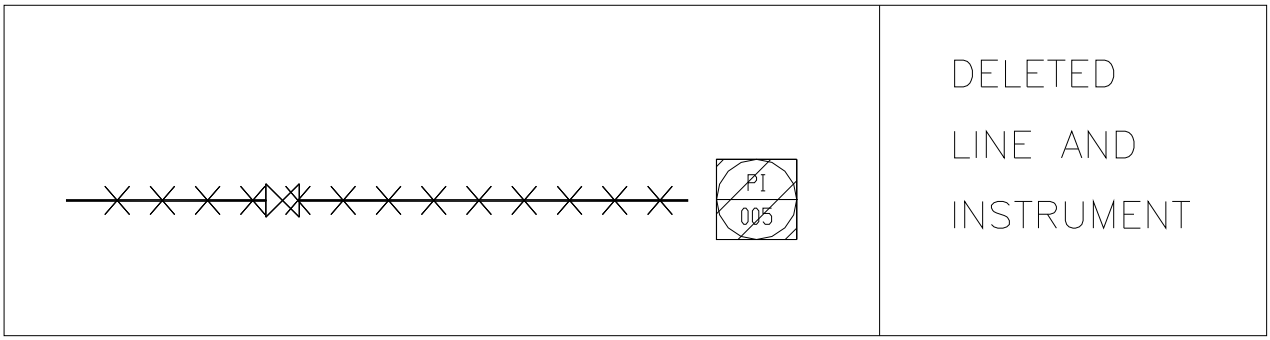
Procedures to identify the lines on P&ID's :

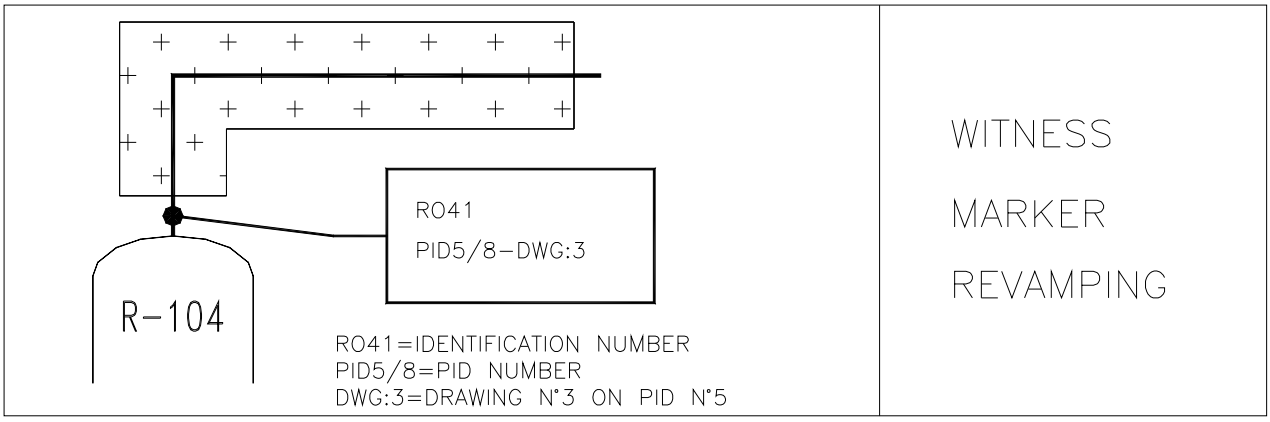
- Existing lines to be maintained shall keep their original identification.
- New lines shall be identified with the symbol (N) and tie-in identification (number, description, location).
- Concerning modification, a point • will defined the witness marker revamping with brief description if necessary.

2.2 PID revamp symbology for existing PID

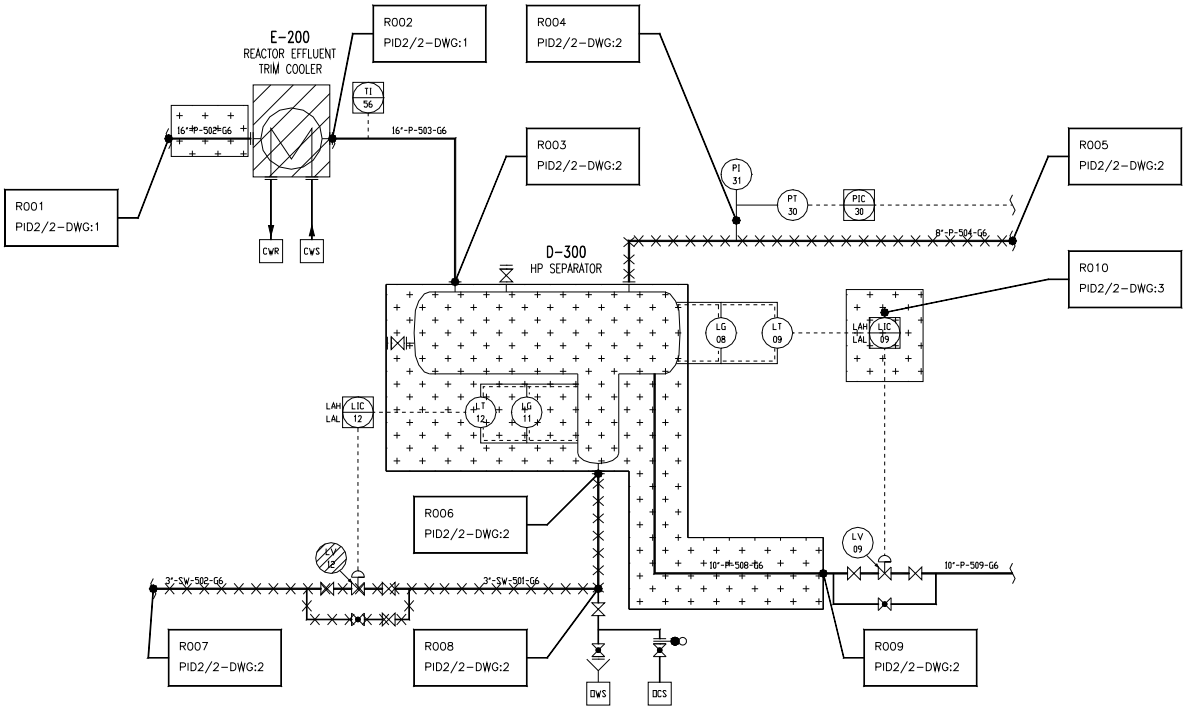






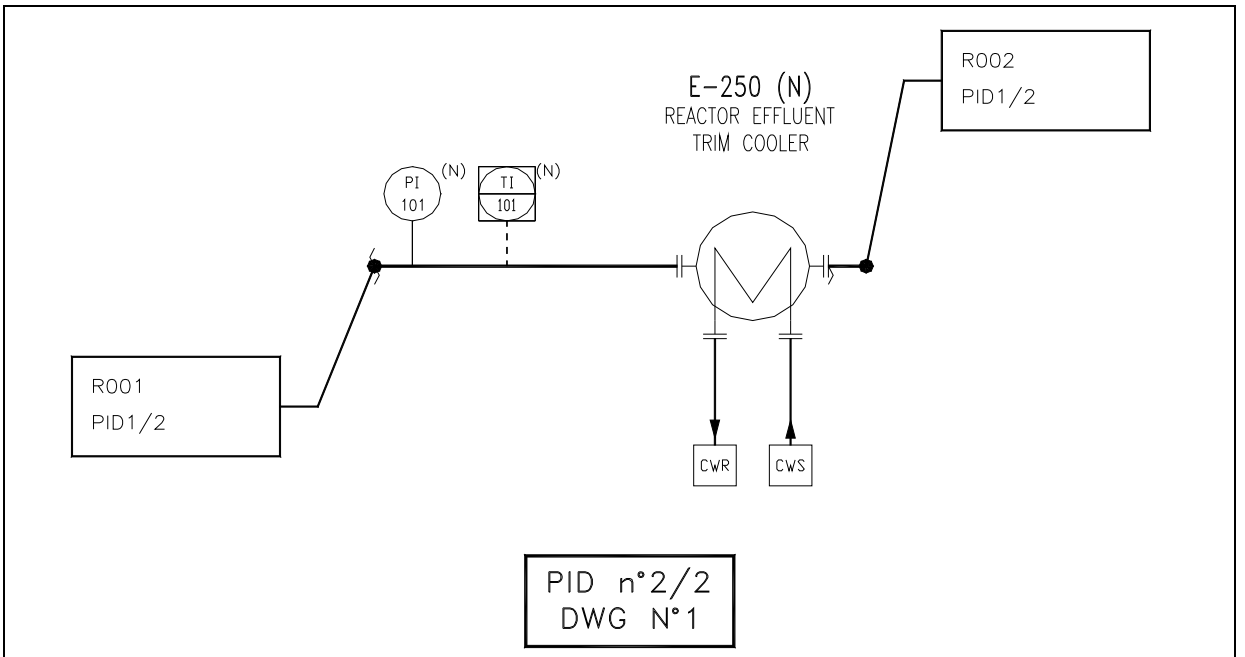


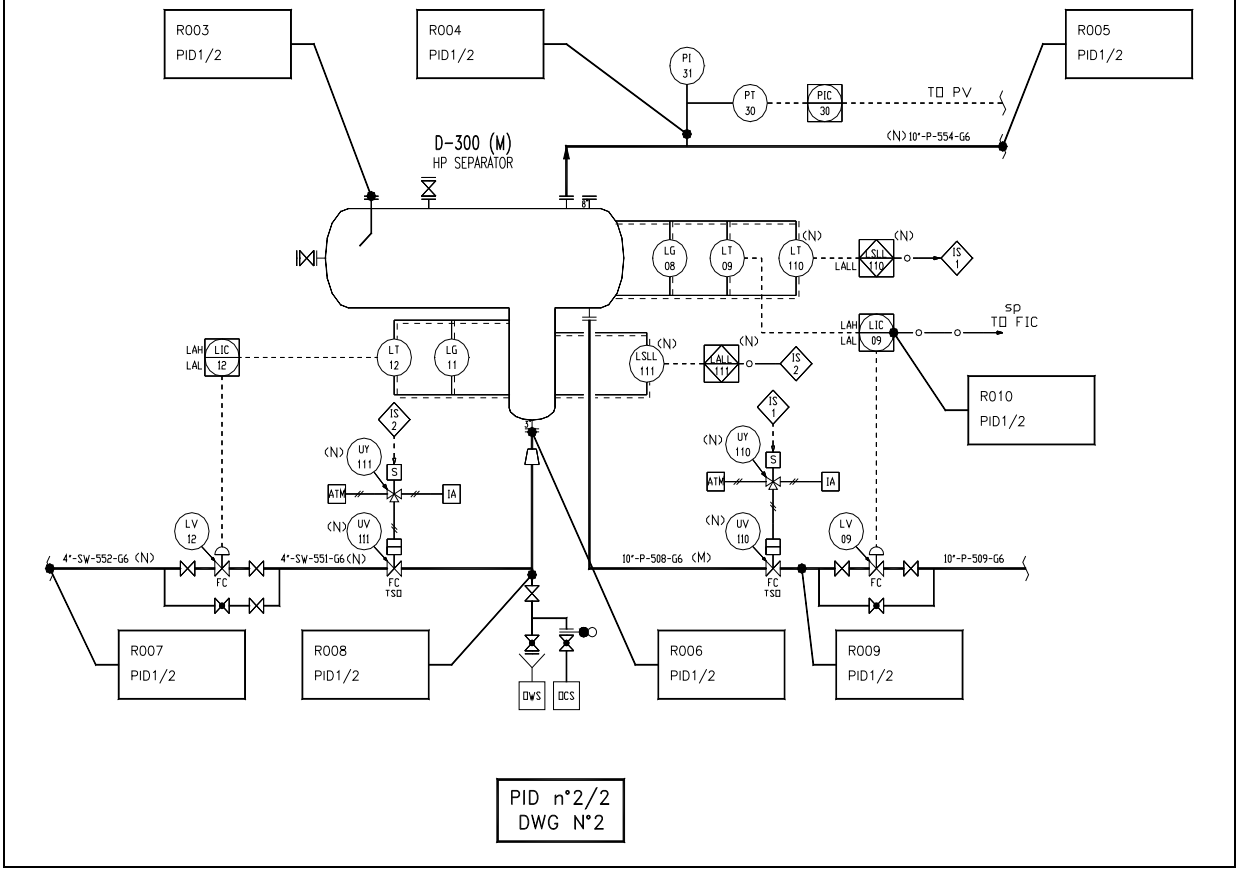
2.3 Existing PID for identification of dismantling and modifications area



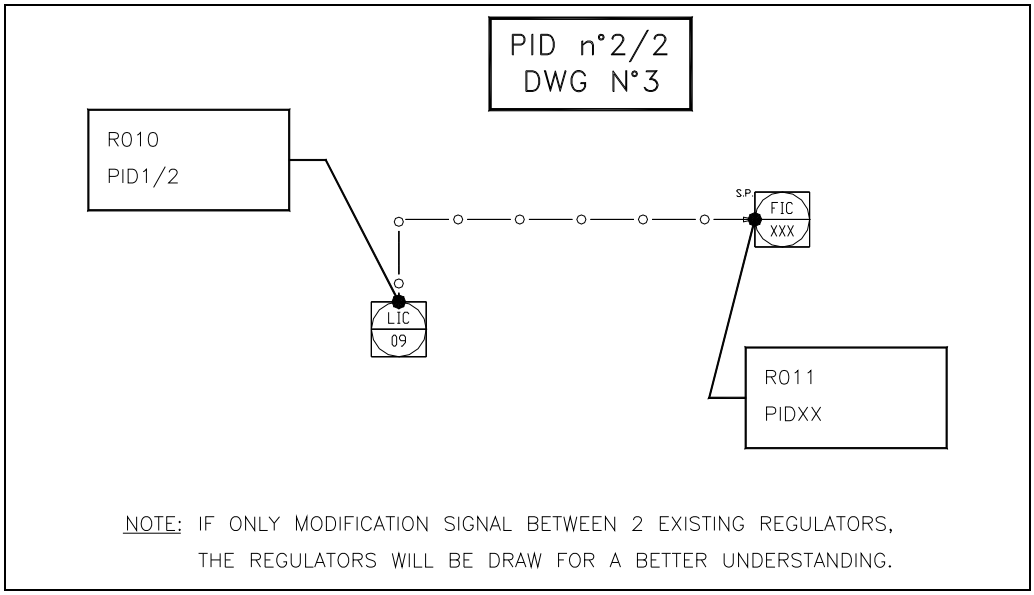
PID n°1/2

2.4 New PID for description of new or modified items and tie-ins location – DWG n° 1 & 2





2.5 New PID for description of new or modified items and tie-ins location – DWG n° 3



3. EQUIPMENT DESIGN BASIS

3.1 Design pressure and temperature

3.1.1 Design pressure for individual equipment items

Design pressure does not include the liquid static as this will be added by the vessel design group based on the high level. Pressure drop accross trays or vessel internals should be included if it is significant.

Whichever is greater :

- 3.5 bar gage.
- Flare design pressure if the vessel is connected to flare.
- For maximum operating pressures less than 15 bar g, use the maximum operating gage pressure + 1.5 bar.
- For maximum operating pressures between 15 bar g and 100 bar g, use 110 per cent of the maximum operating gage pressure.
- For maximum operating pressures 100 bar g and above, use the maximum operating gage pressure + 10 bar.

  Equipment normally operated under vacuum or subject to start-up or shut down evacuation is designed for full vacuum and for the highest pressure the equipment can experience in case of vacuum system failure.

  Full vacuum will be specified for isolable equipment containing fluid having a vapour pressure lower than atmospheric pressure at ambient temperature.

  Full vacuum is not specified for transient operations as steam purging where opening of vent is always considered. For equipment equipped with steam out the following sentence will be specified on the data sheet: “Subject to steam out conditions” with the pressure and temperature of the steam.

3.1.2 Shell and tube heat exchangers

For shell and tube heat exchangers where the design pressure of one side is considerably higher (> 130 per cent) than the other, the design pressure of LP side is equal to 10/13 of design pressure of HP side, according to Code ASME Section VIII div I or is equal to 10/12.5 of design pressure of HP side, according to Code ASME Section VIII div 2 and European Directive on Pressure Vessels. This will avoid the need for provision of relief facilities on the lower pressure side in the event of a tube rupture.

3.1.3 Design pressure for complete systems

When several pieces of equipment are protected by the same relief valve, each piece of equipment will be designed, at least, for the pressure imposed by the conditions of the relief valve in case of emergency corresponding to set pressure.

For fractionation columns, the reference design pressure is taken as that at the bottom of the column.

3.1.3.1 Fractionation tower and auxiliaries

Example (see Figure 1):

Column bottom design pressure : 16.5 x 1.1 = 18.15 kg/cm^2 g

Relief valve set pressure : 16.2 x 1.1 = 17.8 kg/cm^2 g

Reflux drum design pressure : 17.8 kg/cm^2 g

3.1.3.2 Exchangers, vessels and other equipment on the discharge of a pump

Equipment which could have to bear the shut-off pressure of a pump in case of a valve closing (either control valve or block valve) is designed for the following pressure:

Design pressure = Design pressure of the suction vessel + liquid height at vessel NHLL at pump suction + 120 per cent of pump differential pressure.

3.1.3.3 Process system similar to that of a reactor-recycle gas-loop

In this case, the recommendations given in the API Recommended Practice 521, last edition, Appendix "B" and API Recommended Practice 520, last edition, Appendix "B", will be followed.

3.1.4 Design temperature

Maximum operating temperature + 15 degree C, with a minimum of 80 degree C, in the absence of any other specific criteria.

For operating temperatures below 0 degree C, minimum operating temperature minus 5 degree C or minimum ambient temperature.

- The effect of autorefrigeration due to depressurization to atmospheric pressure will be taken into consideration (LPG systems for example).
- For feed/effluent exchangers of reaction sections + 25 degree C to be added to max. operating temperature to take into account the temperature profile modification at low capacity.
- In the case of coolant failure, the maximum operating temperature upstream of the cooler shall be considered as the downstream design temperature (i. e. exothermic reactor).

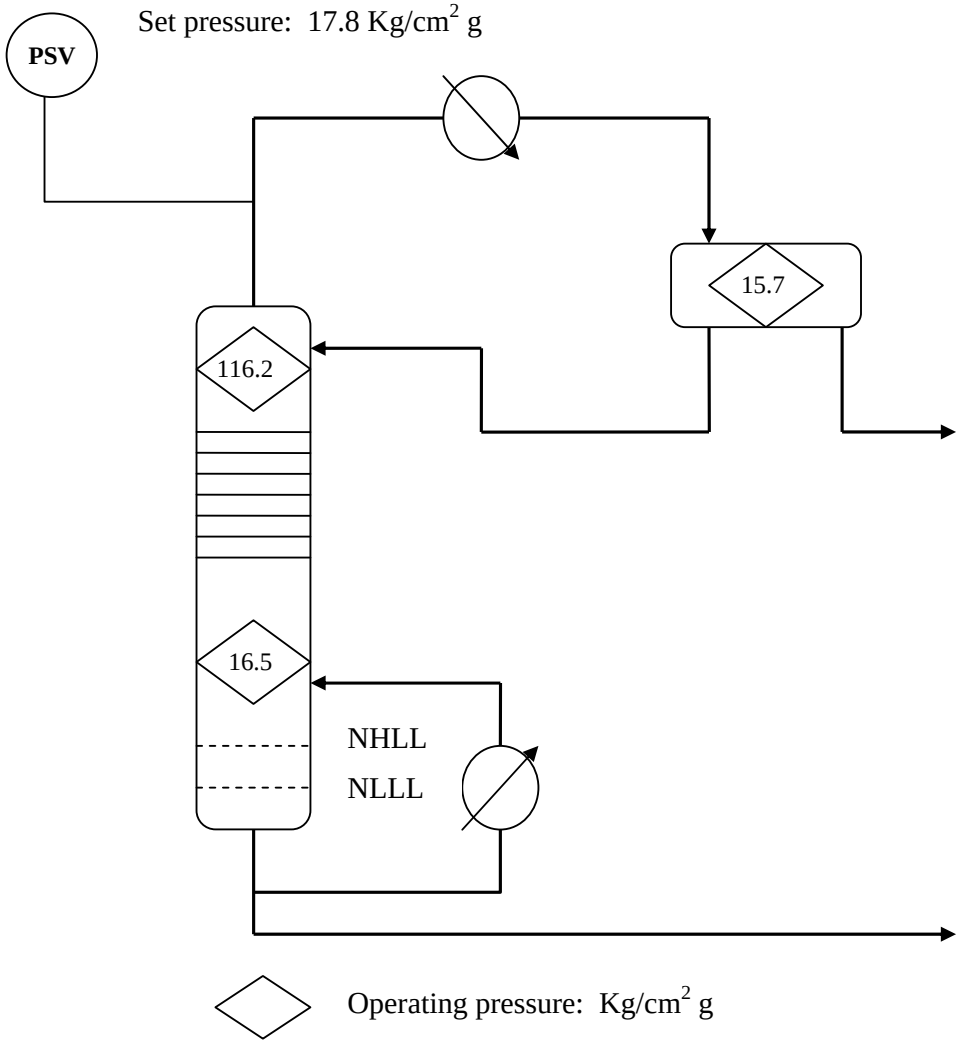
3.1.5 Purging equipment with steam

For equipment submitted to steam purging at start-up or shutdown, indication will be given on the specification sheet (see 2.1.1).

3.1.6 Cyclic operating conditions

For equipment subject to pressure and temperature swings, the magnitude and frequency of these swings will be given on the specification sheet.

Figure 1



3.2 Corrosion allowance

3.2.1 Equipment Design Life

The following design life may be applied to the design of the unit as a standard base:

- Heavy wall reactors/vessels .....30 years
  (including non removable internals and catalyst bed support beams)
- Reactor removable internals: .....20 years
- Columns, vessels: .....20 years
- Exchangers: shell, channel, tubesheets: .....20 years
- Exchanger tubes bundles:.....10 years
- Furnace tubes: .....10 years
- Piping: .....10 years

3.2.2 Corrosion allowance

3.2.2.1 Pressure Retaining Equipment

Axens specifies that the calculated corrosion allowance shall be based on the designed number of years in service.

For carbon steel, Axens considers a minimum corrosion allowance (CA) of 1/8" (3 mm) in general for non-corrosive environment as regular hydrocarbon.

In normal operation under Wet H_2S Service, carbon steel shall have a CA of 1/4" (6 mm).

For other materials, Axens minimum CA is 3 mm (1/8") for low alloyed steels (up to 2.1/4 per cent Cr included), 1.5 mm (1/16") for low alloyed steels (up to 9 per cent Cr included) and 0.75mm (1/32") for stainless steel.

The corrosion allowance of 1.5mm for low alloyed steels (up to 9 per cent Cr) may be extended, in accordance with owner/user, to 3mm for critical equipment (i.e. Reactors, HP Vessels and Furnaces).

For tubular heat exchangers, CA defined for tubes and shell sides, applied to pressure retaining elements. Tubesheet is concerned by CA on each side. Tubes are not concerned by CA, whichever the side.

If equipment is cladded or overlayed, undiluted thickness of clad or overlay is considered as CA allowance.

3.2.2.2 Internals

Definitions :

"Non removable internals" means: welded internals to vessels.

"Removable internals" means: non welded internals to vessels (dip tubes, vortex, mesh, mist eliminator, baffle manhole, fractionation trays, distributor trays, mixing trays, catalyst support trays, support beams, inlet diffusors, outlet collectors, quench pipes, thermocouples supports, etc.)

Removable parts of carbon steel and low alloyed steels (up to 9 per cent Cr) internals shall have a minimum CA of one half of total vessel shell CA on each side in contact with the operating fluid.

Fixed internals carbon steel and low alloyed steel (up to 9 per cent Cr) made shall have the full corrosion allowance on each face (in total 2 times the designed CA of shell).

In general, no corrosion allowance will be given for removable internals made of stainless steel (13 per cent Cr and above) as also for those made of non-ferrous high alloyed . However, a corrosion allowance shall be specified for some internals exposed to severe conditions such as non removable internals of reactor, catalyst bed support beams of reactor. These internals shall therefore have the CA, based on the reactor design life specified in paragraph “Equipment Design Life”, on each exposed surface.

Removable and non removable internals of tubular heat exchangers are not concerned by CA, whichever the side.

No corrosion is considered for internals made with profile wire screen or wire mesh.

3.3 Vessels

a) Liquid residence time

Residence time is defined between low liquid level and high liquid level.

Service		***Residence time***
Reflux	:	5 minutes (1)
Column feed	:	15 minutes on flow control or 8 minutes on cascade level/flow control
Reboiling by heater	:	• between HLL and LLL : max of the two following values - calculated on net bottom product : 15 mn on flow control (or 8 mn on cascade level/flow control) for further processing or 2 mn with discharge to storage. - calculated on total feed heater : 2 mn • between LLL and TL (with a LSLL installed at minimum distance from LLL) : 8 mn on the equivalent flowrate of the vapor generated in the fired heater.
Reboiling by thermosiphon	:	10 to 30 seconds
Product to storage	:	2 minutes
Product feeding another unit	:	15 minutes on flow control or 8 minutes on cascade level/flow control
Feed surge drum	:	30 minutes if diam lower than or equal 1.2 m 20 minutes if diam is higher than 1,2 m and smaller than 1,8 m 15 minutes if diam higher than or equal 1,8 m

(1) In the case of several services such as reflux and liquid distillate to storage, the residence volume (LLL-HLL) of the corresponding vessel will be the sum of the volumes requested by each service.

b) Vessels will be sized according to inside diameter and 2 :1 elliptical heads or hemispherical heads.

c) For shop fabrication or shipping indicate any known limitation (diameter, length, weight).

d) Connections will be flanged.

For connections between equipment with clad and piping where respective materials and design conditions lead to different ratings for flanges, Axens will specify on equipement data sheet to supply counterflange with overlay identical to flange of concerned nozzles.

e) 24-inch manways are currently specified.

Minimum inside diameter shall be 18 inches.

Larger size will be specified when required to accommodate internals.

In trayed columns, manways will be provided above the top tray, at the feed tray and below the bottom tray. A manway will be provided at any tray with removable internals and at intermediate levels so that the maximum number of trays between manways does not exceed 20.

f) Vessels, exception done for reactors, will be provided with vent and drain nozzles.

Vent and drain sizes will be indicated.

g) Separate steam-out connections will be specified.

h) Indicate size/weight limitation for transportation/erection, if any.

3.4 Trays and packing

Columns oversizing will correspond to 20 per cent of normal flow rates.

3.4.1 Trays

a) Valve trays will normally be specified.

b) Valve tray columns will be specified with the following maximum flooding factors:

77 for vacuum towers

82 for other services

70 for column diameters under 900 mm

Remark: A note will be added on tray loading datasheet explaining that maximum flooding factor has to be confirmed by tray manufacturer.

c) Operating range for the trays will be at least 50 to 120 per cent of normal loads.

d) Trays will be numbered from the bottom.

e) 11-13 chromium alloy tray material is generally specified without corrosion allowance.

3.4.2 Packing

Column diameters are estimated using calculation methods provided by the major packing manufacturers.

3.5 Exchangers

- Heat exchangers will be specified according to TEMA Class R. Indicate any restriction concerning the choice of heat exchanger type: Do not use F type.
- Square pitch will be specified, for easier cleaning, when the shell side fouling factor is 0.0004 h·degree C·m^2/kcal or greater.
- U tubes will be specified when the tube side fouling factor is less than 0.0004 h·degree C·m^2/kcal.
- Double-pipe or multiple-tube type exchangers will be specified where appropriate.
- 10 % overdesign at least on flowrate shall be considered.
- No other overdesign will be considered for the heat exchangers, except:
  - Overhead condensers which have to be oversized to take into account the greater of either 120 per cent of the estimated operating duty or the duty increase of the corresponding reboiler.
  - To take into account the risk of undersizing of heat recovery systems (i.e. feed-effluent, feed-bottom), the following oversizing is typically specified:
    * Effluent cooler (or feed preheater): 10 per cent of cooler duty (or preheater duty) or 5 per cent of feed/effluent exchange duty, whichever is greater.
    * Reboiler: 5 per cent of feed/bottom exchange or 15 per cent of reboiler duty, whichever is greater.
    * Bottom cooler: 10 per cent of cooler duty or 5 per cent of feed/bottom exchange duty, whichever is greater.
  - Fouling factor of the cooling water side to be provided by Customer.
  - ~~Axens shows normally on P&ID's a globe valve on the water return line from each water cooler~~; CW heat exchanger configuration : Refer to attached Client PID example.

    Cooling water piping for exchangers shall be so arranged that the cooling equipment remains full of water in the event of failure of water supply.

3.6 Air coolers

- Air cooling has to be maximized.
- If air cooling is preferred but process considerations require trim cooling, indicate the temperature breakpoint between air and water cooling. The breakpoint is 68°C.
- Indicate the air design temperature. ~~Axens normally specifies the process outlet temperature at a minimum of 15 degree C above the design dry bulb temperature. Indicate the preferred process outlet temperature if different~~. Approach of 20°C to be considered.
- 10 % overdesign at least on flowrate shall be considered.
- An overdesign will be considered for the air coolers:
  - Overhead aircondensers which have to be oversized to take into account the greater of either 120 per cent of the estimated operating duty or the duty increase of the corresponding reboiler.
  - To take into account the risk of undersizing of heat recovery systems (i.e. feed-effluent, feed-bottom), the following oversizing is typically specified:
    - Reactor effluent aircooler: 10 per cent of aircooler duty or 5 per cent of feed/effluent exchange duty, whichever is greater.
    - Bottom aircooler: 10 per cent of aircooler duty or 5 per cent of feed/bottom exchange duty, whichever is greater.
- Preferred control type: autovariable pitch angle on 50% of the fans.

3.7 Heaters

- For multipass heaters the following will be specified:
  - Mixed phase: symmetrical arrangement of the passes and board temperature indicator on each pass outlet.
  - Liquid phase: flow control valve with a minimum flow stopper on each pass inlet and board temperature indicator on each pass outlet.
  - Vapour phase: symmetrical arrangement of the passes and board temperature indicator on each pass outlet (except for box-type heaters: in this case see the manufacturer's recommendations).
- Skin thermocouple will be specified for each pass except for box-type heaters with a large number of passes: in this case, see the manufacturer's recommendations.
- 10 % overdesign at least on flowrate shall be considered.
- Oversizing will be considered as follows:

  To take into account the risk of undersizing of heat recovery systems (i.e. feed-effluent, feed-bottom), following oversizing is typically specified:
  - Feed heater: 10 per cent of heater duty or 5 per cent of feed/effluent exchange duty, whichever is greater.
  - Reboiler: 5 per cent of feed/bottom exchange or 10 per cent of reboiler duty, whichever is greater.

3.8 Pumps

- 10 per cent oversizing will normally be specified.
- 20 per cent oversizing will be specified on reflux and reboiler flow rates.
- Electrical motor drivers will be specified. Critical service drivers will be steam turbines ~~or connected to electrical emergency network~~.
- Continuous service process pumps will be specified with full spares.
- Common spares can be specified whenever appropriate for metering pumps.
- Pumps on P&ID's are shown with permanent strainers; Axens will provide additionnal temporary strainers when necessary.

3.9 Compressors

- Electrical motor drivers will be specified. Critical service drivers will be steam turbines ~~or electrical motors connected to the electrical emergency network~~.
- Owing to the high reliability of centrifugal compressors, a spare will not be specified. Full spare capacity will be specified for reciprocating compressors.
- Sparing philosophy: 2 × 100 per cent ~~3 × 50 per cent, 2 × 60 per cent~~
- The compressors oversizing will be specified as follows:

  - Make-up: 10 per cent minimum overcapacity
  - Recycle: 20 per cent minimum overcapacity on gas Quench

3.10 Instruments and control valves

3.10.1 The control system

The symbols to be used will be in accordance with Axens standard (see chapter 1.4.1. Symbols).

Specify the type of architecture instrumentation to be used : FCS ~~(DCS and / or others)~~.

3.10.2 Alarms and shutdown devices

- Alarms and shutdown devices will be specified where required for process, safety or equipment protection considerations.
- Shutdown device connections will be independent from instrument connections.
- All safety devices are connected to one specific system (ESD type).

3.10.3 Isolation valves

Axens specifies double valving when design pressure is higher than 80 bar g.

3.11 Pressure relief valves

- A single pressure relief valve will normally be specified unless a spare valve is required for maintenance purpose owing to the quality of discharged fluid or as per owner standard (if so, to be indicated).
- Pressure relief valves are normally installed on the equipment.
- Pressure relief valves will not be equipped with a by-pass when the depressurization of the vessel to the flare is possible through accessible valves and suitable piping.
- Inlet and outlet isolation block valves will only be specified for spared pressure relief valves (mechanical interlock).
- Pressure relief valves in hydrocarbon vapour service will normally discharge to a flare system.

  Indicate if Customer policy and environmental regulations permit discharging non-toxic vapours to the atmosphere and under which conditions.
- Indicate flare header normal and design pressures.

3.12 Engineering documents

The list of documents to be transmitted to Axens for comments or information is given in the contracts 06-2841;06-2842;06-2843.
~~(see Appendix).~~

APPENDIX

AXENS BASIC PROCESS DESIGN (IN-21-X)

AXENS COMPUTERIZED FILES SUPPLY (IN-25)

STANDARD DRAWINGS AND SPECIFICATIONS (IN-39)

DOCUMENTS TO BE TRANSMITTED TO AXENS FOR COMMENTS OR INFORMATION (IN-38-XX)

These documents are attached hereafter.

AXENS BASIC PROCESS DESIGN

(IN-21-1)

INTRODUCTION

1. PROCESS SPECIFICATIONS SECTION

1.1 Basis of design

1.1.1 Duty of unit

1.1.2 Feeds specification

1.1.3 Products specification

1.1.4 Battery limit conditions

1.1.5 Utilities conditions and site information

1.1.6 Operating conditions

1.2 Unit description

The process flows, the major equipment items and their purpose or function, the control loops are described based on the process flow diagrams.

1.3 Material balances

Detailed material balances based on expected performances of the process.

1.4 Physical and thermal properties of main process streams

1.5 Specifications of catalysts and chemicals

Nature of catalysts, main characteristics, quantities (initial load or consumption).

1.6 Utilities

Estimated figures developed from heat and material balances using assumed usual efficiency figures for the equipment involved in the utility balance.

1.7 Waste effluents

Composition, flow rate, type of treatment or disposal.

1.8 Qualified and recommended equipments, supplies, and sellers

1.9 Documents to be transmitted to AXENS for comments or information

1.10 Materials of construction

2. EQUIPMENT PROCESS SPECIFICATIONS SECTION

The Process specifications are given exclusive of any mechanical specification, except for flange rating.

2.1 Equipment list

2.2 Vessels

The Process specifications include a sketch showing the inside dimensions, nozzles size and location, internals arrangement, type of material and recommended corrosion allowance, operating and design conditions, insulation requirement, flange type and rating according to ASME. Additional sketches showing the process design of the internals are provided.

2.2.1 Drums

2.2.2 Columns

2.2.3 Reactors

2.3 Heat exchange equipment

The Process specifications include flow rate, applicable physical properties of process streams, fouling factors, heat duty, type of material and recommended corrosion allowance on process side, operating and design conditions, recommended type.

Vaporization tables showing liquid and vapour rates and physical properties are provided when applicable.

2.3.1 Heat exchangers

2.3.2 Air coolers

2.3.3 Heaters

2.4 Rotating machines

The Process specifications include operating and design flow rates, applicable physical properties of process streams, operating conditions, available NPSH, type of material on process side, recommended type. Driver recommended type, estimated rated power and operating load are provided.

2.4.1 Pumps

2.4.2 Compressors

2.5 Miscellaneous equipment

3. PIPING PROCESS SPECIFICATIONS SECTION

Process piping is concerned exclusive of utility piping.

Process specifications are given exclusive of any mechanical specification with exception to flange rating according to ASME.

3.1 General notes

3.1.1 Recommendations

3.1.2 Process piping classes

(type of material corrosion allowance, flange type and rating)

3.1.3 Piping identification system

3.2 Piping process specifications

Flow rate, applicable physical properties of process streams, operating and design conditions, process piping classes.

4. INSTRUMENTATION PROCESS SPECIFICATIONS SECTION

Process specifications are given exclusive of any mechanical specification.

4.1 Instruments

Applicable operating conditions and physical properties of process streams, trip and set points for alarms are provided.

4.1.1 Flow

4.1.2 Level

4.1.3 Pressure

4.1.4 Temperature

4.1.5 Miscellaneous (when applicable)

4.1 Valves

Applicable operating conditions and physical properties of process streams, action of the measured variable, position in case of air failure are provided.

4.2.1 Control

4.2.2 On/off

4.2.3 Miscellaneous

4.3 Pressure safety valves

Flow rate, operating conditions, applicable physical properties of emergency streams are provided in each emergency case.

4.4 Alarms

List of set points for alarm trips and alarms.

4.5 Analysis point

List and types to be used.

4.6 Analyzers (when applicable)

4.7 Hand switch (when applicable)

4.8 Shutdown logic and sequence logic (when applicable)

Axens will specify a SIL number for the interlock safety (IS) implemented to prevent the chemical risk.

4.9 Special loops description (when applicable)

5. DIAGRAMS SECTION

5.1 Symbols and standards

5.2 Process flow diagrams

The process flow diagrams show the major equipment with the identification numbers, the main process streams with a number referring to the material balances, the main control loops, the operating temperatures and pressures and estimated duties for heat exchangers and furnaces.

5.3 Material and mechanical diagrams (MMD)

Process flow diagram showing operating and design conditions, material selection, corrosion allowance and safety valve set pressure for major equipment and major process piping with breakpoint.

5.4 Piping and instrumentation diagrams

Process piping exclusive of utilities piping is identified according to a code showing the serial number, nominal size, type of material, corrosion allowance, flange type and ASME rating.

6. OPERATING INSTRUCTIONS SECTION

6.1 Preface of section 6

6.1.1 General

6.1.2 Compulsory instructions and reference documents

6.2 Purpose of the Process

6.3 Chemical reactions and catalysts

6.3.1 Introduction

6.3.2 Chemical reactions

6.3.3 Catalyst

6.3.4 Process variables

6.4 Preparation for start-up

6.4.1 Chronology of operations

6.4.2 Equipment and unit inspection

6.4.3 Preliminary operations

6.4.4 Drying out of the unit (when applicable)

6.4.5 Catalyst loading (when applicable)

6.4.6 Special operations (when applicable)

6.5 First start-up

6.5.1 Status of the unit

6.5.2 Chronology of start-up operations

6.5.3 … } Title and content of chapters to be defined according to the Process

6.6 Operation of the Unit

6.6.1 Summary of operating conditions

6.6.2 Control philosophy of the Process

6.6.3 Operating parameters

6.6.4 Adjustment of operating conditions

6.6.5 Putting the spare reactor into service (when applicable)

6.6.6 Troubleshooting (when applicable)

6.7 Shutdown and restart of the Unit

6.7.1 Normal shutdown

6.7.2 Unit restart

6.7.3 Emergency shutdown

6.8 Catalyst specifications and special procedures

6.8.1 Manufacturer

6.8.2 Catalyst specifications

6.8.3 Packaging, handling and storage

6.8.4 … } Title and content of chapters to be defined according to the Process

6.9 Hazardous and toxic materials

Information on hazardous and toxic substances.

6.10 Analytical control

Analytical methods, reference number for standard methods (like ASTM) or full description for specific methods. List of streams to be analysed, list of test for each stream, frequency.

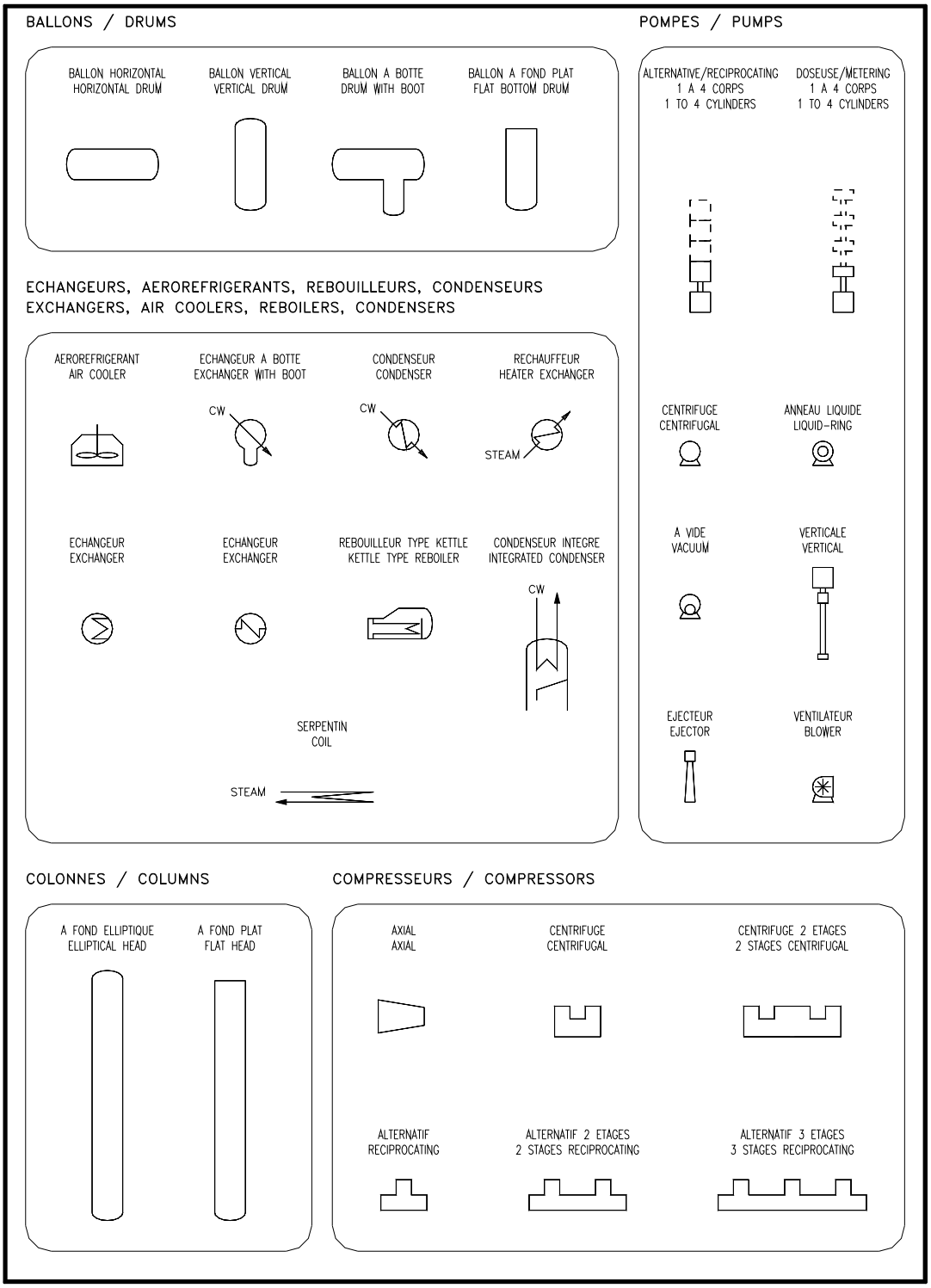
6.10.1 Recommended methods and frequency

6.10.2 Analytical methods

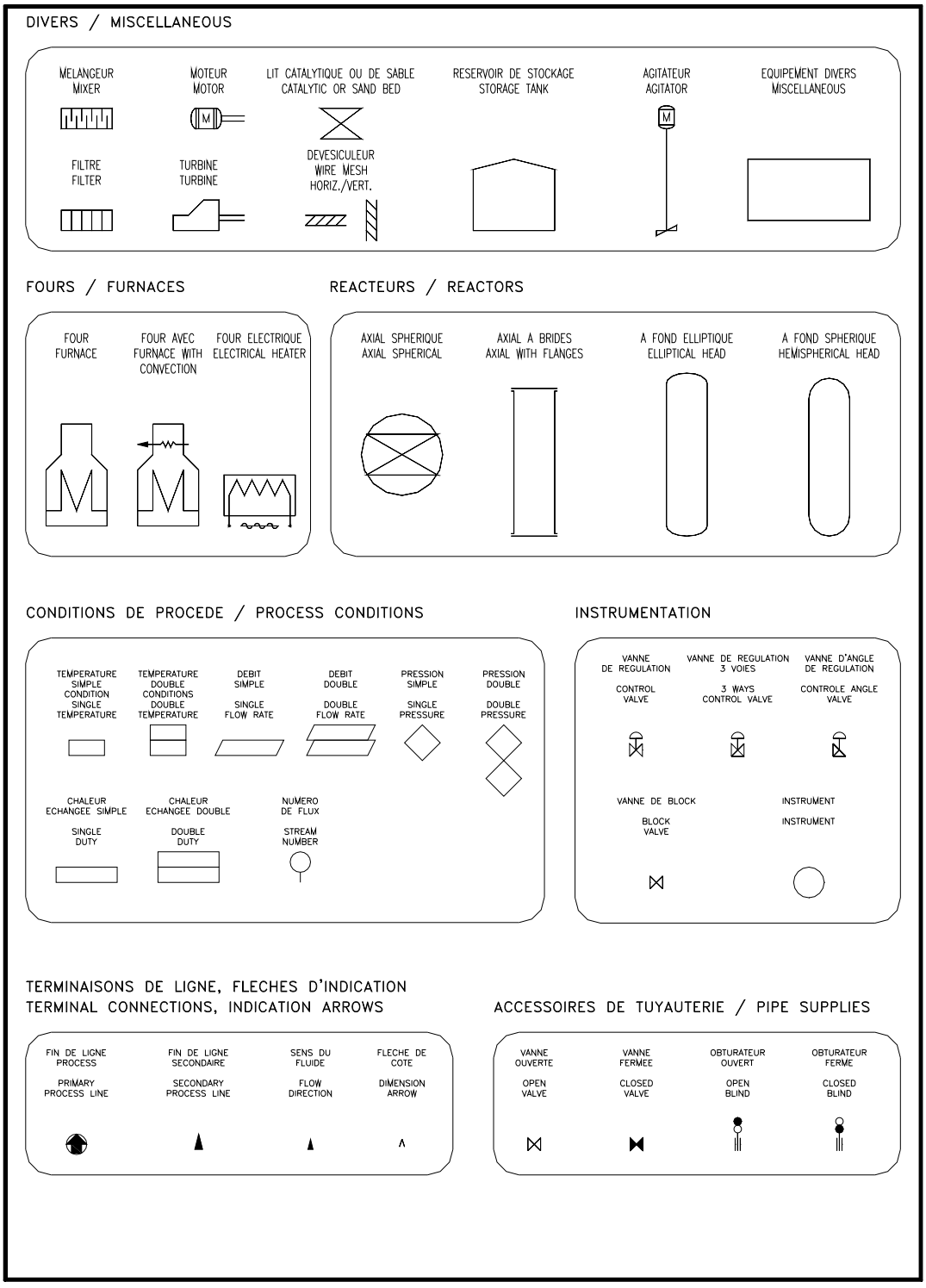
7. AUTOMATION SECTION (when applicable)

AXENS STANDARD DRAWINGS AND SPECIFICATIONS (IN-39)

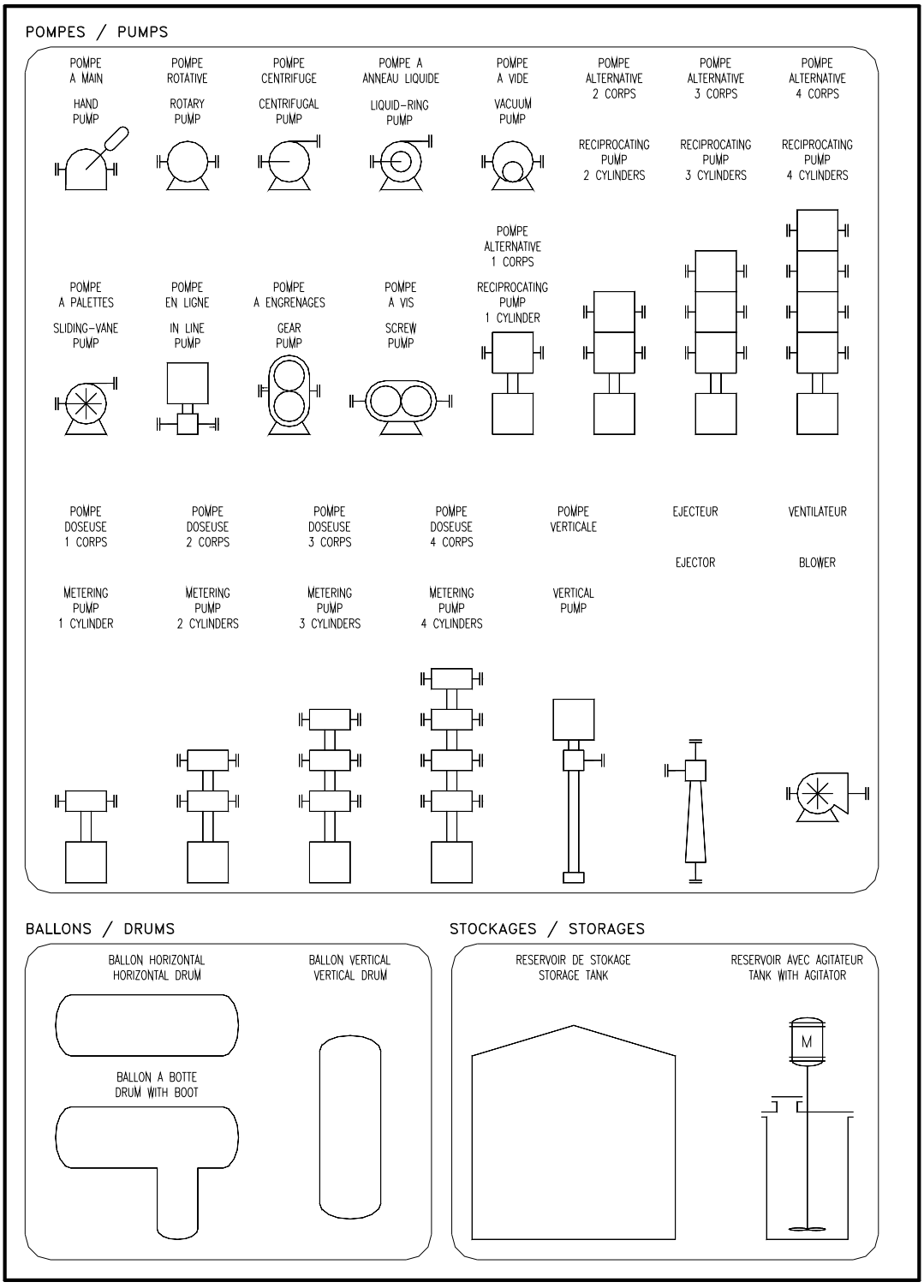
AXENS SYMBOLOGY FOR PFD



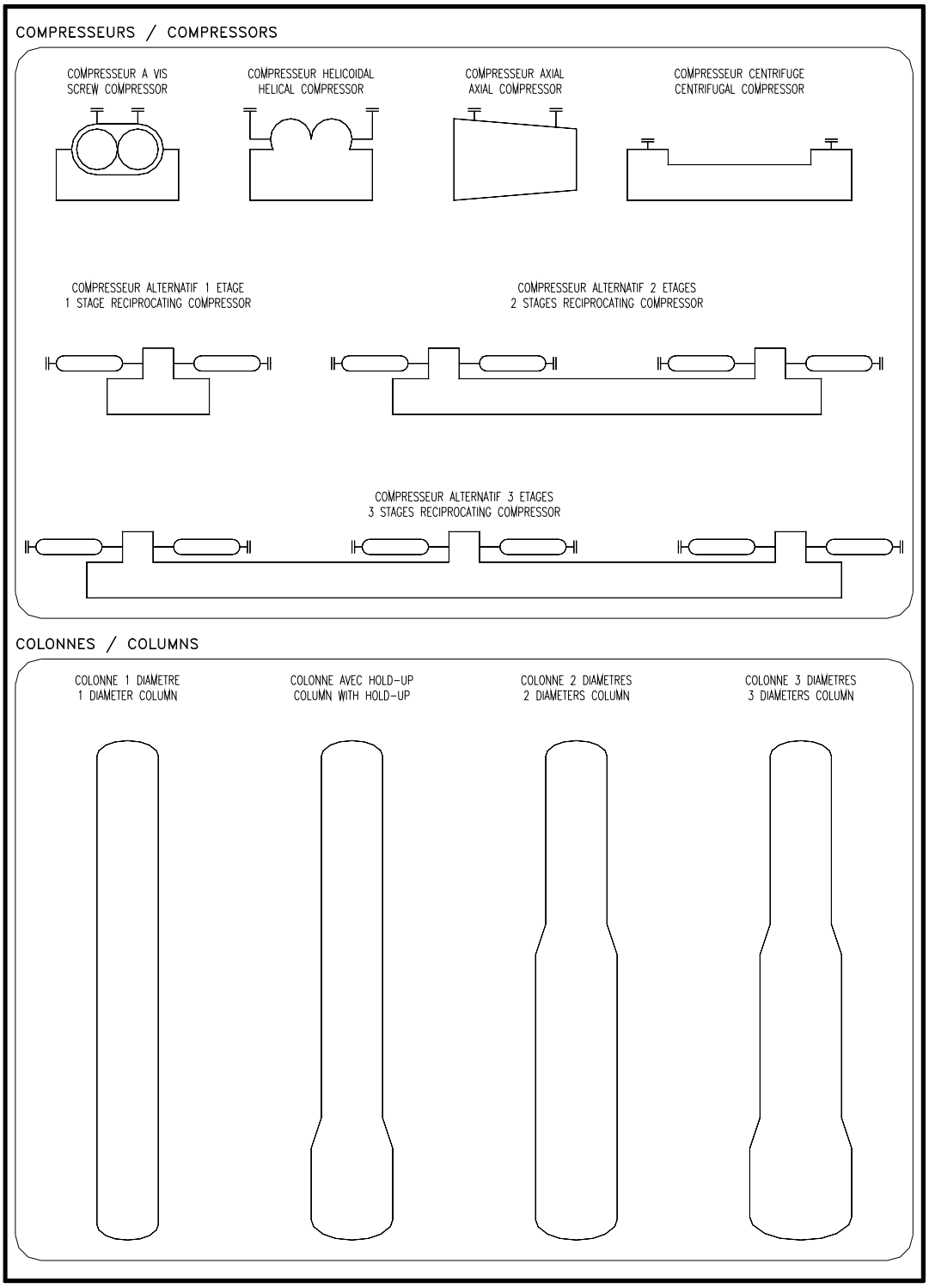
AXENS SYMBOLOGY FOR PFD



AXENS SYMBOLOGY FOR P&ID



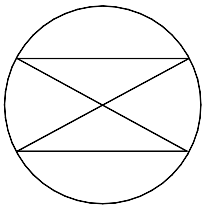
AXENS SYMBOLOGY FOR P&ID



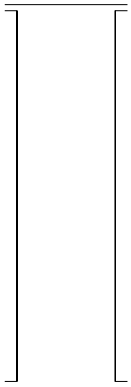
AXENS SYMBOLOGY FOR P&ID

REACTEURS / REACTORS

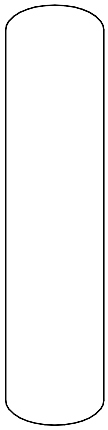
AXIAL SPHERIQUE
AXIAL SPHERICAL



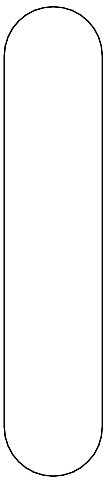
REACTEUR PLAT
PLATE REACTOR



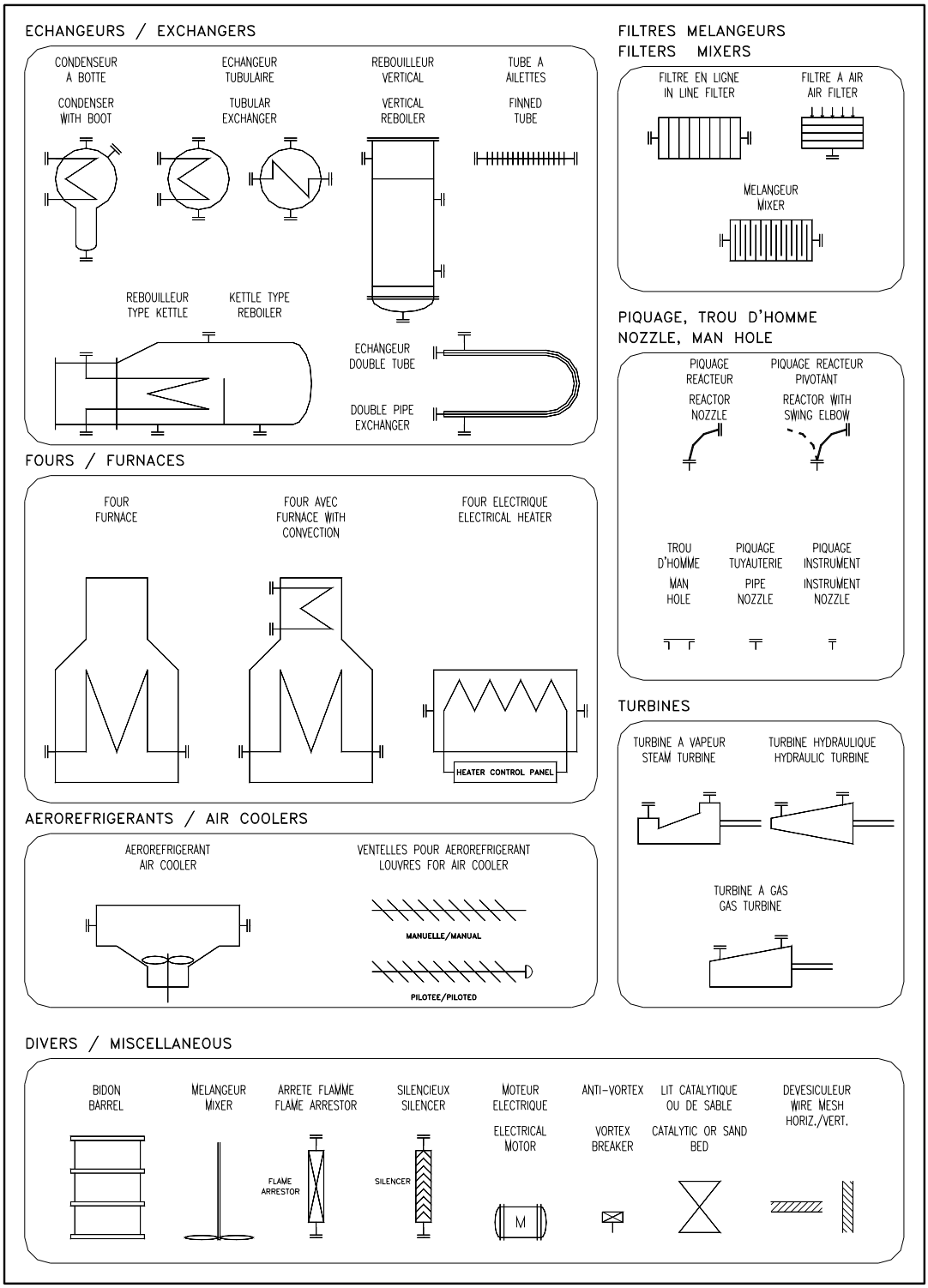
REACTEUR ELLIPTIQUE
ELLIPTICAL REACTOR



REACTEUR SPHERIQUE
SPHERICAL REACTOR



AXENS SYMBOLOGY FOR P&ID



AXENS SYMBOLOGY FOR P&ID

INSTRUMENTATION SYMBOLS

GENERAL INSTRUMENTS

- FIELD MOUNTED LOCAL INSTRUMENT
- INSTRUMENT MOUNTED ON CONSOLE PANEL IN CONTROL ROOM
- THRESHOLD RELAY ON RACK OR BEHIND PANEL IN CONTROL ROOM (INACCESSIBLE)
- INSTRUMENT MOUNTED ON LOCAL PANEL
- INSTRUMENT CONTROLLER/DISPLAY/INDICATOR/ALARM INSTALLED ON SUPERVISOR SYSTEM (DCS) NORMALLY ACCESSIBLE TO OPERATOR
- INSTRUMENT CONNECTED BEHIND SUPERVISOR SYSTEM AND INACCESSIBLE TO OPERATOR
- INSTRUMENT CONNECTED TO SAFETY SYSTEM. FUNCTION INSIDE SAFETY SYSTEM (ESD) ALL ALARMS RELATED TO TRIP INSIDE OR CLOSE TO THIS SYMBOL WILL BE SENT TO DCS VIA SERIAL LINK AND WILL BE SHOWN AT DETAIL ENGINEERING STAGE.
- INSTRUMENT CONNECTED TO PLC FOR SEQUENTIAL LOGIC NON INPLEMENTED IN DCS OR ESD
- BLOCK FUNCTION
- INTERLOCK LOGIC AND SEQUENTIAL CONTROL GENERAL SYMBOL
  I = SEQUENTIAL LOGIC IMPLEMENTED IN DCS
  IS= SAFETY SEQUENTIAL LOGIC IMPLEMENTED IN ESD
  IP= SEQUENTIAL LOGIC IMPLEMENTED IN PLC (NOT DCS NOR ESD)

INSTRUMENTATION LINES

- UNDEFINED SIGNAL
- INSTRUMENT SUPPLY OR CONNECTION TO PROCESS
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL (CONTINUOUS AND DISCRETE)
- SOFTWARE OR DATA LINK
- CAPILLARY TUBE
- ELECTROMAGNETIC, SONIC OR LIGHT BEAM

SELF ACTUATED REGULATOR

- PRESSURE REDUCING REGULATOR
- BACK PRESSURE REGULATOR

PRESSURE RELIEVING DEVICES

- PRESSURE RELIEF OR SAFETY VALVE
- PRESSURE AND VACUUM RELIEF OR SAFETY VALVE
- VACUUM RELIEF VALVE
- RUPTURE DISK FOR VACUUM RELIEF
- RUPTURE DISK FOR PRESSURE RELIEF

SOLENOÏD ACTUATORS

- SINGLE SOLENOÏD WITH SINGLE ACTUATOR
- 4 WAYS SOLENOID WITH DOUBLE ACTUATOR
- 3 WAYS SOLENOID WITH SINGLE ACTUATOR
- S= SOLENOÏD VALVE
  R= LOCAL MANUAL RESET WHEN INITIATED
- 4 WAYS SOLENOID WITH SINGLE ACTUATOR
- R= REMOTE RESET

OTHER DEVICES

FLOW ELEMENTS

- GENERAL SYMBOL FOR TEMPERATURE
- THERMOCOUPLE OR RTD SUPPLIED WITH A TRANSMITTER OR REMOTE MULTI-POINT TEMPERATURE WITH CONPENSATION CABLES SHALL BE DEFINED DURING DETAIL ENGINEERING.
- GENERAL SYMBOL FOR FLOW TRANSMITTER THE FLOW ELEMENT SHALL BE DEFINED DURING DETAIL ENGINEERING

VALVE ACTUATORS

- HAND
- DIAPHRAGM OR GENERAL
- WITH HANDWHEEL
- CYLINDER OR PISTON
- ROTARY MOTOR
- SOLENOÏD

OTHERS

- SAMPLING POINT FOR ANALYSIS TYPE * (SEE SHEET 3/3)
- FLOW RESTRICTION ORIFICE
- DIAPHRAGM SEAL

ELEMENTS FOR PROCESS SPECIFICATIONS

- ROTAMETER
- VORTEX
- TURBINE FLOW METER
- CORIOLIS METER
- VENTURI
- ULTRASONIC METER
- ORIFICE PLATE

GENERAL NOTE

- ALL CONTROL VALVE POSITIONERS AND ACCESSORIES SHALL BE SHOWN AS PART OF DETAIL ENGINEERING SCOPE OF WORK.
- ALL BLOCK AND BLEED VALVES FOR INSTRUMENTS SHALL BE PROVIDED AS PART OF DETAIL ENGINEERING SCOPE OF WORK.
- NOZZLES FOR LEVEL SAFETY INSTRUMENT (LSHH / LSLL) MUST BE INDEPENDENT FROM OTHER LT / LG.
- SIZE AND NUMBER OF LEVEL INSTRUMENTATION NOZZLES SHALL BE DEFINED AT DETAIL ENGINEERING STAGE BASED ON FINAL CUSTOMER REQUIREMENT.

AXENS SYMBOLOGY FOR P&ID

INSTRUMENT IDENTIFICATION

LETTER CODE FOR INSTRUMENT TAG NUMBERS

	FIRST LETTER		SUCCEEDING-LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION				
C	CORROSION			CONTROL	
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		SENSOR (Primary element)		
F	FLOW RATE	RATIO (FRACTION)			
G			GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M		MOMENTARY			MIDDLE INTERMEDIATE
N					
O			ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY, NUMBER	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMITTER	
U	MULTIVARIABLE		MULTIFONCTION	MULTIFONCTION	MULTIFONCTION
V	VIBRATION MECHANICAL ANALYSIS & VISCOSITY			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	AXIS		RELAY,CONVERT,COMPUTE	
Z	POSITION, DIMENTION	AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

IDENTIFICATION

	PROCESS VARIABLE	PRIMARY ELEMENT	TRANSMITER	SCAN	INDICATOR	RECORDER	CONTROLLER	INDICATOR CONTROLLER	RECORDER CONTROLLER	SWITCH				ALARM				GLASS, VIEWING DEVICE	WELL (W) CONNECTION (P)	SELF-ACTUATED REGULATOR VALVE	SOLENOID VALVE RELAYS, CONVERTER	FINAL ELEMENT
										ABNORMAL PROCESS FIRST STATE		ABNORMAL PROCESS SECOND STATE		ABNORMAL PROCESS FIRST STATE		ABNORMAL PROCESS SECOND STATE						
										HIGH	LOW	VERY HIGH	VERY LOW	HIGH	LOW	VERY HIGH	VERY LOW					
A	ANALYSIS	AE	AT	AJ	AI	AR	AC	AIC	ARC	ASH	ASL	ASHH	ASLL	AAH	AAL	AAHH	AALL	–	AP	–	AY	AV
B	BURNER	BE	BT	BJ	BI	BR	BC	BIC	BRC	BSH	BSL	BSHH	BSLL	BAH	BAL	BAHH	BALL	BG			BY	BZ
C	CORROSION	CE	CT		CI																	
D	DENSITY		DT		DI	DR	DC	DIC	DRC	DSH	DSL	DSHH	DSLL	DAH	DAL	DAHH	DALL				DY	
E																						
F	FLOW	FE	FT	FJ	FI	FR	FC	FIC	FRC	FSH	FSL	FSHH	FSLL	FAH	FAL	FAHH	FALL	FG	–	–	FY	FV
FF	FLOW RATIO	–	–	–	FFI	FFR	FFC	FFIC	FFRC	FFSH	FFSL	FFSHH	FFSLL	FFAH	FFAL	FFAHH	FFALL	–	–	–	FFY	FFV
FQ	FLOW QUANTITY	FQE	FQT	FQJ	FQI	FQR	FQC	FQIC	FQRC	FQSH	FQSL	FQSHH	FQSLL	FQAH	FQAL	FQAHH	FQALL	–	–	–	FQY	FQV
G																						
H	HAND	–	–	–	–	–	HC	HIC	–	HS		–	–	–	–	–	–	–	–	–		
I	CURRENT	IE	IT		II	IR	IC	IIC	IRC	ISH	ISL	ISHH	ISLL	IAH	IAL	IAHH	IALL	–	–	–	IY	IZ
J	POWER	JE	JT	JJ	JI	JR	JC	JIC	JRC	JSH	JSL	JSHH	JSLL	JAH	JAL	JAHH	JALL	–	–	–	JY	JV
K	TIME	KE	KT	KJ	KI	KR	KC	KIC	KRC	KSH	KSL	KSHH	KSLL	KAH	KAL	KAHH	KALL	–	–	–	KY	KV
L	LEVEL	LE	LT	LJ	LI	LR	LC	LIC	LRC	LSH	LSL	LSHH	LSLL	LAH	LAL	LAHH	LALL	LG	–	LCV	LY	LV
M																						
N																						
O																						
P	PRESSURE	PE	PT	PJ	PI	PR	PC	PIC	PRC	PSH	PSL	PSHH	PSLL	PAH	PAL	PAHH	PALL	–	–	PCV	PY	PV
PD	PRESSURE DIFFFERENTIAL	PDE	PDT	PDJ	PDI	PDR	PDC	PDIC	PDRC	PDSH	PDSL	PDSHH	PDSLL	PDAH	PDAL	PDAHH	PDALL	–	–	–	PDY	PDV
Q	QUANTITY	QE	QT	QJ	QI	QR	QC	QIC	QRC	QSH	QSL	QSHH	QSLL	QAH	QAL	QAHH	QALL	–	–	–	QY	QZ
R	RADIATION	RE	RT	RJ	RI	RR	RC	RIC	RRC	RSH	RSL	RSHH	RSLL	RAH	RAL	RAHH	RALL	–	–	–	RY	RZ
S	SPEED	SE	ST	SJ	SI	SR	SC	SIC	SRC	SSH	SSL	SSHH	SSLL	SAH	SAL	SAHH	SALL	–	–	–	SY	SV
T	TEMPERATURE	TE	TT	TJ	TI	TR	TC	TIC	TRC	TSH	TSL	TSHH	TSLL	TAH	TAL	TAHH	TALL	–	–	–	TY	TV
TD	TEMPERATURE DIFFERENTIAL	TDE	TDT	TDJ	TDI	TDR	TDC	TDIC	TDRC	TDSH	TDSL	TDSHH	TDSLL	TDAH	TDAL	TDAHH	TDALL	–	TW	TCV	TDY	TDV
U	MULTIVARIABLE	–	–	UJ	UI	UR	–	–	–	–	–	–	–	–	–	–	–	–	–	–	UY	UV
V	VIBRATION;VISCOSITY	VE	VT	VJ	VI	VR	VC	–	–	VSH	VSL	VSHH	VSLL	VAH	VAL	VAHH	VALL	–	–	–	VY	VZ
W	WEIGHT	WE	WW		WI	WR	WC	WIC	WRC	WSH	WSL	WSHH	WSLL	WAH	WAL	WAHH	WALL	–	–	–	WY	WZ
X	UNCLASSIFIED																	–	–	–		
Y	STATE	YE		YJ	YI	YR	YC	YIC	YRC	YSH	YSL	YSHH	YSLL	YAH	YAL	YAHH	YALL	–	–	–	YY	YZ
Z	POSITION	ZE	ZZ	ZJ	ZI	ZR	ZC	ZIC	ZRC	–	–	–	–	–	–	–	–	–	–	–	ZY	ZV

AXENS SYMBOLOGY FOR P&ID

PIPING SERVICE & SPECIAL IDENTIFICATION

PROCESS AND UTILITIES IDENTIFICATION

HEATING/COOLING

CC	COLD CONDENSATE	FG	FUEL GAS
LSC	LOW PRESSURE STEAM CONDENSATE	FO	FUEL OIL
MSC	MEDIUM PRESSURE STEAM CONDENSATE	FR	REFRIGERANT
HSC	HIGH PRESSURE STEAM CONDENSATE	HO	HEAT TRANSFER FLUID
LS	LOW PRESSURE STEAM	LSS	LOW PRESSURE SUPERHEATED STEAM
MS	MEDIUM PRESSURE STEAM	MSS	MEDIUM PRESSURE SUPERHEATED STEAM
HS	HIGH PRESSURE STEAM	HSS	HIGH PRESSURE SUPERHEATED STEAM
CWR	COOLING WATER RETURN	CWS	COOLING WATER SUPPLY

OTHERS

IG	INERT GAS	TW	TEMPERED WATER		
IA	INSTRUMENT AIR	UW	UTILITY WATER		
PA	PROCESS AIR (OIL FREE)	BFW	BOILER FEED WATER		
UA	UTILITY AIR	DW	DEMINERALIZED WATER		
NG	NITROGEN	FW	FIRE WATER		
		PW	PROCESS WATER		
ZA	AMMONIA	RW	RAW WATER		
ZC	CHEMICALS				
ZS	CAUSTIC SODA				
AM	AMINE				
CA	CATALYST				

PROCESS FLUIDS

H	HYDROGEN	P	PROCESS

EFFLUENT DISPOSAL

ATM	VENT TO ATMOSPHERE	BD	BLOWDOWN
FL	FLARE	CS	CHEMICAL SEWER
SL	SLOPS (CLOSED SYSTEM)	OS	OILY SEWER (OPEN SYSTEM)
SWS	SOUR WATER SEWER	FLR	FLUSHING OIL RETURN
V	VENT (TO COLLECTOR)	FLS	FLUSHING OIL SUPPLY

SPECIAL ABBREVIATIONS

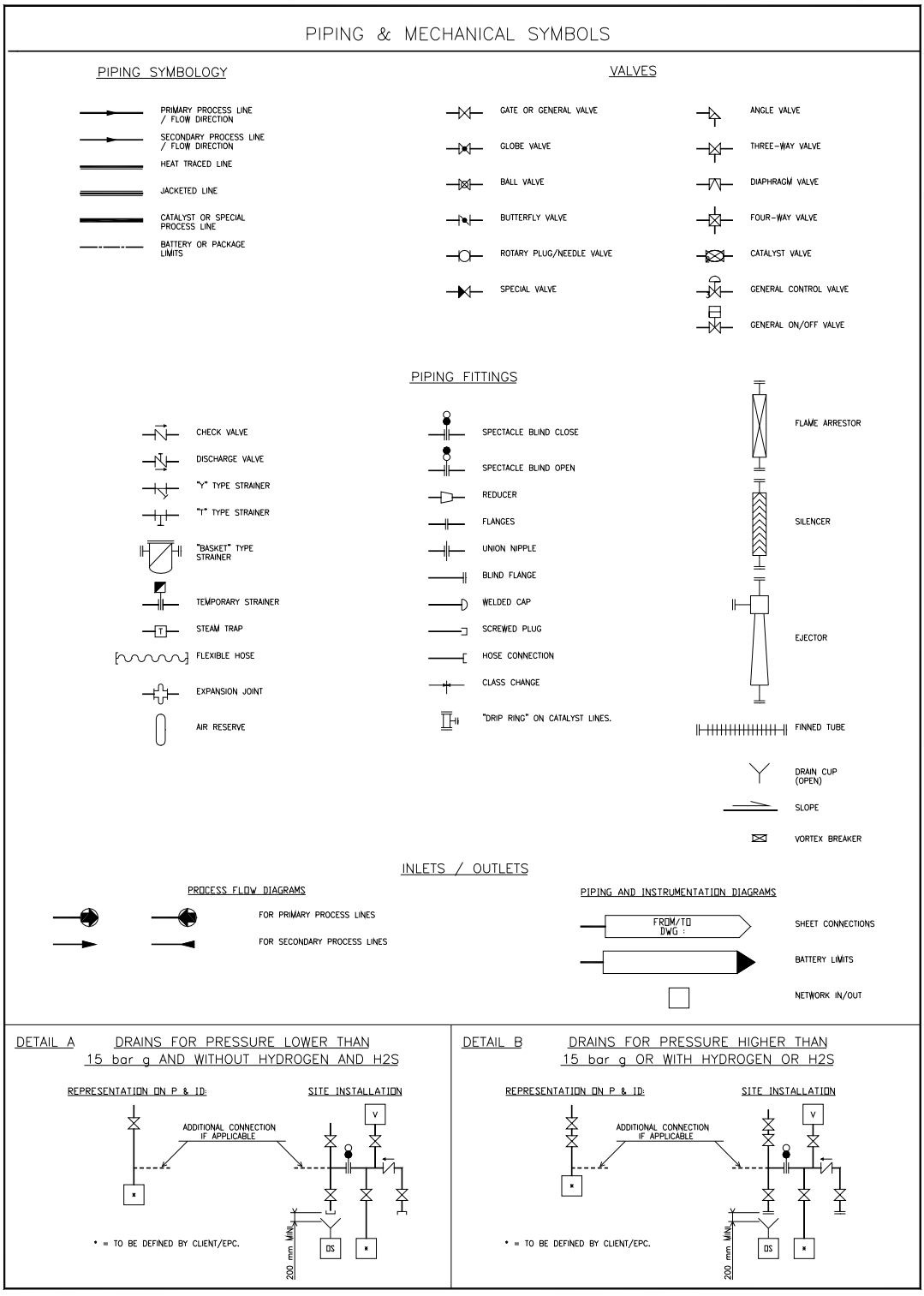
FC	FAIL CLOSED (VALVE TO CLOSE ON AIR OR ELECTRICAL FAILURE)	TSO	TIGHT SHUT-OFF	PV	PROCESS VARIABLE
FO	FAIL OPEN (VALVE TO OPEN ON AIR OR ELECTRICAL FAILURE)	ZSC	LIMIT SWITCH CLOSED	S.P.	EXTERNAL SET POINT
FL	FAIL LOCKED (LAST POSITION)	ZSO	LIMIT SWITCH OPEN	VV	VARIABLE SPEED DRIVER
LO	LOCKED OPEN	CSO	CAR SEALED OPEN (REMOVABLE)	FF	FEEDFORWARD SIGNAL
LC	LOCKED CLOSED	CSC	CAR SEALED CLOSED (REMOVABLE)		
		NNF	NORMALY NO FLOW		

GENERAL NOTES ON P & I D

SYMBOLS OF THIS DWG ARE THOSE USED ON BASIC ENGINEERING P & ID IN ACCORDANCE WITH THE SYMBOLOGIES ISA.

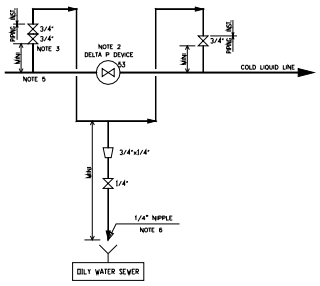
1. P & I D. ARE NOT ISOMETRIC DRAWINGS. THE RELATIVE POSITION OF VARIOUS EQUIPMENT IS PURELY SCHEMATIC.
2. UTILITIES AND CONNECTIONS REPRESENTED ARE ONLY THOSE REQUIRED FOR PROCESS PURPOSES.
3. VENT AND DRAIN CONNECTIONS
   - ON PIPES ALL HIGH POINT VENTS AND LOW POINT DRAINS ARE NOT SHOWN, EXCEPT FOR PROCESS REASONS.
   - FOR PRESSURES < or = 15 bars g (15 kg/cm2 g, 217 PSIG), AND WITHOUT H2 AND H2S, SEE DETAIL A.
   - FOR PRESSURES > 15 bars g (15 kg/cm2 g, 217 PSIG), OR WITH H2 OR H2S, SEE DETAIL B.
   - VENTS ON TOWERS AND DRUMS WILL BE PROVIDED WITH A GATE VALVE AND EITHER A SCREWED CAP OR A BLIND FLANGE.
4. DETAIL OF SAMPLE CONNECTIONS IS REPRESENTED ON A SPECIFIC DETAIL DRAWING.
5. VALVES AND MANIFOLDS ON INSTRUMENTS ARE NOT SHOWN.
6. ALL LINES TO FLARE SHALL BE SLOPED TO THE FLARE HEADER AND NOT POCKETED.
7. DRAIN, VENT, BY-PASS, START-UP VALVES ARE NORMALLY CLOSED.
8. INSTALL VENT VALVES BETWEEN ALL DOUBLE SHUT-OFF VALVES.

AXENS SYMBOLOGY FOR P&ID

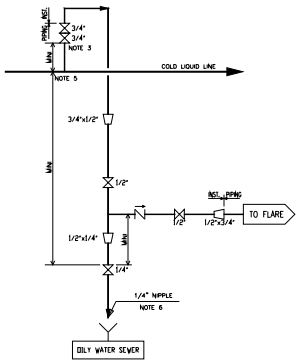


AXENS SAMPLE CONNECTIONS

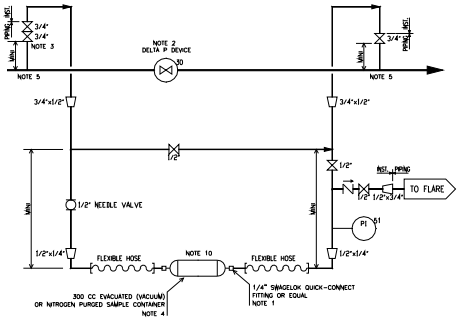
TYPE A
NON HAZARDOUS AND LOW TEMPERATURE LIQUID SAMPLE
(TEMPERATURE < 50°C)



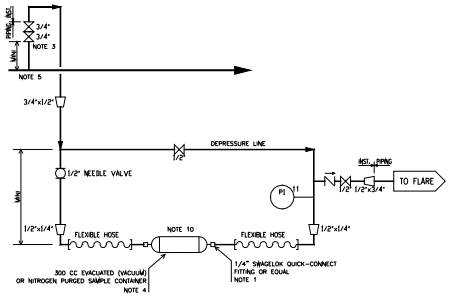
TYPE C
NON HAZARDOUS AND LOW TEMPERATURE LIQUID SAMPLE
(TEMPERATURE < 50°C)



TYPE B
LOW TEMPERATURE GAS OR FLASHING LIQUID
OR HAZARDOUS LIQUID SAMPLE (TEMPERATURE < 50°C)



TYPE D
LOW TEMPERATURE GAS OR FLASHING LIQUID
OR HAZARDOUS LIQUID SAMPLE (TEMPERATURE < 50°C)



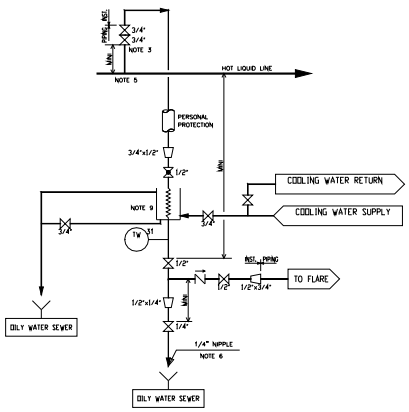
NOTES :

1 – FOR OPERATING PRESSURE UNDER 125 bar g (125 kg/cm2, 1800 PSIG) USE SWAGELOCK QUICK-CONNECTS.
STEMS: SS-QT8-5-8PM
BODIES: SS-QT8-8-8PM
OR EQUAL.
FOR OPERATING PRESSURE ABOVE 125 bar g (125 kg/cm2, 1800 PSIG) USE SWAGELOCK QUICK-CONNECTS.
STEMS: SS-QT2-5-4PM
BODIES: SS-QT2-8-4PM
OR EQUAL.

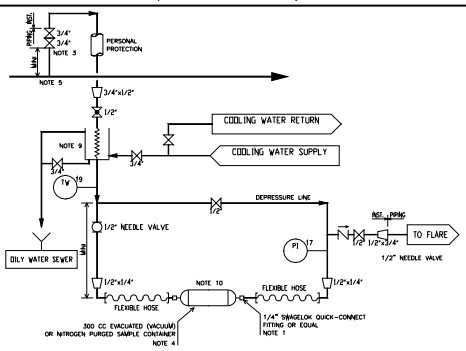
2 – DELTA P DEVICE IS ANY DEVICE OR INSTRUMENT THAT CREATES A PRESSURE DROP TO ENSURE A SUFFICIENT FLOW THROUGH THE LOOP.
3 – USE DOUBLE BLOCK FOR ANY CLASS 900 LINES OR HIGHER AND FOR H2 OR H2S SERVICES.
4 – FOR OPERATING PRESSURE UNDER 125 bar g (125 kg/cm2, 1800 PSIG) USE WHITEY 304L-HDF4-300 SAMPLE BOTTLE OR EQUAL FOR OPERATING PRESSURE 125 bar g (125kg/cm2, 1800 PSIG) AND ABOVE USE XXS 304L PIPE CYCLINDER.
5 – TAKE SAMPLE CONNECTION FROM TOP HORIZONTAL LINE.
6 – BEVEL ALL OPEN ENDS OF SIMPLE CONNECTIONS AT A 45° ANGLE WITH 75 mm MINIMUM EXTENSION.
7 – USE OIL FLUSH AFTER SAMPLING HEAVY LIQUID.
8 – ALL SAMPLING BOMBS SHOWN ON THIS PID SHOULD BE EQUIPED WITH BLOCK VALVES ON EACH SIDE.
9 – THE COOLING BOX SHALL BE INTERNALLY COVERED WITH "EPOXY" THE COIL SHALL BE TUBING SPEC OR SS.
10– A SUPPORT FOR THE CYLINDER "BOMB" SHALL BE FORESEEN.
11– SAMPLING SYSTEM LENGTH MUST BE MINIMUM TO LIMIT THE PRODUCT LOST WHEN FLUSHING.

AXENS SAMPLE CONNECTIONS

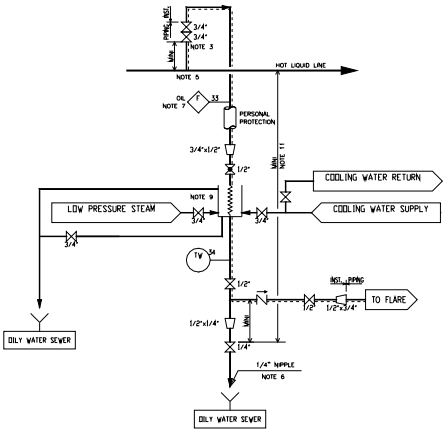
TYPE E
NON HAZARDOUS AND HIGH TEMPERATURE LIQUID SAMPLE
(TEMPERATURE > 50°C)



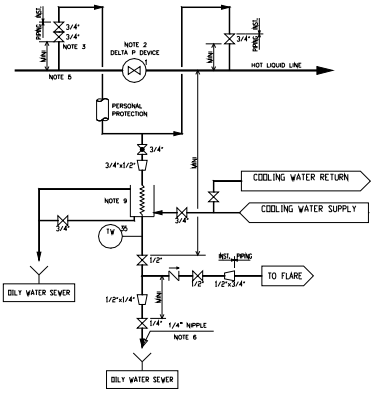
TYPE G
HIGH TEMPERATURE GAS OR FLASHING LIQUID SAMPLE
(TEMPERATURE > 50°C)



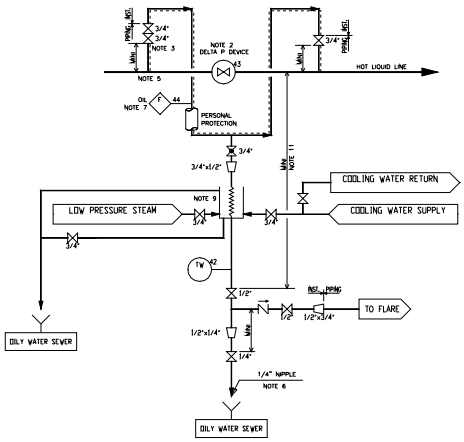
TYPE F
NON HAZARDOUS AND HIGH TEMPERATURE AND HIGH POUR POINT
LIQUID SAMPLING (TEMPERATURE > 50°C)



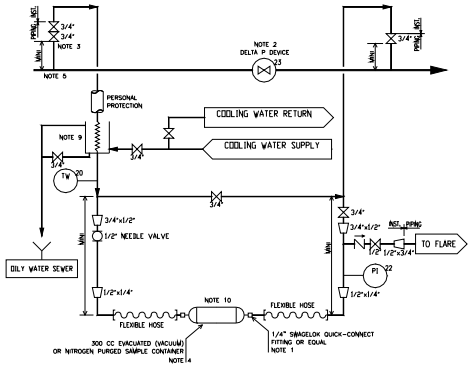
TYPE H
NON HAZARDOUS AND HIGH TEMPERATURE LIQUID SAMPLE
(TEMPERATURE > 50°C)



TYPE J
NON HAZARDOUS AND HIGH TEMPERATURE AND HIGH POUR POINT
LIQUID SAMPLING (TEMPERATURE > 50°C)

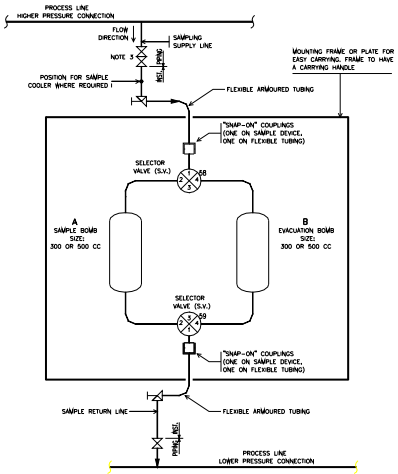


TYPE K
HIGH TEMPERATURE GAS OR FLASHING LIQUID SAMPLE
(TEMPERATURE > 50°C)



AXENS SAMPLE CONNECTIONS

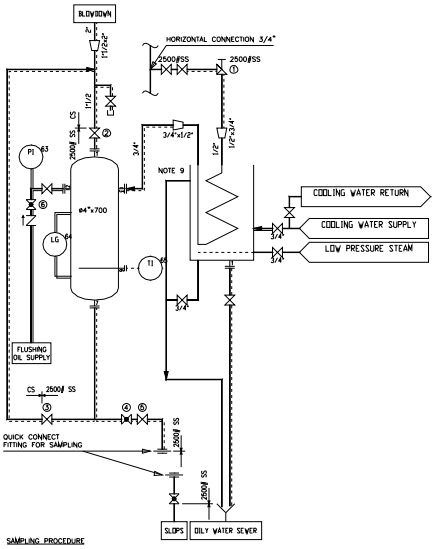
TYPE L
SAMPLING DEVICE FOR VERY HAZARDOUS MATERIAL



OPERATING SEQUENCE

- NEEDLE VALVES CLOSED.
- CONNECT "SNAP-ON" COUPLINGS.
- S.V.S. POSITION 1: OFF
- ANGLE VALVES OPEN
- S.V.S. POSITION 2: FLOW THROUGH BOMB "A" TO RETURN LINE FOR SAMPLE
- S.V.S. POSITION 3: SAMPLING COMPLETE SAMPLE IN BOMB "A"
- ANGLE VALVES CLOSED
- S.V.S. POSITION 4: EVACUATION OF TUBING UP TO THE ANGLE VALVES BACK TO BOMB "B"
- DISCONNECT "SNAP-ON" COUPLINGS.

TYPE M
HIGH PRESSURE LIQUID/VAPOR SAMPLE



SAMPLING PROCEDURE

1 – Check that all valves in the sampling system are closed.

2 – Open the cooling water line to the sample cooler wide open.

3 – Possibly adjust the temperature using steam if too cold.

4 – Check that the pressure indicator shows no pressure. If a pressure is reported, this is an indication of leaking upstream valves. Open valve 2 from the top of the sample pot to blowdown to vent off any pressure. Then close valve 2.

5 – With caution, slowly open valve 1 from the reactor effluent line to the sample pot. Check that the pressure indicator is reading close to the reactor pressure. Liquid in the sample line will drop into the sample pot.

6 – Close valve 1 to block in the sample pot. Then crack open valve 3 from the bottom of the pot to allow the liquid to pressure out to blowdown. Keep the valve open until the pot has depressured to about 7 bar Then close valve 3.

7 – With caution, slowly open valve 1. Crack open valve 2 from the top of the pot to vent to blowdown. Fresh sample will flow through the cooler into the sample pot. The sample should be drawn slowly enough that the sample pot does not get hot (over about 50°C). The object is to draw 1-2 liters of liquid into the sample pot. This typically takes about 30 seconds. Caution : This step is critical since the high pressure system is open directly to blowdown. The valves to blowdown must be operated cautiously and never left without shutting them.

8 – Block off the sample by closing valve 1 from the effluent line. Permit the sample pot to depressure to blowdown through valve 2 from the top of the pot until the pressure is about 3 bar. Then close valve 2.

9 – Open valve 5. Then cautiously open valve 4 to the sample outlet point and withdraw enough liquid in a bottle to clear any old sample or flushing oil from the line. Discard this material.

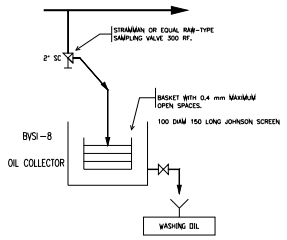
10– With a new bottle, withdraw the sample necessary from the lab. Caution : If oil liquid is withdrawn, close the sample line immediately.

11– Close valves 4 and 5. Then crack open valve 3 at the bottom of the pot to pressure the rest of the sample to blowdown. Then close all valves.

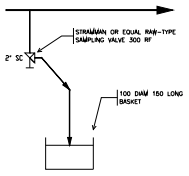
12– Shut off the cooling water and steam, whenever used.

13– Flush the sample system with flushing oil. This is done to remove heavy material that could cool and plug the lines in the system. Open valve 6 to bring flushing oil into the sample pot. Flush any heavy oil from the sample outlet line by opening valves 4 and 5. Then close valve 6 and open valve 3 to pressure the flushing oil to blowdown.

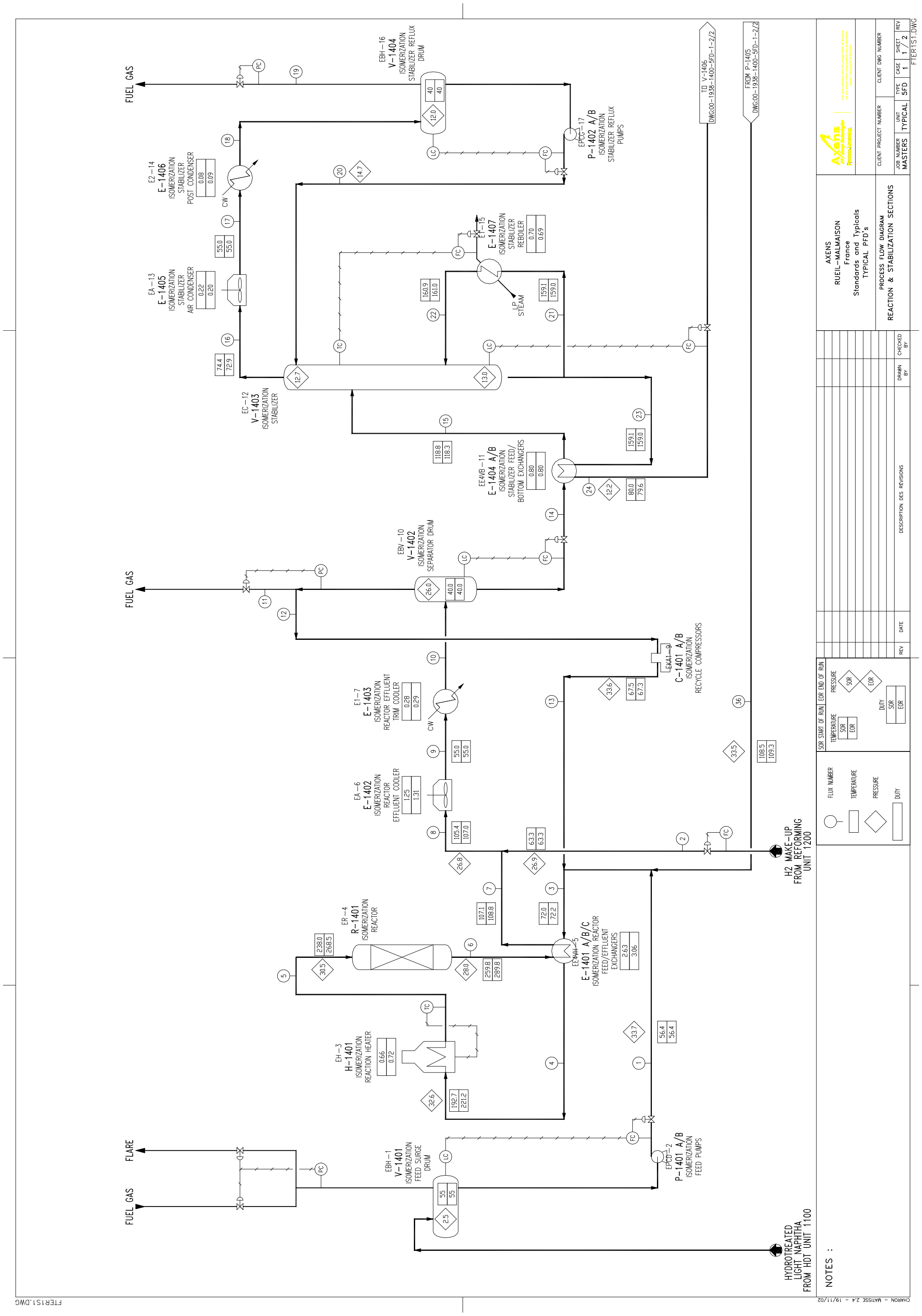
TYPE N
CATALYST SAMPLING



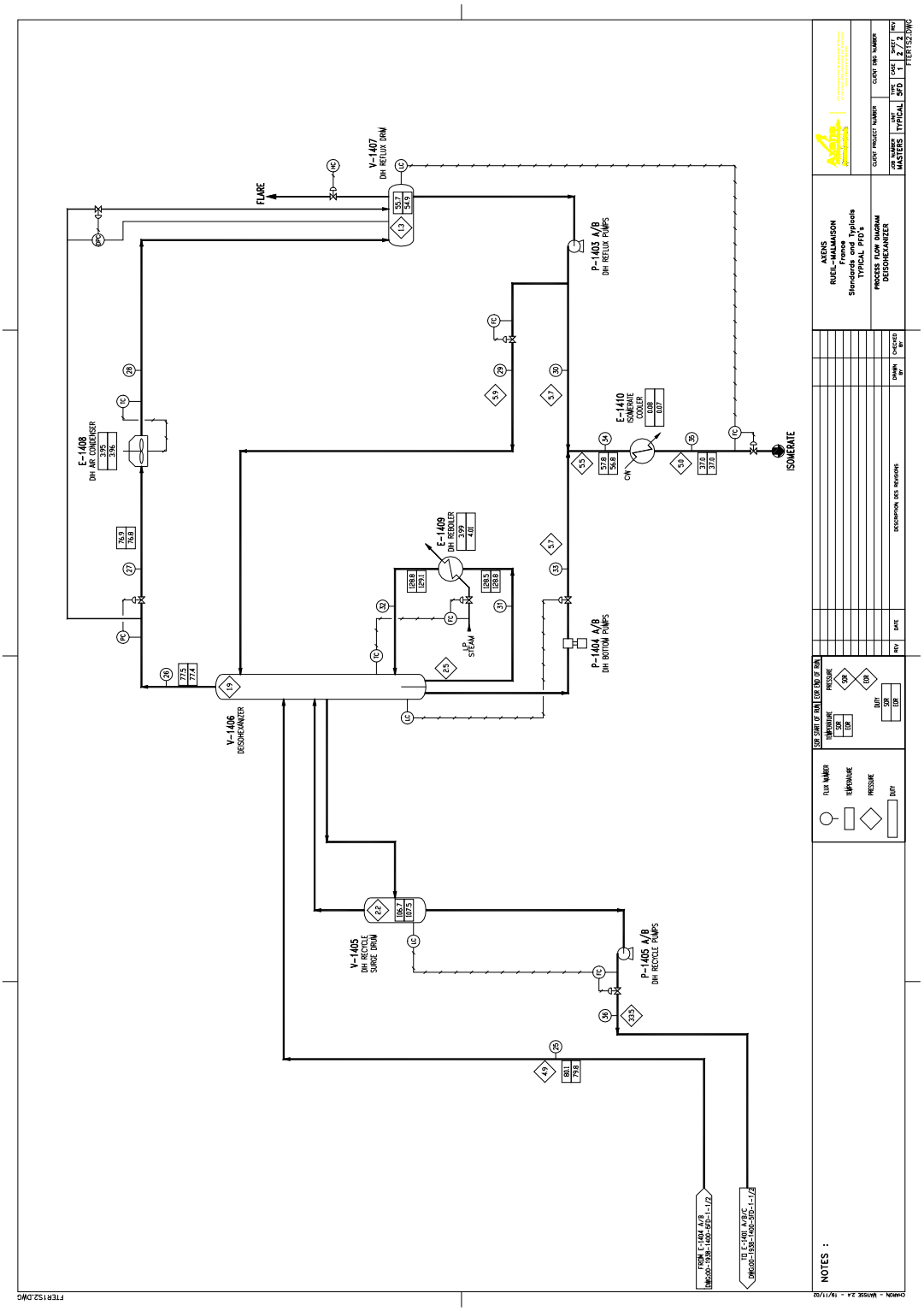
TYPE P
CATALYST SAMPLING



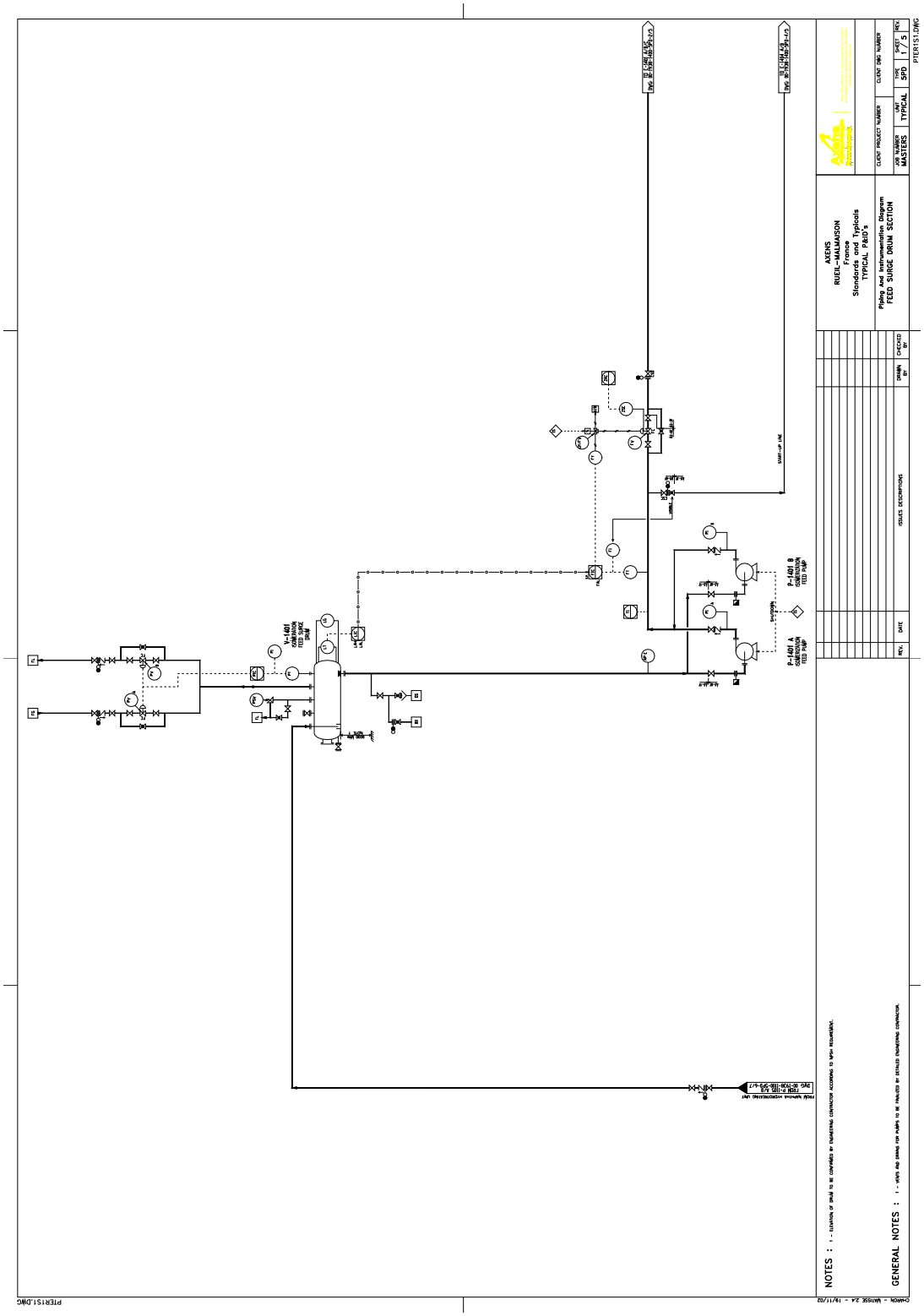
AXENS TYPICAL PFD


FUEL GAS
FLARE
HYDROTREATED LIGHT NAPHTHA FROM HDT UNIT 1100
H2 MAKE-UP FROM REFORMING UNIT 1200
V-1401 ISOMERIZATION FEED SURGE DRUM
P-1401 A/B ISOMERIZATION FEED PUMPS
H-1401 ISOMERIZATION REACTION HEATER
R-1401 ISOMERIZATION REACTOR
E-1401 A/B/C ISOMERIZATION REACTOR FEED/EFFLUENT EXCHANGERS
E-1402 ISOMERIZATION REACTOR EFFLUENT COOLER
E-1403 ISOMERIZATION REACTOR EFFLUENT TRIM COOLER
C-1401 A/B ISOMERIZATION RECYCLE COMPRESSORS
V-1402 ISOMERIZATION SEPARATOR DRUM
E-1404 A/B ISOMERIZATION STABILIZER FEED/BOTTOM EXCHANGERS
V-1403 ISOMERIZATION STABILIZER
E-1405 ISOMERIZATION STABILIZER AIR CONDENSER
E-1406 ISOMERIZATION STABILIZER POST CONDENSER
V-1404 ISOMERIZATION STABILIZER REFLUX DRUM
P-1402 A/B ISOMERIZATION STABILIZER REFLUX PUMPS
E-1407 ISOMERIZATION STABILIZER REBOILER
LP STEAM
CW
NOTES :
AXENS
RUEIL-MALMAISON
France
Standards and Typicals
TYPICAL PFD's
PROCESS FLOW DIAGRAM
REACTION & STABILIZATION SECTIONS
FTER1ST.DWG

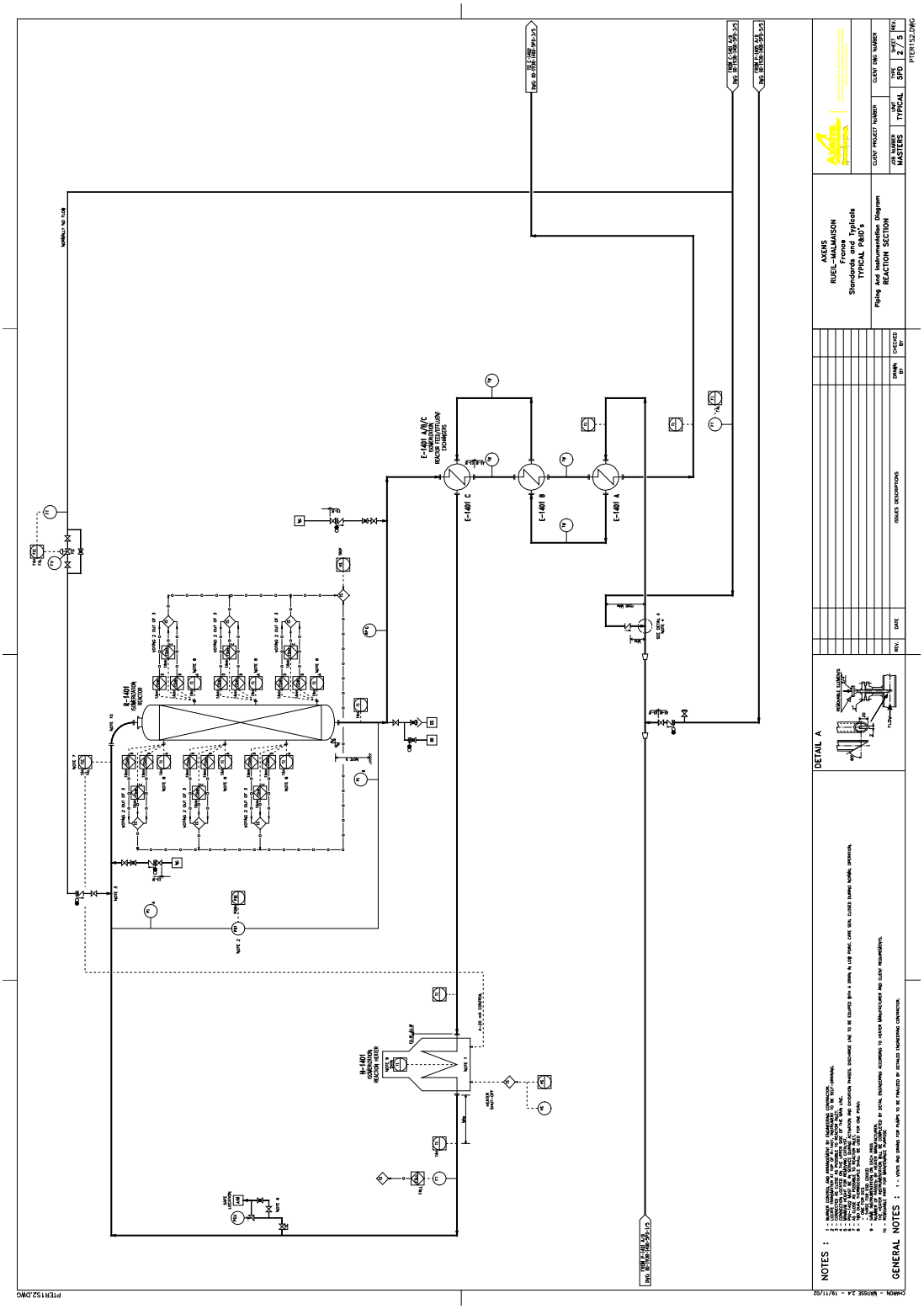
AXENS TYPICAL PFD



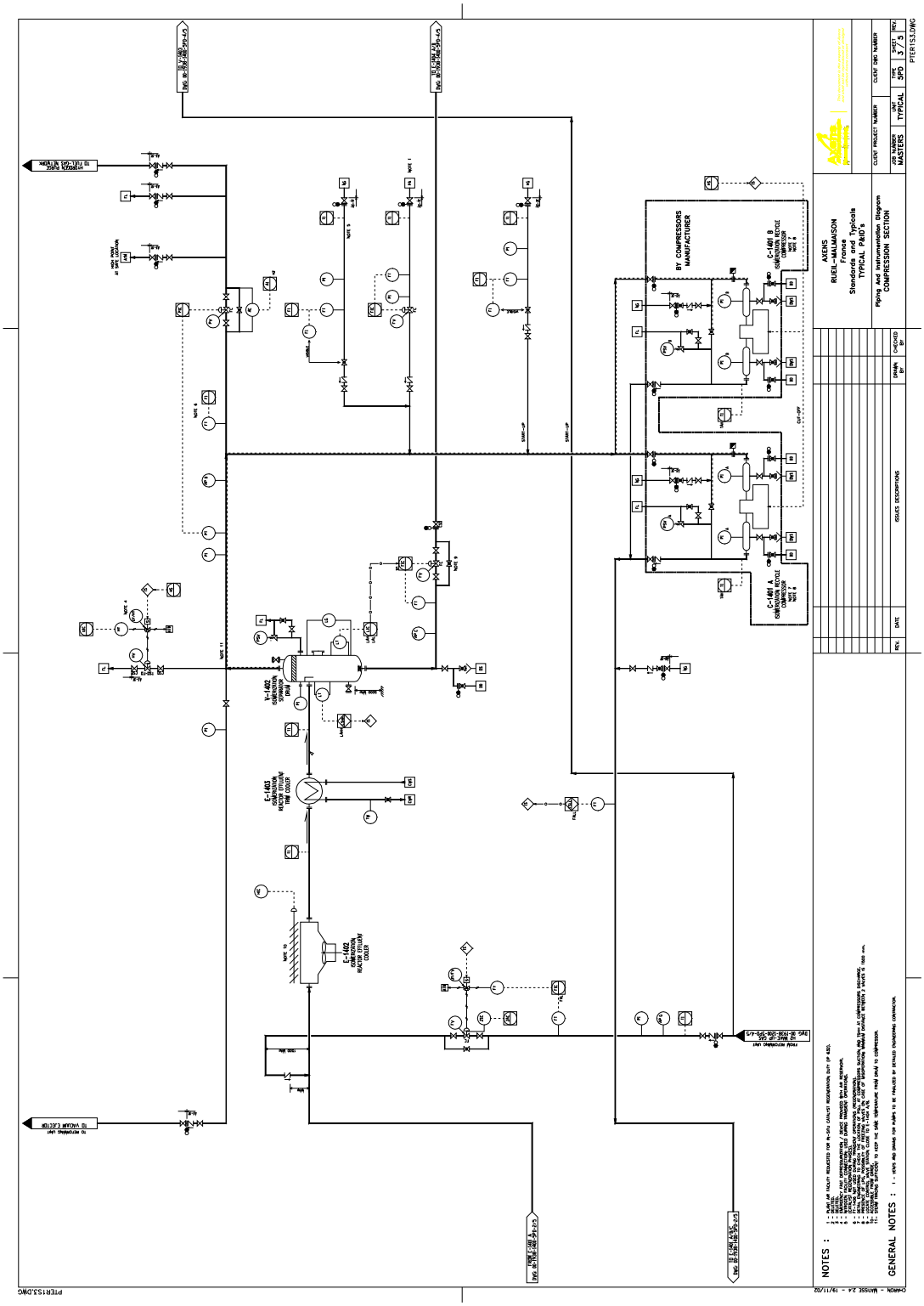
AXENS TYPICAL P&ID


AXENS
RUEIL-MALMAISON
France
Standards and Typicals
TYPICAL P&ID's
Piping And Instrumentation Diagram
FEED SURGE DRUM SECTION
JOB NUMBER
MASTERS
UNIT
TYPICAL
TYPE
SPD
SHEET
1 / 5
REV.
CLIENT DWG NUMBER
CLIENT PROJECT NUMBER
ISSUES DESCRIPTIONS
DRAWN BY
CHECKED BY
DATE
REV.
P-1401 B
CONDENSATION
FEED PUMP
P-1401 A
CONDENSATION
FEED PUMP
V-1401
CONDENSATE
FEED SURGE
DRUM
NOTES :
GENERAL NOTES :
PTER151.DWG

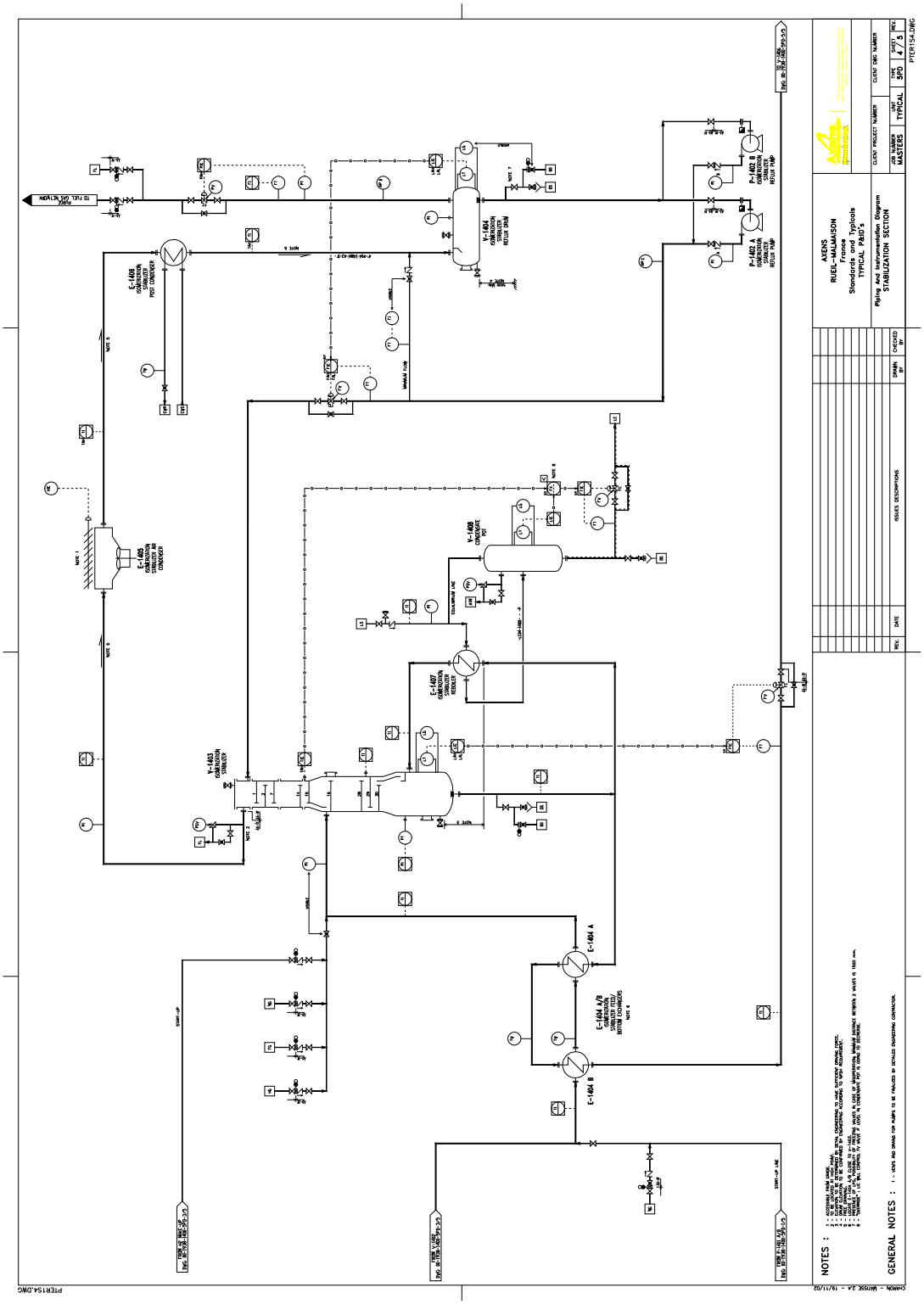
AXENS TYPICAL P&ID


E-1401 A/B/C
REACTOR EFFLUENT/FEED EXCHANGERS
E-1401 C
E-1401 B
E-1401 A
R-1401
CONVERSION REACTOR
H-1401
CONVERSION REACTOR HEATER
DETAIL A
GENERAL NOTES :
NOTES :
AXENS
RUEIL-MALMAISON
France
Standards and Typicals
TYPICAL P&ID's
Piping And Instrumentation Diagram
REACTION SECTION
ISSUES DESCRIPTIONS
DRAWN BY
CHECKED BY
CLIENT PROJECT NUMBER
CLIENT DWG NUMBER
JOB NUMBER
MASTERS
UNIT
TYPICAL
TYPE
SPD
SHEET
2 / 5
REV.
PTER152.DWG

AXENS TYPICAL P&ID


AXENS
RUEIL-MALMAISON
France
Standards and Typicals
TYPICAL P&ID's
Piping And Instrumentation Diagram
COMPRESSION SECTION
BY COMPRESSORS MANUFACTURER
C-1401 A
GENERATION RECYCLE COMPRESSOR
C-1401 B
GENERATION RECYCLE COMPRESSOR
V-1402
GENERATION SEPARATOR DRUM
E-1401
GENERATION REACTOR EFFLUENT AIR COOLER
E-1402
GENERATION REACTOR EFFLUENT COOLER
GENERAL NOTES :
NOTES :

AXENS TYPICAL P&ID


AXENS
RUEIL-MALMAISON
France
Standards and Typicals
TYPICAL P&ID's
Piping And Instrumentation Diagram
STABILIZATION SECTION
NOTES :
GENERAL NOTES :

AXENS TYPICAL P&ID