Certification Course on **Process Piping Fabrication**

Resource Person: Dr B. Sudarshan

Co-ordinator: Sri P. Siva Seshu

Date(s) of Event: 16/11/20 to 04/12/20

Organizing department: Mechanical Engineering

K.S.R.M.COLLEGEOFENGINEERING

(UGC-AUTONOMOUS)

Kadapa,Andhra Pradesh,India–516 005

ApprovedbyAICTE,NewDelhi&AffiliatedtoJNTUA,Ananthapuramu.

Cr./KSRMCE/(Department of ME)/2020-2021

Date: 09/11/2020

To

The Principal,

KSRM College of Engineering,

Kadapa.

Respected Sir

Sub: KSRMCE-(Department of ME) permission to conduct certification course on "**Process Piping Fabrication**" -Request-Reg.

It is brought to your kind notice that, with reference to the cited, the ME department is planning to conduct Certification Course on "**Process Piping Fabrication**" for B.Tech, VII Sem Students from **16,Nov 2020 to 04,Dec 2020**. In this regard I kindly request you to grant permission to conduct the certification course. This is submitted for your kind perusal.

Thanking you sir,

Forwarded to Prinicipal
Sir
D. Anil Kumar

Yours Faithfully

Sri P. Siva Seshu

Asst.Prof,Dept.ME

KSRMCE,Kadapa.

Permitted
U.S.S. Murty

To the Director for Information
To All Deans/HoD's/IQAC

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Cr./KSRMCE/(Department of ME)/2020-2021

Date: 09/11/2020

Circular

All the B.Tech VI Sem ME students are here by informed that department of MECHANICAL is going to conduct certificate course on "**Process Piping Fabrication**" interested students may register their names on or before 14-11-2021, 5 PM

For any queries contact faculty coordinator:

Sri P. Siva Seshu, Asst.Prof, Dept.ME, KSRMCE, Kadapa.

Hod

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

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Department of Mechanical Engineering

Certification Course on "**Process Piping Fabrication**"

List of Participants

S.NO	ROLL NO	NAME OF THE STUDENT	EMAIL ID'S
1	179Y1A0330	MANGALI SRINIVASULU	179Y1A0330@ksrmce.ac.in
2	179Y1A0331	MANTHA GOVARDHAN GOPI	179Y1A0331@ksrmce.ac.in
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10	179Y1A0340	PALLAPOTHULA VINOD KUMAR REDDY	179Y1A0340@ksrmce.ac.in
11	179Y1A0341	PALLE MAHENDRA REDDY	179Y1A0341@ksrmce.ac.in
12	179Y1A0343	PERAM SRI MOHAN REDDY	179Y1A0343@ksrmce.ac.in
13	179Y1A0344	PICHIPATI RAM KISHORE REDDY	179Y1A0344@ksrmce.ac.in
14	179Y1A0347	SAGILI VISHNUBHARADWAJA REDDY	179Y1A0347@ksrmce.ac.in
15	179Y1A0348	SAKIRAJU SUNILKUMAR RAJU	179Y1A0348@ksrmce.ac.in
16	179Y1A0349	SHAIK ABDUR REHAMAN HUSSAIN	179Y1A0349@ksrmce.ac.in
17	179Y1A0350	SHAIK IRFAN AHAMAD	179Y1A0350@ksrmce.ac.in
18	179Y1A0353	SHAIK MOHAMMED ABBAS	179Y1A0353@ksrmce.ac.in
19	179Y1A0354	SHAIK MOHAMMED FAYAZ	179Y1A0354@ksrmce.ac.in
20	179Y1A0355	SHAIK MOHISIN AHMED	179Y1A0355@ksrmce.ac.in
21	179Y1A0356	SHAIK NAZAR HUSSAIN	179Y1A0356@ksrmce.ac.in
22	179Y1A0357	SHAIK SAMEER AHAMMAD	179Y1A0357@ksrmce.ac.in
23	179Y1A0358	SHAIK SUHAIL UR REHAMAN	179Y1A0358@ksrmce.ac.in
24	179Y1A0359	SHAIK ZAHEER AHAMMAD	179Y1A0359@ksrmce.ac.in
25	179Y1A0361	SOMISETTY VENKATA SAI JASWANTH	179Y1A0361@ksrmce.ac.in
26	179Y1A0362	TALARI ABHISHEK	179Y1A0362@ksrmce.ac.in
27	179Y1A0363	TALARI BOYA SRINIVASULU	179Y1A0363@ksrmce.ac.in

28	179Y1A0364	THALAMOPURI RAJESH	179Y1A0364@ksrmce.ac.in
29	179Y1A0365	THANNEERU AMARENDRA	179Y1A0365@ksrmce.ac.in
30	179Y1A0366	VADDEMANI VENKATA DEVENDRAREDDY	179Y1A0366@ksrmce.ac.in
31	179Y1A0367	VANGIMALLA SATHISH KUMAR REDDY	179Y1A0367@ksrmce.ac.in
32	179Y1A0370	VULLITHULA HARI PRASAD	179Y1A0370@ksrmce.ac.in
33	179Y1A0371	YERRABALLI SHAIK SARFARAAZ	179Y1A0371@ksrmce.ac.in
34	189Y5A0334	NAIB MOHAMMED ABID	189Y5A0334@ksrmce.ac.in
35	189Y5A0335	NANDYALA MAHESWARA REDDY	189Y5A0335@ksrmce.ac.in
36	189Y5A0336	NARAPUREDDY PATTABHI REDDY	189Y5A0336@ksrmce.ac.in
37	189Y5A0338	PAPIREDDYGARI SURYAPRAKASH REDDY	189Y5A0338@ksrmce.ac.in
38	189Y5A0339	PENTAM HARSHAVARDHAN	189Y5A0339@ksrmce.ac.in
39	189Y5A0340	POGAKU BALA NARASIMHUDU	189Y5A0340@ksrmce.ac.in
40	189Y5A0341	PUJARI HARSHA VARDHAN	189Y5A0341@ksrmce.ac.in
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45	189Y5A0346	SANNAPU REDDY BHARATH KUMAR REDDY	189Y5A0346@ksrmce.ac.in
46	189Y5A0347	SAYYAD SALEEM	189Y5A0347@ksrmce.ac.in
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53	189Y5A0354	SYED MOHAMMED MATEEN HUSSAIN	189Y5A0354@ksrmce.ac.in
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56	189Y5A0357	YARAPA GANESH	189Y5A0357@ksrmce.ac.in
57	189Y5A0358	YARRAM REDDY HARINATH REDDY	189Y5A0358@ksrmce.ac.in
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Coordinator

HOD

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

Syllabus

PROESS PIPING FABRICATION

Course Objectives

- This course focuses on different types of process piping fabrication work.
- This course helps to practice use of different tools, equipments and machineries applicable in piping fabrication
- This includes hands on practice to student for deciding fundamental technical requirements in piping fabrications.

Unit – I

Introduction to piping classification General definitions Length area, surface & volume Acronyms and abbreviation, Colour coding of piping, as per types fluid passing through, piping (IS 2379:1990) Concept of high point vent & low point drain Duties & responsibilities of piping field engineer. Role of field engineer in safety field craft supports/communications

Unit – II

Life Cycle of Piping Process Plants
Introduction to major phases of piping process plants, Feasibility study (techno- economical survey). Design Construction Commission/erection phase. Operational/production phase.

Unit – III

Piping Components Hanger And Supports
Pipe & tube product Pipe sizes & materials Pipes joints & bending Valves
Strainers & traps Expansion joints Threaded joints Flanges' Gaskets Fasteners Welded & brazed joint Joining ductile or cast iron pipes Hanger And Supports (Restrain Introduction Concept and Function Classification/Types of supports Pipe support material Oversized and Slotted Holes Bolting Installation Procedure Hanger installation guide lines Calculation for pipe supports e.g. spacing, span, and pipe welding space, etc.

Unit – IV

Piping Codes & Standards
Introduction of ASME codes, Code cases interpretation , Introduction of ANSI 4 Introduction of ASTM, Introduction of API, Introduction of AWS.

Unit – V

Pipe Welding & Fabrication

Orbital pipe welding, Up-hill / down-hill welding. Spiral pipe welding Various pipe welding position groove & fillet. General fabrication procedure for piping spool. Shop weld plan for piping. Underground pipe laying (needs & method) Fit-up & set-up for welding of pipe. Purging / Trailing gas concept in pipe fabrication FPWfull penetration welding of pipe. 8.10 Different types of purging.

COURSE OUTCOMES

- Describe the responsibilities of piping field engineer
- Use pipe's standard tables for different calculations.
- Describe the functions and features of various piping components.
- Apply various codes and standard for piping in a given situation.

TEXT BOOKS

1. Piping/mechanical hand book Mohinder L. Nayyar.
2. ASME PIPING CODES ASME
3. Handbook of piping design S.K. Sahu

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Department of Mechanical Engineering

Certification Course on "Process Piping Fabrication"

Schedule

Timing: 4:00pm – 6:00pm

S.No	Date	Course Coordinator	Topic Covered
1	16-11-2020	Sri P. Siva Seshu	Introduction to piping classification General definitions Length area
2	17-11-2020	Dr. B. Sudarshan	Concept of high point vent & low point drain Duties & responsibilities of piping field engineer
3	18-11-2020	Dr. B. Sudarshan	Role of field engineer in safety field craft supports/communications
4	19-11-2020	Sri P. Siva Seshu	Introduction to major phases of piping process plants
5	20-11-2020	Dr. B. Sudarshan	Feasibility study (techno- economical survey
6	21-11-2020	Sri P. Siva Seshu	Design Construction Commission/erection phase. Operational/production phase.
7	23-11-2020	Dr. B. Sudarshan	Pipe & tube product Pipe sizes & materials Pipes joints & bending Valves
8	24-11-2020	Sri P. Siva Seshu	Gaskets Fasteners Welded & brazed joint Joining ductile or cast iron pipes Hanger And Supports
9	25-11-2020	Dr. B. Sudarshan	Bolting Installation Procedure Hanger installation guide lines Calculation for pipe supports
10	26-11-2020	Sri P. Siva Seshu	Introduction of ASME codes, Code cases interpretation
11	27-11-2020	Dr. B. Sudarshan	Introduction of ANSI 4 Introduction of ASTM
12	28-11-2020	Sri P. Siva Seshu	Introduction of API, Introduction of AWS
13	01-11-2020	Dr. B. Sudarshan	Orbital pipe welding, Up-hill / down-hill welding. Spiral pipe welding Various pipe welding position
14	02-11-2020	Sri P. Siva Seshu	General fabrication procedure for piping spool. Shop weld plan for piping.
15	04-12-2020	Dr. B. Sudarshan	Underground pipe laying (needs & method) Fit-up & set-up for welding of pipe

Coordinator

HoD

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

Activity Report

Name of the Event	: Certification Course on "**Process Piping Fabrication**"
Date of the Event	: 16-11-2021 to 04-12-2020
Scheduled Time	: 4.00 to 6.00PM
Target Audience	: B.Tech VII Sem Students
Course coordinator	: P. Siva Seshu

Activity Description:

Process Piping Fabrication is one of the Manufacturing Technique for Mechanical students. Department of ME organized a Certificate Course on "**Process Piping Fabrication**". Head of the Department, faculty & participants of the Course inaugurated with all good spirit. Resource persons began the first day first session Introduction to piping classification Introduction to major phases of piping process plants . Finally valedictory. Students were issued participation certificates by Head of the Department.

Coordinator

HOD

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

V. S. S. Murty
Principal

PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA - 516 003. (A.P.)

K.S.R.M. COLLEGE OF ENGINEERING

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Kadapa, Andhra Pradesh, India– 516 003

Certificate Course on

"Process Piping Fabrication"

16/11/2020 to 04/12/2020

Organized by

DEPARTMENT OF MECHANICAL ENGINEERING

K.S.R.M.COLLEGEOFENGINEERING

(UGC-AUTONOMOUS)

Kadapa,Andhra Pradesh,India–516 005

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Department of Mechanical Engineering

Certification Course on **Process Piping Fabrication**

Attendance Sheet

S.No	Name of the Student	Roll List	16/11/20	17/11	18/11	19/11	20/11	21/11	23/11	24/11	25/11	26/11	27/11	28/11	01/11	02/11	04/12
1	MANGALI SRINIVASULU	179Y1A0330	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
2	MANTHA GOVARDHAN GOPI	179Y1A0331	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
3	MEESALA PRASANTH PRANAY	179Y1A0332	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	MEKALA NEELESH RAHUL	179Y1A0333	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	MUDDI SIVA SAI	179Y1A0334	✓	✓	A	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
6	MUDE SURYAPRAKASH NAIK	179Y1A0335	✓	✓	✓	✓	✓	A	✓	✓	✓	A	A	A	✓	✓	✓
7	MUMMADI SUMANTHREDDY	179Y1A0336	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓
8	ODETI SHARIEF	179Y1A0338	A	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
9	PALAMPALLI VENKATA RAVINDRA REDDY	179Y1A0339	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	PALLAPOTHULA VINOD KUMAR REDDY	179Y1A0340	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	PALLE MAHENDRA REDDY	179Y1A0341	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	PERAM SRI MOHAN REDDY	179Y1A0343	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
13	PICHIPATI RAM KISHORE REDDY	179Y1A0344	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓
14	SAGILI VISHNUBHARADWAJA REDDY	179Y1A0347	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15	SAKIRAJU SUNILKUMAR RAJU	179Y1A0348	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓

16	SHAIK ABDUR REHAMAN HUSSAIN	179Y1A0349	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17	SHAIK IRFAN AHAMAD	179Y1A0350	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
18	SHAIK MOHAMMED ABBAS	179Y1A0353	✓	✓	✓	✓	✓	A	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
19	SHAIK MOHAMMED FAYAZ	179Y1A0354	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	A	✓	A	✓	✓	✓	✓
20	SHAIK MOHISIN AHMED	179Y1A0355	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
21	SHAIK NAZAR HUSSAIN	179Y1A0356	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
22	SHAIK SAMEER AHAMMAD	179Y1A0357	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
23	SHAIK SUHAIL UR REHAMAN	179Y1A0358	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
24	SHAIK ZAHEER AHAMMAD	179Y1A0359	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
25	SOMISETTY VENKATA SAI JASWANTH	179Y1A0361	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
26	TALARI ABHISHEK	179Y1A0362	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓
27	TALARI BOYA SRINIVASULU	179Y1A0363	A	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
28	THALAMOPURI RAJESH	179Y1A0364	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
29	THANNEERU AMARENDRA	179Y1A0365	✓	A	✓	A	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓
30	VADDEMANI VENKATA DEVENDRAREDDY	179Y1A0366	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
31	VANGIMALLA SATHISH KUMAR REDDY	179Y1A0367	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
32	VULLITHULA HARI PRASAD	179Y1A0370	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
33	YERRABALLI SHAIK SARFARAAZ	179Y1A0371	✓	✓	A	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
34	NAIB MOHAMMED ABID	189Y5A0334	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
35	NANDYALA MAHESWARA REDDY	189Y5A0335	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓
36	NARAPUREDDY PATTABHI REDDY	189Y5A0336	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
37	PAPIREDDYGARI SURYAPRAKASH REDDY	189Y5A0338	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
38	PENTAM HARSHAVARDHAN	189Y5A0339	✓	✓	✓	A	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
39	POGAKU BALA NARASIMHUDU	189Y5A0340	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
40	PUJARI HARSHA VARDHAN	189Y5A0341	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
41	RODDAM SHARATH	189Y5A0342	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
42	S IBRAHIM KHAN	189Y5A0343	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
43	SALE MADAN KUMAR	189Y5A0344	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
44	SAMPURI SUDHEER	189Y5A0345	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
45	SANNAPU REDDY BHARATH KUMAR REDDY	189Y5A0346	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
46	SAYYAD SALEEM	189Y5A0347	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓

47	SHAIK MAHAMMAD SADIQ PATEL	189Y5A0348	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
48	SHAIK RAHAMATHULLA	189Y5A0349	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
49	SHAIK SHABEEH AHMED	189Y5A0350	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
50	SIRLU JAGAN	189Y5A0351	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
51	SUDDAMALLA SIVANAGADASTAGIRI REDDY	189Y5A0352	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
52	SULLAGALLA PAWAN KALYAN	189Y5A0353	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
53	SYED MOHAMMED MATEEN HUSSAIN	189Y5A0354	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
54	VENNAPUSA CHANDRAHASAREDDY	189Y5A0355	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
55	YANAMADALA BHARGAV	189Y5A0356	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
56	YARAPA GANESH	189Y5A0357	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
57	YARRAM REDDY HARINATH REDDY	189Y5A0358	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
58	YEDULA RAMMOHAN	189Y5A0359	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓

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CHAPTER

DESIGN CODES AND STANDARDS

The manufacture and installation of pressure piping is tightly regulated by the American Society of Mechanical Engineers, ASME "B31" code series such as B31.1 or B31.3. These codes have their basis in the ASME Boiler and Pressure Vessel Codes and are mandatorily applied in Canada and the USA. Europe has an equivalent system of codes.

DIFFERENCE BETWEEN CODES AND STANDARDS

Design Codes

The "Codes" define the rules and regulations deemed necessary for safe design and construction. For example, the piping codes address the following design requirements:

- Allowable stresses and stress limits
- Allowable dead loads and load limits
- Allowable live loads and load limits
- Materials
- Minimum wall thickness
- Maximum deflection
- Seismic loads and
- Thermal expansion

Note that the piping codes DO NOT include components such as fittings, valves, flanges and meters; rather, they define the design requirements for these components by reference to industry standards.

Design Standards

The "Standards" provide specific design criteria and rules for individual components or classes of components such as valves, flanges and fittings. Standards apply to both dimensions and performance of system components.

- **Dimensional standards** provide configuration control parameters for components. The primary objective of dimensional standards is

to ensure that similar components manufactured by different suppliers permit interchangeability.

- **Pressure-integrity standards** provide uniform minimum-performance criteria. The main objective is to ensure that the components designed and manufactured to the same standard will function in an equivalent manner. For example, all NPS 10 (DN 250) Class 150 ASTM A105 flanges, which are constructed in accordance with ASME B16.5, Pipe Flanges and Flanged Fittings, have a pressure-temperature rating of 230 psig (1590 kPa gauge) at 300°F (149°C).

3.2. PRESSURE PIPING CODES

The American Society of Mechanical Engineers (ASME) established the B31 Pressure Piping Code Committees to promote safety in pressure piping design and construction through published engineering criteria.

The intent of ASME B31 codes is to set forth engineering requirements deemed necessary for safe design and construction of piping installations. However, the Codes are not designed to replace competent engineering design or judgment. Most importantly, the Codes do not "approve," "rate," or "endorse" any items of construction, proprietary devices, or activity. The Codes do not put a limit on conservatism and, conversely, the Codes also allow for designs that are capable of more rigorous engineering analysis which justifies less conservative designs.

ASME B31 codes have the force of law in Canada and the USA. Even if there is no legal requirement, the client, and insurance underwriters may require compliance/with ASME codes. And at a minimum, good engineering practices should be followed that are described in the Codes. If a facility is outside the United States, there may be a set of international Codes that are prescribed.

Important

- The OWNER has the overall responsibility for meeting compliance with ASME B31 codes and standards for the design of piping installations.
- ASME Code is not intended to apply to piping that has been placed in service.

The following list defines the ASME Pressure Piping Codes used for the design, construction and inspection of pressurized piping systems.

3.2.1. B31.1 Power Piping

ASME B31.1 Code is typically used for the design and construction of power piping found in Electric Power Generating Stations, Industrial and Institutional Plants, Geothermal Heating Systems, and Central & District Heating and Cooling Systems. The code covers external piping for power boilers and high temperature, high-pressure water boilers in which steam or vapor is generated at a pressure of more than 15 psig and high-temperature water is generated at pressures exceeding 160 psig or temperatures exceeding 250°F.

- B31.1 is intended to be applied to:
  - ✓ Piping for steam, water, oil, gas, air and other services.
  - ✓ Metallic and nonmetallic piping.
  - ✓ All pressures.
  - ✓ All temperatures above -29°C (-20°F).
- B31.1 does NOT apply to:
  - × Boilers, pressure vessel heaters and components covered by the ASME Boiler and Pressure Vessel Code (BPVC). Note: A boiler needs pipe, both internally and externally. The internal pipe would come under the rules of Section I and the external piping would come under B31.1.
  - × Building heating and distribution steam and condensate systems designed for 15 psig or less.
  - × Hot water heating systems designed for 30 psig or less.

Important

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

3.2.2. B31.3 Process Piping

ASME B31.3 Code is typically used for the design and construction of pressure piping found in Petroleum Refineries, Chemical, Pharmaceutical, Textile, Paper, Semiconductor, and Cryogenic Plants and related Processing Plants and Terminals.

- B31.3 is intended to be applied to:

- ✓ Piping for all fluid services.
- ✓ Metallic and nonmetallic piping.
- ✓ All pressures.
- ✓ All temperatures.

- B31.3 does NOT apply to:
  - × Piping systems designed for pressures at or above 0 but less than 15 psig, provided they meet certain other requirements including temperature ranges.
  - × Tubes and pipes internal to a heater enclosure.
  - × Pressure vessels and certain other equipment and piping.

Important

- Compatibility of materials with the service and hazards from instability of contained fluids are NOT within the scope of ASME B31.3.
- The OWNER is responsible for designating when certain fluid services, i.e. Category M (toxic), high purity, high pressure, elevated temperature or Category D (nonflammable, nontoxic fluids at low pressure and temperature) are applicable to specific systems and for designating if a Quality System is to be imposed.

3.2.3. B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons

ASME B31.4 Code is typically used for the pipelines that transport liquids between plants, terminals and pumping regulating and metering stations.

The liquids include crude oil, condensate, natural gasoline, liquefied petroleum gas, carbon dioxide, liquid alcohol, liquid anhydrous ammonia, and liquid petroleum products between producers' lease facilities, tank farms, natural gas processing plants, refineries, stations, ammonia plants, terminals (marine, rail, and truck), and other delivery and receiving points.

- B31.4 is intended to be applied to:
  - ✓ Piping transporting liquids such as crude oil, condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, carbon dioxide, liquid alcohol, liquid anhydrous ammonia, and liquid petroleum products.

- ✓ Piping at pipeline terminals (marine, rail, and truck), tank farms, pump stations, pressure reducing stations, and metering stations, including scraper traps, strainers, and loops;
- ✓ All pressures
- ✓ Temperatures from -29 to 121°C (-20 to 250°F) inclusive.

- B31.4 does NOT apply to:
  - × Auxiliary piping, e.g., water, air, or steam.
  - × Pressure vessels, heat exchangers and similar equipment.
  - × Piping designed at or below 1 bar (15 psig) at any temperature.
  - × Piping above 1 bar (15 psig) if temperature is below –20°F (–30°C) or above 250°F (120°C).
  - × Piping, casing or tubing used in oil well and related assemblies.
  - × Petroleum refinery piping with certain exceptions.
  - × Gas transmission and distribution lines.

3.2.4. B31.5 Refrigeration Piping and Heat Transfer Components

ASME B31.5 Code is typically used for the design and construction of pressure piping containing refrigerants or secondary coolants.

- B31.5 is intended to be applied to:
  - ✓ Refrigerant and secondary coolant piping.
  - ✓ Heat transfer components such as condensers and evaporators.
  - ✓ All pressures.
  - ✓ Temperatures at and above -320°F (-196°C)
- B31.5 does NOT apply to the following:
  - × Any self-contained or unit systems subject to the requirements of Underwriters Laboratories or another nationally recognized testing laboratory.
  - × Water piping.
  - × Piping designed for external or internal gauge pressure not exceeding 15 psi regardless of size.

- × Pressure vessels, compressors or pumps.

3.2.5. B31.8 Gas Transmission and Distribution Piping Systems

ASME B31.8 Code is typically used for gas transportation piping between sources and terminals. It includes gas pipelines, gas compressor stations, gas metering and regulation stations, gas mains, and service lines up to the outlet of the customer's meter set assembly.

- B31.8 is intended to be applied to:
  - ✓ Onshore and offshore pipeline facilities used for the transport of gas.
  - ✓ Gathering pipelines.
  - ✓ Gas distribution systems.
  - ✓ Piping at compressor, regulating and metering stations.
  - ✓ All pressures.
  - ✓ Temperatures from -29 to 232°C (-20 to 450°F) inclusive.

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

- B31.8 does NOT apply to the following:
  - × Pressure vessels covered by the BPVC.
  - × Piping with metal temperatures above 450°F (232°C) or below –20°F (–30°C).
  - × Piping beyond the outlet of the customer's meter assembly.
  - × Wellhead assemblies.
  - × Design and manufacture of heat exchangers to Tubular Exchanger Manufacturers Association (TEMA) standards.

3.2.6. B31.9 Building Services Piping

ASME B31.9 Code is typically used for the design and construction of piping found in Industrial, Institutional, Commercial, Public Buildings and multi-unit residences which do not require the range of sizes, pressures and temperatures covered by ASME B31.1 Power Piping Code.

- B31.9 is intended to be applied to:
  - ✓ Piping for water and anti-freeze solutions for heating and cooling, steam and steam condensate, air, combustible liquids and other nontoxic, nonflammable fluids contained in piping not exceeding the following:

    Dimensional limits

    - Carbon steel: NPS 42 (DN 1050) and 0.500 in. (12.7 mm) wall.
    - Stainless steel: NPS 24 (DN 600) and 0.500 in. (12.7 mm) wall.
    - Aluminum: NPS 12 (DN 300).
    - Brass and copper NPS 12 (DN 300), 12.125 in. (308 mm) for copper tube.
    - Thermoplastics: NPS 24 (DN 600).
    - Ductile Iron: NPS 24 (DN 600).
    - Reinforced Thermosetting Resin: NPS 24 (DN 600).
  - ✓ Pressure and temperature limits, inclusive:
    - Compressed air, steam and steam condensate to 1035 kPa (150 psi) gage.
    - Steam and steam condensate from ambient to 186°C (366°F).
    - Other gases from ambient to -18 to 93°C (0 to 200°F)
    - Liquids to 2415 kPa (350 psi) gage and from -18 to 121°C (0 to 250°F).
    - Vacuum to 1 Bar (14.7 psi).
  - ✓ Piping connected directly to ASME Section IV Heating Boilers.

3.2.7. B31.11 Slurry Transportation Piping Systems

ASME B31.11 Code is typically used for aqueous slurries of nonhazardous materials, such as coal, mineral ores and other solids, between the slurry processing plant and

the receiving plant. One of the uses of these systems is in the mining industries in moving ores from the mines to elsewhere.

- B31.11 is intended to be applied to:
  - ✓ Piping transporting aqueous slurries of nonhazardous materials.
  - ✓ Piping in pumping, and regulating stations.
  - ✓ All pressures.
  - ✓ Temperatures from -29 to 121°C (-20 to 250°F) inclusive.
- B31.11does NOT apply to the following:
  - × Auxiliary piping such as for water, air, and similar liquids and gases.
  - × Pressure vessels.
  - × Piping designed for pressures below 15 psig at any temperature.
  - × Piping designed for pressures above 15 psig, when temperature is below —20°F (–30°C) or above 250°F (120°C).
  - × Piping within the battery limits of slurry processing plants and other non-storage facilities.
  - × Design and fabrication of proprietary items.

Code Applicability

There are a number of similarities in each Code, such as in the calculation of minimum 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 the facility.

In most plants, one piping code applies to all piping systems, but sometimes it is not appropriate 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 designed to B31.1, and parts may be designed to ASME Boiler & Pressure Vessel Code. No one code fits all.

- Power piping is focused on high pressure and high temperature water and steam with very few chemicals. The plants tend to be vertical, which creates high thermal vertical movements that must be accommodated by spring

supports. Plants are usually away from residential areas and the potential for damage to nearby landowners is typically insignificant.

- Petrochemical plants typically operate at much lower pressures and temperatures than power plants, but the various chemicals result in corrosion issues and the use of many special alloy materials. These plants are also laid out horizontally with most pipe supports being rigid on pipe racks. Plants are often in large industrial areas. If there is a fire or explosion, there is always a concern in minimizing the damage to the local area of a plant or a unit within a plant. Explosions may release hazardous chemicals in the air or in water, and thus mechanical integrity must always be a primary design criterion.
- Pipelines are typically underground with no thermal considerations. The pipes are not put in bending at supports, and thus design rules allow thinner pipe for the same pressure compared to B31.1 and B31.3. Pipelines may be in unpopulated areas, or running through suburban and urban areas. Because of the potential for damage to nearby landowners, rules are different based on the pipe's proximity to populated areas.

Important

It is the OWNER's responsibility to determine which code section is applicable to piping 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 [ASME B31.3, para 300.1.3]:

- Piping systems designed for internal gage pressures at or above zero but less than 15 psi, provided the fluid handled is nonflammable, nontoxic, and not damaging to human tissue as defined in ASME B31.3 Para. 300.2 and its design temperature is between -20°F through 366°F
- Tubes, tube headers, crossovers, and manifolds of fired heaters, which are internal to the heater enclosure.

Caution

Once a Code has been selected to apply to a particular piping system, only that code should be applied. For example, it is not a practice to use a minimum wall thickness calculation from B31.3, an allowable stress value from B31.8, and an inspection

method from B31.1. While it appears obvious that we cannot "cherry pick" the aspects we like from each Code, there are many times that the Codes are incomplete or give no guidance for certain conditions. In these situations, it is appropriate to research other codes, technical papers and other published documents for guidelines to properly engineer the piping system. With this information, a rational engineering judgment can be made that is at least as conservative as the governing Code.

3.3. How the Chapters are arranged?

While each section of the ASME B31 piping codes follows the same general setup of chapters described below, ASME B31.3 is used as the reference here.

- **Chapter I Scope and Definitions (para 300)** includes general information on responsibilities, intent of the Code, Code requirements, and scope. The chapter also includes specific nomenclature and definitions.
- **Chapter II Design (para 301 through 322)** defines the minimum sections that are required in the engineering design process. They are divided into six sub-sections:
  - **Part 1 Conditions and Criteria**

    Part 1, Conditions and Criteria, (para 301 through 302) describes the design pressure, design temperatures and forces to consider in design. Forces include ambient, dynamic, weight, thermal expansion and contraction, support movement, reduced ductility, cyclic and air condensation effects. Part 1 provides pressure-temperature ratings, stress criteria, design allowances, and the minimum design values along with permissible variations. Discussion is provided on how the allowables were generated and the application of allowables for different design conditions.
  - **Part 2 Pressure Design of Piping Components**

    Part 2, Pressure Design of Piping Components, (para 303 through 304) describes the design of straight pipe, bends, branches, closures, flanges, and reducers along with other pressure components under pressure only. Components manufactured in accordance with standards listed in Table 326.1 of B31.3 shall be considered suitable for use at the listed pressure-temperature

J	Nomenclature
K	Allowable Stress for High Pressure Piping
L	Aluminum Alloy Pipe Flanges
M	Guide to Classifying Fluid Services
Q	Quality System Program
V	Allowable Variations in Elevated Temperature Service
X	Metallic Bellows Expansion Joints
Z	Preparation of Technical Inquiries

3.4. Process Steps or Expectations

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) Section VIII, Rules for Construction of Pressure Vessels) are not design handbooks. The ASME Codes are to be used as a guide to the analyses that should be performed and do not eliminate the need for competent engineering judgment. The ASME Codes set forth engineering requirements deemed necessary for the safe design and construction of pressure systems.

To the greatest possible extent, code requirements for design are stated in terms of basic design principles and formulas. These are supplemented, as necessary, with specific requirements to assure uniform application of principles and to guide selection and application of pressure system elements.

3.5. ASSOCIATIONS PROVIDING PIPING MATERIAL SPECIFICATIONS

- American Petroleum Institute (API)
- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- American Welding Society (AWS)
- Manufacturers Standardization Society (MSS)
- National Association of Corrosion Engineers (NACE)
- National Fire Protection Association (NFPA)
- Society of Automotive Engineers (SAE)

3.5.1. API - American Petroleum Institute Standards

Rules, practices and standards for oil and gas industry are issued by this institute and followed by almost all oil and gas companies in the world.

Among the many standards issued by the institute, there is also a standard for the design of pipelines: API STANDARD 5L. Within this standard, materials for oil and gas transportation pipelines are specified, with denomination API 5L.

- API 5L
  - API 5L provides dimensions, weights, and test pressures for plain-end line pipe in sizes up to 80 inches in diameter.
  - Several weights are available in each line pipe diameter. The weight of the pipe in lb/ft, in turn, varies as the wall thickness for a given outside diameter. For instance, API Spec 5L lists 24 different weights in the 16-inch-diameter size (five weights are special weights), ranging from 31.75 lb/foot to 196.91 lb/foot.
  - The corresponding wall thickness ranges from 0.188 inch to 1.250 inches. As the wall thickness increases for a given outside diameter, the inside diameter of the pipe decreases from 15.624 inches for the lightest weight pipe to 13.500 inches for the line pipe weighing 196.91 lb/foot. Greater wall thicknesses are selected for high-pressure applications, or when the pipe segment might be subjected to unusual external forces such as seismic activities and landslides.

This is a family of carbon steels almost equivalent to ASTM A53 / A106.

Equipment specified to these standards is typically more robust than general industrial applications.

Common API standards are:

Spec. 5L	Line Pipe
Spec. 6D	Pipeline Valves
Spec. 6FA	Fire Test for Valves
Spec. 12D	Field Welded Tanks for Storage of Production Liquids
Spec. 12F	Shop Welded Tanks for Storage of Production Liquids

ratings. The rules provided in para 304 are intended for pressure design of components not covered in Table 326.1.

- **Part 3 Fluid Service Requirements for Piping Components**

  Part 3, Fluid Service Requirements for Piping Components (para 305 through 309), discusses the types of components which can be used in the intended Fluid Service.

- **Part 4 Fluid Service Requirements for Piping Joints**

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

- **Part 5 Flexibility and Support**

  Part 5, Flexibility and Support (para 319 through 321.4), provides basic and specific requirements for flexibility analyses as well as providing the design requirements and analyses for piping supports. Formal flexibility analysis is not necessary if the design temperature is at or below 150°F and the piping is laid out with inherent flexibility, or the design temperature is at or below 250°F and the piping is analyzed for flexibility using simplified methods of calculation. Design of pipe supports are addressed in Standards such as Manufacturers Standardization Society of the Valve and Fittings Industry MSS-SP-58. Allowable stress levels for supports are provided in the American Institute of Steel Construction (AISC) Manual of Steel Construction and the AISC Standard N690.

- **Part 6 Systems**

  Part 6, Systems (para 322), defines requirements for instrument piping and pressure relieving devices.

- **Chapter III Materials** (para 323 through 325) describes where to find materials, how they are specified, and their limitations. Chapter III also describes how the materials are to be marked.

  When the materials are not listed by the ASME code, the material must be qualified in accordance with the requirements of the ASME Code. Reviewing the material of an unlisted component is done to ensure a specified minimum allowable stress at the design temperature. The

sources for allowable stress values include the ASME B31 Codes of Pressure Piping and the ASME BPV Code Section II. BPV Code Cases should also be reviewed for allowable stresses for specific materials.

- **Chapter IV Standards for Piping Components** (para 326) describes where to find piping dimensional requirements.
- **Chapter V Fabrication, Assembly, and Erection** (para 327 through 335) describes how to create joints, form, or bend materials for system fabrication. Chapter V describes how to qualify the joint being manufactured 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, post heat treatment, and joint repair.
- **Chapter VI Inspection, Examination, and Testing** (para 340 through 346) explains responsibilities for inspection to B31.3 requirements. Chapter VI addresses the non-destructive examination (NDE) required for a particular service, qualification of the person performing the NDE, and the acceptance criteria for the NDE. Chapter VI describes the minimum pressure testing required and how to determine the testing requirements.
- Chapter VII Nonmetallic Piping and Piping Lined with Nonmetals
- Chapter VIII Piping for Category M Fluid Service
- Chapter IX High Pressure Piping
- **Appendices**

A	Allowable Stresses and Quality Factors for Metallic Piping and Bolting Materials
B	Stress Tables and Allowable Pressure Tables for Nonmetals
C	Physical Properties of Piping Materials
D	Flexibility and Stress Intensification Factors
E	Reference Standards
F	Precautionary Considerations
G	Safeguarding
H	Sample Calculations for Branch Reinforcement

Spec. 12J	Oil and Gas Separators
Spec. 12K	Indirect Type Oil Field Heaters
Std. 594	Wafer and Wafer-Lug Check Valves
Std. 598	Valve Inspection and Testing
Std. 599	Metal Plug Valves - Flanged and Butt-Welding Ends
Std. 600	Steel Gate Valves-Flanged and Butt-Welding Ends
Std. 602	Compact Steel Gate Valves-Flanged Threaded, Welding, and Extended-Body Ends
Std. 603	Class 150, Cast, Corrosion-Resistant, Flanged-End Gate Valves
Std. 607	Fire Test for Soft-Seated Quarter-Turn Valves
Std. 608	Metal Ball Valves-Flanged and Butt-Welding Ends
Std. 609	Lug-and Wafer-Type Butterfly Valves
Std. 610	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Services
Std. 611	General Purpose Steam Turbines for Refinery Services
Std. 612	Special Purpose Steam Turbines for Refinery Services
Std. 613	Special Purpose Gear Units for Refinery Services
Std. 614	Lubrication, Shaft-Sealing and Control Oil Systems for Special Purpose Application
Std. 615	Sound Control of Mechanical Equipment for Refinery Services
Std. 616	Gas Turbines for Refinery Services
Std. 617	Centrifugal Compressors for General Refinery Services
Std. 618	Reciprocating Compressors for General Refinery Services
Std. 619	Rotary-Type Positive Displacement Compressors for General Refinery Services
Std. 620	Design and Construction of Large, Welded, Low Pressure Storage Tanks
Std. 630	Tube and Header Dimensions for Fired Heaters for Refinery Service
Std. 650	Welded Steel Tanks for Oil Storage
Std. 660	Heat Exchangers for General Refinery Service
Std. 661	Air-Cooled Heat Exchangers for General Refinery Service

Std. 670	Vibrations, Axial Position, and Bearing-Temperature Monitoring Systems
Std. 671	Special Purpose Couplings for Refinery Service
Std. 674	Positive Displacement Pumps-Reciprocating
Std. 675	Positive Displacement Pumps-Controlled Volume
Std. 676	Positive Displacement Pumps-Rotary
Std. 677	General Purpose Gear Units for Refineries Services
Std. 678	Accelerometer-Base Vibration Monitoring System
Std. 1104	Welding Pipelines and Related Facilities
Std. 2000	Venting Atmospheric and low-Pressure Storage Tanks - Non-Refrigerated and Refrigerated
RP 530	Calculation for Heater Tube Thickness in Petroleum Refineries
RP 560	Fired Heater for General Refinery Services
RP 682	Shaft Sealing System for Centrifugal and Rotary Pumps
RP 1110	Pressure Testing of Liquid Petroleum Pipelines
Publ. 941	Steel for Hydrogen Service at Elevated Temperature and Pressures in Petroleum Refineries and Petrochemical Plants
Publ. 2009	Safe Welding and Cutting Practices in Refineries
Publ. 2015	Safe Entry and Cleaning of Petroleum Storage Tanks

3.5.2. ASTM – American Society of Testing Materials

ASTM developed a collection of documents called material specifications for standardizing materials of large use in the industry.

- Specifications starting with "A" are for steel.
- Specifications starting with "B" are for non-ferrous alloys (bronze, brass, copper nickel alloys, aluminum alloys and so on).
- Specifications starting with "D" are for plastic material, as PVC.

An ASTM specification specifies the basic chemical composition of material and the process through which the material is shaped into the final product. Some of the common material standards are:

*C507	Ball Valves, 6 In. Through 48 In. (150 mm Through 1,200 mm)
*C508	Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
*C509	Resilient-Seated Gate Valves for Water Supply Service
*C510	Double Check Valve Backflow Prevention Assembly
*C511	Reduced-Pressure Principle Backflow Prevention Assembly
C900	PVC Pressure Pipe, 4-inch through 12-inch, for Water
C950	Glass-Fiber-Reinforced Thermosetting Resin Pressure Pipe

* Not listed in ASME B31.3

3.5.6. MSS Standard Practices

The Manufacturers Standardization Society (MSS) standards are directed at general industrial applications. The most common MSS-SP standards are:

MSS SP 6	Standard Finishes for contact surface for flanges
MSS SP 25	Standard marking system for valves, fittings, flanges
MSS SP 42	Class 150 corrosion resistant gate, globe and check valves
MSS SP 43	Wrought stainless steel butt weld fittings
MSS SP 56	Pipe hanger supports; material, design and manufacture
MSS SP 61	Pressure testing of valves
MSS SP 67	Butterfly Valves
MSS SP 68	High Pressure off seat butterfly valves
MSS SP 69	Pipe hanger supports; selection and applications
MSS SP 70	Cast Iron Gate valves
MSS SP 71	Cast iron check valves
MSS SP 72	Ball Valves
MSS SP 78	Cast iron plug valves
MSS SP 80	Bronze gate, globe and check valves
MSS SP 81	Stainless steel bonnet less knife gate valves
MSS SP 83	Pipe unions
MSS SP 85	Cast iron globe valves

MSS SP 88	Diaphragm valves
MSS SP 89	Pipe hangers and supports; fabrication and installation practices
MSS SP 90	Pipe hangers and supports; guidelines on terminology
MSS SP 92	MSS valves user guide
MSS SP 108	Resilient seated eccentric CI plug valves

3.5.7. National Fire Protection Association (NFPA)

NFPA13	Installation of Sprinkler Systems
NFPA14	Installation of Standpipe, Private Hydrant, and Hose Systems
NFPA15	Water Spray Fixed Systems for Fire Protection
NFPA16	Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA24	Installation of Private Fire Service Mains and Their Appurtenances
NFPA54	National Fuel Gas Code
NFPA58	Liquefied Petroleum Gas Code
NFPA59A	Production, Storage, and Handling of Liquefied Natural Gas (LNG)
NFPA Z662	Oil and Gas Pipeline Systems

3.5.8. Compressed Gas Association (CGA) Piping System Standards

CGA G2.1	Requirements for the Storage and Handling of Anhydrous Ammonia (ANSI K61.1)
CGA G4.4	Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems
CGA G5.4	Standard for Hydrogen Piping Systems at Consumer Locations

3.5.9. Chlorine Institute Piping System Standards (selected)

006	Piping Systems for Dry Chlorine
060	Chlorine Pipelines
094	Sodium Hydroxide Solution and Potassium Hydroxide Solution (Caustic): Storage Equipment and Piping Systems
163	Hydrochloric Acid Storage and Piping Systems

B16.5	Pipe Flanges and Flanged Fittings
B16.9	Factory Made Wrought Steel Butt welding Fittings
B16.10	Face to Face and End to End Dimensions of Valves
B16.11	Forged Fittings, Socket Welding and Threaded
B16.12	Cast Iron Threaded Drainage Fittings
B16.14	Ferrous Pipe Plugs, Bushings and Locknuts with Pipe Threads
B16.15	Cast Bronze Threaded Fittings Class 125 and 250
B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
B16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges
B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.23	Cast Copper Alloy Solder Joint Drainage Fittings – DWV
B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400,600, 900, 1500 and 2500
B16.25	Butt welding Ends
B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
B16.28	Wrought Steel Butt welding Short Radius Elbows and Returns
B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV
B16.32	Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems
B16.33	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes ½ through 2)
B16.34	Valves – Flanged, Threaded and Welding End
B16.36	Orifice Flanges
B16.37	Hydrostatic Testing of Control Valves
B16.38	Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2 ½ to 12, 125 psig maximum)
B16.39	Malleable Iron Threaded Pipe Unions, Classes 1150, 250 and 300
B16.40	Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution
B16.41	Functional Qualification Requirement for Power Operated Active Valve Assemblies for Nuclear Power Plants
B16.42	Ductile Iron Pipe Flanges and Flanged Fittings, Class 150 and 300

B16.45	Cast Iron Fittings for Solvent Drainage Systems
B16.44	Manually Operated Metallic Gas Valves for Use in House Piping Systems
B16.47	Large Diameter Steel Flanges (NPS 26 through NPS 60)
B16.48	Steel Line Blanks
B16.49	Factory-Made Wrought Steel Butt-welding Induction Bends for Transportation and Distribution Systems
B16.50	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
B16.51	Cast and Wrought Copper and Copper Alloy Press-Connect Pressure Fittings (draft)

3.5.4. American Welding Society (AWS)

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

3.5.5. American Water Works Association (AWWA)

These standards refer to the piping elements required for low pressure water services. These are less stringent than other standards and are rarely arbitrated by piping engineers.

***C104**	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C110	Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water
C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
C151	Ductile-Iron Pipe, Centrifugally Cast, for Water
***C153**	Ductile-Iron Compact Fittings for Water Service
C300	Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
C302	Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids
***C501**	Cast-Iron Sluice Gates
***C502**	Dry-Barrel Fire Hydrants
***C503**	Wet-Barrel Fire Hydrants
C504	Rubber-Seated Butterfly Valves

A 36	Specification for Structural Steel
A 53	Specification for Pipe, Steel, Black and Hot –Dipped, Zinc Coated Welded and Seamless
A 105	Specification for Forgings, Carbon Steel, for Piping Components
A 106	Specification for Seamless Carbon Steel Pipe for High Temperature Service
A 181	Specification for Forgings, Carbon Steel for General Purpose Piping
A 182	Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service
A 193	Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
A 194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
A 234	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
A 333	Specification for Seamless and Welded Steel Pipe for Low Temperature Service
A 350	Specification for Forgings, Carbon and Low Alloy Steel Requiring Notch Toughness Testing for Piping Components
A 352	Specification for Steel Castings, Ferritic and Martensitic for Pressure Containing Parts Suitable for Low Temperature Service
A 420	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service
A 694	Specification for Forgings, carbon and Alloy Steel for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Service
A 707	Specifications for Flanges, Forged, Carbon and Alloy Steel for Low Temperature Service

Non-Ferrous Piping Materials

B 42	Seamless Copper Pipe
B 43	Seamless Red Brass Pipe
B 210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
B 241	Seamless Aluminum and Aluminum Alloy Pipe

B 251	Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
B 315	Seamless Copper Alloy Pipe and Tube
B 337	Seamless & Welded Titanium and Titanium Alloy Pipe
B 429	Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
B 466	Seamless Copper Nickel Pipe & Tube
B 467	Welded Copper Nickel pipe
B 658	Seamless & Welded Zirconium and Zirconium Alloy Pipe.
C 76	Specification for Concrete Pipe
C599	Process Glass Pipe and Fittings
D1785	UPVC Plastic Pipe
D 2239	Specification for Polyethylene Pipe
D2282	ABS Plastic Pipe (SDR-PR)
D2464	Threaded PVC Plastic Pipe Fittings, Sch 80
D2468	Socket-Type ABS Plastic Pipe Fittings, Sch 40
D2517	Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
D2846	CPVC Plastic Hot and Cold Water Distribution Systems
D3261	Butt Heat Fusion PE Plastic Fittings for PE Plastic Pipe and Tubing
D5421	Contact Molded Fiberglass RTR Flanges
F423	PTFE Plastic-Lined Ferrous Metal Pipe and Fittings
F492	Polypropylene and PP Plastic-Lined Ferrous Metal Pipe and Fittings
D 3033/3034	UPVC Fittings

3.5.3. ASME Piping Components Standards

These standards provide design, dimensional and manufacturing criteria for many commonly used piping components for use in B31.3 process piping systems.

B16.1	Cast Iron Pipe Flanges and Flanged Fittings
B16.3	Malleable Iron Threaded Fittings, Class 150 and 300
B16.4	Cast Iron Threaded Fittings, Classes 125 and 250

3.5.10. Unified Numbering System (UNS)

The UNS number itself is not a specification, since it establishes no requirements for form, condition, quality etc. It is a unified identification of metals and alloys for which controlling limits have been established in specifications elsewhere.

The UNS provides means of correlating many naturally used numbering systems currently administered by societies, trade associations, individual users and producers of metals and alloys, thereby avoiding confusion caused by the use of more than one identification number for the same material and by the opposite situation of having the same number assigned to two different materials.

UNS establishes 18 Series numbers of metals and alloys. Each UNS number consists of a single letter prefix followed by five digits. In most cases the alphabet is suggestive of the formula of metal identified.

A00001 - A99999	Aluminum & Al. Alloys.
C00001 - C99999	Copper & Copper alloys
E00001 - E99999	Rare earth & rare earth like metal &Alloys.
L00001 - L99999	Low melting metals & alloys
M00001 - M99999	Miscellaneous nonferrous metals & alloys
N00001 - N99999	Nickel & nickel alloys
P00001 - P99999	Precious Metals & alloys
R00001 - R99999	Reactive & refractory metal & alloys
Z00001 - Z99999	Zinc & Zinc alloys
D00001 - D99999	Specified Mech. Properties of Steels
F00001 - F99999	Cast Iron & Cast Steels
G00001 - G99999	AISI & SAE Carbon & Alloy Steels
H00001 - H99999	AISIH Steels
J00001 - J99999	Cast Steels
K00001 - K99999	Misc. steels & Ferrous alloys
S00001 - S99999	Stainless Steels
T00001 - T99999	Tool Steels
W00001 - W99999	Welding Filler Metals & Electrodes

3.5.11. EN – European Standards

EN 10088-1	List of corrosion resistant steel types
EN 10204	Types of inspection documents
EN 10296 -2	Welded round stainless steel tubes for general applications
EN 10297-2	Seamless round austenitic stainless steel tubes for general applications
EN 10217-7	Welded round austenitic stainless steel tubes for special applications
EN ISO 1127	Tolerance for stainless steel welded tube
EN 1092-1 type 5 PN 6-100	Blind flanges PN 6-100
EN 1092-1 type 1 PN 10	Flat welding flanges PN 10
EN 1092-1 type 11 PN 10	Welding neck flanges PN 10
EN 1092-1 type 11 PN 16	Welding neck flanges PN 16
EN 1092-1 type 11 PN 25	Welding neck flanges PN 25
EN 1092-1 type 11 PN 40	Welding neck flanges PN 40
EN 1092-1 PN 64	Welding neck flanges PN 64
EN 1092-1 PN 10	Collar rings and flanges PN 10

3.5.12. Canadian Standards Association

***Z245.1**	Steel Pipe
***Z245.6**	Coiled Aluminum Line Pipe and Accessories
***Z245.11**	Steel Fittings
***Z245.12**	Steel Flanges
***Z245.15**	Steel Valves

* Not listed in ASME B31.3

3.6. MAJOR ORGANIZATIONS FOR STANDARDS

Country	Organization	Abbreviation
USA	American National Standards Institute	ANSI
Canada	Standards Council of Canada	SCC
France	Association Francaise	AFNOR

United Kingdom	British Standards Institute	BSI
Europe	Committee of European Normalization	CEN
Germany	Deutsches Institut fur Normung	DIN
Japan	Japanese Industrial Standards Committee	JISC
Italy	Ente Nazionale Italiano di Unificazione	UNI
Sweeden	Swedish Standards Institution	SS
Norway	Norsk Sokkels Konkuranseposisjon	NORSOK
Worldwide	International Standards Organization	ISO

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This completes the 1st module of the 9 module series. Please refer to the other course modules in Annexure -1.

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This is to certify that

Mr/Ms. O. SHARIEF

Bearing the Roll No 17991A0338

has Succesfully completed certification course on

PROCESS PIPING FABRICATION

From 16/11/20 *to* 04/12/20 *, Organized by Department of*

MECHANICAL ENGINEERING

Coordinator

Head Of Department

V. S. S. Murthy
Principal

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		U.S.S. Murty

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Department of Mechanical Engineering
Certification Course on Process Piping Fabrication

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	MANGALI SRINIVASULU	179Y1A0330	yes	Agree	Strongly Ag	Yes	4	5	Nil
2	MANTHA GOVARDHAN GOPI	179Y1A0331	yes	Agree	Agree	Yes	5	5	Need extra Explanatic
3	MEESALA PRASANTH PRANAY	179Y1A0332	yes	Agree	Agree	Yes	4	5	Nil
4	MEKALA NEELESH RAHUL	179Y1A0333	yes	Agree	Agree	Yes	5	5	Nil
5	MUDDI SIVA SAI	179Y1A0334	yes	Agree	Agree	Yes	5	5	Provide PPT
6	MUDE SURYAPRAKASH NAIK	179Y1A0335	yes	Agree	Agree	Yes	5	4	Nil
7	MUMMADI SUMANTHREDDY	179Y1A0336	yes	Agree	Agree	Yes	5	4	Nil
8	ODETI SHARIEF	179Y1A0338	yes	Agree	Agree	Yes	4	5	Nil
9	PALAMPALLI VENKATA RAVINDRA REDDY	179Y1A0339	yes	Agree	Agree	Yes	5	5	Nil
10	PALLAPOTHULA VINOD KUMAR REDDY	179Y1A0340	yes	Agree	Agree	Yes	5	5	Nil
11	PALLE MAHENDRA REDDY	179Y1A0341	yes	Agree	Agree	Yes	5	5	Nil
12	PERAM SRI MOHAN REDDY	179Y1A0343	yes	Agree	Agree	Yes	5	5	Nil

13	PICHIPATI RAM KISHORE REDDY	179Y1A0344	yes	Agree	Agr	Yes		5	Nil
14	SAGILI VISHNUBHARADWAJA REDDY	179Y1A0347	yes	Agree	Agree	Yes	5	5	Nil
15	SAKIRAJU SUNILKUMAR RAJU	179Y1A0348	yes	Agree	Agree	Yes	5	5	Nil
16	SHAIK ABDUR REHAMAN HUSSAIN	179Y1A0349	yes	Agree	Agree	Yes	5	5	Nil
17	SHAIK IRFAN AHAMAD	179Y1A0350	yes	Agree	Agree	Yes	5	5	Nil
18	SHAIK MOHAMMED ABBAS	179Y1A0353	yes	Agree	Agree	Yes	4	5	Nil
19	SHAIK MOHAMMED FAYAZ	179Y1A0354	yes	Agree	Agree	Yes	5	5	Nil
20	SHAIK MOHISIN AHMED	179Y1A0355	yes	Agree	Agree	Yes	5	5	Nil
21	SHAIK NAZAR HUSSAIN	179Y1A0356	yes	Agree	Agree	Yes	5	5	Nil
22	SHAIK SAMEER AHAMMAD	179Y1A0357	yes	Agree	Agree	Yes	5	5	Nil
23	SHAIK SUHAIL UR REHAMAN	179Y1A0358	yes	Agree	Agree	Yes		5	Nil
24	SHAIK ZAHEER AHAMMAD	179Y1A0359	yes	Agree	Agree	Yes	5	5	Nil
25	SOMISETTY VENKATA SAI JASWANTH	179Y1A0361	yes	Agree	Agree	Yes	5	5	Nil
26	TALARI ABHISHEK	179Y1A0362	yes	Agree	Agree	Yes	5	5	Nil
27	TALARI BOYA SRINIVASULU	179Y1A0363	yes	Agree	Agree	Yes	5	5	Nil
28	THALAMOPURI RAJESH	179Y1A0364	yes	Agree	Agree	Yes		5	Nil
29	THANNEERU AMARENDRA	179Y1A0365	yes	Agree	Agree	Yes	5	5	Nil
30	VADDEMANI VENKATA DEVENDRAREDDY	179Y1A0366	yes	Agree	Agree	Yes	5	5	Nil
31	VANGIMALLA SATHISH KUMAR REDDY	179Y1A0367	yes	Agree	Agree	Yes	5	5	Nil
32	VULLITHULA HARI PRASAD	179Y1A0370	yes	Agree	Agree	Yes	5	5	Nil
33	YERRABALLI SHAIK SARFARAAZ	179Y1A0371	yes	Agree	Agree	Yes	4	5	Nil
34	NAIB MOHAMMED ABID	189Y5A0334	yes	Agree	Agree	Yes	5	5	Nil
35	NANDYALA MAHESWARA REDDY	189Y5A0335	yes	Agree	Agree	Yes	5	5	Nil
36	NARAPUREDDY PATTABHI REDDY	189Y5A0336	yes	Agree	Agree	Yes	5	5	Nil
37	PAPIREDDYGARI SURYAPRAKASH REDDY	189Y5A0338	yes	Agree	Agree	Yes	5	5	Nil
38	PENTAM HARSHAVARDHAN	189Y5A0339	yes	Agree	Agree	Yes	4	5	Nil

39	POGAKU BALA NARASIMHUDU	189Y5A0340	yes	Agree	Agr	Yes	5	5	Nil
40	PUJARI HARSHA VARDHAN	189Y5A0341	yes	Agree	Agree	Yes	5	5	Nil
41	RODDAM SHARATH	189Y5A0342	yes	Agree	Agree	Yes	5	5	Nil
42	S IBRAHIM KHAN	189Y5A0343	yes	Agree	Agree	Yes	5	5	Nil
43	SALE MADAN KUMAR	189Y5A0344	yes	Agree	Agree	Yes	4	5	Nil
44	SAMPURI SUDHEER	189Y5A0345	yes	Agree	Agree	Yes	5	5	Nil
45	SANNAPU REDDY BHARATH KUMAR REDDY	189Y5A0346	yes	Agree	Agree	Yes	5	5	Nil
46	SAYYAD SALEEM	189Y5A0347	yes	Agree	Agree	Yes	5	5	Nil
47	SHAIK MAHAMMAD SADIQ PATEL	189Y5A0348	yes	Agree	Agree	Yes	5	5	Nil
48	SHAIK RAHAMATHULLA	189Y5A0349	yes	Agree	Agree	Yes	4	5	Nil
49	SHAIK SHABEEH AHMED	189Y5A0350	yes	Agree	Agree	Yes	5	5	Nil
50	SIRLU JAGAN	189Y5A0351	yes	Agree	Agree	Yes	5	5	Nil
51	SUDDAMALLA SIVANAGADASTAGIRI REDDY	189Y5A0352	yes	Agree	Agree	Yes	5	5	Nil
52	SULLAGALLA PAWAN KALYAN	189Y5A0353	yes	Agree	Agree	Yes	5	5	Nil
53	SYED MOHAMMED MATEEN HUSSAIN	189Y5A0354	yes	Agree	Agree	Yes	5	5	Nil
54	VENNAPUSA CHANDRAHASAREDDY	189Y5A0355	yes	Agree	Agree	Yes	4	5	Nil
55	YANAMADALA BHARGAV	189Y5A0356	yes	Agree	Agree	Yes	5	5	Nil
56	YARAPA GANESH	189Y5A0357	yes	Agree	Agree	Yes	5	5	Nil
57	YARRAM REDDY HARINATH REDDY	189Y5A0358	yes	Agree	Agree	Yes	5	5	Nil
58	YEDULA RAMMOHAN	189Y5A0359	yes	Agree	Agree	Yes	5	5	Nil

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