Process Design Basis

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1. General

This document defines the design basis for a methanol plant with a nameplate production capacity of 5,000 MTPD of purified methanol to Middle East Kimiaye Pars Co. The plant will be located in Bandar Assaluyeh in Iran.

The plant must be able to operate at 100% on lean as well as rich natural gas.

1.1. Plant capacity for design

Methanol product, MTPD (Grade AA), as 100% MeOH 5,000

1.2. Hours of operation

One year is defined as 7,920 hours

2. Feed stock

2.1. Natural gas

Natural gas will be used as feed and fuel for the production.

(1) In TOPSOE's BDP, the Natural Gas composition is as follows.

Composition, mol%	Lean	Rich
Lower heating value, (MJ/Nm³)	34. 5	37.0
Methane	95.0	85.8
Ethane	0.44	5.5
Propane	0.23	2.0
i-Butane	-	0.3
n-Butane	-	0.5
C4+	-	0.04
Nitrogen	4.0	5.0
Carbon dioxide	0.327	0.857
Water	0.003	0.003
Sulphur content		
Total sulphur, mol ppm, max.		5.0
Maximum possible content of organic sulphur, mg/Nm^3		17.3
Maximum possible content of hydrogen sulphide, mg/Nm^3		5.3

(2) Design Gas Composition provided by Damavand Co.

COMPONENT	UNIT	ACTUAL RECORDED VALUE Min/Max	NIGC STANDARD	
Methane(CH_4)	Mol%	89.92 / 94.61	Min	80
Ethane(C_2H_5)	Mol%	0.58 / 3.94	Max	12
Propane(C_3H_8)	Mol%	0.01 /1.49	Max	4
Iso Butane(I-C_4)	Mol%	0.00 / 0.51	Max	1
Normal Butane (N -C_4)	Mol%	0.00/ 0.01	Max	

COMPONENT	UNIT	ACTUAL RECORDED VALUE Min/Max	NIGC STANDARD	
Iso Pentane (I-C_5)	Mol%	0.00 / 0.08	Max	0.5
Normal Pentane (N -C_5)	Mol%		Max	
Hexane and Heavier(C_6+)	Mol%		Max	
Nitrogen(N_2)	Mol%	3.77 / 4.20	Max	6
Carbon Dioxide(CO_2)	Mol%	0.63 /1.30	Max	1
Hydrogen Sulfide(H_2S)	mg/Sm^3	0.1 / 2	Max	5
Mercaptane(as RSH)	mg/Sm^3	0.6 / 12.1	Max	15
Total Sulfur (as S)	mg/Sm^3	5.36 / 13.08	Max	30
Water Dew Point at 44 Barg	℃	-	Max	-10
HC Dew Point at 55 Barg	℃	-	Max	-10
Density (SP.G)	-	0.56 / 0.6		
Molecular Weight (MW)	g/mol	16.81 / 17.89		
Gross Heating Value(GHV)	kCal/Sm^3	8514 / 8989	Min / Max	8900 / 10500

(3) Battery limit conditions

Parameter	Units	Min.	Norm.	Max.	Mech. design
Pressure	barg	54.1	58.3	62	69
Temperature	C	35	40	40	85

2.2. Oxygen

Phase: Gas

Component	Mol %
O_2	99.80
N_2 + Ar	0.20

Parameter	Units	Min.	Norm.	Max.	Mech. design
Pressure	barg	40.9	41.6	43	55
Temperature	C	N/A	Ambient	48	85

3. Products

3.1. Methanol

The product of the plant shall be produced according to high quality standards, suitable for any end-users and shall meet the following specifications and requirements as minimum:

Characteristics	Requirement	Test Method
(as Grade AA specification)		
- Acetone and Aldehydes: Wt, percent max.	0.003	

- Acetone, wt percent max: 0.002
- Ethanol, wt percent max: less than 0.0008
- Acidity (as Acetic Acid): 0.003

- Appearance and hydrocarbons
  Free of opalescence suspended matter and Sediment (Clear - Colorless)
- Carbonizable substances color
  Not darker than color standard No.30 of ASTM D1209, Platinum - Cobalt scale
- Color
  Not darker than color standard No.5 of ASTM-D1209, Platinum-Cobalt scale
- - Distillation range
  Not more than 1°C and shall include 64.6 °C + 0.10° C at 760mmHg
- Specific Gravity, max 0.7928 at 20 °C/20 °C
- Percent Methanol by Weight, minimum 99.85
- Nonvolatile content mg /1000 ml max 8
- Odor
  Characteristics non-residual
- Permanganate fading time
  No discharge of color in 50 minutes
- Water content, wt percent max 0.10
- Alkalinity (as ammonia) 0.003 wt% max
- Iron (ppm) Less than 0.03
- Chloride (ppm) Less than 0.1
- Trimethylamine(TMA) (ppb) Less than 20

Battery limit conditions

Parameter	Units	Min.	Norm.	Max.	Mech. design
Pressure	barg	4.6	5.0	5.2	14
Temperature	C	N/A	48	52	75

4. Process effluents

4.1. Boiler blow down to BL

	Normal	Mech.design
Pressure, barg	5.0	8.0
Temperature,℃	48	85

4.2. Liquid off stream to BL

	Normal	Mech. design
Pressure, barg	3.0	8.0
Temperature, ℃	48	85

4.3. COC(continuously oily contaminated water and process effluent)

	Normal	Mech. design
Pressure, barg	3.1	9.0
Temperature, ℃	48	65

4.4. POC(Potentially oily contaminate water)

	Normal	Mech. design
Pressure, barg	3.5	5.5
Temperature, ℃	Amb	85

4.5. SN(Sanitary sewage)

	Normal	Mech. design
Pressure, barg	3	5
Temperature, ℃	Amb	85

5. Site condition

5.1. Plot area

The plot area of the ISBL unit is: 280.0 m x 233.0 m

5.2. Temperature

Maximum recorded temperature : 52 °C
Minimum Dry bulb temperature (winter): 5 °C
Winterizing temperature : not to be considered
Max. Wet bulb temperature (summer): 33 °C
Max. Dry bulb temperature (summer): 48 °C
Dry bulb temperature for design of air coolers : 50 °C
Max temperature for mechanical, civil and structural design : 55 °C
Max temperature for EQUIPMENT exposed to sunlight (design): 85 °C
Design temperature for Electrical Equipment:
Max. Outdoor 48 °C
Max. Indoor 45 °C
Soil temperature for cable selection : 30 °C
Average value of daily minimum temperature of the coldest month: 6.5 °C
Average temperature of annual mean temperature: 23.6°C
Average temperature of the hottest month: 35°C
Average value of daily maximum temperature in the hottest month: 44°C

Average temperature of the coldest month: 17°C
Summer daily range temperature : 20 °C to 48 °C

5.3. Humidity

- Ambient Air Relative Humidity
  a.Maximum in summer : 76%
  b. Minimum in winter : 74%
- Design relative humidity :
  - Air conditioned space :
    Outdoor
    At Max. Temp, (summer) 65%
    At Min. Temp, (winter) 100%
    Electrical Equipment: 80%

5.4. Barometric pressure

The barometric pressure as site varies between 990 up to 1100 mbar

5.5. Emissions

NOx, vol ppm, (dry, 3%O2) max.	100
CO, vol ppm, (dry, 3%O2) max.	20

5.6. Noise

Maximum dB(A) at 1 m from equipment	85

6. Utilities

6.1. Steam

Steam shall be produced and consumed inside the plant as far as possible during normal operation.

6.1.1. High High Pressure Superheated Steam

This level of steam will not be available from OSBL and will be produced and consumed inside the PLANT.

Process Design:

Pressure, barg	Max.105.8
	Nor. 98
	Min. 93
Temperature ,°C	Max. 460
	Nor. 454
	Min. 444

Mechanical Design:

Pressure, barg 112

Temperature, °C 490

Fouling factor for HHP Steam Services (m^2.°C/W) 0.00020

6.1.2. High Pressure Superheated Steam (Nominal 43 Bar)

HP steam will be available from OSBL for start-up only and in normal operating condition shall be produced as export steam to the OSBL of the PLANT (as defined in Annex 1I)

Process Design: Import (start-up) / Export

Pressure, barg Max.45

Nor. 43

Min. 39.9

Temperature, °C Max. 43

Nor.410

Min. 395

Mechanical Design:

Pressure, barg 52

Temperature, °C 470

Note: Steam export is not allowed.

Fouling factor for HP Steam Services (m^2.°C/W) 0.00025

Min. steam quality:

		Pure Steam
Conductivity µS/cm (after cationic exchanger, and CO_2 removal)		<1
Ammonia wt-ppm (water treatment in deaerator by amine (morpholine))	Natural Gas	<1
Ammonia wt-ppm (water treatment in		
Volatile alkalizing Amines, wt-ppm		<15
Methanol, wt-ppm		<4
CO_2, wt-ppm		<2
SiO_2, wt-ppm		<0.02
Fe, wt-ppm		<0.02
Cu, wt-ppm		<0.03
Na+K, wt-ppm		<0.02

6.1.3. Medium Pressure Steam (Nominal 40 bar)

This level of steam will not be available from OSBL and will be produced and consumed inside the PLANT.

Process Design:		
• Pressure barg	Max	40.8
	Norm	39.8
	Min	33.7
• Temperature °C	Max	260
	Norm	252
	Min	240
Mechanical Design:		
• Pressure barg		45
• Temperature °C		300

Fouling factor for LP Steam Services ($m^2.^oC/W$) 0.00030

6.1.4. Low Pressure Steam (Nominal 7 Bar)

This level of steam will not be available from OSBL.

Process Design:

Pressure, barg	Max. 8.5
	Nor. 7
	Min. 6.5
Temperature, °C	Max. 200
	Nor. 188
	Min. 178

Mechanical Design:

Pressure , barg	9.5
Temperature, °C	340

Fouling factor for LP Steam Services ($m^2.^0C/W$) 0.00030

6.2. Condensate

Steam Turbine Condensate

Composition

pH		5.5-8.5
Sodium as Na	ppm max	0 .2
Fe as Fe	ppm max	0.3
Cu as Cu	ppm max	0.3
Silica as SiO2	ppm max	1
Organic material	ppm max	15
Oil	ppm max	8

Conductivity (16-66°C) micro S/CM max 10

Process Design:

Pressure, bar A Max. 6
Nor. 5
Min. 3.5

Temperature, °C Min.40
Nor. 52
Max.65

Mechanical Design:

Pressure, bara 7

Temperature, °C 160

Fouling factor for Steam condensate (m^2.°C/W) 0.00025

6.3. Instrument air and plant air (From OSBL)

Process Design:	Plant Air	Instrument Air
• Pressure barg	Max 9.3	Max 8.7
	Nor. 9.1	Nor. 8.3
	Min 7.5	Min 7.5
• Temperature °C	ambient-48	Ambient-48
Mechanical Design:		
• Pressure barg	10.5	10.5
• Temperature °C	85	85
Dew Point °C at 9 bara		-40

Note: Free from dust, water droplets and oil.

6.4. Nitrogen (From OSBL)

Process Design:		
• Pressure barg	Max	8.7
	Nor.	8.7
	Min	7.5
• Temperature °C		Ambient-48
Mechanical Design:		
• Pressure barg		10.5
• Temperature °C		85
Dew Point °C at atm.		-70
Purity, mol %		
• N_2 Content, vol %	Min	99.9
• 0_2 Content, ppm	Max	2
• CO Content, ppm	Max	10

• CO_2 Content, ppm	Max	10
• Oil Content		nil
• S Content by weight, ppm	Max	0.2
• Water Content, ppm	Max	1

6.5. Water analysis

6.5.1. De-mineralized Water

pH	6.5-8.5
Fe	<0.02 ppm
Cu	<0.003 ppm
Chloride (as Cl)	<1 ppm
Silica	0.02 ppm
Total dissolved solids	<0.05 mg/Lit
Conductivity (micro ohm/cm)	<0.1
Process Design:	
Pressure,	5-5.8-6.7 barg
Temperature,	Ambient-48 °C
Mechanical Design:	
Pressure,	8.5 barg
Temperature,	85 °C
Fouling factor (m^2. °C/w) 0.00020	

6.5.2. Boiler Feed Water (BFW)

The BFW shall be produced and consumed inside the PLANT and is not available from OSBL. De mineralized water will be supplied as make-up from OSBL for the production of BFW and necessary polishing unit, physical and chemical treatment and air removal for BFW production need to be considered inside the plant by Contractor.

Fouling factor for BFW Services (m^2.°C/W) 0.00020

6.5.3. Cooling Water

Open loop water as cooling media:

Open loop cooling water, not corrosive to carbon steel and copper alloys, free of suspended solids and biological solids and biological growth, to be circulated inside the Plant.

pH	7.5
Chloride (as Cl)	nor. 35 ppm max. 65 ppm
Cooling Water Supply Pressure Bar, G	4.5
Cooling Water Return Pressure Bar, G	2.5

Design Pressure	8.5 bara
Design Temperature, °C	100
Cooling Water Supply Temperature, °C	38
Cooling Water Return Temperature, °C	maximum 48
Fouling Factor (water side) m2 °C/W	0.0003

The make up for closed loop cooling water system will be supplied by OWNER from OSBL.

6.5.4. Fire Water

Fire water to be supplied at the B.L of the plant from the fire water pump house. In normal condition, fire water ring(s) and accessories will be tilled and kept by desalinated water. During fire case, first desalinated water will be used for short period and sea water will be as back up and in case of continuation of fire, sea water will be introduced to the firefighting system.

Process Design:

Pressure, barg	Nor. 10
Pressure, barg	Min. 7*
Temperature, °C	Ambient

Mechanical Design:

Pressure, barg	17
Temperature, °C	85

* At most remote hydrant.

6.5.5. Potable Water

Process Design:

Pressure, barg	5.5-5.8-6.6
Temperature, °C	5-35

Mechanical Design:

Pressure, barg	12
Temperature, °C	65

Potable Water Composition will be as internationally accepted drinking water.

6.5.6. Safety Showers & Eye Washes

Process Design as NFPA recommendation

Mechanical Design as potable water

6.6. Electricity

Electricity is to be generally supplied at 20000 V(to be confirmed during kick-off meeting), 3 phases, 3 wires 50HZ. The standard voltage ratings for various utilization loads are as follows:

Item No.		AC/DC	Rated Voltage	Phase/Wire
1	Motors			

	2500KW and above	AC	11000/20000	3/3
	l50KWabove	AC	6000V	3/3
	0.2KW to below 150KW	AC	400V	3/3
	below 0.2KW	AC	230V	1/2
2	Construction & Maintenance	AC	230/400V	1/2
3	Lighting Fixtures	AC	230V	1/2
4	Emergency Lighting Fixtures	AC	230V	1/2
5	Instruments	AC	110V	1/2
		DC	24V	
6	Controls for H.T. Boards	DC	110V	
7	Controls for L.T. Boards	AC	230V	1/2
8	Expected short circuit level	500 MVA at 20 KV Supply		

6.7. Fuels

(1)Methanol Feed with specification defined in item 4.1.1 shall he also used as fuel in the plant.
(2)Gas Oil (Only for Diesel Engines)

Viscosity, Kinematic cSt @ 37.8°F	2.0-5.5
Gravity Specified® 60/60°F	0,82-0.86
Flash point, (mm.) °C	54.5
Cloud point, (max.) °C	1.7
Pour point, (max.) °C	-3.9
Diesel index, (min)	55
Cetane index (min.)	50
Heat Value, (gross) Kj/kg	44,665
Acidity mgkoH/Fr	trace
Sulphur, Total (max.) %Wt	1.0
Vanadium, ppm	Nil
Sodium & Potassium ppm	0.40
Carbon Residue (max.) % Wt	1.10
Ash (max.) % Wt	0.01
Water & Sediment (max.) % Vol.	0.05

7. Codes and standards

The following standards specifications shall be applied for the Engineering of the PLANT:

7.1. General

The latest edition of codes and standards (English version) issued at the time of signature of the CONTRACT shall be used. Latest editions to be listed and mutually agreed during the KICK-OFF MEETING.

VENDOR'S standard deviations will be accepted, if justifiable explanations can be presented but OWNER'S approval is required case by case.
The sourcing of equipment should follow Topsoe's category list.
For equipment fabricated in China may follow Chinese Codes and Standards, if proved that technically equivalent to the Standards, mentioned in this document and equipment can be purchased from Chinese vendor list, and the vendor list shall be approved by the Owner before signing EPC Contract.(both parties will finalize this sentence on Jan. 18, 2011.)

7.2. System of units

SI metric system to be used, except the units in Appendix 2.

7.3. Symbology

Middle East Kimiaye Pars project symbology to be used.

7.4. Material codes

DIN, BS or any other well known international materials as substituted materials to ASTM/ASME ones can be selected, if they are equivalent or superior to ASTM/ASME ones. The certification should be presented. For major components the VENDOR shall provide details as chemical composition and mechanical properties in case of non-ASTM/or non-ASME materials.

7.5. Design codes for mechanical design

7.5.1. Fired Heater

ASME Sec. I, API 560,API 630, API-RP-530, ASME B36.10, B 16.9, B 16.28, ASTM.

7.5.2. Quench System (incl. Steam Drums)

ASME VIII Div. 1

7.5.3. Heat exchangers: (Note I)

- Process shell and tube exchangers and double pipe heat exchangers — ASME Sec. II, V, VIII Div. 1 or 2, IX and TEMA Class R
- Auxiliary shell and tube exchangers for rotating and packaged equipment VENDOR'S standard
- Surface condensers — ASME Sec. VIII Div. 1 / HEI (Heat Exchanger Institute)
- Air cooled exchangers — API 661, ASME Sec. VIII
- Plate exchangers — API 662, ASME Sec. VIII Div. 1
- Welded Type heat exchanger — VENDOR'S Standards or ASME Sec. VIII Div. 1

7.5.4. Reactors: (Note I)

- Reactors/critical pressure vessels — ASME Sec. VIII Div. 1 or Div. 2, Sec II, V, IX

♦ Other reactors	ASME Sec. VIII Div.I, Sec II, V, IX

7.5.5. Pressure vessels: (Note I)

♦ Pressure vessels	ASME Sec. VIII Div. 1 or 2, Sec II, V, IX
♦ Steam drums / Power boiler	ASME VIII Div- 1 or 2' Sec II, V,IX
♦ Auxiliary vessels for rotating and vessels in packaged equipment	VENDOR'S standard

7.5.6. Storage tanks:

♦ Atmospheric and low pressure	API 620, 650
♦ Pressurized	ASME Section VIII, Div. 1 or Div. 2

7.5.7. Rotating machinery for process:

♦ Centrifugal compressors	
- Blower	API 672 and Vendor's standard
- Process compressor	API 617
- Air compressor	API 672
♦ Centrifugal pumps	API 610,
Except for slurry pumps or any other particular pumps which cannot be covered by API, well known international standard to be specified.	
♦ Centrifugal fans	API 673
♦ Steam turbines for compressors	API 612
♦ Steam turbines for pumps	API 611
♦ Lubrication, shaft sealing and control oil	API 614
♦ Mechanical Seal	API 682 for API Pumps
♦ Vibration, axial position bearing, temperature monitoring	API 670
♦ Chemical injection units	VENDOR'S standard
♦ Ancillary items	VENDOR'S standard
♦ Reciprocating compressors	API 618
♦ Screw compressors	API 619
♦ Rotary positive displacement pumps	API 674, 675, 676
♦ Gas turbine	API 616 and VENDOR'S standard
♦ Controlled volume pumps	API 675
♦ Reciprocating pumps	API 674

7.5.8. Packaged equipment

♦ Main pressure vessel	ASME Sec. VIII Div. 1
♦ Main shell and tube exchangers	ASME Sec. VIII Div. 1 and TEMA
♦ Auxiliary vessels, tanks and exchangers	VENDOR'S standard

- ♦ Compressors, pumps and fans/blowers — VENDOR'S standard
- ♦ Internal piping — VENDOR'S standard
- ♦ Connection Flange with outside — ASME B 16.5
- ♦ Instruments/Electrical — IEC-ISA

7.5.9. Boiler

ABM A, Press, parts ASME Sec.I, others VENDOR'S standard or equivalent European standard.

7.5.10. Piping

- ♦ Process piping — ASME B 31.3
- ♦ Boiler piping — ASME B 31.1
- ♦ Safety relief valves — API RP 520 / 527, ASME Sec. VIII or Sec. I
- ♦ Flare piping — ASME B 31.3
- ♦ Fittings — ANSI ASME or API
- ♦ Bolts, Nuts, Gaskets — ANSI ASME or API
- ♦ Valves — ANSI ASME, API or BS (if ANSI,API are not available)
- ♦ Flanges — ASME B 16.5, B 16.47 Series B
- ♦ Cement lined piping — AWWA C 602-83 or equivalent VENDOR'S standard
- ♦ Rubber lined piping — ASTM D 3491-85 or equivalent VENDOR'S standard
- ♦ Rubber seated butterfly valves — AWWA C 504 or equivalent VENDOR'S standard

7.5.11. Ancillary system

- ♦ HVAC — VENDOR'S standard and/or A.S.H.R.A.E.
- ♦ Crane /Hoist — VENDOR'S standard
- ♦ Loading arms — NFPA, OCMA and VENDOR'S standard

7.5.12. Structural steel / Concrete

- ♦ Design — AISC, ACI, UBC, BS

7.5.13. Insulation

- ♦ Materials — ASTM, DIN, or BS

7.5.14. Painting

Surface preparation — SIS or equivalent

- ♦ Materials — ASTM,DIN
- ♦ For machinery — Vendor's standard

7.5.15. Fire fighting and protection safety

- ♦ Design — NFPA 11, 12, 13, 15, 2001, 70, 72, API,

		DIN and NPC regulations and standards
♦	Materials	VENDOR'S standard

7.5.16. Electrical

♦	General	IEC, NEC,NEMA, ISO,ANSI, API,EN,CENELEC,BS
♦	Bearing of motors	ISO R281 or equivalent
♦	Illumination level	API 540
♦	Fire alarm system	NFPA, IEC, BS or equivalent
♦	Air craft warning system	IEC 529, ICAO or equivalent
♦	Cathodic protection system	NACE, IEC, NEC or equivalent
♦	Area classification	API RP 505
♦	Certifications for hazardous classification: or equivalent (as per owner approval)	IEC,EN,CENELEC,BS,NFPA,ANSI,API
♦	Ex-type electrical EQUIPMENT selection	IEC 79

7.5.17. Instruments

♦	General	ISO, ISA, API, IEC, NFPA
♦	Orifice	ISO 5167
♦	Thermocouple	1EC-60584

7.5.18. Flare Assembly

API RP 520 & 521., ASTM, AICS, AWS, ASME SecII, V, VIII, IX, ASME B.31.3

- Note: ASME stamping is included for vessels and exchangers over 100 bar design pressure.

8. Mechanical design conditions

8.1. General

The PLANT shall be designed to operate satisfactorily at a capacity of 40 to 100 % of FEED.
Equipment and machinery shall be provided so that the PLANT can operate for at least two years without major overhaul or inspection.
Standby EQUIPMENT (installed or stored) shall be provided where necessary to achieve a continuous operational period of 7920 h/a.
For All pumps and reciprocating / screw compressors an installed standby shall be provided .
Block and bypass valves shall be provided for all control valves, when it is not against safety and process limitation.
A Fieldbus Control System (FCS) shall be provided for PROCESS control.

8.2. Design pressure

8.2.1. General Rule

Design pressure of process static EQUIPMENT shall be based on the max. operating pressure.

Malfunction and EQUIPMENT failure shall be taken into consideration by safety devices. Design pressure shall be selected from the list below:

- For max operating pressure below 2 barg use 3.5 barg
- For max operating pressure between 2 barg and 15 barg use max operating pressure + 1.5 bar
- For max operating pressure between 15barg and 100 barg use max operating pressure x 110 %
- For max operating pressure equal and above 100 barg use the maximum operating pressure + 10 bar.

8.2.2. Equipment under Vacuum

Equipment normally operated under vacuum is designed for full vacuum and for the highest pressure it can experience in case of vacuum failure.
Equipment containing a fluid with a vapour pressure at ambient temperature lower than atmospheric pressure which can be isolated shall be equipped with vacuum breaking device or else be designed for full vacuum.
Equipment subject to vacuum due to mal-operation or failure shall be equipped with vacuum breaking devices or else be designed for full vacuum.

8.2.3. Complete Systems

Several pieces of EQUIPMENT protected by the same relief valve shall have a design pressure of at least the set pressure of the relief valve.

8.2.4. Equipment on the Discharge of a Pump

Equipment which may have to bear the shut-off pressure of a pump shall have a design pressure equal to or higher that the shut-off pressure. Pump shut-off pressure shall be estimated according to Paragraph 8.

8.2.5. Reactor Loops and Similar Process Systems

For reactor loops and similar PROCESS systems the recommendations of API RP 521 Appendix F (latest edition) and API PR 520 Appendix B (latest edition agree) will be followed.

8.2.6. Thin walled Tanks and Vessels

Atmospheric thin walled tanks and vessels shall have a design press equal to the highest pressure imposed upon discharge of the pressure relief device.
The design pressure for vacuum shall be equal to the lowest pressure imposed upon suction of the vacuum relief device.

8.3. Design temperature

Design temperature for PROCESS equipment shall be whichever is higher:

- Maximum operating temperature + 15 °C at least with minimum of 60 °C(+25°C for

Feed/Effluent exchanger)

- Boiling temperature at design pressure of PROCESS medium inside, if applicable. Design temperature shall be rounded up to full 5 °C steps.

Design minimum temperature shall be specified only if the minimum operating temperature is below 0 °C. Design minimum temperature shall be 5 °C less than the minimum operating temperature. Special attention shall be given to low boiling liquids such as LPG.

For piping, design temperature shall be determined according to ASME B 31.3.

8.4. Corrosion allowance

Materials of construction and corrosion allowance for all EQUIPMENT and machinery shall be for a design life of 20 years (except for heat exchanger tubes).

However, minimum corrosion allowance shall be for carbon steel (including 0.5 Mo alloy steels):

Pressure vessels and other applicable EQUIPMENT	3 mm
Storage tanks	1.5 mm
Piping	1.5 mm
Removable parts or internals (on each side in Contact with operating fluid)	0.75 mm
For stainless steel/titanium / Aluminum / alloy	0 mm
Carbon steel with epoxy resin coating	3 mm

8.5. Hydraulic retention times

Hydraulic retention time (Hold-up Requirements) is defined between low level (LL) and high level (LH).

Type of Service	Retention Time
Interstage drum for cracked gas compressor	10 minutes
Reflux only	5 minutes
Column Feed	15 minutes
on flow control	
On cascade level/flow control	8 minutes
Reboiling by fired heater	8 minutes
	on feed to heater
Reboiling by thermo siphon	10 to*30 seconds
	on circulation
Cold section separators	(to be proposed by BIDDER)
PRODUCTS to storage	
without pump	5 minutes
with pump	7 minutes
Feed and Products feeding another Unit	
on flow control	15 minutes
on cascade/level flow control	8 minutes
Tanks	individually, according to the CONTRACT

Steam drum (LL to empty) Min	From high level to empty 12 minutes From low level to empty 10 minutes
Deareator Min	15 minutes

In case of pumps ensuring several services such as reflux and liquid distillate to storage , the retention time of the corresponding vessels will be whichever is greater from the above list.
Retention time can be modified depends on each process.

9. Design criteria

9.1. Air coolers

Air coolers shall be used wherever economically feasible.
65 °C shall be considered the economic break point temperature.
Air coolers shall be designed for 110% of the operating duty based on the dry bulb design temperature.

9.2. Heat exchangers

In general heat exchangers shall be designed to 110 % of their operating duty. Columns overhead coolers shall be designed to 120 % of their operating duty. Large heat exchangers shall be split into two or more shells for easy operation and maintenance.

9.3. Pumps

Normally pumps shall be designed to 110 % of their maximum required flow rate in worse case of operation. Pumps for fractionation column reflux, pump round and reboiler, flow rates shall be designed to 120% of their maximum required flow rates.
The shut-off pressure shall be estimated according to the following criteria whichever is higher:

- Differential head at rated flow x 120 % + LH (level high) suction static head + max operating pressure suction side.
- Differential head of pump at rated flow + LHH (level high high) suction static head + design pressure suction side x 120 %.

No over design shall be applied to the rated pressure.

9.4. Compressors

In general, compressors shall be designed to a minimum of 110% of their maximum required flow， and high efficiency rotating equipment to be specified. However, they are subject to special considerations according to the PROCESS.

9.5. Pressure relief valves

Pressure relief valves shall be supplied with locked open isolating valves.
Spares for pressure relief valves shall be provided where necessary for PROCESS reasons.
The set pressure of pressure relief valves shall be equal to the design pressure.

All safely valves will have bypass with exception of safety valves which are only for fire cases and if there is more than one safety valve. Not applicable for oil systems of machinery.

9.6. Column and vessel

9.6.1. Nozzle

- Minimum size 3/4" (for S.S shall be 1 inch)
- Nozzle rating for instrument according to once of connected piping min. Class 150 ANSI rating.

9.6.2. Manhole

- Manhole size 24 inches (*1)
- Manhole installation for Tray Tower

For tray towers, manholes shall be provided at top, bottom, feed point and draw-off point of tower and for each 20 trays or 15 m elevation distance, whichever shorter distance, as minimum.
(* 1) In case there is restriction for diameter, minimum 20" may be used.

9.6.3. Hand hole or Inspection hole

- Preferable Size 8 inches
- Minimum Size 6 inches

9.6.4. Vent and Drain

Vent and drain for vessels will b normally be provided at the minimum length on overhead or bottom line in accordance with the following table:

Volume or diameter of vessel (m3 or mm)	Vent diameter (inches)	Drain diameter (inches)
V < 75 or D <= 4,500	2	2
75 < V <= 220 or 4,500 < D <= 6,000	3	3
220 < V <= 420 or D > 6,000	4	4
V >420	6	4

Note: Vent and drain connections are not necessarily located on vessels.

9.6.5. Steam out

Steam out nozzles shall be sized as follows;	**Nozzle (inches)**
Drums and heat exchangers (when applicable)	2
Column diameter (m)	
D<=4	2
A < D <= 5.5	3
D>5.5	4

9.7. Storage (Product/Chemical/Catalyst/Additives)

Contractor shall consider all facilities necessary for safe, loading, unloading, storage, dilution, transportation within the PLANT measuring, preparation for process and waste disposal.

Appendix 1 - Numbering and codification

1. Unit Number and Serial Number

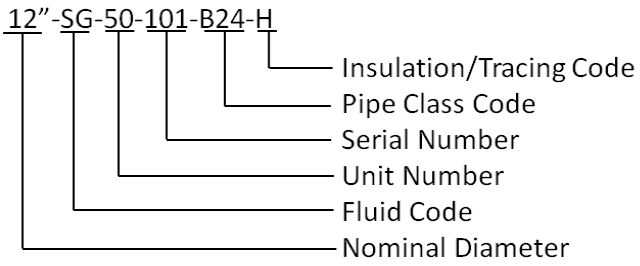
Generally, the tag numbers of equipment, pipe and instrument involves unit number indicating the unit that the item belongs to, and serial number. Table 1 presents the unit number and the serial number of equipment, pipe and instrument respectively for each unit.

Table 1 Unit Number and Serial Number in Tag Number

Unit	Unit Number	Unit Code		Serial Number Range		
		Equipment /Instrument	Pipe	Equipment	Instrument	Pipe
General Management	0000					
Desulphurisation unit (Include Gas Station)	1000	1	10	Full range		
Reformer	2000	2	20	Full range		
Methanol synthesis	3000	3	30	Full range		
Methanol tanks	4000	4	40	Full range		
Distillation unit	5000	5	50	Full range		
Saturator unit	6000	6	60	Full range		
Steam system and utilities	7000	7	70	Full range		
Polishing unit	7200	7	72	Full range		
Pipe rack and pipe net	8000	8	80	Full range		
Flare	8500	85	85	Full range		
General Technical	9000	9	90	Full range		
General plot plan	9200			Full range		
Water supply & drainage for whole plant	9400	94	94	Full range		
Power supply for whole plant	9500			Full range		
Telecom for whole plant	9600			Full range		
Fire fighting for whole plant	9700	97	97	Full range		
Lab.	0203			Full range		
MCC Substation	0201			Full range		
Control room	0202	02	02	Full range		
Cooling water Unit	0500	05	05	Full range		
Foam station	0300	03	03	Full range		

2. Pipe Tag Number

The following figure presents the elements composing pipe tag number.



The fluid codes are listed in Table 2

Rules of unit number and serial number are described in Table 1.

Pipe class codes are listed in Table 3.

Insulation and tracing codes are listed in Table 4.

Table 2 Fluid Code

Code	Fluid	Code	Fluid
AM	Ammonia Water	MZ	Lean Methanol Gas Liquid
BD	Boiler Blow-down	N	Nitrogen
BFW	Boiler Feed Water	PA	Process Air
BW	Warm Up Water	PG	Off Gas
CBD	Continuous Blow Down	PH	Phosphate Solution
CD	Closed Drain	PMC	Crude Methanol
CS	Caustic Solution	PMP	Rich Methanol Liquid
CWR	Cooling Water Return	PMV	Rich Methanol Gas
CWS	Cooling Water Supply	PMW	Methanol Water
DMW	Demineralized Water	PO	Process Oxygen
FG	Fuel Gas	PRC	Process Condensate
FLG	Flare/Vent Gas	PRG	Process Gas-HDS
FWG	Flue Gas	PZ	Process Gas Liquid
HG	Hydrogen Gas	RFG	Reformed Gas
HHPS	High High Pressure Steam	SG	Synthesis Gas
HPC	High Pressure Condensate	SPC	Stripped Condensate
HPS	High Pressure Steam	SZ	Synthesis Gas Liquid
LOS	Liquid Off Stream Methanol	TC	Turbine Condensate
LPC	Low Pressure Steam Condensate	VA	Vent to Atmosphere
LPS	Low Pressure Steam	VG	Vent Gas
ME	Methanol	HZ	Oxygen Scavenger
MPC	Medium Pressure Steam Condensate	NG	Natural Gas
MPS	Medium Pressure Steam	NS	NaOH Solution
CH1	Corrosion Inhibitor Solution	OW	Oily Water
CH2	Antiscale Solution	FRD	Firefighting Runoff
CLO	NaClO Solution (10%)	FW	Fire Fighting Water

COC	Continuously Oily Contaminated Water And Process Effluents	HC	HCl Solution (2~40%)
CSW	Clean Salty Water	POC	Potentially Oily Contaminate Water
PW	Potable Water	RW	RO Water
SN	Sanitary Sewage	SW	Service Water
SU	H2SO4 Solution (98%)		

Table 3 Pipe Class Code

First letter indicates flange rating	Number indicates material of the pipe.
B=Class 150	24=CS
D=Class 300	34=P11
F=Class 600	36=P22
G=Class 900	40=SS304L
H=Class 1500	42=SS316L
J=Class 2500	44=SS321
	50=SS304
	64=SS321H
	66=SS347H
	70=MNL
Miscellaneous:	
C1A = CS, Class 150 RF	
G1A = CS/GALV, Class 150 RF	
G1B = CS/GALV, Class 150 RF	
L1A = CS/PVC Lined, Class 150 RF	
N0A = PVC-U, Gravity Flow	
N0C = PE, Gravity Flow	
N2A = CS, GRP	
N2B = CS, HDEP	
N2C = CS, PVC-C	
N2D = CS, PP-R	
U1A = CS, CS PTFE Coated	

Table 4 Insulation and Tracing Code

Insulation Code	Insulation Purpose	Tracing Code	Heating Tracing Media
C	Cold insulated	ET	Electric Traced
H	Hot insulated	ST	Steam Traced
N	Not insulated	SJ	Steam Jacketed
P	Personnel protection insulated	TR	Traced-Media
W	Warp and Coating		

3. Special Pipe Fitting and Valve Code

Table 4 Special pipe fitting and valve code

Item	Code
Automatic Recirculation Valve	ARV
Breathing Valve	BV
Emergency Relief Manhole	ERM
Flame Arrester	FA
Restriction Orifice	FO
Flexible Connection	FX
Spray Nozzle	FZ
Mixer	MX
Over Flow	OF
Safety Relief Valve	PSV
Rupture Disc	RD
Safety Shower and Eye Washer	SEW
Special Piping Element	SP
Steam Trap	ST
Strainer	STR
Sight Glass	XG
Hose	XH

Appendix 2 –Units of measurements

Temperature	[℃]
Pressure	[barg], [mm WG]
Volume	[m^3], [l]
Length/diameter	[m], [mm]
Mass or weight	[kg], [MT], [ton]
Volume (gases)	[Nm^3], [kmol]
Flow rate:	
- volume	[m^3/h], [Nm^3/h]
- mass	[kg/h], [ton/h]
- mole	[kmol/h]
Velocity	[m/s]
Energy	[MJ], [kJ]
Power	[kW], [MW]
Work	[kWh]
Heat capacity	[kcal/kg ℃]
Thermal conductivity	[kcal/h m ℃]
Heat transfer coefficient	[kj/h m^2 ℃]
Absolute viscosity	[cP],
Density	[kg/m^3]
Sound	[dBA]
Electric current	[A]
Voltage	[V]
Frequency	[Hz]
Rotational frequency	[RPM]
Nominal pipe diameter	[inch]
Nozzle size	[inch]