Kandula Srinivasa Reddy Memorial College of Engineering (Autonomous)

Kadapa-516003. AP

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)

(An ISO 9001-2008 Certified Institution)

Department of Mechanical Engineering

Certification Course

on

"Process Piping Fabrication"

Resource Person : Sri G.Venkata subbaiah,Assistant Professor, Dept.of ME,KSRMCE

Course Coordinator: Sri S.Vijaya kumar

Date: 7/02/22 to 24/02/22

Lr./KSRMCE/ME/2021-22/ Date: 04-02-2022

To
The Principal,
KSRMCE,
Kadapa.

Sub: Permission to Conduct Certificate Course on "**Process Piping Fabrication**" from 07-02-2022 to 24-02-2022 – Reg.

Respected Sir,

The Department of Mechanical Engineering is planning to offer a certification course on "**Process Piping Fabrication**" to B. Tech. students. The course will be conducted from 07-02-2022 to 24-02-2022. In this regard, we are requesting you to grant permission to conduct certificate course.

Thanking you

Yours faithfully

S. Vijaya Kumar

(Sri.S.Vijaya Kumar, Asst.Professor)

Forwarded to Principal Sir.

Permitted
V. S. S. Murty

Cr./KSRMCE/ME/2021-22/

Date: 05/02/2022

Circular

The Department of Mechanical Engineering is offering a certification course on "**Process Piping Fabrication**" From 07-02-2022 to 24-02-2022 to B.Tech students. In this regard, interested students are required to register for the Certification Course. The registration link is given below.

https://forms.gle/EU3uxhQGw2Mmisr6A

The Course Coordinators and Resource Persons
Sri S.Vijaya kumar,Asst.professor
Sri G.Venkata subbaiah, Asst.Professor
Dept. of Mechanical Engg.-KSRMCE.

HOD

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

Cc to:

IQAC-KSRMCE

Registration for Certificate Course on "Process Piping Fabrication" from 07-02-2022 to 24-02-2022

1. Roll No

___

2. Name of the Student

___

3. Branch

___

4. Year & Semester

___

5. Name of the College

___

K.S.R.M. COLLEGE OF ENGINEERING

(UGC-AUTONOMOUS)

Kadapa, Andhra Pradesh, India– 516 003

LIGHTED TO LIGHTEN **Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu.**

An ISO 14001:2004 & 9001: 2015 Certified Institution

Department of Mechanical Engineering
REGISTRATION LIST
Certification courseon"Process Piping Fabrication" from 07thFeb 2022 to 24ThFeb 2022

S.NO	Date	Roll No	Name of the Student	Branch	Year & Semester	Name of the College
1	07/02/2022	199Y5A0311	GUNTHA MANI SAGAR	Mech	III&VI	KSRMCE
2	07/02/2022	199Y5A0323	MAKAM JOSHUA	Mech	III&VI	KSRMCE
3	07/02/2022	199Y1A0302	B SRINIDHI SAI	Mech	III&VI	KSRMCE
4	07/02/2022	199Y1A0303	BANDI SHIVA REDDY	Mech	III&VI	KSRMCE
5	07/02/2022	199Y1A0304	CHAGANTI SUNIL KUMAR REDDY	Mech	III&VI	KSRMCE
6	07/02/2022	199Y1A0305	CHEPPALI AMATHYA	Mech	III&VI	KSRMCE
7	07/02/2022	199Y1A0306	CHIRUCHAPALA ABDUL SUBAHAN	Mech	III&VI	KSRMCE
8	07/02/2022	199Y1A0307	DEVAPATLA BHARATH SIMHA REDDY	Mech	III&VI	KSRMCE
9	07/02/2022	199Y1A0308	DUDIMANI SAI SRUJAN KUMAR	Mech	III&VI	KSRMCE
10	07/02/2022	199Y1A0310	GANGALA VENKATA PRATHAP	Mech	III&VI	KSRMCE
11	07/02/2022	199Y1A0311	GANUGAPENTA BHARATH	Mech	III&VI	KSRMCE
12	07/02/2022	199Y1A0312	GODDENDLA ASHOK KUMAR	Mech	III&VI	KSRMCE

13	07/02/2022	199Y1A0313	GUDURU SUBHAN	Mech	III&VI	KSRMCE
14	07/02/2022	199Y1A0315	KAPURAM VAMSINATH REDDY	Mech	III&VI	KSRMCE
15	07/02/2022	199Y1A0316	KETHIREDDY NAVEEN KUMAR REDDY	Mech	III&VI	KSRMCE
16	07/02/2022	199Y1A0317	KONANGI SUBBANNA	Mech	III&VI	KSRMCE
17	07/02/2022	199Y1A0319	KOTHAPALLE VAMSIDHAR REDDY	Mech	III&VI	KSRMCE
18	07/02/2022	199Y1A0320	KUMMARI MANJUNATH	Mech	III&VI	KSRMCE
19	07/02/2022	199Y1A0321	KUMMETHA SAI KUMAR REDDY	Mech	III&VI	KSRMCE
20	07/02/2022	199Y1A0322	L M VINAY KUMAR	Mech	III&VI	KSRMCE
21	07/02/2022	199Y1A0324	MALEPATI SIVA SAI REDDY	Mech	III&VI	KSRMCE
22	07/02/2022	199Y1A0325	MANJUNATHA DINESH KUMAR	Mech	III&VI	KSRMCE
23	07/02/2022	199Y1A0326	MARKAPURAM MYSORA REDDY	Mech	III&VI	KSRMCE
24	07/02/2022	199Y1A0327	MEDIMALA KIRAN KUMAR	Mech	III&VI	KSRMCE
25	07/02/2022	199Y1A0328	MOGHAL JUNAID BAIG	Mech	III&VI	KSRMCE
26	07/02/2022	199Y1A0329	MOLAKALA SREEKANTH REDDY	Mech	III&VI	KSRMCE
27	07/02/2022	199Y1A0330	MOYILLA CHARAN REDDY	Mech	III&VI	KSRMCE
28	07/02/2022	199Y1A0331	NADIMINTI NAVANEETH KUMAR	Mech	III&VI	KSRMCE
29	07/02/2022	199Y1A0334	PALLETI VAMSIDHAR REDDY	Mech	III&VI	KSRMCE
30	07/02/2022	199Y1A0335	PASUPALA RAVI KUMAR	Mech	III&VI	KSRMCE
31	07/02/2022	199Y1A0336	PATHAN	Mech	III&VI	KSRMCE

			KHALEELULLA KHAN			
32	07/02/2022	199Y1A0337	PULAKONDAM BHEEMAIAH	Mech	III&VI	KSRMCE
33	07/02/2022	199Y1A0338	REDDAM VEERA TEJASWAR REDDY	Mech	III&VI	KSRMCE
34	07/02/2022	199Y1A0339	S K RAJESH	Mech	III&VI	KSRMCE
35	07/02/2022	199Y1A0340	SAGIRAJU DILLI VARMA	Mech	III&VI	KSRMCE
36	07/02/2022	199Y1A0341	SHAIK ABDUL RASHEED	Mech	III&VI	KSRMCE
37	07/02/2022	199Y1A0343	SHAIK GHOUSE BASHA	Mech	III&VI	KSRMCE
38	07/02/2022	199Y1A0344	SHAIK KURNOOL DADA KHALANDAR	Mech	III&VI	KSRMCE
39	07/02/2022	199Y1A0345	SHAIK MAHAMMED MANSOOR	Mech	III&VI	KSRMCE
40	07/02/2022	199Y1A0347	SHAIK MOHAMMED SAJID	Mech	III&VI	KSRMCE
41	07/02/2022	199Y1A0348	SHAIK MOHAMMED SHOAIB AKTHAR	Mech	III&VI	KSRMCE
42	07/02/2022	199Y1A0349	SHAIK NAYEEMUR RAHMAN	Mech	III&VI	KSRMCE
43	07/02/2022	199Y1A0350	SHAIK ZABEEULLA	Mech	III&VI	KSRMCE
44	07/02/2022	199Y1A0352	SUDA ABHILASH KUMAR REDDY	Mech	III&VI	KSRMCE
45	07/02/2022	199Y1A0353	SUNKESULA BABA SAB	Mech	III&VI	KSRMCE
46	07/02/2022	199Y1A0354	SYED ASLAM	Mech	III&VI	KSRMCE
47	07/02/2022	199Y1A0355	TAMMINENI SURENDRA NAIDU	Mech	III&VI	KSRMCE
48	07/02/2022	199Y1A0356	VANGALA BHARGAVA KUMAR REDDY	Mech	III&VI	KSRMCE
49	07/02/2022	199Y1A0357	VENKATAGIRI BHARGAV	Mech	III&VI	KSRMCE

50	07/02/2022	199Y1A0358	VUTUKURU HITESH REDDY	Mech	III&VI	KSRMCE
51	07/02/2022	199Y1A0360	YARRAPUREDDY HARSHAVARDHAN REDDY	Mech	III&VI	KSRMCE
52	07/02/2022	209Y5A0301	ACHUKATLA NUMAIR	Mech	III&VI	KSRMCE
53	07/02/2022	209Y5A0302	BHOJANAPALLE NAGA SIVA	Mech	III&VI	KSRMCE
54	07/02/2022	209Y5A0303	BIJJE PURUSHOTHAM	Mech	III&VI	KSRMCE
55	07/02/2022	209Y5A0304	BUCHUPALLI SIVA PRASAD REDDY	Mech	III&VI	KSRMCE
56	07/02/2022	209Y5A0305	CHINNI GURU PRASAD	Mech	III&VI	KSRMCE
57	07/02/2022	209Y5A0306	CHINTHAGINJALA VENKATA SUBBARAYUDU	Mech	III&VI	KSRMCE
58	07/02/2022	209Y5A0307	CHITRALA VENKATA SWAMY SETTY	Mech	III&VI	KSRMCE
59	07/02/2022	209Y5A0308	DAKALA SRINIVASULU	Mech	III&VI	KSRMCE
60	07/02/2022	209Y5A0309	DHARA SUNIL KUMAR	Mech	III&VI	KSRMCE
61	07/02/2022	209Y5A0311	GORLA CHARAN KUMAR REDDY	Mech	III&VI	KSRMCE
62	07/02/2022	209Y5A0312	GUDISHA DILIP KUMAR	Mech	III&VI	KSRMCE
63	07/02/2022	209Y5A0313	GUTTURU GIRISHKUMAR REDDY	Mech	III&VI	KSRMCE
64	07/02/2022	209Y5A0314	JAMPANGI OBULESU	Mech	III&VI	KSRMCE
65	07/02/2022	209Y5A0315	JONNADULA SATISH	Mech	III&VI	KSRMCE
66	07/02/2022	209Y5A0316	KOTA UPENDRA REDDY	Mech	III&VI	KSRMCE
67	07/02/2022	209Y5A0317	KUNU SIVA BABJI	Mech	III&VI	KSRMCE
68	07/02/2022	209Y5A0318	KURUVA AJAY KUMAR	Mech	III&VI	KSRMCE

69	07/02/2022	209Y5A0319	LAKKINENI SUDHARSHAN	Mech	III&VI	KSRMCE
70	07/02/2022	209Y5A0320	LANKAMSETTY VENKATA LOKESH	Mech	III&VI	KSRMCE
71	07/02/2022	209Y5A0321	LINGAMBOTI BHUSHAN	Mech	III&VI	KSRMCE
72	07/02/2022	209Y5A0322	MEALLA GOWTHAMSAI	Mech	III&VI	KSRMCE
73	07/02/2022	209Y5A0323	MEDIREDDY BHARATH REDDY	Mech	III&VI	KSRMCE
74	07/02/2022	209Y5A0324	MOKA VEERABHADRA	Mech	III&VI	KSRMCE
75	07/02/2022	209Y5A0325	GORLA CHARAN KUMAR REDDY	Mech	III&VI	KSRMCE
76	07/02/2022	209Y5A0325	MOOLI CHENNAKESAVA REDDY	Mech	III&VI	KSRMCE
77	07/02/2022	209Y5A0326	NEELAM PAVAN KUMAR	Mech	III&VI	KSRMCE
78	07/02/2022	209Y5A0327	PATTU MONESH	Mech	III&VI	KSRMCE
79	07/02/2022	209Y5A0328	PATURU NARASIMHA REDDY	Mech	III&VI	KSRMCE
80	07/02/2022	209Y5A0329	PETNIKOTA ADINARAYANA	Mech	III&VI	KSRMCE
81	07/02/2022	209Y5A0330	PINNAPURAM MADHU SUDHAN	Mech	III&VI	KSRMCE
82	07/02/2022	209Y5A0331	POREDDY HARI VARDHAN REDDY	Mech	III&VI	KSRMCE
83	07/02/2022	209Y5A0332	PRODDATURU NAZEER BASHA	Mech	III&VI	KSRMCE
84	07/02/2022	209Y5A0334	SAYYAD MAHAMMAD ALI	Mech	III&VI	KSRMCE
85	07/02/2022	209Y5A0336	SHAIK MAZ AHAMED	Mech	III&VI	KSRMCE
86	07/02/2022	209Y5A0337	SUNKARI UDAY KIRAN	Mech	III&VI	KSRMCE

87	07/02/2022	209Y5A0338	SYED FAROOQ	Mech	III&VI	KSRMCE
88	07/02/2022	209Y5A0339	SYED SAMIUDDIN	Mech	III&VI	KSRMCE
89	07/02/2022	209Y5A0340	TELUGU LAKSHMANNA	Mech	III&VI	KSRMCE
90	07/02/2022	209Y5A0341	THOTA SATHISHREDDY	Mech	III&VI	KSRMCE
91	07/02/2022	209Y5A0342	VADDE SRAVAN KUMAR	Mech	III&VI	KSRMCE
92	07/02/2022	209Y5A0343	YATAGIRI HEMANTH KUMAR	Mech	III&VI	KSRMCE
93	07/02/2022	209Y5A0344	YEDDULADODDI ASHOK	Mech	III&VI	KSRMCE
94	07/02/2022	209Y5A0345	YEDUGURU SHASHI KIRAN REDDY	Mech	III&VI	KSRMCE
95	07/02/2022	209Y5A0346	YERRABALLE VENU	Mech	III&VI	KSRMCE

Coordinator

HOD

Mechanical Engg.

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

Syllabus of Certification Course

Course Name:PROCESS PIPING FABRICATION

Duration: 30 Hours

CHAPTER-1: THEBASICSOFPIPINGSYSTEM

Thischaptercoverstheintroductiontothepipesizes,pipeschedules, dimensional tolerances, pressure ratings, frequentlyusedmaterials,criterialformaterialselection,associations involvedin generatingpipingcodes,design factors dependingon fluid type, pressure, temperature and corrosion, roles andresponsibilities of piping discipline, key piping deliverables andcostofpipingsystem.

CHAPTER–2: DEFINITIONS, TERMINOLOGY AND ESSENTIALVOCABULARY

Thischapterprovidesessentialdefinitionsandterminology, each piping engineer and designer should familiar with. This isbased on the Author's experience on the use of vocabulary inmost design engineering, procurement and construction (EPC)companies.

CHAPTER–3: DESIGNCODESANDSTANDARDS

This chapter discusses the associations involved in generatingpiping codes and material specifications. It provides descriptionof various ASME pressure piping codes such as B31.1 PowerPiping,B31.3ProcessPiping,B31.4PipelineTransportationSystems forLiquid Hydrocarbons,B31.5 Refrigeration Pipingand Heat Transfer Components, B31.8 Gas Transmission andDistribution Piping Systems, B31.9 Building Services Piping andB31.11 Slurry Transportation Piping Systems.It also providesinformationontheassociationsinvolvedinmaterialspecificationssuchasAPI-AmericanPetroleumInstituteStandards,ASTM–AmericanSocietyofTestingMaterials,ASMEPipingComponentsStandards,AmericanWeldingSociety(AWS),AmericanWaterWorks Association(AWWA)
andEN–EuropeanStandards.

Text books

1. Introduction to Process Engineering and Design**2017 by** Shuchen B. Thakore

2.Modern Methods of Pipe Fabrication by S.D. Bowman

SCHEDULE

Department of Mechanical Engineering

Certification course
on
"Process Piping Fabrication"

Date	Timing	Course Instructor	Topic to be covered
07/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Introduction to piping classification General definitions Length area
08/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Concept of high point vent & low point drain Duties & responsibilities of piping field engineer
09/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Role of field engineer in safety field craft supports/communications
10/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Introduction to major phases of piping process plants
11/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Feasibility study (techno- economical survey
14/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Design Construction Commission/erection phase. Operational/production phase.
15/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Pipe & tube product Pipe sizes & materials Pipes joints & bending Valves
16/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Gaskets Fasteners Welded & brazed joint Joining ductile or cast iron pipes Hanger And Supports
17/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Bolting Installation Procedure Hanger installation guide lines Calculation for pipe supports
18/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Introduction of ASME codes,. Code cases interpretation
19/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Introduction of ANSI 4 Introduction of ASTM
20/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Introduction of API, Introduction of AWS
21/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Orbital pipe welding, Up-hill / down-hill welding. Spiral pipe welding Various pipe welding position
22/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	General fabrication procedure for piping spool..

23/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Underground pipe laying (needs & method) Fit-up & set-up for welding of pipe
24/02/2022	4 PM to 6 PM	G.Venkata Subbaiah	Shop weld plan for piping

Course Coordinator: Sri.S.Vijaya Kumar

HOD

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
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Department of Mechanical Engineering

Attendance sheet of Certification course on "Process Piping Fabrication" from 07th Feb 2022 to 24Th Feb 2022

Sl. No.	Roll No.	Name	7/2	8/2	9/2	10/2	11/2	14/2	15/2	16/2	17/2	18/2	19/2	21/2	22/2	23/2	24/2
1	199Y5A0311	GUNTHA MANI SAGAR	A	P	P	P	P	P	A	P	P	A	P	P	P	P	P
2	199Y5A0323	MAKAM JOSHUA	P	A	P	P	A	P	P	P	P	P	P	A	P	P	A
3	199Y1A0302	B SRINIDHI SAI	P	P	A	P	A	P	P	P	P	A	P	P	A	P	P
4	199Y1A0303	BANDI SHIVA REDDY	P	A	P	P	P	P	P	A	P	P	P	P	A	P	A
5	199Y1A0304	CHAGANTI SUNIL KUMAR REDDY	P	P	A	P	P	A	P	P	P	P	A	P	P	P	P
6	199Y1A0305	CHEPPALI AMATHYA	A	P	P	P	A	P	P	P	A	P	P	P	P	P	P
7	199Y1A0306	CHIRUCHAPALA ABDUL SUBAHAN	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P
8	199Y1A0307	DEVAPATLA BHARATH SIMHA REDDY	P	P	P	P	P	A	P	P	A	P	P	P	A	P	P
9	199Y1A0308	DUDIMANI SAI SRUJAN KUMAR	P	A	P	A	P	P	P	A	P	P	P	P	P	A	P

10	199Y1A0310	GANGALA VENKATA PRATHAP	P	P	P	P	P	P	P	A	P	P	P	P	A	P	P
11	199Y1A0311	GANUGAPENTA BHARATH	A	P	P	P	P	P	P	A	P	P	P	P	P	P	A
12	199Y1A0312	GODDENDLA ASHOK KUMAR	P	A	P	P	A	P	A	P	P	P	P	P	P	P	P
13	199Y1A0313	GUDURU SUBHAN	P	P	P	P	P	P	A	P	P	A	P	A	P	P	P
14	199Y1A0315	KAPURAM VAMSINATH REDDY	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P
15	199Y1A0316	KETHIREDDY NAVEEN KUMAR REDDY	A	P	A	P	A	P	P	P	P	A	P	P	P	P	P
16	199Y1A0317	KONANGI SUBBANNA	P	P	A	P	P	A	P	P	P	P	P	P	P	P	P
17	199Y1A0319	KOTHAPALLE VAMSIDHAR REDDY	P	P	P	P	P	P	P	P	A	P	P	A	P	A	A
18	199Y1A0320	KUMMARI MANJUNATH	P	A	P	P	P	P	A	P	P	P	A	P	A	P	P
19	199Y1A0321	KUMMETHA SAI KUMAR REDDY	P	P		A	P	P	P	A	P	P	P	P	P	A	P
20	199Y1A0322	L M VINAY KUMAR	P	P	A	P	P	A	P	P	P	A	P	P	P	P	P
21	199Y1A0324	MALEPATI SIVA SAI REDDY	A	A	P	P	A	P	P	P	P	P	A	P	P	A	P
22	199Y1A0325	MANJUNATHA DINESH KUMAR	P	P	A	P	P	A	P	P	A	P	P	P	A	P	P
23	199Y1A0326	MARKAPURAM MYSORA REDDY	P	P	A	P	P	P	A	P	P	P	P	P	P	P	P
24	199Y1A0327	MEDIMALA KIRAN KUMAR	P	A	P	A	P	P	P	P	A	P	P	A	P	P	P
25	199Y1A0328	MOGHAL JUNAID BAIG	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
26	199Y1A0329	MOLAKALA SREEKANTH REDDY	P	P	P	P	A	P	P	P	P	P	P	P	A	P	P

27	199Y1A0330	MOYILLA CHARAN REDDY	A	P	P	P	P	P	P	A	P	P	P	P	P	P	P
28	199Y1A0331	NADIMINTI NAVANEETH KUMAR	P	A	P	P	A	P	A	P	A	P	P	P	A	P	P
29	199Y1A0334	PALLETI VAMSIDHAR REDDY	P	P	P	A	P	P	A	P	P	P	A	P	P	P	P
30	199Y1A0335	PASUPALA RAVI KUMAR	P	A	P	P	P	P	P	P	P	A	P	P	P	P	P
31	199Y1A0336	PATHAN KHALEELULLA KHAN	P	P	P	P	A	P	P	P	P	P	P	A	P	P	P
32	199Y1A0337	PULAKONDAM BHEEMAIAH	P	P	A	P	P	P	P	P	P	P	P	P	P	A	P
33	199Y1A0338	REDDAM VEERA TEJASWAR REDDY	A	P	P	P	P	A	P	P	P	P	P	P	P	P	A
34	199Y1A0339	S K RAJESH	P	A	P	P	P	P	P	P	A	P	P	P	P	P	P
35	199Y1A0340	SAGIRAJU DILLI VARMA	P	P	P	A	P	P	A	P	P	P	P	A	P	P	P
36	199Y1A0341	SHAIK ABDUL RASHEED	P	A	P	P	P	P	P	P	P	A	P	P	P	P	P
37	199Y1A0343	SHAIK GHOUSE BASHA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
38	199Y1A0344	SHAIK KURNOOL DADA KHALANDAR	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P
39	199Y1A0345	SHAIK MAHAMMED MANSOOR	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
40	199Y1A0347	SHAIK MOHAMMED SAJID	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A
41	199Y1A0348	SHAIK MOHAMMED SHOAIB AKTHAR	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P

42	199Y1A0349	SHAIK NAYEEMUR RAHMAN	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P
43	199Y1A0350	SHAIK ZABEEULLA	P	P	A	P	P	P	A	P	P	P	P	P	P	P	P
44	199Y1A0352	SUDA ABHILASH KUMAR REDDY	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P
45	199Y1A0353	SUNKESULA BABA SAB	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P
46	199Y1A0354	SYED ASLAM	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P
47	199Y1A0355	TAMMINENI SURENDRA NAIDU	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P
48	199Y1A0356	VANGALA BHARGAVA KUMAR REDDY	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A
49	199Y1A0357	VENKATAGIRI BHARGAV	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P
50	199Y1A0358	VUTUKURU HITESH REDDY	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P
51	199Y1A0360	YARRAPUREDDY HARSHAVARDHAN REDDY	A	A	P	P	P	P	P	P	P	P	A	P	P	P	P
52	209Y5A0301	ACHUKATLA NUMAIR	P	P	A	P	P	P	P	A	P	P	P	P	P	P	P
53	209Y5A0302	BHOJANAPALLE NAGA SIVA	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
54	209Y5A0303	BIJJE PURUSHOTHAM	A	P	P	P	P	P	P	A	P	P	P	P	P	P	P
55	209Y5A0304	BUCHUPALLI SIVA PRASAD REDDY	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
56	209Y5A0305	CHINNI GURU PRASAD		A	P	P	A	P	P	P	P	P	P	P	P	P	P
57	209Y5A0306	CHINTHAGINJALA VENKATA SUBBARAYUDU	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P

58	209Y5A0307	CHITRALA VENKATA SWAMY SETTY	A	P	P	P	P	P	A	P	P	P	P	A	P	P	P
59	209Y5A0308	DAKALA SRINIVASULU	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P
60	209Y5A0309	DHARA SUNIL KUMAR	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P
61	209Y5A0311	GORLA CHARAN KUMAR REDDY	P	P	P	P	A	P	A	A	P	P	P	P	P	P	P
62	209Y5A0312	GUDISHA DILIP KUMAR	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P
63	209Y5A0313	GUTTURU GIRISHKUMAR REDDY	P	P	A	P	P	P	P	P	A	P	A	P	P	P	P
64	209Y5A0314	JAMPANGI OBULESU	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
65	209Y5A0315	JONNADULA SATISH	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
66	209Y5A0316	KOTA UPENDRA REDDY	P	P	P	A	P	P	P	P	P	P	P	A	P	P	A
67	209Y5A0317	KUNU SIVA BABJI	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
68	209Y5A0318	KURUVA AJAY KUMAR	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P
69	209Y5A0319	LAKKINENI SUDHARSHAN	P	P	A	P	P	P	P	P	P	P	A	P	P	P	P
70	209Y5A0320	LANKAMSETTY VENKATA LOKESH	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
71	209Y5A0321	LINGAMBOTI BHUSHAN	P	P	A	P	P	P	P	P	P	A	P	P	P	P	P
72	209Y5A0322	MEALLA GOWTHAMSAI	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P
73	209Y5A0323	MEDIREDDY BHARATH REDDY	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P

74	209Y5A0324	MOKA VEERABHADRA	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P
75	209Y5A0325	GORLA CHARAN KUMAR REDDY	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P
76	209Y5A0325	MOOLI CHENNAKESAVA REDDY	P	P	P	P	A	P	P	P	A	P	P	P	P	P	P
77	209Y5A0326	NEELAM PAVAN KUMAR	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
78	209Y5A0327	PATTU MONESH	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P
79	209Y5A0328	PATURU NARASIMHA REDDY	P	P	A	P	P	P	P	P	P	P	A	P	P	P	P
80	209Y5A0329	PETNIKOTA ADINARAYANA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
81	209Y5A0330	PINNAPURAM MADHU SUDHAN	P	P	P	P	P	A	P	P	P	P	P	A	P	P	P
82	209Y5A0331	POREDDY HARI VARDHAN REDDY	P	P	P	P	P	P	P	A	P	P	P	P	P	P	A
83	209Y5A0332	PRODDATURU NAZEER BASHA	P	P	A	P	P	P	P	P	P	P	P	P	P	A	P
84	209Y5A0334	SAYYAD MAHAMMAD ALI	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P
85	209Y5A0336	SHAIK MAZ AHAMED	P	P	P	P	P	A	P	P	A	P	P	P	P	P	P
86	209Y5A0337	SUNKARI UDAY KIRAN	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P
87	209Y5A0338	SYED FAROOQ	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P
88	209Y5A0339	SYED SAMIUDDIN	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P
89	209Y5A0340	TELUGU LAKSHMANNA	A	P	P	P	A	P	P	P	P	P	P	P	P	P	P
90	209Y5A0341	THOTA SATHISHREDDY	P	P	P	P	P	P	A	P	P	A	P	P	P	P	P

91	209Y5A0342	VADDE SRAVAN KUMAR	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P
92	209Y5A0343	YATAGIRI HEMANTH KUMAR	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P
93	209Y5A0344	YEDDULADODDI ASHOK	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P
94	209Y5A0345	YEDUGURU SHASHI KIRAN REDDY	P	P	P	P	A	P	P	P	P	P	P	P	A	P	P
95	209Y5A0346	YERRABALLE VENU	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P

Coordinator

HoD-Mechanical Engg.

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

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DEPARTMENT OF MECHANICAL ENGINEERING

A Certification Course on

" Process Piping & Fabrication "

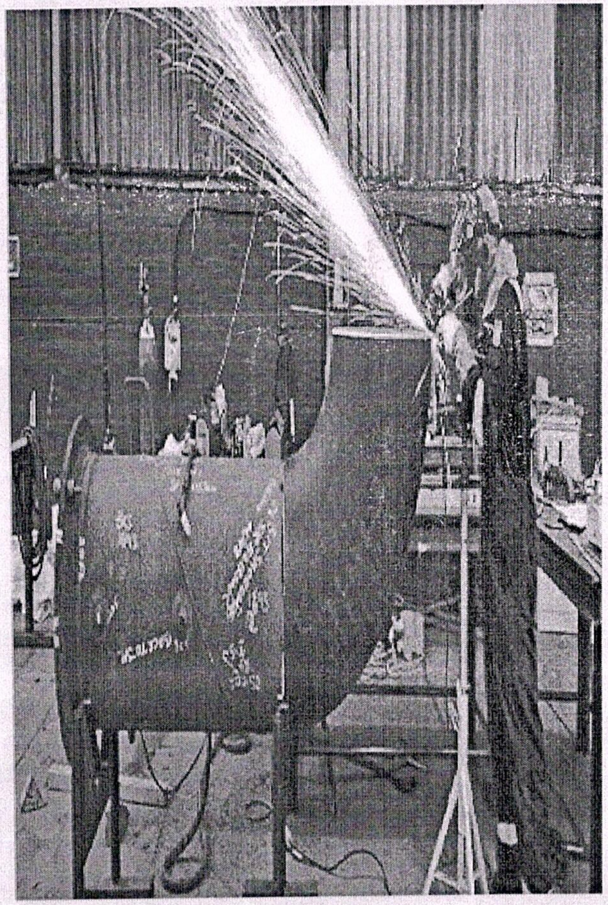
Department of ME

07/02/2022 to 24/02/2022

ME Seminar Hall - 103

Coordinator
Sri S. vijaya Kumar.
Assistent Professor
Mech. Engg.Dept

Resource person
Sri G.Venkata subbaiah
Assistant Professor
Mech. Engg.Dept



Dr. D. Ravikanth (HOD)
Dr. V.S.S. Murthy (Principal)
Dr. Kandula Chandra Obul Reddy (Managing Director)
Smt. K.Rajeswari (Correspondent Secretary, Treasurer)
Sri K. Madan Mohan Reddy (Vice - Chairman)
Sri K. Raja Mohan Reddy (Chairman)

ksrmceofficial www.ksrmce.ac.in 8143731980, 8575697569

Report of
Certification Course on "Process Piping Fabrication"
From 07/02/2022 to 24/02/2022

Target Group	:	**Students**
Details of Participants	:	**95 Students**
Co-coordinator(s)	:	**S.Vijaya Kumar**
Resource Person	:	**G.Venkata Subbaiah**
Organizing Department	:	**Mechanical Engineering**
Venue	:	**Seminar Hall, Mechanical Department**

Description:

The Department of Mechanical Engineering conducted a certification course on "Process Piping Fabrication" from 07th Feb 2022 to 24th Feb 2022. The course duration was 30 hours .The course Resource Person are Sri G.Venkata Subbaiah, Assistant Professor and Co-Ordinator Sri S.Vijaya Kumar Assistant. Professor Department Mechanical Engineering, KSRMCE.

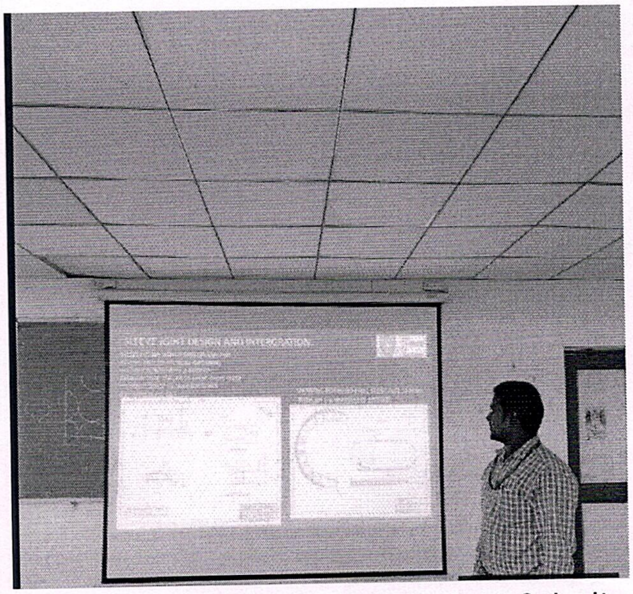
This course focuses on different types of process piping fabrication work. This course helps to practice use of different tools, equipment's and machineries applicable in piping fabrication. This includes hands on practice to student for deciding fundamental technical requirements in piping fabrications. This course also helps student to become conversant with related manufacturing codes and standards of process piping fabrication e.g. ASME, API, ASTM, ANSI etc. This also creates safety consciousness and basic abilities required for the piping fabrication work. Thus this course prepares the student for the employable in process piping fabrication industries.

With this Certificate course students enhanced their knowledge in the area of process piping fabrication.

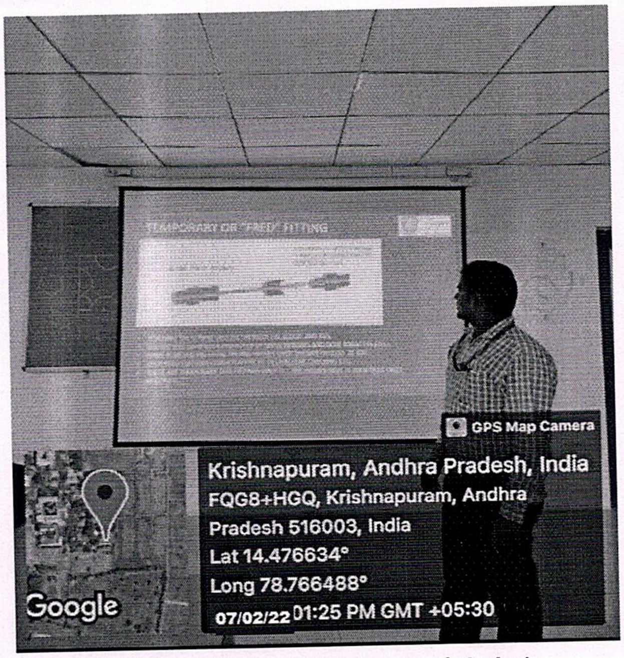
Photos

The pictures taken during the course are given below:

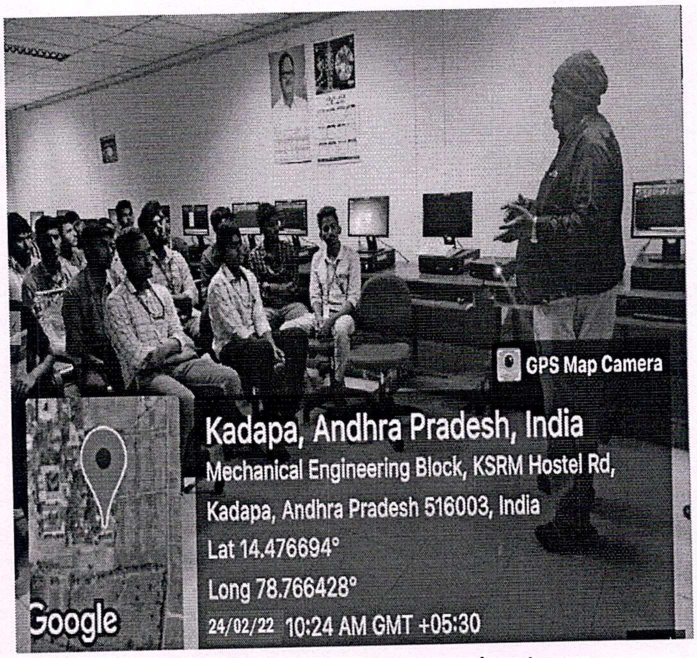
Introduction of process piping fabrication



Explanation of flanges, gaskets& bolts



Explanation of piping fitting and joints



Hod interaction with students

Coordinator

HOD

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

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Certificate of Completion

This to certify that Mr/Mrs. KUNU SIVA BABJI Bearing the Roll Number 2094 5A0317 has Successfully Completed Certification Course on " process piping fabrication " from 7/2/2022 to 24/2/2022, Organized by Department of Mechanical Engineering, KSRMCE, Kadapa.

Coordinator

HOD ME

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

V. S. S. Murthy

Principal

PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA-516003. (A.P.)

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Certificate of Completion

This to certify that Mr/Mrs. G. DILIP KUMAR Bearing the Roll Number 20945A0312 has Successfully Completed Certification Course on " PROCESS PIPING FABRICATION " from 7/2/2022 to 24/2/2022, Organized by Department of Mechanical Engineering, KSRMCE, Kadapa.

Coordinator	HOD ME	Principal
S. Vijay	Professor & Head Department of Mechnical Engineering K.S.R.M. College of Engineering KADAPA - 516 003.	V. S. S. Murthy PRINCIPAL K.S.R.M. COLLEGE OF ENGINEERING KADAPA-516003. (A.P.)

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Certificate of Completion

This to certify that Mr/Mrs. P. RAVI KUMAR Bearing the Roll Number 199Y1A0335 has Successfully Completed Certification Course on " process piping fabrication " from 7/2/2022 to 24/2/2022, Organized by Department of Mechanical Engineering, KSRMCE, Kadapa.

S. Vijaya
Coordinator

HOD ME
Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

V. S. S. Murthy
Principal
PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA-516003. (A.P.)

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Certificate of Completion

This to certify that Mr/Mrs. C. SUNIL KUMAR REDDY Bearing the Roll Number 19941A0304 has Successfully Completed Certification Course on "PROCESSPIPING FABRICATION" from 7/02/2022 to 24/02/2022, Organized by Department of Mechanical Engineering, KSRMCE, Kadapa.

Coordinator

HOD ME

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

V.S.S. Murthy

Principal

PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA-516003. (A.P.)

Feedback on Certificate Course on "Process Piping Fabrication" from 07/02/2022 to 24/02/2022

*Required

1. Student Name (Optional)

____

2. Roll Number (Optional)

____

3. The objectives of the course were met (Objective) *

Mark only one oval.

- ( ) Excellent
- ( ) Good
- ( ) Satisfactory
- ( ) Poor

4. The pace of the course was appropriate to the content and attendees(Content) *

Mark only one oval.

- ( ) Excellent
- ( ) Good
- ( ) Satisfactory
- ( ) Poor

5. The content of the course was organized and easy to follow (Delivery) *

Mark only one oval.

- Excellent
- Good
- Satisfactory
- Poor

6. The Resource Persons were well prepared and able to answer any questions (Interaction) *

Mark only one oval.

- Excellent
- Good
- Satisfactory
- Poor

7. The exercises / role play were helpful and relevant (Syllabus Coverage) *

Mark only one oval.

- Excellent
- Good
- Satisfactory
- Poor

8. The venue was appropriate for the course (About Venue)*

Mark only one oval.

- Excellent
- Good
- Satisfactory
- Poor

9. The Course satisfy my expectation as a value added Programme (Course Satisfaction) *

Mark only one oval.

- Excellent
- Good
- Satisfactory
- Poor

10. Any Other comments

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Department of Mechanical Engineering

Certification Course on **Process Piping Fabrication**

Feedback Form

S. No	Name of the Student	Roll List	Is the Course content meet your expectation	Is the lecture sequence well planned	Is the level of course high	Is the course exposed you to the new knowledge and practices	Rate the Knowledge of the Speaker	Rate the value of Course in increasing your skills	Any Issues
1	GUNTHA MANI SAGAR	199Y5A0311	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
2	MAKAM JOSHUA	199Y5A0323	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
3	**B SRINIDHI SAI**	**199Y1A0302**	Excellent	Good	Excellent	Excellent	Good	Excellent	
4	BANDI SHIVA REDDY	199Y1A0303	Good	Good	Good	Good	Good	Good	--
5	**CHAGANTI SUNIL KUMAR REDDY**	**199Y1A0304**	Excellent	Excellent	Excellent	Good	Excellent	Excellent	
6	CHEPPALI AMATHYA	199Y1A0305	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
7	**CHIRUCHAPALA ABDUL SUBAHAN**	**199Y1A0306**	Excellent	Excellent	Excellent	Excellent	Excellent	Good	-

8	DEVAPATLA BHARATH SIMHA REDDY	199Y1A0307	Excellent	Excellent	Excellent	Good	Excellent	Good	
9	**DUDIMANI SAI SRUJAN KUMAR**	**199Y1A0308**	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	No
10	GANGALA VENKATA PRATHAP	199Y1A0310	Good	Excellent	Good	Excellent	Good	Excellent	
11	GANUGAPENTA BHARATH	199Y1A0311	Excellent	Excellent	Excellent	Excellent	Excellent	Good	
12	GODDENDLA ASHOK KUMAR	199Y1A0312	Excellent	Good	Good	Excellent	Good	Good	
13	**GUDURU SUBHAN**	**199Y1A0313**	Good	Good	Good	Good	Good	Satisfactory	
14	**KAPURAM VAMSINATH REDDY**	**199Y1A0315**	Good	Good	Good	Good	Good	Good	It is useful for us
15	KETHIREDDY NAVEEN KUMAR REDDY	199Y1A0316	Good	Good	Good	Good	Good	Good	--
16	KONANGI SUBBANNA	199Y1A0317	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
17	KOTHAPALLE VAMSIDHAR REDDY	199Y1A0319	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
18	KUMMARI MANJUNATH	199Y1A0320	Excellent	Good	Excellent	Good	Excellent	Excellent	
19	KUMMETHA SAI KUMAR REDDY	199Y1A0321	Excellent	Excellent	Excellent	Excellent	Good	Good	
20	L M VINAY KUMAR	199Y1A0322	Good	Good	Good	Excellent	Good	Good	
21	MALEPATI SIVA SAI REDDY	199Y1A0324	Excellent	Excellent	Good	Excellent	Good	Excellent	
22	MANJUNATHA DINESH KUMAR	199Y1A0325	Good	Good	Good	Good	Good	Good	--
23	**MARKAPURAM MYSORA REDDY**	**199Y1A0326**	Excellent	Good	Good	Satisfactory	Excellent	Excellent	
24	MEDIMALA KIRAN KUMAR	199Y1A0327	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	-
25	**MOGHAL JUNAID BAIG**	**199Y1A0328**	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Nothing to say
26	**MOLAKALA SREEKANTH REDDY**	**199Y1A0329**	Good	Satisfactory	Excellent	Excellent	Excellent	Satisfactory	
27	MOYILLA CHARAN REDDY	199Y1A0330	Good	Excellent	Excellent	Good	Excellent	Good	
28	NADIMINTI NAVANEETH KUMAR	199Y1A0331	Good	Good	Good	Good	Good	Good	--
29	**PALLETI VAMSIDHAR REDDY**	**199Y1A0334**	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
30	PASUPALA RAVI KUMAR	199Y1A0335	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	

31	**PATHAN KHALEELULLA KHAN**	**199Y1A0336**	Excellent	Excellent	Good	Good	Good	Excellent	
32	PULAKONDAM BHEEMAIAH	199Y1A0337	Good	Good	Excellent	Good	Good	Good	
33	REDDAM VEERA TEJASWAR REDDY	199Y1A0338	Excellent	Excellent	Good	Good	Good	Good	
34	S K RAJESH	199Y1A0339	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	-
35	SAGIRAJU DILLI VARMA	199Y1A0340	Good	Good	Good	Good	Good	Good	No
36	SHAIK ABDUL RASHEED	199Y1A0341	Excellent	Good	Good	Good	Satisfactory	Excellent	
37	**SHAIK GHOUSE BASHA**	**199Y1A0343**	Good	Good	Good	Good	Good	Good	No
38	SHAIK KURNOOL DADA KHALANDAR	199Y1A0344	Excellent	Excellent	Good	Good	Good	Good	
39	SHAIK MAHAMMED MANSOOR	199Y1A0345	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
40	**SHAIK MOHAMMED SAJID**	**199Y1A0347**	Good	Good	Good	Good	Good	Good	
41	SHAIK MOHAMMED SHOAIB AKTHAR	199Y1A0348	Good	Good	Good	Good	Good	Good	Nothing
42	SHAIK NAYEEMUR RAHMAN	199Y1A0349	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
43	**SHAIK ZABEEULLA**	**199Y1A0350**	Good	Good	Good	Good	Good	Good	
44	**SUDA ABHILASH KUMAR REDDY**	**199Y1A0352**	Good	Good	Good	Good	Good	Good	--
45	**SUNKESULA BABA SAB**	**199Y1A0353**	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
46	SYED ASLAM	199Y1A0354	Good	Good	Good	Good	Good	Good	
47	TAMMINENI SURENDRA NAIDU	199Y1A0355	Excellent	Excellent	Good	Good	Excellent	Excellent	Nothing
48	VANGALA BHARGAVA KUMAR REDDY	199Y1A0356	Good	Good	Good	Good	Good	Good	__
49	VENKATAGIRI BHARGAV	199Y1A0357	Excellent	Good	Excellent	Good	Good	Excellent	
50	**VUTUKURU HITESH REDDY**	**199Y1A0358**	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
51	YARRAPUREDDY HARSHAVARDHAN REDDY	199Y1A0360	Good	Excellent	Good	Good	Good	Good	Ok
52	ACHUKATLA NUMAIR	209Y5A0301	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
53	BHOJANAPALLE NAGA SIVA	209Y5A0302	Excellent	Excellent	Good	Good	Good	Good	
54	BIJJE PURUSHOTHAM	209Y5A0303	Good	Good	Excellent	Good	Excellent	Excellent	
55	BUCHUPALLI SIVA PRASAD REDDY	209Y5A0304	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Nothing

56	CHINNI GURU PRASAD	209Y5A0305	Good	Excellent	Excellent	Good	Good	Good	
57	CHINTHAGINJALA VENKATA SUBBARAYUDU	209Y5A0306	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
58	CHITRALA VENKATA SWAMY SETTY	209Y5A0307	Excellent	Excellent	Good	Good	Good	Good	
59	DAKALA SRINIVASULU	209Y5A0308	Excellent	Good	Excellent	Good	Excellent	Good	
60	DHARA SUNIL KUMAR	209Y5A0309	Excellent	Excellent	Good	Satisfactory	Good	Good	Nothing
61	GORLA CHARAN KUMAR REDDY	209Y5A0311	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
62	GUDISHA DILIP KUMAR	209Y5A0312	Good	Good	Excellent	Excellent	Excellent	Excellent	
63	GUTTURU GIRISHKUMAR REDDY	209Y5A0313	Excellent	Excellent	Excellent	Good	Excellent	Excellent	
64	JAMPANGI OBULESU	209Y5A0314	Excellent	Excellent	Good	Good	Good	Excellent	
65	JONNADULA SATISH	209Y5A0315	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Nothing
66	KOTA UPENDRA REDDY	209Y5A0316	Good	Excellent	Good	Excellent	Good	Excellent	
67	KUNU SIVA BABJI	209Y5A0317	Good	Good	Excellent	Satisfactory	Satisfactory	Good	
68	KURUVA AJAY KUMAR	209Y5A0318	Excellent	Good	Excellent	Good	Excellent	Good	
69	LAKKINENI SUDHARSHAN	209Y5A0319	Good	Good	Good	Good	Good	Good	
70	LANKAMSETTY VENKATA LOKESH	209Y5A0320	Excellent	Excellent	Good	Good	Good	Excellent	
71	LINGAMBOTI BHUSHAN	209Y5A0321	Good	Excellent	Good	Excellent	Good	Excellent	
72	MEALLA GOWTHAMSAI	209Y5A0322	Good	Good	Good	Good	Good	Good	
73	MEDIREDDY BHARATH REDDY	209Y5A0323	Good	Good	Good	Good	Satisfactory	Satisfactor y	Nothing
74	MOKA VEERABHADRA	209Y5A0324	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
75	GORLA CHARAN KUMAR REDDY	209Y5A0325	Good	Good	Good	Satisfactory	Good	Good	
76	MOOLI CHENNAKESAVA REDDY	209Y5A0325	Excellent	Good	Excellent	Good	Excellent	Good	
77	NEELAM PAVAN KUMAR	209Y5A0326	Excellent	Excellent	Good	Excellent	Excellent	Good	
78	PATTU MONESH	209Y5A0327	Good	Good	Good	Good	Excellent	Good	
79	PATURU NARASIMHA REDDY	209Y5A0328	Excellent	Good	Satisfact ory	Excellent	Excellent	Good	Nothing
80	PETNIKOTA ADINARAYANA	209Y5A0329	Good	Excellent	Good	Excellent	Good	Excellent	
81	PINNAPURAM MADHU SUDHAN	209Y5A0330	Good	Excellent	Good	Excellent	Excellent	Good	

82	POREDDY HARI VARDHAN REDDY	209Y5A0331	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
83	PRODDATURU NAZEER BASHA	209Y5A0332	Good	Satisfactory	Good	Excellent	Good	Satisfactory	
84	SAYYAD MAHAMMAD ALI	209Y5A0334	Excellent	Good	Good	Excellent	Excellent	Excellent	
85	SHAIK MAZ AHAMED	209Y5A0336	Good	Excellent	Excellent	Good	Good	Excellent	
86	SUNKARI UDAY KIRAN	209Y5A0337	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
87	SYED FAROOQ	209Y5A0338	Excellent	Excellent	Excellent	Excellent	Good	Excellent	
88	SYED SAMIUDDIN	209Y5A0339	Excellent	Excellent	Good	Good	Good	Good	
89	TELUGU LAKSHMANNA	209Y5A0340	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
90	THOTA SATHISHREDDY	209Y5A0341	Excellent	Good	Good	Good	Good	Good	
91	VADDE SRAVAN KUMAR	209Y5A0342	Excellent	Good	Excellent	Good	Excellent	Good	
92	YATAGIRI HEMANTH KUMAR	209Y5A0343	Excellent	Excellent	Good	Excellent	Excellent	Good	
93	YEDDULADODDI ASHOK	209Y5A0344	Good	Good	Good	Good	Excellent	Good	
94	YEDUGURU SHASHI KIRAN REDDY	209Y5A0345	Excellent	Good	Satisfactory	Excellent	Excellent	Good	
95	YERRABALLE VENU	209Y5A0346	Excellent	Excellent	Good	Excellent	Excellent	Good	

Coordinator

HOD

Professor & Head
Department of Mechnical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

K.S.R.M. COLLEGE OF ENGINEERING (AUTONOMOUS), KADAPA-516003
DEPARTMENT OF MECHANICAL ENGINEERING
VALUE ADDED COURSE ON
PROCESS PIPING FABRICATION
FROM 07/02/2022 TO 24/02/2022
AWARD LIST

S.No	Roll Number	Name of the Student	Marks Obtained
1	199Y5A0311	Guntha Mani Sagar	13
2	199Y5A0323	Makam Joshua	12
3	199Y1A0302	B Srinidhi Sai	12
4	199Y1A0303	Bandi Shiva Reddy	13
5	199Y1A0304	Chaganti Sunil Kumar Reddy	14
6	199Y1A0305	Cheppali Amathya	12
7	199Y1A0306	Chiruchapala Abdul Subahan	12
8	199Y1A0307	Devapatla Bharath Simha Reddy	13
9	199Y1A0308	Dudimani Sai Srujan Kumar	12
10	199Y1A0310	Gangala Venkata Prathap	13
11	199Y1A0311	Ganugapenta Bharath	13
12	199Y1A0312	Goddendla Ashok Kumar	14
13	199Y1A0313	Guduru Subhan	13
14	199Y1A0315	Karuram Vamsinath Reddy	14
15	199Y1A0316	Kethireddy Naveen Kumar Reddy	13
16	199Y1A0317	Konangi Subbanna	14
17	199Y1A0319	Kothapalle Vamsidhar Reddy	12
18	199Y1A0320	Kummari Manjunath	13
19	199Y1A0321	Kummetha Sai Kumar Reddy	13
20	199Y1A0322	Lm Vinay Kumar	12
21	199Y1A0324	Malepati Siva Sai Reddy	12
22	199Y1A0325	Manjunatha Dinesh Kumar	13
23	199Y1A0326	Markapuram Mysora Reddy	12
24	199Y1A0327	Medimala Kiran Kumar	12
25	199Y1A0328	Moghal Junaid Baig	13
26	199Y1A0329	Molakala Sreekanth Reddy	12
27	199Y1A0330	Moyilla Charan Reddy	13
28	199Y1A0331	Nadiminti Navaneeth Kumar	13
29	199Y1A0334	Palleti Vamsidhar Reddy	14
30	199Y1A0335	Pasupala Ravi Kumar	13
31	199Y1A0336	Pathan Khaleelulla Khan	14
32	199Y1A0337	Pulakondam Bheemaiah	13
33	199Y1A0338	Reddam Veera Tejaswar Reddy	12
34	199Y1A0339	Sk Rajesh	12
35	199Y1A0340	Sagiraju Dilli Varma	13
36	199Y1A0341	Shaik Abdul Rasheed	14
37	199Y1A0343	Shaik Ghouse Basha	12
38	199Y1A0344	Shaik Kurnool Dada Khalandar	12
39	199Y1A0345	Shaik Mahammed Mansoor	13
40	199Y1A0347	Shaik Mohammed Sajid	12

41	199Y1A0348	Shaik Mohammed Shoaib Akthar	13
42	199Y1A0349	Shaik Nayeemur Rahman	13
43	199Y1A0350	Shaik Zabeeulla	14
44	199Y1A0352	Suda Abhilash Kumar Reddy	13
45	199Y1A0353	Sunkesula Baba Sab	14
46	199Y1A0354	Syed Aslam	13
47	199Y1A0355	Tammineni Surendra Naidu	12
48	199Y1A0356	Vangala Bhargava Kumar Reddy	12
49	199Y1A0357	Venkatagiri Bhargav	13
50	199Y1A0358	Venkatagiri Bhargav	12
51	199Y1A0360	Yarrapureddy Harshavardhan Reddy	13
52	209Y5A0301	Achukatla Numair	13
53	209Y5A0302	Bhojanapalle Naga Siva	14
54	209Y5A0303	Bijje Purushotham	13
55	209Y5A0304	Buchupalli Siva Prasad Reddy	14
56	209Y5A0305	Chinni Guru Prasad	13
57	209Y5A0306	Chinthaginjala Venkata Subbarayudu	12
58	209Y5A0307	Chitrala Venkata Swamy Setty	12
59	209Y5A0308	Dakala Srinivasulu	13
60	209Y5A0309	Dhara Sunil Kumar	12
61	209Y5A0311	Gorla Charan Kumar Reddy	13
62	209Y5A0312	Gudisha Dilip Kumar	13
63	209Y5A0313	Gutturu Girishkumar Reddy	13
64	209Y5A0314	Jampangi Obulesu	12
65	209Y5A0315	Jonnadula Satish	13
66	209Y5A0316	Kota Upendra Reddy	12
67	209Y5A0317	Kunu Siva Babji	12
68	209Y5A0318	Kuruva Ajay Kumar	13
69	209Y5A0319	Lakkineni Sudharshan	14
70	209Y5A0320	Lankamsetty Venkata Lokesh	12
71	209Y5A0321	Lingamboti Bhushan	12
72	209Y5A0322	Mealla Gowthamsai	13
73	209Y5A0323	Medireddy Bharath Reddy	12
74	209Y5A0324	Moka Veerabhadra	13
75	209Y5A0325	Gorla Charan Kumar Reddy	13
76	209Y5A0325	Mooli Chennakesava Reddy	14
77	209Y5A0326	Neelam Pavan Kumar	13
78	209Y5A0327	Pattu Monesh	14
79	209Y5A0328	Paturu Narasimha Reddy	13
80	209Y5A0329	Petnikota Adinarayana	14
81	209Y5A0330	Pinnapuram Madhu Sudhan	12
82	209Y5A0331	Poreddy Hari Vardhan Reddy	13
83	209Y5A0332	Proddaturu Nazeer Basha	12
84	209Y5A0334	Sayyad Mahammad Ali	12
85	209Y5A0336	Shaik Maz Ahamed	13
86	209Y5A0337	Sunkari Uday Kiran	12
87	209Y5A0338	Syed Farooq	13
88	209Y5A0339	Syed Samiuddin	13

89	209Y5A0340	Telugu Lakshmanna	14
90	209Y5A0341	Thota Sathishreddy	13
91	209Y5A0342	Vadde Sravan Kumar	14
92	209Y5A0343	Yatagiri Hemanth Kumar	13
93	209Y5A0344	Yedduladoddi Ashok	12
94	209Y5A0345	Yeduguru Shashi Kiran Reddy	12
95	209Y5A0346	Yerraballe Venu	13

Coordinator

HoD

Professor & Head
Department of Mechanical Engineering
K.S.R.M. College of Engineering
KADAPA - 516 003.

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ASSESSMENT TEST

13

Roll Number: 199Y1A0313 **Name of the Student:** G. Subhan

Time: 20 Min **(Objective Questions)** **Max.Marks 20**

Note: Answer the following Questions and each question carries **one** mark.

1. What does "pipe size" refer to in a piping system? [b] ✓
a) Length of the pipe
b) Diameter of the pipe
c) Wall thickness of the pipe
d) Material of the pipe

2. Pipe schedules indicate: [d] ✓
a) Pipe manufacturing location
b) Pipe pressure rating
c) Pipe material composition
d) Pipe wall thickness

3. What are dimensional tolerances in piping systems? [b] ✓
a) Measurements of pipe diameter
b) Allowable variations in pipe dimensions
c) Pipe pressure limits
d) Design criteria for pipe supports

4. Pressure ratings of pipes are related to their ability to withstand: [c] ✗
a) Temperature fluctuations
b) Corrosion
c) Fluid flow velocity
d) Pressure stresses

5. Which of the following is NOT a frequently used material in piping systems? [d] ✗
a) Steel
b) Copper
c) Glass
d) PVC

6. What factors are considered when selecting materials for piping systems? [C] ✓
a) Color preference
b) Availability of materials
c) Fluid type, pressure, temperature, and corrosion resistance
d) Material cost only

7. The roles and responsibilities of the piping discipline refer to: [c]
a) The study of fluid dynamics
b) Organizing pipe sizes and schedules
c) Functions and duties of professionals working in piping design
d) Pressure testing of pipes

8. What are key piping deliverables in a project? [c]
a) Invoice reports
b) Material costs
c) Important documents produced during various project phases
d) Project management reports

9. The cost of a piping system includes: [d]
a) Material costs only
b) Labor costs only
c) Material, labor, and maintenance costs
d) Maintenance costs only

10. Piping codes and design factors depend on: [d]
a) Project location
b) Pipe color
c) Fluid viscosity
d) Fluid type, pressure, temperature, and corrosion

11. What is the purpose of providing essential definitions and terminology in piping engineering? [b]
a) To confuse engineers and designers
b) To demonstrate author's vocabulary knowledge
c) To ensure a common understanding among professionals
d) To list all possible technical terms

12. The essential definitions and terminology are based on: [C]
a) The opinions of industry experts
b) The author's personal preferences
c) The author's experience in EPC companies
d) Academic research

13. What does EPC stand for in the context of the chapter? [d]
a) Engineering, Process, and Construction
b) Essential Piping Concepts
c) Economic Piping Criteria
d) Engineering, Procurement, and Construction

14. Why is familiarity with essential vocabulary important for piping engineers and designers? [c] ✓
a) To impress colleagues with technical jargon
b) To meet word count requirements in reports
c) To facilitate effective communication and understanding
d) To reduce the need for project documentation

15. Which phase of a project involves translating design plans into physical Installations? [c] ✓
a) Procurement
b) Engineering
c) Construction
d) Inspection

16. What is the primary goal of providing essential vocabulary and terminology? [a] ✗
a) To exclude non-technical staff from project discussions
b) To align with academic definitions
c) To enhance collaboration and clarity in project communication
d) To highlight the author's linguistic skills

17. In the context of piping, what does the term "vocabulary" refer to? [b] ✓
a) The list of all pipe sizes
b) A collection of technical terms and concepts
c) The language spoken by pipe manufacturers
d) The sound of flowing fluids in pipes

18. What is the significance of the author's experience in defining essential vocabulary? [a] ✗
a) It indicates the author's expertise in linguistics
b) It adds credibility and relevance to the provided definitions
c) It showcases the author's artistic writing style
d) It guarantees the accuracy of the definitions

19. Which document outlines the project's required materials and quantities? [~~a~~] d ✓
a) Vocabulary report
b) Piping codes
c) Material selection criteria
d) Bill of materials

20. What is the main purpose of using standardized definitions and terminology in piping projects? [a] ✗
a) To confuse readers
b) To make documents longer
c) To ensure clear communication and understanding
d) To promote the author's vocabulary preferences

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DEPARTMENT OF MECHANICAL ENGINEERING

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PROCESS PIPING FABRICATION FROM 07/02/2022 TO 24/02/2022

ASSESSMENT TEST

14

Roll Number: 1994IA0341 **Name of the Student:** S. Abdul Rasheed

Time: 20 Min **(Objective Questions)** **Max.Marks 20**

Note: Answer the following Questions and each question carries **one** mark.

1. What does "pipe size" refer to in a piping system? [b]
a) Length of the pipe
b) Diameter of the pipe
c) Wall thickness of the pipe
d) Material of the pipe

2. Pipe schedules indicate: [d]
a) Pipe manufacturing location
b) Pipe pressure rating
c) Pipe material composition
d) Pipe wall thickness

3. What are dimensional tolerances in piping systems? [C]
a) Measurements of pipe diameter
b) Allowable variations in pipe dimensions
c) Pipe pressure limits
d) Design criteria for pipe supports

4. Pressure ratings of pipes are related to their ability to withstand: [C]
a) Temperature fluctuations
b) Corrosion
c) Fluid flow velocity
d) Pressure stresses

5. Which of the following is NOT a frequently used material in piping systems? [C]
a) Steel
b) Copper
c) Glass
d) PVC

6. What factors are considered when selecting materials for piping systems? [C]
a) Color preference
b) Availability of materials
c) Fluid type, pressure, temperature, and corrosion resistance
d) Material cost only

7. The roles and responsibilities of the piping discipline refer to: [c]
a) The study of fluid dynamics
b) Organizing pipe sizes and schedules
c) Functions and duties of professionals working in piping design
d) Pressure testing of pipes

8. What are key piping deliverables in a project? [c]
a) Invoice reports
b) Material costs
c) Important documents produced during various project phases
d) Project management reports

9. The cost of a piping system includes: [c]
a) Material costs only
b) Labor costs only
c) Material, labor, and maintenance costs
d) Maintenance costs only

10. Piping codes and design factors depend on: [d]
a) Project location
b) Pipe color
c) Fluid viscosity
d) Fluid type, pressure, temperature, and corrosion

11. What is the purpose of providing essential definitions and terminology in piping engineering? [c]
a) To confuse engineers and designers
b) To demonstrate author's vocabulary knowledge
c) To ensure a common understanding among professionals
d) To list all possible technical terms

12. The essential definitions and terminology are based on: [c]
a) The opinions of industry experts
b) The author's personal preferences
c) The author's experience in EPC companies
d) Academic research

13. What does EPC stand for in the context of the chapter? [a]
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b) Essential Piping Concepts
c) Economic Piping Criteria
d) Engineering, Procurement, and Construction

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a) To impress colleagues with technical jargon
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c) To enhance collaboration and clarity in project communication
d) To highlight the author's linguistic skills

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a) The list of all pipe sizes
b) A collection of technical terms and concepts
c) The language spoken by pipe manufacturers
d) The sound of flowing fluids in pipes

18. What is the significance of the author's experience in defining essential vocabulary? [a]
a) It indicates the author's expertise in linguistics
b) It adds credibility and relevance to the provided definitions
c) It showcases the author's artistic writing style
d) It guarantees the accuracy of the definitions

19. Which document outlines the project's required materials and quantities? [d]
a) Vocabulary report
b) Piping codes
c) Material selection criteria
d) Bill of materials

20. What is the main purpose of using standardized definitions and terminology in piping projects? [a]
a) To confuse readers
b) To make documents longer
c) To ensure clear communication and understanding
d) To promote the author's vocabulary preferences

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ASSESSMENT TEST

12

Roll Number: 20945A0344 **Name of the Student:** Y. Ashok

Time: 20 Min **(Objective Questions)** **Max.Marks 20**

Note: Answer the following Questions and each question carries **one** mark.

1. What does "pipe size" refer to in a piping system? [b]
a) Length of the pipe
b) Diameter of the pipe
c) Wall thickness of the pipe
d) Material of the pipe

2. Pipe schedules indicate: [a]
a) Pipe manufacturing location
b) Pipe pressure rating
c) Pipe material composition
d) Pipe wall thickness

3. What are dimensional tolerances in piping systems? [b]
a) Measurements of pipe diameter
b) Allowable variations in pipe dimensions
c) Pipe pressure limits
d) Design criteria for pipe supports

4. Pressure ratings of pipes are related to their ability to withstand: [c]
a) Temperature fluctuations
b) Corrosion
c) Fluid flow velocity
d) Pressure stresses

5. Which of the following is NOT a frequently used material in piping systems? [c]
a) Steel
b) Copper
c) Glass
d) PVC

6. What factors are considered when selecting materials for piping systems? [a]
a) Color preference
b) Availability of materials
c) Fluid type, pressure, temperature, and corrosion resistance
d) Material cost only

7. The roles and responsibilities of the piping discipline refer to: [c]
a) The study of fluid dynamics
b) Organizing pipe sizes and schedules
c) Functions and duties of professionals working in piping design
d) Pressure testing of pipes

8. What are key piping deliverables in a project? [c]
a) Invoice reports
b) Material costs
c) Important documents produced during various project phases
d) Project management reports

9. The cost of a piping system includes: [4]
a) Material costs only
b) Labor costs only
c) Material, labor, and maintenance costs
d) Maintenance costs only

10. Piping codes and design factors depend on: [d]
a) Project location
b) Pipe color
c) Fluid viscosity
d) Fluid type, pressure, temperature, and corrosion

11. What is the purpose of providing essential definitions and terminology in piping engineering? [C]
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d) To reduce the need for project documentation

15. Which phase of a project involves translating design plans into physical Installations? [c]
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c) Construction
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a) Vocabulary report
b) Piping codes
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d) To promote the author's vocabulary preferences

Process Piping Fabrication

G.VENKATA SUBBAIAH

ProcessPipingFundamentals,CodesandStandards

One of the most important components of the process infrastructure is the vastnetwork of pipelines —literally millions and millions of miles. The term process pipinggenerally refers to the system of pipes that transport fluids (e.g. fuels, chemicals,industrial gases, etc.) around an industrial facility involved in the manufacture ofproducts or in the generation of power. It also is used to describe utility pipingsystems (e.g., air, steam, water, compressed air, fuels etc.) that are used in, or insupport of the industrial process. Also, certain drainage piping, where corrosive ortoxicfluidsarebeingtransportedandsevereconditionsmaybepresent,orwhereitis simply outside the scope ofplumbingcodes, is also sometimes classified asprocess piping. Some places where process piping is used are obvious, such aschemicalandpetrochemicalplants,petroleumrefineries,pharmaceuticalmanufacturin g facilities, and pulp and paper plants. However, there are many othernot so obvious places where process piping is commonplace, such as semiconductorfacilities, automotive and aircraft plants, water treatment operations, waste treatmentfacilities andmanyothers.

This course provides fundamental knowledge in the design of process piping. Itcovers theguidanceonthe applicablecodesandmaterials.

This course is the 1st of a 9-module series that cover the entire gamut of pipingengineering. All topics are introduced to readers with no or limited background onthesubject.

ThiscourseisdividedinThree(3)chapters:

CHAPTER-1: THEBASICSOFPIPINGSYSTEM

Thischaptercoverstheintroductiontothepipesizes,pipeschedules, dimensional tolerances, pressure ratings, frequentlyusedmaterials,criterialformaterialselection,associations involvedin generatingpipingcodes,design factors dependingon fluid type, pressure, temperature and corrosion, roles andresponsibilities of piping discipline, key piping deliverables andcostofpipingsystem.

CHAPTER–2: DEFINITIONS, TERMINOLOGY AND ESSENTIALVOCABULARY

Thischapterprovidesessentialdefinitionsandterminology, each piping engineer and designer should familiar with. This isbased on the Author's experience on the use of vocabulary inmost design engineering, procurement and construction (EPC)companies.

CHAPTER–3: DESIGNCODESANDSTANDARDS

This chapter discusses the associations involved in generatingpiping codes and material specifications. It provides descriptionof various ASME pressure piping codes such as B31.1 PowerPiping,B31.3ProcessPiping,B31.4PipelineTransportationSystems forLiquid Hydrocarbons,B31.5 Refrigeration Pipingand Heat Transfer Components, B31.8 Gas Transmission andDistribution Piping Systems, B31.9 Building Services Piping andB31.11 Slurry Transportation Piping Systems.It also providesinformationontheassociationsinvolvedinmaterialspecificationssuchasAPI-AmericanPetroleumInstituteStandards,ASTM–AmericanSocietyofTestingMaterials,ASMEPipingComponentsStandards,AmericanWeldingSociety(AWS),AmericanWaterWorksAssociation(AWWA) andEN–EuropeanStandards.

CHAPTER- 1

1. THEBASICSOFPIPINGSYSTEM

A pipingsystem is an assembly ofpipe, fittings, valves, and specialty components.All piping systems are engineered to transport a fluid or gas safely and reliably fromonepiece ofequipmentto another.

Pipingisdividedintotwomaincategories:

- Smallborelines
- Largeborelines

As a general practice, those pipe lines with nominal diameters 2" (50mm) and underareclassifiedas small bore andgreaterthan2"(50mm)NBas largebore.

This course is designed to introduce you to the basic concepts of piping engineering,whichisallaboutdesigning,fabricatingandconstructinglinesforconveyingfluids.

1.1. ABBREVIATIONS

NPS	NominalPipeSize
DN	DiamètreNominal
ID	InsideDiameter
OD	OutsideDiameter
SCH	Schedule(WallThickness)
STD	StandardWeightWallThickness
XS	ExtraStrongWallThickness
XXS	DoubleExtraStrongWallThickness

1.2. PIPE SIZES

Pipesizesaredesignatedbytwonumbers:DiameterandThickness.

In the US, pipe size is designated by two non-dimensional numbers: Nominal PipeSize(NPS)andschedule (SCH).Let's check somekeyrelationships:

- Nominal pipe size (NPS) is used to describe a pipe by name only. Nominalpipe size (NPS) is generally associated with the inside diameter (ID) for sizes1/8"to12".Forsizes14"andbeyond,theNPS isequal totheoutsidediameter(OD)in inches.

- Outside diameter (OD) and inside diameter (ID), as their names imply, refer topipe by their actual outside and inside measurements. Outside diameter (OD)remainssameforagivensize irrespectiveofpipethickness.
- Schedulereferstothepipewallthickness.Astheschedulenumberincreases,thewal lthicknessincreases,andtheinsidediameter(ID)isreduced.
- Nominal Bore (NB) along with schedule (wall thickness) is used in Britishstandardsclassification.

Important

In process piping, the method of sizing pipe maintains a uniform outside diameterwhilevaryingtheinsidediameter.Thismethodachievesthedesiredstrengthneces sary for pipe to perform its intended function while operating under varioustemperatures and pressures. It is also important to maintain certain interchangeabilityofpipefittings.

1.2.1.TheEuropeandesignation

TheEuropeandesignationequivalenttoNPSisDN(DiamètreNominal/nominaldiameter).T he pipesizesaremeasuredin millimetres.

Relationship-NPS andDN pipesizes

NPS	½	3/4	1	1¼	1½	2	2½	3	3½	4
DN	15	20	25	32	40	50	65	80	90	100

Note - For NPS of 4 and larger, the DN is equal to the NPS multiplied by 25 (not25.4).

1.3. PIPESCHEDULES(SCH)

The Schedule of pipe refers to the wall thickness of pipe in the American system.Elevenschedulenumbers areavailable forCarbonSteel Pipes:

5,10, 20, 30, 40, 60,80,100, 120, 140,&160

Themost popular schedule, byfar,is40.

Schedules 5, 60, 100, 120, & 140 have rarely been used.Thickness of the pipe increases with the schedule number.Thismeansthat:

- Schedule80steelpipeswillbeheavier andstrongerthanschedule40pipe.
- Schedule 80 pipe will provide greater factor of safety allowing it to handlemuchhigherdesign pressures.
- Schedule 80 pipe will use more material and therefore costlier to make andinstall.

Stainless steel piping schedules generally match with Carbon Steel piping schedules,but are alwaysidentified with Suffix S from 1/8” to 12”. Schedule 40S and 80S arethe same as their corresponding schedule 40 and 80 in all sizes except 12” inschedule40.

1.3.1. How tocalculateSchedule?

Asimpleruleof thumbexpressionis:

Schedule Number = (1,000)

(P/S)Where,

- P=theinternalworkingpressure, psig
- S=theallowablestress(psi)forthematerialofconstructionattheconditionsofuse.

<u>Example</u>

CalculateallowableinternalpressurePforSchedule40mildsteelpipehavingultimatete nsile strength(Svalue)of65,300psi.

Rearrangethescheduleequation:

P=SCHxS/1,000

Therefore,P=40x65,300/1,000=2,612psi.

This is reasonable, based on a current-day published value of 2,849-psi for 1-inchSchedule40 steel pipe.

1.4. INTERNALDIAMETER(ID)OFPIPE

Forprocessengineers,themostimportantparameterforhydraulicsizingisthepipeInternalD iameter(ID).

The ID can then easily be calculated

as:ID =OD -2t

Example

A4inchesSchedule40pipehasanoutsidediameterof4.500inches,awallthickness of0.237inches.

Therefore,PipeID=4.5inches – 2x0.237inches =4.026inches

A4inchesSchedule80pipehasanoutsidediameterof4.500inches,awallthickness of0.337inches.

Therefore,PipeID=4.5inches – 2x0.337inches =3.826inches

1.5. PIPINGDIMENSIONALSTANDARDS

Pipe sizes are documented by a number of standards, including API 5L, **ANSI/ASMEB36.10M**in theUS, andBS 1600and BS1387intheUnited Kingdom.

Typically, the pipe wall thickness is the controlled variable, and the Inside Diameter(I.D.) is allowed to vary. The pipe wall thickness has a variance of approximately 12.5percent.

Standard Carbon Steel Welded and Seamless Pipe

SizesANSI/ASMEB36.10

NominalPipe Size (NPS)	PipeSchedule	Outside Diameter	InsideDiameter	WallThickness
0.75'	40	1.05'	0.824'	0.113'
0.75'	80	1.05'	0.742'	0.154'
0.75'	160	1.05'	0.612'	0.219'
1"	40	1.315'	1.049'	0.133'
1"	80	1.315'	0.957'	0.179'
1"	160	1.315'	0.815'	0.25'
1.25”	40	1.66'	1.38'	0.14'
1.25'	80	1.66'	1.278'	0.191'
1.25'	160	1.66'	1.16'	0.25'
1.5'	40	1.9'	1.61'	0.145'
1.5'	80	1.9'	1.5'	0.2'
1.5'	160	1.9'	1.338'	0.281'
2"	40	2.37'5	2.067'	0.154'
2"	80	2.37'5	1.939'	0.218'
2"	160	2.37'5	1.687'	0.344'
2.5'	40	2.87'5	2.469'	0.203'
2.5'	80	2.87'5	2.323'	0.276'
2.5'	160	2.87'5	2.125'	0.375'

NominalPipe Size (NPS)	PipeSchedule	Outside Diameter	InsideDiameter	WallThickness
3"	40	3.5'	3.068'	0.216'
3"	80	3.5'	2.9'	0.3'
3"	160	3.5'	2.804'	0.438'
4"	40	4.5'	4.026'	0.237'
4"	80	4.5'	3.826'	0.337'
4"	160	4.5'	3.438'	0.531'
5"	40	5.563'	5.047'	0.258'
5"	80	5.563'	4.813'	0.375'
5"	160	5.563'	4.313'	0.625'
6"	40	6.625'	6.065'	0.28'
6"	80	6.625'	5.761'	0.432'
6"	160	6.625'	5.187'	0.719'
8"	40	8.625'	7.981'	0.322'
8"	80	8.625'	7.625'	0.5'
8"	160	8.625'	6.813'	0.906'
10"	40	10.75'	10.02'	0.365'
10"	80	10.75'	9.562'	0.594'
10"	160	10.75'	8.5'	1.125'
12"	40	12.75'	11.938'	0.406'
12"	80	12.75'	11.374'	0.688'
12"	160	12.75'	10.126'	1.312'

1.6. DIMENSIONALTOLERANCES

Thedimensionaltolerancesforpipesareprovidedby**ASTMA530**standardthatpermitsfollowingvariations inpipesize,pipelengthsandtheweight.

Nominalpipesize

- Up to4" = ±0.79mm
- 5 thru 8"=+1.58mm/-0.79mm
- 10thru 18"=+ 2.37mm/-0.79mm
- 20thru 24"=+ 3.18mm/-0.79mm

WallThickness

Mostpipingstandardsallowpipemanufacturersafabricationmilltolerance of12.5%onthe wall thickness.

- AllDiameters=- 12.5%(+tolerancenotspecified)

- Length=+6.40mm/-0mm
- Weight=+ 10%/-1.5%

1.7. PRESSURERATINGS

The pressure rating of the pipe is associated to the maximum allowable workingpressure. It is the ability of the pipe material to resist the internal pressure andpressuresurges. Itisdefined bypipe schedule orthickness.

Minimum wall thickness of pipe is calculated by ASME B31.3 code (hoop stress)formula:

$$t = \frac{PD}{2(SE + PY)} + A$$

$$t_m = t + A$$

Where,

- t=requiredwallthickness, inches
- tm=minimumrequiredwallthickness,inches
- P=Designpressure,psi
- D= Pipeoutsidediameter,inches.
- A=Corrosionallowance,inches
- S = Allowable Stress @ Design Temperature, psi (From ASME B31.3, TableA-1)
- E= Longitudinal-jointqualityfactor(FromASMEB31.3,TableA-1B)
- Y = Wall thickness correction factor (From ASME B31.3, Table

304.1.1)Example

Calculatethepipewallthicknessforfollowing designconditions:

- DesignPressure(P)= 3000psig
- DesignTemp(T)=85°C=185°F
- Diameterof Pipe(D)=12"
- Material= API 5LGr BSeamless
- TensileStress=60Ksi=60000Psi

- YieldStress=35Ksi=35000Psi
- AllowableStress@DesignTemperature(S)=20000Psi
- CorrosionAllowance(A)= 3mm=0.1181099inch
- MillTolerance=12.5%
- Longitudinalweldjoints(E) =1.0for Seamlesspipe.
- Values of Co-efficient (Y) = 0.4 (Below 900

°F)DesignFormula:

$$t = \frac{PD}{2(SE+PY)} + A$$

t=(3000 x12)/2[(20000 x1)+(3000 x0.4)]

= 36000/42400

t = 0.849056

incht_m= t+A

=0.849056+ 0.1181099

= 0.96716inch

Most piping specifications allow the manufacturer a (-) 12.5% dimensional toleranceon the wall thickness; the minimum wall thickness can be as low as 87.5% (1 – MillTolerance) of the nominal value. Therefore, in selecting the pipe schedule, tm shouldbedivided by0.875togetnominal thickness.

$t_{nom.}$=0.96716/ 0.875

= 1.1053inch

$t_{nom.}$=28.07462mm(AsperDesign)

Therefore,MinimumThicknessRequired=Sch140(28.58mm)

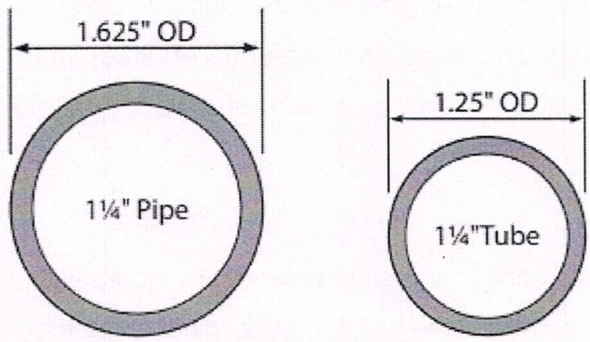
1.7.1.Pressure–TemperatureRelationship

Among other parameters, the pressure rating of the pipe is also influenced by thetemperature of the fluid.The hotter the fluid, the lower the pressure it can hold andthereforehighershould bethe pressure rating.Tablebelow providespressureratings ofCarbon Steel.Ratings are given for standard seamless pipe sizes attemperaturesfrom100°Fto750°F.AllratingsareinpsigandarebasedonANSI/ASMEB 31.1.

1.8. DIFFERENCEBETWEENPIPEANDTUBE

Tubing is supplied in sizes up to four inches in diameter but has a wall thickness lessthan that of either large bore or small bore piping. The essential difference betweenpipeandtubeisthatpipeisspecifiedby nominalboreandschedule.Tubeisspecifiedbytheoutsidediameter(OD)and awallthickness.

For example: The actual outside diameter of 1¼" pipe is 1.625" – while 1¼" tube hasatrue 1.25"outsidediameter



1.9. FREQUENTLYUSEDPIPEMATERIALS

1.9.1. CarbonSteel

Thevastmajorityof pipingismadeof CarbonSteel.

Carbon steel contains only a tiny amount of carbon; sometimes much less than 1%andisclassified as:

- MildSteels - upto0.3%Carbon
- Medium CarbonSteels(orsimplyCarbonSteels)-0.3to0.6% carbon
- HighCarbonSteels-over0.6%Carbon

Thecarbon%ageinfluences themechanicalcharacteristics ofthematerial.

- Materialcontainingcarbonmorethan0.35becomesbrittle.
- Materialcontaining carbonmorethan0.43are**NOT**weldable

Lowcarbonsteelisthemostcommonindustrialpipingmaterial.Thematerialspecifications are governed by ASTM A53 and ASTM A106 standards which definesthree Grades A, B and C. The grades refer to the tensile strength of the steel, withGrade C having the highest strength. Grade B permits higher carbon and manganesecontents than Grade A.A106 is preferable for more stringent high temperature andhighpressure services.

1.9.2. AlloySteel

- Nickel Steels - These steels contain from 3.5% nickel to 5% nickel. The nickelincreases the toughness and improves low temperature properties (up to -150°F/-100°C). Nickel steel containing more than 5% nickel has an increasedresistancetocorrosion and scale.
- Molybdenum - Molybdenum provides strength at elevated temperatures. It isoften used in combination with chromium and nickel. The molybdenum addstoughness to the steel and can be used in place of tungsten to make thecheaper gradesofhigh-speedsteel foruseinhigh-pressure tubing.Anaddition of about 0.5% Molybdenum greatly improves the strength of steel upto 900°F/480°C. Moly is often alloyed to resist corrosion of chlorides (like seawater).
- ChromiumSteels-Chromiumandsiliconimprovehardness,abrasionresistanceandcorrosionresistance.Anadditionofupto9%Chromiumcombats the tendency to oxidize at high temperatures and resists corrosionfrom sulfurcompounds.StainlessSteelscontainat least10.5%Chromium.
- Chrome Vanadium Steel - This steel has the maximum amount of strengthwith the least amount of weight. Steels of this type contain from 0.15% to0.25%vanadium,0.6%to1.5% chromium,and0.1%to0.6%carbon.
- TungstenSteel-Thisisaspecialalloythathasacharacteristicpropertyofred hardness. It has the ability to continue to cut after it becomes red-hot. Agood grade of this steel contains from 13% to 19% tungsten, 1% to 2%vanadium,3%to5%chromium,and0.6%to0.8%carbon.
- ManganeseSteels-Smallamountsofmanganeseproducestrong,free-machining steels. Larger amounts (between 2% and 10%) produce somewhatbrittlesteel,whilestilllargeramounts(11%to14%)producesteelthatistoughandveryresistantto wearafterproperheattreatment.

1.9.3. StainlessSteel

Stainless steel pipe and tubing are used for a variety of reasons: to resist corrosionandoxidation,to resist high temperatures, for cleanlinessandlow maintenancecosts, andtomaintainthepurityofmaterials whichcomeincontact withstainless.

The ability of stainless steel to resist corrosion is achieved by the addition of aminimumof12%chromiumtotheironalloy.Nickel,molybdenum,titaniumandother elements are often alloyed along in varying quantities to produce a wide range ofStainless Steelgrades,each with its unique properties.

Stainless steel is classified by the American Iron and Steel Institute (AISI) into twogeneralseriesnamedthe200-300seriesand 400 series.

1.9.4. AusteniticSteel

The 200-300 series of stainless steel is known as Austenitic. There are eighteendifferentgradesof Austenitic steel,ofwhichtypeSS304isthemost widelyused.

Grade SS304 contains 18% chromium and 8% nickel. It has a maximum carboncontentof.08%.

It is not recommended for use in the temperature range between 400°C and 900°Cdue to carbide precipitation at the grain boundaries which can result in inter-granularcorrosionand earlyfailure undercertain conditions.

Type 304L. Is the same as 304 except that a 0.03% maximum carbon content ismaintained which precludes carbon precipitation and permits the use of this analysisinweldedassembliesundermoreseverecorrosiveconditions.

Grade SS316 contains 16% chromium, 10% nickel and 2% molybdenum. It has highresistancetochemical and saltwatercorrosion.

Stainless steel pipe is manufactured in accordance with ASTM A312 when 8" orsmallersizesareneeded.

Largesizes(8" andup)of stainlesssteelpipearecoveredbyASTMA358.

Extra light wall thickness (schedule 5S) and light wall thickness (schedule 10S)stainless steel pipesarecoveredbyASTMA409.

400SeriesStainlessSteel

The400seriesof steelissubdividedintotwomaingroups:FerriticandMartensitic.

1.9.5. FerriticSteel

These are plain chromium stainless steels with chromium content between 12 and18% but with low carbon content in ranges of 0.08% to 0.20%. They offer moderatecorrosionresistance,nothardenable byheattreatment.

- Theyaremagnetic.
- Weldabilityandformabilityarepoor.

- Theyarefrequentlyusedforadecorativetrimwiththeequipmentbeingsubjectedto high pressuresandtemperatures.
- Thetypicalgradeis430.

1.9.6. MartensiticSteel

MartensiticSSexhibitrelatively highcarboncontent(0.1-1.2%)with12to18%chromium.Theywere theoriginal commercial SS.

- Theyaremagnetic.
- Theyoffermoderatecorrosionresistanceandcanbeheattreated.
- Theyhavehighstrengthbut weldabilityisbad.
- Thetypicalgradeis410.

1.9.7. DuplexStainlessSteel

Duplex Stainless Steel has high chromium content (between 18 and 28%) and areasonableamountofnickel(between4.5and8%).Thesesteelsexhibitacombination of ferritic and austenitic structure and hence called duplex. Some duplexsteels containmolybdenum from2.5-4%.

- Theyofferexcellentresistancetostresscorrosioncracking.
- Thesehavebetterresistancetochlorides.
- Theyarebetterthanausteniticandferriticsteelsintensileandyieldstrengthwhileoffering goodweldabilityand formability.
- Thetypicalgradeis2205.

1.9.8. Cast Iron/DuctileIron

Cast iron is any iron containing greater than **2%** carbon. The high carbon contentmakes it extremely hard and brittle. Cast iron has a high compressive strength andgoodwearresistance;however,it lacksductility, malleability,andimpactstrength.

Two types of cast iron are used, grey cast iron and ductile iron. Both Grey Iron andDuctile Iron are prepared by adding carbon in the hot beds where they are liquefiedbut ductile iron develops high strength and ductility with the addition of small amountsofmagnesiumtograyiron.

1.9.9. GalvanizedPipe

Galvanized iron pipe (GI) is a regular iron pipe that is coated with a thin layer of zinc.The zinc greatly increases the life of the pipe by protecting it from rust and corrosion.GI usually comes in 6-meter (21-foot) lengths, and is joined together by threadedconnections.

1.9.10. Titanium

Titaniumhassuperbcorrosionresistanceespecially forseawaterdutiesinheatexchanger tubes/piping. This material is relatively expensive compared to most othermaterials;however,iflifetimecosting isconsidered,itwouldlikelybecompetitive.

1.9.11. Copper,Brass,CopperNickelAlloys

Coppertubingisusedwhereeaseoffabricationisimportant.

70%/30% - Cu/Zn brass is a good general purpose material used for a variety ofapplications,e.g.heatexchangertubesandclosed circuitsystems.

Brass with 76%/2%/0.04%-Cu/Al/As and RemainderZn has good resistance toseawaterattackandis used fordiverseprocessplants fortransferringseawaterunderturbulentconditions toresistcorrosionandimpingementattack.

Admiraltybrass70%/1%/29%-Cu/Sn/Znhasslightlyimprovedresistancetopollutedwatercomparedto70/30brass.

Cupro Nickel Containing31%/2% -Ni/Fe and “Kunifer" containing10.5%/1.7% -Ni/Fe are also used for transferring seawater and high good strength at elevatedtemperatures.

1.9.12. PlasticPipingSystems

The two most common types of plastic pipe are Polyethylene (PE) and Polyvinylchloride(PVC).

- Polyethylene pipe (PE) and HDPE are lightweight, flexible pipes that come inlarge coils 30 meters or more in length. The pipe varies in density and isgenerallyjoinedbyheatfusion.Thejointistypicallyleak free.
- Plastic polyvinyl chloride pipe (PVC) is a rigid pipe, usually white or gray incolor. It comes in 3 or 6 meter lengths and is joined primarily by solventcement. The pipe varies in density and, when buried is extremely resistant tocorrosion.

Plasticpipesdohavelimitationsonthemechanicalandthermalproperties.

1.10. GRADES

In steel pipe, the word "grade" designates divisions within different types based oncarboncontentormechanicalproperties (tensileandyieldstrengths).

- Grade A steel pipe has lower tensile and yield strengths than Grade B steelpipe. This is because it has lowercarbon content. Grade A is more ductileandis betterforcoldbendingandclose coilingapplications.
- GradeBsteelpipeisbetterforapplicationswherepressure,structuralstrength and collapse are factors. It is also easier to machine because of itshigher carbon content. It is generally accepted for Grade B welds as well asGradeA.

1.11. PIPECONSTRUCTION

- **ElectricResistanceWelding(ERW)**
  - Electric Resistance Welding (ERW) pipe is manufactured by rollingmetal and then welding it longitudinally across its length. The weldzonecanalsobeheattreated,sotheseamis less visible.
  - Weldedpipeoftenhastighterdimensionaltolerancesthanseamless, and can be cheaper if manufactured in large quantities.These can be manufactured up to 24” OD in a variety of lengths toover100feet.
  - It is mainly used for low/ medium pressure applications such astransportationofwater /oil.
  - Other welding technique for pipe fabrication is fusion weld (FW)sometimes called “continuous weld” or spiral weld (SW) pipe. Thebasic differencebetween ERWandFWis:
    - Nomaterialisaddedduringwelding processinERW.
    - FillermaterialisaddedduringweldingprocessinFW.
    - Largediameterpipe(about10”orgreater)maybeERW,orSubmerg edArcWelded(SAW)pipe.

SubmergedArcWelded(SAW)

- Submerged Arc Welding (SAW) is an arc welding process whereanarcisestablishedbetweenoneormorecontinuousbare-solidor cored-metal electrodes and the work. The welding arc or arcsand molten puddle are shielded by a blanket of granular, fusiblematerial.Fillermetalisobtainedfromtheelectrodes,andonoccasion,fromasupplementaryweldingwire.

Seamless(SMLS)

- Seamless(SMLS)pipeismanufacturedbypiercingabilletfollowedbyrollingordrawing,orbothtothedesiredlength;therefore, a seamless pipe does not have a welded joint in itscross-section.
- Seamlesspipeisfinishedtodimensionalandwallthicknessspecifications in sizes from 1/8 inch to 26 inch OD. Seamless pipeis produced in single and double random lengths. Single randomlengths vary from 16'-0" to 20'-0" long. Pipes that are 2" and beloware foundindoublerandomlengthsmeasuring35'-0" to40'-0"long.
- Seamless pipe is generally more expensive to manufacture butprovides higherpressureratings.

Important

PressurePipingCodeB31waswrittentogovernthemanufactureofpipe.Inparticular, code B31.1.0 assigns a strength factor of 85% for a rolled pipe, 60% for aspiral-weldedand 100%efficiencyfor aseamlesspipe.

Generally, wider wall thicknesses are produced by the seamless method. Seamlesspipeis usuallypreferredoverseamweldedpipeforreliabilityandsafety.

Seamless pipes cannot be substituted for others. Only ERW and SAW pipes can besubstituted.

Seam welded pipe should not be specified for installation in which it will be operatingin the material's creep range [700°F (370°C) for carbon/low alloy steels and from800°F(430°C)forhighalloyandstainlesssteels].However,forthemanylow-pressureusesofpipe,thecontinuousweldedmethodis themosteconomical.

HowtoIdentifySeamlessorERWStainlessSteel pipes?

To identify that a pipe supply is seamless or ERW, simply read the stencil on the sideofthe pipe

- IfitisASTMA53,
  - TypeSmeansseamless.
  - TypeFisfurnacebut welded.
  - TypeEisElectricalresistancewelded.

That'showit istheeasiest waytoidentifywhetherpipeisseamlessorERW.

RecommendedGuidelines

- Allpipelinescarryingtoxicinflammablefluidsshallbeseamless.
- Utilitypiping canbeERWorSeamwelded.
- Steampipelinesshallpreferablybeseamless.

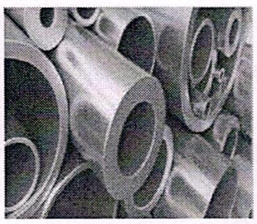
1.12. PIPEPROCUREMENT

- **StandardSizes**
  - NPS1/8,¼,3/8,½,¾,1,1½,2,3,4,6,8,10,12,14,16,18,20,24, 28,30,32,36, 40,44,48, 52,56,60.
  - NPS1¼, 2½,3½,5areNOTused.
- **StandardLengths**
  - Pipe is supplied in Random length (18 to 25 ft.) or double randomlength(38to48ft.).
- **EndPreparation**

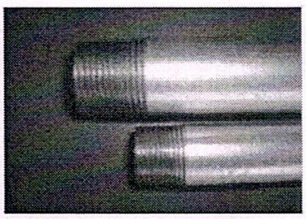
Steel pipes can generally be specified with a specific end preparation at thetimeofpurchase.Threeend prepsarestandard.

- **Plain Ends (PE) -** A plain end pipe is a pipe that has been cut at90° perpendicular to the pipe run. This type of end is needed whenbeing joined by mechanical couplings, socket weld fittings, or slip-onflange.

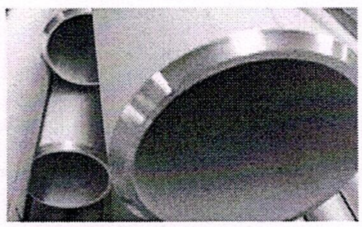
- **Bevel Ends (BE) -** A bevel is a surface that is not at a right angle(perpendicular) to another surface. The standard angle on a pipebevel is 37.5° but other non-standard angles can be produced.Bevelingof pipeortubingistopreparetheendsforButtwelding.
- **Threaded Ends (TE) -** Typically used on pipe 3" and smaller,threadedconnectionsarereferredtoasscrewedpipe.Withtapered grooves cut into the ends of a run of pipe, screwed pipeand screwed fittings can easily be assembled without welding orother permanent means of attachment. In the United States, thestandard pipe thread is National (not nominal) Pipe Thread (NPT).The reason forthis is thatas NPTconnections are assembled,they becomeincreasinglymoredifficult fortheprocesstoleak.ThestandardtaperforNPTpipeis3/4"foreveryfoo



PLAIN END



THREAD END



BEVEL END

t.

CommonAbbreviations

Commonabbreviationsforthetypesof pipeendsareasfollows:

BevelEnd(BE) Bevel Both Ends (BBE)Bevel Large End (BLE)Bevel One End (BOE)Bevel Small End (BSE)Bevel for Welding (BFW)Butt weld End(BE)	End of Pipe (EOP)FlangeOneEnd(FOE)Plain End(PE) PlainBothEnds(PBE)P lainOneEnd(POE)	ThreadEnd(TE) ThreadBothEnds(TBE)T hread Large End (TLE)Thread One End (TOE)Thread Small End (TSE)Threads Only (TO)ThreadsperInch(TPI)

1.13. PIPINGDESIGN

The main aim of piping design is to configure and lay equipment, piping and otheraccessories meeting relevant standards and statutory regulations. The piping designandengineering involvessix(6)majorsteps:

- Selectionofpipematerialsonthebasisofthecharacteristicsofthefluidandoperating conditionsincludingmaximumpressuresandtemperatures.
- Findingeconomicalpipediameterandwallthickness.
- Selectionofjoints,fittingsandcomponentssuchasflanges,branchconnections,ext rudedtees,nozzlebranchesetc.
- Developingpipinglayoutandisometrics.
- Performingstress analysis takinginto account the potential upsetconditionsandanallowanceforthoseupsetconditionsinthedesignof pipingsystems.
- Estimatingmaterialtake-off(MTO)andraisingmaterialrequisition.

1.13.1. CodesandStandards

The design basis for any project should state the required design codes for materialsand equipment. This is usually set by the client, and the engineer should review therequirements to assure they are complete and not contradictory. Local laws mayrequirespecialrequirementsforhurricanes,earthquakesorotherpublicsafetyissues.

The main associations involved in generating piping codes and standards for processindustryin US are:

- ASME:AmericanSocietyofMechanicalEngineers
- ANSI:AmericanNationalStandardizationInstitute
- ASTM:AmericanSocietyofTestingMaterials
- API: AmericanPetroleumInstitute(primarilyforOil&GasIndustry)

The basic rules for piping engineering are ASME B31 codes. The important codesare:

- ASMEB31.1-PowerPiping
- ASMEB31.2-FuelGasPiping
- ASMEB31.3-ProcessPiping
- ASMEB31.4-LiquidPiping
- ASMEB31.5-RefrigerationPiping
- ASMEB31.8-GasDistributionandTransportation

- ASMEB31.9-BuildingServicePiping
- ASMEB31.11-SlurryPiping
- ASME Boiler and Pressure Vessel Code applies to boiler suppliedpiping.
- For pipelines there are Department of Transportation requirementsthatmayapply,suchasCFRPart192.
- For modifications to existing plants, OSHA 1910.119 may apply toManagementofChange,MechanicalIntegrityandInspectionRequirements.

EachCodeprovidesthetypicalloadingconditionstobeconsidered;allowablestresses; minimum wall thickness calculations; and minimum fabrication, inspectionandtesting requirements.

1.13.2. PipingMaterialSpecifications(PMS)

The Pipe Material Specification (PMS)istheprimary specification document forpiping engineers. This document describes the physical characteristics and specificmaterial attributes of pipe, fittings and manual valves necessary for the needs of bothdesign and procurement. These documents also become contractual to the projectandthosecontractorsthatworkunderthem.

- **TenEssentialItemsofPMS**

  A piping specification should contain only those components and informationthat would typically be used from job to job. The ten line items below providethe primary component information and notations required for a typical pipingsystem.

  - Pressure/Temperaturelimitofthespec
  - LimitingfactorforPressure/Temperature
  - Pipematerial
  - Fittingtype,ratingandmaterial
  - Flangetype,ratingandmaterial
  - Gaskettype,ratingandmaterial
  - Bolt &nuttypeandmaterial

– Manualvalvesgroupedbytype
– Notes
– Branchchartmatrixwithcorrosionallowance

1.14. DESIGNFACTORS

Thedesignfactorsthatinfluencepipingengineeringinclude:

- FluidServiceCategories(Type)
- Flowrate
- Corrosionrate
- OperatingPressureandTemperature

AllthisinformationisavailableintheProcessFlowDiagrams(PFD's),PipingandInstrumentationDrawings (P&ID's)andPipingMaterialSpecification(PMS).

1.15. FLUIDSERVICECATEGORIES

ASMEB31.3recognizesthefollowingfluidservicecategoriesandaspecialdesignconsideration basedonpressure.

B31.3 FluidService	B31.3Definition	Containment SystemCharacteristics
Category D[Utility]	Category D fluid Service: a fluid serviceinwhich all of thefollowingapply: 1) The fluid handled is nonflammable,nontoxic, and not damaging to humantissues; 2) The design gage pressure does notexceed1035kPa(150psi);and 3) The design temperature is from -29ºC(-20ºF)to186ºC(366ºF).	Lowest cost Usuallynotfireresistant Usually not blow-outresistant
Normal[Process]	Normal Fluid Service: a fluid servicepertainingtomostpipingcoveredbyth is	Moderatecost Maybefireresistantor

	Code, i.e., not subject to the rules ofCategory D, Category M or HighPressureFluid Service.	not May be blow-outresistantor not
HighPressure	High Pressure Fluid Service: a fluidservice for which the owner specifies theuse of Chapter IX for piping design andconstruction. High Pressure Piping Service is definedas that in which the pressure is in excessof that allowed by the ASME B16.5 2500flangeclassratings.	Highcost Usuallyfireresistant Usually blow-outresistant
Category M[Lethal]	Category M Fluid Service: a fluid servicein which the potential for personnelexposure is judged to be significant andinwhichasingleexposuretoaverysmall quantity of a toxic fluid, caused byleakage, can produce serious irreversibleharm to persons on breathing or bodilycontact, even when prompt restorativemeasuresaretaken.	Highcost Usuallyfireresistant Usually blow-outresistant

A variety of other service conditions may result in different types of deteriorationincluding hydrogen damage, erosion, corrosion, fatigue, stress relief cracking etc.Embrittlement and creep are two of the several characteristics of metals associatedwithservice relateddeterioration.

1.16. FACTORSDEPENDINGUPONFLUIDTYPE

1. Material

Noncorrosivefluids:Serviceswhereimpuritiesareaccepted

- Example
  - Industrialwaterlines(coolingwater)
  - Steam

– Lubeoilreturn/beforefilterlines

  - Airlines
  - Ventsanddrains
- Material
  - CarbonSteel
  - LowAlloySteel(HighT)

Corrosivefluids:Serviceswhereimpuritiesarenotaccepted

- Example
  - Demineralizedwater
  - Lubeoilafterfilters
  - Fuelgas/oil
  - Seawater(watercontainingChlorine)
- Material
  - StainlessSteel
  - NoIron(Fe)
  - Copper/Nickel Alloys (Cu-

Ni)AggressiveChemicals

- Example
  - StrongAcids/Bases
- Material
  - Plastic:PVC –TEFLON– PE
  - Rubber:NBR,Viton
  - Composites:RESINGLASS

RefertoChapter3forfurtherdiscussiononpipingmaterials.

2. **CorrosionAllowances**

Thicknessofthepipeincreaseswithrespecttocorrosion.Typicalcorrosionallowanc eforwateris3mm.

3. **Typeof Joints**

Dangerousfluidsareconveyedinfullyweldedpipes,wereleaksarenotaccepted.

4. **TestingandExamination**

ForDangerousFluids100%ofjointsarelikelytobeX-Rayexamined

1.17. FACTORSDEPENDINGUPONFLOWRATE

1. **PipeDiameter**

- Foragiven flowrate
  - Smalldiametermeanshighervelocityoftheconveyedfluid.
  - Big diametermeansslowervelocityoftheconveyedfluid.
- Velocityoffluidsinpipelinesaffects
  - Pressurelossesalongthepipeline.
  - Pressurelossesareproportionaltothesquarevelocity.
  - Vibrationofthepipeline.
- Usualvelocitiesoffluidsinsidepipelinesare
  - Gas:20m/s-max.40/50 m/sec.
  - Liquid:2to4m/s-max.10m/sec.

1.18. FACTORSDEPENDINGUPONDESIGNPRESSURE

1. **WallThicknessCalculation**
2. **Typeof Joint**
   - Lowpressurepipelinescanbethreadedorsocketwelded
   - HighPressurepipelinesareButtWelded
3. **TestingandExamination**
   - NonprocessPipelines(ForExampleVentsanddrainlines)mayevenha ve no testsatall
   - LowPressurePipelinescanundergoonlytheHydraulicTest

- Forintermediatepressuresa10%to50%ofjointsmustbeexaminedwith X-rays
- HighPressurePipelinesareusually100%X-rayexamined.

Important

Note that the Design Pressure is selected based on Operating Pressure plus sometolerance to allow for system deviation from normal operating conditions. Determiningthe tolerance required can be complicated and needs to incorporate consideration ofitemssimilartothefollowing:

- Possibledeadheadingofpumps
- Possiblelossof temperaturecontrolscausingariseinpressure
- Achangeinreactionkineticswhichcouldcausepressurerises.
- Systempressurizationusinginertgas
- Thermalexpansionof somefluids

1.19. FACTORSDEPENDINGUPONTEMPERATURE

1. **Material**
   - Steelfor HighTemperature(LowAlloySteelCreepResistant)
2. **WallThicknessCalculation**
3. **ThermalInsulation**
   - T>60°CInsulationforPersonnelProtectionismandatoryforallpipelinep artsthatcanbereachedbyhands.

Important

The design temperature of the fluid in the piping is generally assumed to be thehighesttemperatureofthefluidintheequipmentconnectedwithsuchpiping.

1.20. STRESSANALYSIS

Hotlinesmustberoutedproperly.Provisionsshallbetakensothatwhenthetemperaturerise sfromambienttoanoperatingtemperature,thethermalexpansionofpipelines does notgeneratestressestoohighforthepipestowithstand.

1.21. COSTOFPIPINGSYSTEM

The piping installation cost is made up of material 30%, fittings 10%, installation labor25%, installation equipment 10%, supports 15% and P&G 10%. The total cost canvary from $600 to $1200 per meter, depending on the pipe diameter, slope of theterrain,andcross-countryorwell pad piping.

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CHAPTER- 2

2. DEFINITIONS,TERMINOLOGYANDESSENTIALVOCABULARY

- **BALANCEOFPLANT(BOP)**
  - This is another term for Offsite and/or anything else other than theOnsiteUnitsortheUtilityBlock.
- **BATTERYLIMIT**
  - Line used on a plot plan to determine the outside limit ofa unit.The Battery Limit line is usually established early in the project anddocumented on all discipline documents such as Plot Plans, SitePlans, Drawing Indexes, etc. In this area, feed to the plant orproduct fromthe plantisconnected fromanupstreamprocessor.to adownstreamprocess/storage.
- **BUILDINGCODE**
  - Abuildingcodeisasetofregulationslegallyadoptedbyacommunity to ensure public safety, health and welfare insofar astheyare affectedbybuildingconstruction.
- **BOUNDARY**
  - Boundaryoftheequipmentisthetermusedinaprocessingfacility,by animaginarylinethatcompletely encompassesthedefined site. The term distinguishes areas of responsibility anddefinestheprocessingfacilityfortherequiredscopeofwork.
- **BROWNFIELDPROJECTS**
  - Revampsandretrofits
  - Maintenanceandrepairs
  - Modificationsanddebottlenecking
  - Turnaroundsandshutdowns
  - Inspection

- **CATALYTICCRACKING**
  - A refining process for breaking down large, complex hydrocarbonmolecules into smaller ones. A catalyst is used to accelerate thechemicalreactionsinthecracking process.
- **CODESANDSTANDARDS**
  - A code is a set of regulations that tells you when to do something.A code will have requirements specifying the administration andenforcementofthe document.
  - A standard is a series of requirements that tell you how to dosomething.Astandardtendsnottohaveanyenforcementrequirements.Astandardbecomesanenforceabledocumentwhenitisadoptedbyreference inacode.
- **CONDENSATE**
  - Liquid hydrocarbons recovered by surface separators from naturalgas.Itisalsoreferredtoas naturalgasolineanddistillate.
- **COMMONCODES,STANDARDSANDPRACTICES**
  - ANSI(AmericanNationalStandardsInstitute)
  - API(AmericanPetroleumInstitute)
  - ASME(AmericanSocietyofMechanicalEngineers)
  - ASTM–AmericanSocietyof TestingMaterials
  - AWS(AmericanWeldingSociety)–
  - AWWA(AmericanWaterWorksAssociation)
  - CFR(CodeofFederalRegulations)
  - DivisionofWeights&Measures
  - DOT(DepartmentofTransportation)
  - FAR(FederalAccountingRegulations)
  - IRI(InsuranceRegulatorsInstitute)
  - LocalPermits(Country,State,City,etc.)
  - MSS(ManufacturingStandardsSociety)

- NACE(NationalAssociationofCorrosionEngineers)
- NFPA(NationalFireProtectionAssociation)
- OIA(OilInsurersAssociation)
- PFI(PipeFabricationInstitute)
- TEMA=ThermalExchangersManufacturersAssociation
- USCG(UnitedStatesCoastGuard)Regulations

- **CRYOGENICLIQUIDS**
  - Cryogenicliquidsaresubstanceshavingsub-zerotemperature.
- **DIKE**
  - A dike is an earth or concrete wall providing a specified liquidretention capacity. At many manufacturing or storage facilities, theflammable liquid storage area can be a number of small tankswithina commondiked area.
- **DOWNSTREAM**
  - Those activities in the oil and gas industry which take place awayfrom the source of the supply. Downstream operations commonlyincluderefining andmarketing endeavors.
- **ENVIRONMENT,HEALTH&SAFETY(EHS)**
  - AnEnvironmental,HealthandSafety(EHS)department,alsocalled SHE (Safety, Health and Environmental) or HSE (Health,Safety and Environment) is the department in a company or anorganizationinvolvedinenvironmentalprotection,worksafety,occu pational health and safety, compliance and best practices. Forexample,fire,explosionandreleaseofharmfulsubstancesintothee nvironmentortheworkareamustbeprevented.Organizationsbasedint heUnitedStatesaresubjecttoEHSregulations in the Code of Federal Regulations, particularly CFR29,40,and49.
- **EASEMENTS**
  - A vested or acquired right to use land other than as a tenant, for aspecificpurpose;suchrightbeingheldbysomeoneotherthanthe

owner who holds the title to the land. An easement is typically astrip of land within which overhead power lines or undergroundpipes arerun.

- **FEED**
  - FEED stands for Front End EngineeringDesign. The FEED isbasic engineering which comes after the Conceptual design orFeasibilitystudy.TheFEEDdesignfocusesthetechnicalrequirements as well as rough investment cost for the project. TheFEED can be divided into separate packages covering differentportions of the project. The FEED package is used as the basis forbidding the Execution Phase Contracts (EPC, EPCI, etc) and isusedasthedesignbasis.
- **FEEDSTOCK**
  - Rawmaterialorfuelrequiredforanindustrialprocessormanufacturingindustry.
  - GrassRootsorGreenfield(Newconstruction).
  - Powerrequirementsandsource.
- **FIRECODE**
  - A fire code is a set of regulations legally adopted by a communitythat define minimum requirements and controls to safeguard life,property,orpublicwelfarefromthehazardsoffireandexplosion.A fire code can address a wide range of issues related to thestorage, handling or use ofsubstances, materials or devices. Italso can regulate conditions hazardous to life, property, or publicwelfareintheoccupancyofstructuresorpremises.
- **GRADING**
  - Site grading is the process of adjusting the slope and elevation ofthe soil. Prior to construction or renovation, site grading may beperformedtoevenoutthesurfaceandprovideasolidfoundation.
- **GREENFIELDPROJECTS**
  - Newplantconstruction

  - Plant expansions on a fresh site with minimum interfacing to theexistingplant

- **GEOTECHNICAL**
  - Geotechnical engineering is the branch of engineering concernedwith the analysis, design and construction of foundations, slopes,retainingstructures,embankments,tunnels,levees,wharves,l andfills and other systems that are made of or are supported bysoilorrock.

- **HIGHFLASHSTOCK**
  - High Flash Stock Are those having a closed up flash point of 55°Cor over (such as heavy fuel oil, lubricating oils, transformer oilsetc.). This category does not include any stock that may be storedattemperaturesabove orwithin 8°Cofitsflashpoint.

- **HYDROCARBON**
  - A hydrocarbon is an organic compound made ofnothing morethancarbonsandhydrogens.Crudeoil,tar,bitumenandcondensa teareallpetroleumhydrocarbons.

- **ClassI**
  - Hazardous locations or areas where flammable gases or vaporsare/could become present in concentrations suitable to produceexplosive and/or ignitable mixtures. Class I locations are furtherdividedinto 2 divisions:
  - Class I, Division 1: There are three different situations that couldexisttoclassifyanareaas aClassI,Division1 location.
    - When the atmosphere of an area or location is expected tocontain explosive mixtures of gases, vapors or liquids duringnormal working operations. (This is the most common Class I,Div.1)
    - Anareawhereignitableconcentrationsfrequentlyexistbecauseofr epairormaintenanceoperations.

- The release of ignitable concentrations of gases or vapors duetoequipmentbreakdown,whileatthesametimecausingelectric alequipmentfailure.

- Class I, Division 2: One of the following three situations must existinorderforanareatobeconsideredaClassI,Division2location.
  - An area where flammable liquids and gases are handled, butnot expected to be in explosive concentrations. However, thepossibility for these concentrations to exist might occur if therewasanaccidentalruptureorotherunexpectedincident.
  - Anareawhereignitablegasesorvaporsarenormallypreventedfrom accumulatingbypositivemechanicalventilation, yet could exist in ignitable quantities if there was afailureinthe ventilationsystems.
  - AreasadjacenttoClassI,Division1locationswhereitispossible for ignitable concentrations of gas/vapors to come intothis areabecausethereisn'tproperventilation.

- **ClassII**
  - Class II hazardous locations are areas where combustible dust,rather than gases or liquids, may be present in varying hazardousconcentrations.
  - Class II, Division 1: The following situations could exist, making anareabecome aClassII,Division1 locations:
    - Where combustible dust is present in the air under normaloperating conditions in such a quantity as to produce explosiveorignitablemixtures.Thiscouldbeonacontinuous,interm ittent,orperiodicbasis.
    - Whereanignitableand/orexplosivemixturecouldbeproducedifam echanicalfailureorabnormalmachineryoperationoccurs.
    - Whereelectricallyconductivedustsinhazardousconcentrations are present.

  - Class II, Division 2: Such locations exist in response to one of thefollowingconditions:
    - Where combustible dust is present but not normally in the air inconcentrationshighenoughtobeexplosiveorignitable.
    - Ifdustbecomessuspendedintheairduetoequipmentmalfunctions andifdustaccumulationmaybecomeignitablebyabnormaloperatio norfailureof electronicequipment.

- **ClassIII**
  - ClassIIIhazardouslocationscontaineasilyignitablefibersorflyings, but the concentration ofthese fibers or flyings are notsuspendedintheairinsuchquantitiesthatwouldproduceignitablemi xtures.
  - ClassIII,Division1:Theselocationsareareaswhereeasilyignitable fibers or items that produce ignitable flyings are handled,manufacturedorusedinsomekindofaprocess.
  - ClassIII,Division2:Theselocationsareareaswhereeasilyignitablefiber sarestoredorhandled.

- **EquipmentforClassIHazardousLocations**
  - The equipment used in Class I hazardous locations are housed inenclosures designed to contain any explosion that might occur ifhazardous vapors were to enter the enclosure and ignite. Theseclosures are also designed to cool and vent the products of thisexplosionistopreventthesurroundingenvironmentfromexploding. The lighting fixtures used in Class I hazardous locationsmust be able to contain an explosion as well as maintain a surfacetemperature lower than the ignition temperature of the surroundinghazardous atmosphere.

- **EquipmentforClassIIHazardousLocations**
  - Class II hazardous locations make use of equipment designed tosealoutdust.Theenclosuresarenotintendedtocontainaninternal explosion, but rather to eliminate the source of ignition sonoexplosioncanoccurwithintheenclosure.Theseenclosuresare

alsotestedtomakesuretheydonotoverheatwhentotallycovered with dust, lintorflyings.

- **EquipmentforClassIIIHazardousLocations**
  - EquipmentusedinClassIIIhazardouslocationsneedstobedesigned to prevent fibers and flyings from entering the housing. Italso needs to be constructed in such a way as to prevent theescape of sparks or burning materials. It must also operate belowthepointofcombustion.ThesameexceptionfortheClassIIhazard ous location holds true for the Class III hazardous locations;fixed, dust-tight equipment, other than lighting fixtures, does notneed to be marked with the class, group, division or operatingtemperature, as long as it is acceptable for Class III hazardouslocations.
- **INVERTELEVATION**
  - The elevation ofan invert (lowest inside point) ofa pipe or seweratagiven locationin referenceto abenchmark.
  - The pipe invertelevation is simply the elevation ofthe lowestinsidelevelof thepipeataspecificpointalongtherunofthepipe.
  - A 2% slope means the pipe invert will fall 2 feet for every 100 feetofpiperun.
  - For example, if the slope is 2%, then multiply the length by 2% toget the difference in elevation of the two points. If, for example, theinvertelevationatpoint1is2meters,andthelengthofthepipeis 40.75 meters, the slope will be 2%; multiply 40.75 by 2% and youget 0.815. Therefore, the invert elevation at point 1 is 2 m, and theinvertelevationatpoint2is equaltoI.E.2-0.815= 1.185.
- **ISOMETRICDRAWINGS**
  - Isometric drawings are 3D representation of piping showing thebird'seyeviewofthepipingindicatingvariousvalves,gages,support s,hangers,anchorsandrestraints.Thedrawingisanengineer's language and represents the information in a codifiedform to the down-stream agencies. The isometric of piping is usedforconstructionandindicatesthetransportablesegmentsof

piping. The isometric drawing contains Bill of Materials (BOM, alsoknown as BOQ). The total weight of all the items covered in asingle system is indicated. The isometric, in its final form, is usedforfield work.

- The isometric diagrams are used for giving inputs to the pipingstress analysis computer programs like CAESAR II and CAEPIPE.The outputs of the piping stress analysis are used to up-date theisometrics.As the design is an iterative process (based on trialand error process), the design of the piping is done in severalstages.
- The presently used Plant Design Systems (PDS) and Plant DesignManagement Systems (PDMS) computer programs assist in thepreparationofpiping isometrics.

- **LOWFLASHSTOCKS**
  - Low-Flash Stocks are those having a closed up flash point under55°C such as gasoline, kerosene, jet fuels, some heating oils,dieselfuelsandanyotherstockthatmaybestoredattemperatures aboveorwithin8°Cofitsflashpoint.
- **OFFSITES**
  - Inaprocessplant(Refinery,Chemical,Petrochemical,Power,etc.),any supportingfacilitythatisnotadirectpartoftheprimaryor secondary process reaction train or utility block is called offsites.Offsitesarealso calledOSBL.
- **ONSITE**
  - Anysingleorcollectionofinter-relatedandinter-connectedprocess equipment that perform an integrated process function.Typically, any Onsite Unit could be made to function independentlyofanotherOnsiteUnit.OnsiteUnitsarealsocalled ISBL.
- **PROPERTYLINE**
  - A Property Line is the recorded boundary ofa plot ofland. Itdefines the separation between what is recognized legally as theOwner's land,non-Owner'sorotherland.

- **ONPROPERTY**
  - Alllandandorwaterinsidethe Propertylineshownonthepropertymap ordeed.
- **OFFPROPERTY**
  - Off property is any land (or water) outside of the Property lineshownon the propertymapordeed.
- **RIGHTOFWAY (ROW)**
  - Any land (On Property or Off Property) set aside and designatedfor a specific use or purpose. A Right-of-Way within a piece ofproperty may also be designated for use by someone other thanthepropertyowner.
- **SETBACKORSETBACKLINE**
  - A line established by law, deed restriction, or custom, fixing theminimum distance from the property line of the exterior face ofbuildings, walls and any other construction form; street, road, orhighwayright-of-wayline.
  - Setback is a clear area normally at the boundary of a piece ofpropertywithconditions andrestrictionsforbuildingoruse.
- **PRIMARY,SECONDARYANDBY-PRODUCTS**
  - Primary product is a product consisting of a natural raw material,anunmanufacturedproduct,orintendedasfirststageoutput.
  - Secondary product is a product that has been processed from rawmaterials that is not classed as the primary product produced bythecompany
  - A by-product is a secondary product derived from a manufacturingprocessorchemicalreaction.Itisnottheprimaryproduct orservicebeingproduced.
- **SEISMICZONE**
  - ASeismiczoneisanareawheretherateofseismicactivityremains fairly consistent. This may mean that seismic activity isveryrare,orthatitisverycommon.Somepeopleoftenusethe

term "seismic zone" to talk about an area with an increased risk ofseismic activity, while others prefer to talk about "seismic hazardzones"whendiscussingareaswhereseismicactivityismoreco mmon.

- **TERRAIN**
  - A stretch of land, especially with regard to its physical features, forexample – Level vs.Sloping.
- **ATMOSPHERICTANK**
  - According to the NFPA, atmospheric storage tanks are defined asthose tanks that are designed to operate at pressures betweenatmospheric and 6.9 kPa gage, as measured at the top of the tank.Such tanks are built in two basic designs: the cone-roof designwhere the roofremains fixed and the floating-roofdesign wherethe roof floats on top of the liquid and rises and falls with the liquidlevel.
- **PRESSUREVESSEL**
  - A pressure vessel is a container designed to hold gases or liquidsata pressure substantially different from the ambientpressure.The pressure differential is dangerous, and fatal accidents haveoccurredinthehistoryofpressurevesseldevelopmentandoperati on.
  - The ASME Code is a construction code for pressure vessels andcontains mandatory requirements, specific prohibitions and non-mandatoryguidanceforpressurevesselmaterials,design,fabrication, examination,inspection,testing, andcertification.
- **PETROCHEMICALS**
  - Petrochemicalsarechemicalproductsderivedfrompetroleum.Primary petrochemicalsaredividedintothreegroupsdependingontheirchemic al structure:
    - **Olefins**includeethylene,propylene,andbutadiene.Ethylene and propylene are important sources of industrialchemicals, resins, fibers, lubricants and plastics

products.Butadieneis usedinmaking syntheticrubber.

- **Aromatics**includebenzene,toluene,andxylenes.Benzeneisa rawmaterialfordyesandsyntheticdetergents, and benzene and toluene for isocyanates MDIand TDI used in making polyurethanes. Manufacturers usexylenes toproduceplasticsandsyntheticfibers.
- **Synthesisgas**isamixtureofcarbonmonoxideandhydrogen used to make ammonia and methanol. Ammoniais used to make the fertilizer urea, and methanol is used asasolventandchemical intermediate.

– Oilrefineriesproduceolefinsandaromaticsbyfluidcatalyticcrackingofp etroleumfractions.Aromaticsareproducedbycatalytic reforming ofnaphtha.

- **SOURGAS**

  – Naturalgascontaminatedwithchemicalimpurities,notablyhydrogen sulfide or other sulfur compounds, which cause a foulodor.

- **PLATFORM**

  – Structure used in offshore drilling on which the drilling rig, crewquarters andotherrelated itemsarelocated.

- **PIPERACK**

  – The pipe rack is the elevated supporting structure used to conveypiping between equipment. This structure is also utilized for cabletrays associated with electric-power distribution and for instrumenttray.

- **SPILLCONTAINMENT**

  – Spillcontainmentiswherespillsofchemicals,oils,sewageetc.are contained within a barrier or drainage system rather than beingabsorbedatthesurface.

- **SLEEPERS**

  – Thesleeperscomprisethegrade-levelsupportingstructureforpiping between equipment for facilities, e.g., tank farm or otherremoteareas.

- **UTILITYBLOCK**
  - A single or multiple grouping of facilities that generate the supportservices required by the Onsite Process units to function. Thisnormally includes: Steam Generation, Plant Air, Instrument Air,DecimalizedWater, PlantWater,etc.

CHAPTER- 3

3. DESIGNCODESANDSTANDARDS

ThemanufactureandinstallationofpressurepipingistightlyregulatedbytheAmerican Society of Mechanical Engineers, ASME "B31" code series such as B31.1or B31.3. These codes have their basis in the ASME Boiler and Pressure VesselCodesandaremandatorilyappliedinCanadaandtheUSA.Europehasanequivalent systemofcodes.

3.1. DIFFERENCEBETWEENCODESANDSTANDARDS

3.1.1. DesignCodes

The "Codes" define the rules and regulations deemed necessary for safedesign and construction. For example, the piping codes address the followingdesignrequirements:

- Allowablestressesandstresslimits
- Allowabledeadloadsandloadlimits
- Allowableliveloadsandloadlimits
- Materials
- Minimumwallthickness
- Maximumdeflection
- Seismicloadsand
- Thermalexpansion

Note that the piping codes DO NOT include components such as fittings, valves,flangesandmeters;rather,theydefinethedesignrequirementsforthesecomponent s byreference toindustrystandards.

3.1.2. DesignStandards

The"Standards"providespecificdesigncriteriaandrulesforindividualcomponents or classes of components such as valves, flanges and fittings.Standardsapplytobothdimensionsandperformanceof systemcomponents.

- **Dimensional standards** provide configuration control parametersforcomponents.The primaryobjective ofdimensionalstandardsis toensurethatsimilarcomponentsmanufacturedbydifferentsuppliers permitinterchangeability.

- **Pressure-integritystandards**provideuniformminimum-performancecriteria.Themainobjectiveistoensurethatthecomponents designed and manufactured to the same standard willfunction in an equivalent manner. For example, all NPS 10 (DN250) Class 150 ASTM A105 flanges, which are constructed inaccordance with ASME B16.5, Pipe Flanges and Flanged Fittings,have a pressure-temperature rating of 230 psig (1590 kPa gauge)at300°F(149°C).

3.2. PRESSUREPIPINGCODES

TheAmericanSocietyofMechanicalEngineers(ASME)establishedtheB31Pressure Piping Code Committees to promote safety in pressure piping design andconstructionthroughpublishedengineering criteria.

The intent of ASME B31 codes is to set forth engineering requirements deemednecessary forsafedesignand constructionof pipinginstallations.However,theCodes are not designed to replace competent engineering design or judgment. Mostimportantly,theCodesdonot“approve,”“rate,”or“endorse”anyitemsofconstruction,proprietarydevices,oractivity.TheCodesdonotputalimitonconservatism and, conversely, the Codes also allow for designs that are capable ofmorerigorousengineeringanalysis whichjustifieslessconservativedesigns.

ASME B31 codes have the force of law in Canada and the USA. Even if there is nolegalrequirement,theclient,andinsuranceunderwritersmayrequirecompliance/withASMEcodes.Andataminimum,goodengineeringpracticesshould be followed that are described in the Codes. If a facility is outside the UnitedStates,theremaybea setofinternational Codesthat areprescribed.

Important

- The OWNER has the overall responsibility for meeting compliance with ASMEB31codes andstandardsforthedesignofpiping installations.
- ASMECodeisnotintendedtoapplytopipingthat hasbeenplacedinservice.

The following list defines the ASME Pressure Piping Codes used for the design,constructionandinspectionofpressurizedpiping systems.

3.2.1. B31.1PowerPiping

ASME B31.1 Code is typically used for the design and construction of power pipingfoundinElectricPowerGeneratingStations,IndustrialandInstitutionalPlants,Geothermal Heating Systems, and Central & District Heating and Cooling Systems.Thecodecoversexternalpipingforpowerboilersandhightemperature,high-pressure water boilers in which steam or vapor is generated at a pressure of morethan 15 psig and high-temperature water is generated at pressures exceeding 160psigortemperaturesexceeding250°F.

- B31.1isintendedtobeappliedto:
  - ✓ Pipingforsteam,water,oil,gas,airandotherservices.
  - ✓ Metallicandnonmetallicpiping.
  - ✓ Allpressures.
  - ✓ Alltemperaturesabove-29°C(-20°F).
- B31.1doesNOTapplyto:
  - ×Boilers, pressure vessel heaters and components covered by theASME Boiler and Pressure Vessel Code (BPVC). Note: A boilerneeds pipe, both internally and externally. The internal pipe wouldcome under the rules of Section I and the external piping wouldcomeunderB31.1.
  - ×Building heating and distribution steam and condensate systemsdesignedfor15psig orless.
  - ×Hot water heatingsystemsdesignedfor 30psigor less.

Important

B31.1 is mandatory for piping that is attached directly to an ASME Section I boiler upto the first isolation valve, except in the case of multiple boiler installations where it ismandatoryup tothesecond isolation valve.

3.2.2. B31.3ProcessPiping

ASME B31.3 Code is typically used for the design and construction ofpressurepipingfoundinPetroleumRefineries,Chemical,Pharmaceutical,Textile,Paper,Semiconductor,andCryogenicPlantsandrelatedProcessingPlantsandTerminals.

- B31.3isintendedtobeappliedto:

- ✓ Pipingfor allfluidservices.
- ✓ Metallicandnonmetallicpiping.
- ✓ Allpressures.
- ✓ Alltemperatures.

- B31.3doesNOTapplyto:
  - ×Piping systems designed for pressures at or above 0 but less than15 psig, provided they meet certain other requirements includingtemperatureranges.
  - ×Tubesandpipesinternaltoaheaterenclosure.
  - ×Pressurevesselsandcertainotherequipmentandpiping.

Important

- Compatibility of materials with the service and hazards from instability ofcontainedfluidsareNOT withinthe scopeofASMEB31.3.
- The OWNER is responsible for designating when certain fluid services, i.e.CategoryM(toxic),highpurity,highpressure,elevatedtemperatureorCategory D (nonflammable, nontoxic fluids at low pressure and temperature)are applicable to specific systems and for designating if a Quality System is tobeimposed.

3.2.3. B31.4PipelineTransportationSystemsforLiquidHydrocarbons

ASME B31.4 Code is typically used for the pipelines that transport liquids betweenplants,terminals andpumping regulatingandmeteringstations.

The liquids include crude oil, condensate, natural gasoline, liquefied petroleum gas,carbondioxide,liquidalcohol,liquidanhydrousammonia,andliquidpetroleumproduct sbetweenproducers'leasefacilities,tankfarms,naturalgasprocessingplants, refineries, stations, ammonia plants, terminals (marine, rail, and truck), andotherdeliveryand receiving points.

- B31.4isintendedtobeappliedto:
  - ✓ Piping transporting liquids such as crude oil, condensate, naturalgasoline,naturalgasliquids,liquefiedpetroleumgas,carbondio xide,liquidalcohol,liquidanhydrousammonia,andliquidpetroleumpro ducts.

- ✓ Piping at pipeline terminals (marine, rail, and truck), tank farms,pump stations, pressure reducing stations, and metering stations,includingscrapertraps,strainers,andloops;
- ✓ Allpressures
- ✓ Temperaturesfrom-29to121ºC(-20to250ºF)inclusive.

- B31.4doesNOTapplyto:
  - × Auxiliarypiping,e.g.,water,air,orsteam.
  - × Pressurevessels,heatexchangersandsimilarequipment.
  - × Piping designedat or below1bar(15psig)atanytemperature.
  - × Piping above 1 bar (15 psig) if temperature is below –20°F (–30°C)orabove 250°F(120°C).
  - × Piping,casingortubingusedinoilwellandrelatedassemblies.
  - × Petroleumrefinerypipingwithcertainexceptions.
  - × Gastransmissionanddistributionlines.

3.2.4. B31.5RefrigerationPipingandHeatTransferComponents

ASMEB31.5Codeistypically usedforthedesignandconstruction ofpressurepipingcontaining refrigerants orsecondarycoolants.

- B31.5isintendedtobeappliedto:
  - ✓ Refrigerantandsecondarycoolantpiping.
  - ✓ Heattransfercomponentssuchascondensersandevaporators.
  - ✓ Allpressures.
  - ✓ Temperaturesatandabove-320°F(-196°C)

- B31.5doesNOTapplytothefollowing:

×Anyself-containedorunitsystemssubjecttotherequirementsofUnderwritersLaboratoriesoranothernationallyrecognizedtestinglaboratory.

×Water piping.

×Piping designed for external or internal gauge pressure not exceeding15psi regardlessofsize.

- Pressurevessels, compressorsorpumps.

3.2.5. B31.8GasTransmissionandDistributionPipingSystems

ASME B31.8 Code is typically used for gas transportation piping between sourcesand terminals. It includes gas pipelines, gas compressor stations, gas metering andregulation stations, gas mains, and service lines up to the outlet of the customer'smetersetassembly.

- B31.8isintendedtobeappliedto:
  - ✓ Onshoreandoffshorepipelinefacilitiesusedforthetransportofgas.
  - ✓ Gatheringpipelines.
  - ✓ Gasdistributionsystems.
  - ✓ Pipingatcompressor,regulating andmeteringstations.
  - ✓ Allpressures.
  - ✓ Temperaturesfrom-29to232ºC(-20to450ºF)inclusive.

B31.8 covers the design, construction, operation, and maintenance of these pipingsystems, but it does not have requirements for auxiliary piping, such as water, air,steamorlubricating oil.

- B31.8doesNOTapplytothefollowing:
  - × Pressurevessels coveredbytheBPVC.
  - × Pipingwithmetaltemperaturesabove450°F(232°C)orbelow–20°F(–30°C).
  - × Piping beyondtheoutletofthecustomer'smeterassembly.
  - × Wellheadassemblies.
  - × Design and manufacture of heat exchangers to Tubular ExchangerManufacturersAssociation (TEMA)standards.

3.2.6. B31.9BuildingServicesPiping

ASME B31.9 Code is typically used for the design and construction of piping found inIndustrial, Institutional, Commercial, Public Buildings and multi-unit residences whichdo not require the range of sizes, pressures and temperatures covered by ASMEB31.1PowerPipingCode.

- B31.9isintendedtobeappliedto:
  - ✓ Piping for water and anti-freeze solutions for heating and cooling,steam and steam condensate, air, combustible liquids and othernontoxic, nonflammable fluids contained in piping not exceedingthefollowing:

    Dimensionallimits

    - Carbonsteel:NPS42(DN1050)and0.500in.(12.7mm)wall.
    - Stainlesssteel:NPS24(DN600)and0.500in.(12.7mm)wall.
    - Aluminum: NPS12(DN300).
    - BrassandcopperNPS12(DN300),12.125in.(308mm)forcopp ertube.
    - Thermoplastics:NPS24(DN600).
    - Ductilelron: NPS24(DN600).
    - ReinforcedThermosettingResin:NPS24(DN600).
  - ✓ Pressureandtemperaturelimits,inclusive:
    - Compressedair,steamandsteamcondensateto1035kPa(150 psi)gage.
    - Steamandsteamcondensatefromambientto186°C(366°F).
    - Othergasesfromambientto-18to 93°C(0to200°F)
    - Liquidsto2415kPa(350psi)gageandfrom-18to121°C(0to 250°F).
    - Vacuumto1Bar(14.7psi).
  - ✓ Piping connecteddirectlytoASMESectionIVHeatingBoilers.

3.2.7. B31.11SlurryTransportationPipingSystems

ASME B31.11 Code is typically used for aqueous slurries of nonhazardous materials,suchascoal,mineraloresandothersolids,betweentheslurryprocessingplantan d the receiving plant. One of the uses of these systems is in the mining industries inmovingoresfromthemines toelsewhere.

- B31.11is intendedtobeappliedto:
  - ✓ Pipingtransportingaqueousslurriesofnonhazardousmaterials.
  - ✓ Pipinginpumping,andregulatingstations.
  - ✓ Allpressures.
  - ✓ Temperaturesfrom-29to121ºC(-20to250ºF)inclusive.
- B31.11doesNOT applytothefollowing:
  - × Auxiliarypipingsuchasforwater,air,andsimilarliquidsandgases.
  - × Pressurevessels.
  - × Piping designedforpressuresbelow15psigatanytemperature.
  - × Pipingdesigned forpressuresabove15psig,whentemperatureisbelow—20°F (–30°C)orabove 250°F(120°C).
  - × Piping within the battery limits of slurry processing plants and othernon-storagefacilities.
  - × Designandfabricationofproprietaryitems.

Code Applicability

Thereare anumberofsimilaritiesineachCode,such asinthecalculationofminimum wall thickness, inspection and testing. But the exact rules are different,depending on the type of facility. Allowable stresses are different in each code,reflecting a different factor of safety based on the expected use and operation of thefacility.

In most plants, one piping code applies to all piping systems, but sometimes it is notappropriate to take this approach. A petrochemical plant may be designed to B 31.3,but there may be a power boiler supplying power and that piping should be designedto B31.1, and parts may be designed to ASME Boiler & Pressure Vessel Code. Noonecodefitsall.

- Power piping is focused on high pressure and high temperature water andsteam with very few chemicals.The plants tend to be vertical, which createshighthermalverticalmovementsthatmustbeaccommodatedbyspring supports. Plants are usually away from residential areas and the potential fordamageto nearbylandownersis typicallyinsignificant.

- Petrochemicalplantstypicallyoperateatmuchlowerpressuresandtemperatures than power plants, but the various chemicals result in corrosionissues and the use of many special alloy materials. These plants are also laidout horizontally with most pipe supports being rigid on pipe racks. Plants areoften in large industrial areas. If there is a fire or explosion, there is always aconcerninminimizingthedamagetothelocalareaofaplantoraunitwithina plant.Explosions may release hazardous chemicals in the air or in water,andthusmechanicalintegritymust always beaprimarydesigncriterion.
- Pipelines are typically underground with no thermal considerations. The pipesare not put in bending at supports, and thus design rules allow thinner pipe forthesamepressurecomparedtoB31.1andB31.3.Pipelinesmaybeinunpopulate d areas, or runningthrough suburban and urban areas. Becauseof the potential for damage to nearby landowners, rules are different based onthepipe'sproximitytopopulated areas.

Important

It is the OWNER's responsibility to determine which code section is applicable topiping installations and to ensure compliance with the respective code, i.e., B31.1,B31.3,etc.

Exclusions

Piping systems that can be excluded from the application of ASME B31 include[ASMEB31.3,para300.1.3]:

- Piping systems designed for internal gage pressures at or above zero but lessthan 15 psi, provided the fluid handled is nonflammable, nontoxic, and notdamaging to human tissue as defined in ASME B31.3 Para. 300.2 and itsdesigntemperatureisbetween -20°Fthrough366°F
- Tubes, tube headers, crossovers, and manifolds of fired heaters, which areinternaltotheheaterenclosure.

Caution

Once a Code has been selected to apply to a particular piping system, only that codeshould be applied. For example, it is not a practice to use a minimum wall thicknesscalculationfromB31.3,anallowablestressvaluefromB31.8,andaninspection methodfromB31.1.Whileitappearsobviousthatwecannot“cherrypick”theaspects we like from each Code, there are many times that the Codes are incompleteor give no guidance for certain conditions. In these situations, it is appropriate toresearch other codes, technical papers and other published documents for guidelinesto properly engineer the piping system.With this information, a rational engineeringjudgmentcanbemadethat is atleastasconservativeas thegoverningCode.

3.3. HowtheChaptersarearranged?

While each section of the ASME B31 piping codes follows the same general setup ofchaptersdescribedbelow,ASMEB31.3 is usedas thereferencehere.

- **ChapterIScopeandDefinitions(para300)**includesgeneralinformation on responsibilities, intent ofthe Code, Code requirements,andscope.Thechapteralsoincludesspecificnomenclatureand definitions.
- **Chapter II Design (para 301 through 322)** defines the minimum sectionsthat are required in the engineering design process.They are divided intosixsub-sections:
  - **Part1ConditionsandCriteria**

    Part 1, Conditions and Criteria, (para 301 through 302) describesthedesignpressure,designtemperaturesandforcestoconsi derindesign.Forcesincludeambient,dynamic,weight,thermalexpansi on and contraction, support movement, reduced ductility,cyclic and air condensation effects.Part 1 provides pressure-temperature ratings, stress criteria, design allowances, and theminimumdesignvaluesalongwithpermissiblevariations.Discussio n is provided on how the allowables were generated andtheapplicationofallowablesfordifferentdesignconditions.
  - **Part2PressureDesignofPipingComponents**

    Part 2, Pressure Design of Piping Components, (para 303 through304)describesthedesignofstraightpipe,bends,branches,clos ures,flanges,andreducersalongwithotherpressurecomponents under pressure only.Components manufactured inaccordance with standards listed in Table 326.1 of B31.3 shall beconsideredsuitableforuseatthelistedpressure-temperature ratings.The rules provided in para 304 are intended for pressuredesignofcomponentsnotcovered inTable 326.1.

- **Part 3FluidServiceRequirementsforPipingComponents**

  Part 3, Fluid Service Requirements for Piping Components (para305 through 309), discusses the types ofcomponents which canbeused intheintendedFluid Service.

- **Part 4FluidServiceRequirementsforPipingJoints**

  Part 4, Fluid Service Requirements for Piping Joints (para 310through 318), discusses the acceptable types and limitations ofweld, braze,solder,threaded,or otherjoint configurations.

- **Part 5FlexibilityandSupport**

  Part 5, Flexibility and Support (para 319 through 321.4), providesbasic and specific requirements for flexibility analyses as well asprovidingthedesignrequirementsandanalysesforpipingsupports.Formal flexibility analysis is not necessary if the designtemperature is at or below 150°F and the piping is laid out withinherent flexibility, or the design temperature is at or below 250°Fand the piping is analyzed for flexibility using simplified methods ofcalculation.Design of pipe supports are addressed in Standardssuch as Manufacturers Standardization Society of the Valve andFittings Industry MSS-SP-58.Allowable stress levels for supportsare provided in the American Institute of Steel Construction (AISC)ManualofSteelConstructionandtheAISCStandardN690.

- **Part6Systems**

  Part 6, Systems (para 322), defines requirements for instrumentpipingand pressurerelievingdevices.

- **Chapter III Materials** (para 323 through 325) describes where to findmaterials, how they are specified, and their limitations.Chapter III alsodescribes howthematerialsaretobemarked.

When the materials are not listed by the ASME code, the material must bequalifiedinaccordancewiththerequirementsoftheASMECode.Reviewing the material of an unlisted component is done to ensure aspecifiedminimumallowablestressatthedesigntemperature.The sources forallowablestressvaluesincludetheASMEB31CodesofPressure Piping and the ASME BPV Code Section II.BPV Code Casesshouldalsobereviewedforallowablestressesforspecificmaterials.

- **Chapter IV Standards for Piping Components** (para 326) describeswheretofindpiping dimensional requirements.
- **Chapter V Fabrication, Assembly, and Erection** (para 327 through 335)describeshowtocreatejoints,form,orbendmaterialsforsystemfabrication .ChapterVdescribeshowtoqualifythejointbeingmanufactured and how to qualify personnel to perform joint fabrication(refers to ASME Section IX).Chapter V describes joint preparation, pre-heat requirements, filler material to use, performance of the weld detail,postheattreatment,andjointrepair.
- **Chapter VI Inspection, Examination, and Testing** (para 340 through346)explainsresponsibilitiesforinspectiontoB31.3requirements.Chapter VI addresses the non-destructive examination (NDE) required fora particular service, qualification of the person performing the NDE, andthe acceptance criteria for the NDE.Chapter VI describes the minimumpressuretestingrequiredandhowtodeterminethetestingrequirements.
- ChapterVIINonmetallicPipingandPipingLinedwithNonmetals
- ChapterVIIIPipingforCategoryMFluidService
- ChapterIXHighPressurePiping
- **Appendices**

A	Allowable Stresses and Quality Factors for Metallic Piping andBoltingMaterials
B	StressTablesandAllowablePressureTablesforNonmetals
C	PhysicalPropertiesofPipingMaterials
D	FlexibilityandStressIntensificationFactors
E	ReferenceStandards
F	PrecautionaryConsiderations
G	Safeguarding
H	SampleCalculationsforBranchReinforcement

J	Nomenclature
K	AllowableStressforHighPressurePiping
L	AluminumAlloyPipeFlanges
M	GuidetoClassifyingFluidServices
Q	QualitySystem Program
V	AllowableVariationsinElevatedTemperatureService
X	MetallicBellowsExpansionJoints
Z	PreparationofTechnicalInquiries

3.4. ProcessStepsorExpectations

In applying ASME Codes to pressure systems, it is important to note that the codes(ASME B31.3, Process Piping and ASME Boiler and Pressure Vessel (BPV) SectionVIII, Rules for Construction of Pressure Vessels) are not design handbooks.TheASMECodesaretobeusedasaguidetotheanalysesthatshouldbeperformedand do not eliminate the need for competent engineering judgment.The ASMECodes set forth engineering requirements deemed necessary for the safe design andconstructionofpressuresystems.

To the greatest possible extent, code requirements for design are stated in terms ofbasic design principles and formulas.These are supplemented, as necessary, withspecificrequirementstoassureuniformapplicationofprinciplesandtoguideselectionand applicationofpressuresystemelements.

3.5. ASSOCIATIONSPROVIDINGPIPINGMATERIALSPECIFICATIONS

- AmericanPetroleumInstitute(API)
- AmericanSocietyforTestingandMaterials(ASTM)
- AmericanWaterWorksAssociation (AWWA)
- AmericanWeldingSociety(AWS)
- ManufacturersStandardizationSociety(MSS)
- NationalAssociationofCorrosionEngineers(NACE)
- NationalFireProtectionAssociation(NFPA)
- Societyof AutomotiveEngineers(SAE)

3.5.1. API-AmericanPetroleumInstituteStandards

Rules,practices and standards foroil and gas industry are issued by thisinstituteandfollowedbyalmostall oiland gascompaniesinthe world.

Among the many standards issued by the institute, there is also a standard for thedesign of pipelines:API STANDARD 5L. Within this standard, materials for oil andgastransportationpipelines arespecified,withdenominationAPI5L.

- API5L
  - API 5L provides dimensions, weights, and test pressures for plain-endlinepipe insizesupto 80inches in diameter.
  - Severalweightsareavailableineachlinepipediameter.Theweight of the pipe in lb/ft, in turn, varies as the wall thickness for agiven outside diameter. For instance, API Spec 5L lists 24 differentweightsinthe16-inch-diametersize(fiveweightsarespecialweights),rangingfrom31.75lb/footto196.91lb/foot.
  - The corresponding wall thickness ranges from 0.188 inch to 1.250inches.Asthewallthicknessincreasesforagivenoutsidediameter, the inside diameter of the pipe decreases from 15.624inches for the lightest weight pipe to 13.500 inches for the line pipeweighing 196.91 lb/foot. Greater wall thicknesses are selected forhigh-pressure applications, or when the pipe segment might besubjected to unusual external forces such as seismic activities andlandslides.

Thisisafamilyof carbonsteelsalmostequivalent toASTMA53/A106.

Equipmentspecifiedtothesestandardsistypicallymorerobustthangeneralindustrialapplications.

CommonAPIstandardsare:

Spec.5L	LinePipe
Spec.6D	PipelineValves
Spec.6FA	FireTestforValves
Spec.12D	FieldWeldedTanksforStorageofProductionLiquids
Spec.12F	ShopWeldedTanksforStorageofProductionLiquids

Spec.12J	OilandGas Separators
Spec.12K	IndirectTypeOilFieldHeaters
Std.594	WaferandWafer-LugCheck Valves
Std.598	ValveInspectionandTesting
Std.599	MetalPlugValves-FlangedandButt-WeldingEnds
Std.600	SteelGateValves-FlangedandButt-WeldingEnds
Std.602	CompactSteelGateValves-FlangedThreaded, Welding,andExtended-BodyEnds
Std.603	Class150,Cast,Corrosion-Resistant,Flanged-EndGateValves
Std.607	FireTestforSoft-SeatedQuarter-TurnValves
Std.608	MetalBallValves-FlangedandButt-WeldingEnds
Std.609	Lug-andWafer-TypeButterflyValves
Std.610	Centrifugal Pumpsfor Petroleum,Heavy Duty Chemical andGasIndustryServices
Std.611	GeneralPurposeSteamTurbinesforRefineryServices
Std.612	SpecialPurposeSteam TurbinesforRefineryServices
Std.613	SpecialPurposeGearUnitsforRefineryServices
Std.614	Lubrication,Shaft-SealingandControlOilSystemsforSpecialPurposeApplication
Std.615	SoundControlofMechanicalEquipmentforRefineryServices
Std.616	GasTurbinesforRefineryServices
Std.617	CentrifugalCompressorsforGeneralRefineryServices
Std.618	ReciprocatingCompressorsforGeneralRefineryServices
Std.619	Rotary-TypePositiveDisplacementCompressorsforGeneralRefineryServices
Std.620	DesignandConstructionofLarge,Welded,LowPressureStorageTanks
Std.630	TubeandHeaderDimensionsforFiredHeatersforRefineryService
Std.650	WeldedSteelTanksforOilStorage
Std.660	HeatExchangersforGeneralRefineryService
Std.661	Air-CooledHeatExchangersforGeneralRefineryService

Std.670	Vibrations,AxialPosition,andBearing-TemperatureMonitoringSystems
Std.671	SpecialPurposeCouplingsforRefineryService
Std.674	PositiveDisplacementPumps-Reciprocating
Std.675	PositiveDisplacementPumps-ControlledVolume
Std.676	PositiveDisplacementPumps-Rotary
Std.677	GeneralPurposeGearUnitsforRefineriesServices
Std.678	Accelerometer-BaseVibrationMonitoringSystem
Std.1104	WeldingPipelinesandRelatedFacilities
Std.2000	VentingAtmosphericandlow-PressureStorageTanks-Non-RefrigeratedandRefrigerated
RP530	CalculationforHeaterTubeThicknessinPetroleumRefineries
RP560	FiredHeaterforGeneralRefineryServices
RP682	ShaftSealingSystemforCentrifugalandRotaryPumps
RP1110	PressureTestingofLiquidPetroleumPipelines
Publ.941	SteelforHydrogenServiceatElevatedTemperatureandPressuresinPetroleumRefineriesandPetrochemicalPlants
Publ.2009	SafeWeldingandCuttingPracticesinRefineries
Publ.2015	SafeEntryandCleaningofPetroleumStorageTanks

3.5.2. ASTM– AmericanSocietyofTestingMaterials

ASTMdevelopedacollectionofdocumentscalledmaterialspecificationsforstandardizing materialsoflargeuseintheindustry.

- Specificationsstartingwith"A" areforsteel.
- Specificationsstartingwith"B"arefornon-ferrousalloys(bronze,brass,coppernickelalloys,aluminumalloysandsoon).
- Specificationsstartingwith"D"areforplasticmaterial,asPVC.

An ASTM specification specifies the basic chemical composition of material and theprocess through which the material is shaped into the final product. Some of thecommonmaterial standardsare:

A36	SpecificationforStructuralSteel
A53	SpecificationforPipe,Steel,BlackandHot–Dipped,ZincCoatedWeldedand Seamless
A105	SpecificationforForgings,CarbonSteel,forPipingComponents
A106	SpecificationforSeamlessCarbonSteelPipeforHighTemperatureService
A181	SpecificationforForgings,CarbonSteelforGeneralPurposePiping
A182	Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings,and ValvesandPartsfor HighTemperatureService
A193	SpecificationforAlloySteelandStainlessSteelBoltingMaterialsforHighTemperatu reService
A194	SpecificationforCarbonandAlloySteelNutsforBoltsforHighPressureandHighTe mperatureService
A234	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel forModerate andElevatedTemperatures
A333	SpecificationforSeamlessandWeldedSteelPipeforLowTemperatureService
A350	SpecificationforForgings,CarbonandLowAlloySteelRequiringNotchToughness Testingfor PipingComponents
A352	SpecificationforSteelCastings,FerriticandMartensiticforPressureContaining PartsSuitableforLowTemperatureService
A420	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel forLowTemperatureService
A694	Specification for Forgings, carbon and Alloy Steel for Pipe Flanges, Fittings,Valvesand PartsforHigh PressureTransmissionService
A707	SpecificationsforFlanges,Forged,CarbonandAlloySteelforLowTemperatureSer vice

Non-FerrousPipingMaterials

B42	SeamlessCopperPipe
B43	SeamlessRedBrassPipe
B210	SpecificationforAluminumandAluminum-AlloyDrawnSeamlessTubes
B241	SeamlessAluminumandAluminum AlloyPipe

B251	SpecificationforGeneralRequirementsforWroughtSeamlessCopperandCopper-AlloyTube
B315	SeamlessCopperAlloyPipeandTube
B337	Seamless&WeldedTitanium andTitaniumAlloyPipe
B429	SpecificationforAluminum-AlloyExtrudedStructuralPipeandTube
B466	SeamlessCopperNickelPipe&Tube
B467	WeldedCopperNickelpipe
B658	Seamless&WeldedZirconiumandZirconiumAlloyPipe.
C76	SpecificationforConcretePipe
C599	ProcessGlassPipeandFittings
D1785	UPVCPlastic Pipe
D2239	SpecificationforPolyethylenePipe
D2282	ABSPlasticPipe(SDR-PR)
D2464	ThreadedPVCPlastic PipeFittings,Sch80
D2468	Socket-TypeABSPlasticPipeFittings,Sch40
D2517	ReinforcedEpoxyResinGasPressurePipeandFittings
D2846	CPVCPlastic HotandColdWaterDistributionSystems
D3261	ButtHeatFusionPEPlasticFittingsforPEPlastic PipeandTubing
D5421	ContactMoldedFiberglassRTRFlanges
F423	PTFEPlastic-LinedFerrousMetalPipeandFittings
F492	PolypropyleneandPPPlastic-LinedFerrousMetalPipeandFittings
D3033/3034	UPVCFittings

3.5.3. ASMEPipingComponentsStandards

Thesestandardsprovidedesign,dimensionalandmanufacturingcriteriaformanycommonlyusedpipingcomponentsforuseinB31.3processpiping systems.

B16.1	CastIronPipeFlangesandFlangedFittings
B16.3	MalleableIronThreadedFittings,Class150and300
B16.4	CastIronThreadedFittings,Classes125and250

B16.5	PipeFlangesandFlangedFittings
B16.9	FactoryMadeWroughtSteelButtweldingFittings
B16.10	FacetoFaceandEndtoEndDimensionsofValves
B16.11	ForgedFittings,SocketWeldingandThreaded
B16.12	CastIronThreadedDrainageFittings
B16.14	FerrousPipePlugs,BushingsandLocknutswithPipeThreads
B16.15	CastBronzeThreadedFittingsClass125and250
B16.18	CastCopperAlloySolderJointPressureFittings
B16.20	RingJointGasketsandGroovesforSteelPipeFlanges
B16.21	NonmetallicFlatGasketsforPipeFlanges
B16.22	WroughtCopperandCopperAlloySolderJointPressureFittings
B16.23	CastCopper AlloySolderJointDrainageFittings–DWV
B16.24	CastCopper AlloyPipeFlangesandFlangedFittingsClass150,300,400,600,900, 1500and2500
B16.25	ButtweldingEnds
B16.26	CastCopperAlloyFittingsforFlaredCopperTubes
B16.28	WroughtSteelButtweldingShortRadiusElbowsandReturns
B16.29	WroughtCopperandWroughtCopperAlloySolderJointDrainageFittingsDWV
B16.32	CastCopperAlloySolderJointFittingsforSolventDrainageSystems
B16.33	ManuallyOperatedMetallic GasValvesforUseinGasPipingSystemsUpto125psig(sizes½through2)
B16.34	Valves –Flanged,ThreadedandWeldingEnd
B16.36	OrificeFlanges
B16.37	HydrostaticTestingofControlValves
B16.38	LargeMetallic ValvesforGasDistribution(ManuallyOperated,NPS2½to12,125psigmaximum)
B16.39	MalleableIronThreadedPipeUnions,Classes1150,250and300
B16.40	ManuallyOperatedThermoplasticGasShutoffsandValvesinGasDistribution
B16.41	Functional Qualification Requirement for Power Operated Active Valve Assemblies forNuclearPower Plants
B16.42	DuctileIronPipeFlanges andFlangedFittings,Class150and300

B16.45	CastIronFittingsforSolventDrainageSystems
B16.44	ManuallyOperatedMetallicGasValvesforUseinHousePipingSystems
B16.47	LargeDiameterSteelFlanges(NPS26throughNPS60)
B16.48	SteelLineBlanks
B16.49	Factory-MadeWroughtSteelButt-weldingInductionBendsforTransportationand DistributionSystems
B16.50	WroughtCopperandCopperAlloyBraze-JointPressureFittings
B16.51	CastandWroughtCopperandCopperAlloyPress-ConnectPressureFittings(draft)

3.5.4. AmericanWeldingSociety(AWS)

These standards provide information on the welding fundamentals, weld design,welder's training qualifications, testing and inspection of the welds and guidance onthe application and use of welds. Individual electrode manufacturers have given theirown brand names for the various electrodes and the same are sold under thesenames.

3.5.5. AmericanWaterWorksAssociation(AWWA)

Thesestandardsrefertothepipingelementsrequiredforlowpressurewaterservices. These are less stringent than other standards and are rarely arbitrated bypipingengineers.

***C104**	Cement-MortarLiningforDuctile-IronPipeandFittings forWater
C110	Ductile-IronandGray-IronFittings,3In.-48In.(76mm-1,219mm),forWater
C115	FlangedDuctile-IronPipewithDuctile-IronorGray-IronThreadedFlanges
C151	Ductile-IronPipe,CentrifugallyCast,forWater
***C153**	Ductile-IronCompactFittingsforWaterService
C300	ReinforcedConcretePressurePipe,SteelCylinderType,forWaterandOtherLiquid s
C302	ReinforcedConcretePressurePipe,NoncylinderType,forWaterandOtherLiqui ds
***C501**	Cast-IronSluiceGates
***C502**	Dry-BarrelFireHydrants
***C503**	Wet-BarrelFireHydrants
C504	Rubber-SeatedButterflyValves

***C507**	BallValves,6In.Through 48In.(150mm Through1,200mm)
***C508**	Swing-CheckValvesforWaterworksService,2In.(50mm) Through24In.(600mm) NPS
***C509**	Resilient-SeatedGateValvesforWaterSupplyService
***C510**	DoubleCheck ValveBackflowPreventionAssembly
***C511**	Reduced-PressurePrincipleBackflowPreventionAssembly
C900	PVCPressurePipe,4-inchthrough12-inch,forWater
C950	Glass-Fiber-ReinforcedThermosettingResinPressurePipe

*NotlistedinASMEB31.3

3.5.6. MSSStandardPractices

TheManufacturersStandardizationSociety(MSS)standardsaredirectedatgeneralindustrialapplications.ThemostcommonMSS-SPstandardsare:

MSSSP6	StandardFinishesforcontactsurfaceforflanges
MSSSP25	Standardmarkingsystem forvalves,fittings,flanges
MSSSP42	Class150corrosionresistantgate,globeandcheck valves
MSSSP43	Wroughtstainlesssteelbuttweldfittings
MSSSP56	Pipehangersupports;material,designandmanufacture
MSSSP61	Pressuretestingofvalves
MSSSP67	ButterflyValves
MSSSP68	HighPressureoffseatbutterflyvalves
MSSSP69	Pipehangersupports;selectionandapplications
MSSSP70	CastIronGatevalves
MSSSP71	Castironcheckvalves
MSSSP72	BallValves
MSSSP78	Castironplugvalves
MSSSP80	Bronzegate,globeandcheck valves
MSSSP81	Stainlesssteelbonnetlessknifegatevalves
MSSSP83	Pipeunions
MSSSP85	Castironglobevalves

MSSSP88	Diaphragmvalves
MSSSP89	Pipehangersandsupports;fabricationandinstallationpractices
MSSSP90	Pipehangersandsupports;guidelinesonterminology
MSSSP92	MSSvalvesuserguide
MSSSP108	ResilientseatedeccentricClplugvalves

3.5.7. NationalFireProtectionAssociation(NFPA)

NFPA13	InstallationofSprinklerSystems
NFPA14	InstallationofStandpipe,PrivateHydrant,andHoseSystems
NFPA15	WaterSprayFixedSystemsforFireProtection
NFPA16	InstallationofFoam-WaterSprinklerandFoam-WaterSpraySystems
NFPA24	InstallationofPrivateFireServiceMainsandTheirAppurtenances
NFPA54	NationalFuelGasCode
NFPA58	LiquefiedPetroleumGasCode
NFPA59A	Production,Storage,andHandlingofLiquefiedNaturalGas(LNG)
NFPAZ662	OilandGasPipelineSystems

3.5.8. CompressedGasAssociation(CGA)PipingSystemStandards

CGAG2.1	RequirementsfortheStorageandHandlingofAnhydrousAmmonia(ANSI K61.1)
CGAG4.4	IndustrialPracticesforGaseousOxygenTransmissionandDistributionPiping Systems
CGAG5.4	StandardforHydrogenPipingSystemsatConsumerLocations

3.5.9. ChlorineInstitutePipingSystemStandards(selected)

006	PipingSystemsforDryChlorine
060	ChlorinePipelines
094	SodiumHydroxideSolutionandPotassiumHydroxideSolution (Caustic):Storage EquipmentandPiping Systems
163	HydrochloricAcidStorageandPipingSystems

3.5.10. UnifiedNumberingSystem(UNS)

The UNS number itself is not a specification, since it establishes no requirements forform, condition, quality etc. It is a unified identification of metals and alloys for whichcontrollinglimits havebeenestablishedinspecifications elsewhere.

The UNS provides means of correlating many naturally used numbering systemscurrentlyadministeredbysocieties,tradeassociations,individualusersandproducers of metals and alloys, thereby avoiding confusion caused by the use ofmore than one identification number for the same material and by the oppositesituationofhavingthesame numberassignedtotwo differentmaterials.

UNSestablishes18Seriesnumbersofmetalsandalloys.EachUNSnumberconsists of a single letter prefix followed by five digits. In most cases the alphabet issuggestiveoftheformulaofmetal identified.

A00001-A99999	Aluminum&Al.Alloys.
C00001-C99999	Copper&Copperalloys
E00001- E99999	Rareearth&rareearthlikemetal&Alloys.
L00001-L99999	Lowmeltingmetals&alloys
M00001-M99999	Miscellaneousnonferrousmetals&alloys
N00001-N99999	Nickel&nickelalloys
P00001- P99999	PreciousMetals&alloys
R00001-R99999	Reactive&refractorymetal&alloys
Z00001-Z99999	Zinc&Zincalloys
D00001-D99999	SpecifiedMech.PropertiesofSteels
F00001-F99999	CastIron&CastSteels
G00001-G99999	AISI&SAECarbon&AlloySteels
H00001-H99999	AISIHSteels
J00001-J99999	CastSteels
K00001-K99999	Misc.steels&Ferrousalloys
S00001- S99999	StainlessSteels
T00001-T99999	ToolSteels
W00001-W99999	WeldingFillerMetals&Electrodes

3.5.11. EN–EuropeanStandards

EN10088-1	Listofcorrosionresistantsteeltypes
EN10204	Typesofinspectiondocuments
EN10296-2	Weldedroundstainlesssteeltubesforgeneralapplications
EN10297-2	Seamless roundausteniticstainlesssteel tubes forgeneralapplications
EN10217-7	Weldedroundausteniticstainlesssteeltubesforspecialapplications
ENISO1127	Toleranceforstainlesssteelweldedtube
EN1092-1type5PN 6-100	BlindflangesPN6-100
EN1092-1type1PN 10	FlatweldingflangesPN10
EN1092-1 type11PN10	Weldingneck flangesPN10
EN1092-1 type11PN16	Weldingneck flangesPN16
EN1092-1 type11PN25	Weldingneck flangesPN25
EN1092-1 type11PN40	Weldingneck flangesPN40
EN1092-1PN 64	Weldingneck flangesPN64
EN1092-1PN 10	CollarringsandflangesPN 10

3.5.12. CanadianStandardsAssociation

***Z245.1**	SteelPipe
***Z245.6**	CoiledAluminumLinePipeandAccessories
***Z245.11**	SteelFittings
***Z245.12**	SteelFlanges
***Z245.15**	SteelValves

*NotlistedinASMEB31.3

3.6. MAJORORGANIZATIONSFORSTANDARDS

Country	Organization	Abbreviation
USA	AmericanNationalStandardsInstitute	ANSI
Canada	StandardsCouncilofCanada	SCC
France	AssociationFrancaise	AFNOR

UnitedKingdom	BritishStandardsInstitute	BSI
Europe	CommitteeofEuropeanNormalization	CEN
Germany	DeutschesInstitutfur Normung	DIN
Japan	JapaneseIndustrialStandardsCommittee	JISC
Italy	EnteNazionaleItalianodiUnificazione	UNI
Sweeden	SwedishStandardsInstitution	SS
Norway	NorskSokkelsKonkuranseposisjon	NORSOK
Worldwide	InternationalStandardsOrganization	ISO

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This completes the 1st module of the 9 module series. Please refer to the othercoursemodulesin Annexure-1.