MANUAL

PIPING CLASSES - BASIS OF DESIGN

DEP 31.38.01.10-Gen.

December 1997
(DEP Circulars 11/98 and 33/99 have been incorporated)

DESIGN AND ENGINEERING PRACTICE

PREFACE

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The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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APPENDICES

1. INTRODUCTION

1.1 SCOPE

This DEP explains the design basis of the SIOP and SIEP Piping Classes (DEP 31.38.01.12-Gen. and DEP 31.38.01.15-Gen., respectively). Guidance on the application of piping classes for projects are given in DEP 31.38.01.21-Gen.

This DEP is a revision of the DEP of the same number dated December 1994. This is mainly an editorial revision; the main non-editorial changes are summarised in (1.5).

Line pipe and fittings for oil and gas transmission pipeline systems are outside the scope of this DEP.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors nominated by them (i.e. the distribution code is "C", as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants, onshore and offshore exploration and production facilities, and supply/marketing installations (all within the property limits as defined in ASME B31.3 par. 300.1).

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Piping class An assembly of piping components, suitable for a defined service and design limits, in a piping system. The piping classes are contained in the following DEPs:

DEP 31.38.01.12-Gen.- "SIOP Piping Classes". This binder contains piping classes primarily developed for oil refineries, chemical plants and gas plants; also suitable for onshore SIEP facilities.

DEP 31.38.01.15-Gen.- "SIEP Piping Classes". This binder contains piping classes primarily developed for offshore SIEP facilities (platform piping).
NOTE: For standardization and interchangeability, the Principal may decide to use the SIEP piping classes also for onshore facilities, depending on the size of the project.

A summary of the main differences between the SIOP piping classes and the SIEP piping classes is given in (4.2).

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (5).

1.5 SUMMARY OF CHANGES SINCE LAST REVISION

This DEP is a revision of the DEP of the same number dated December 1994. This is mainly an editorial revision; the main non-editorial changes are summarised below:

2.1 Galvanised pipe has been added to digit 8.

3.1 Reference to DEP 30.10.60.18-Gen. has been removed.

3.3 Unnecessary detail has been removed.

3.8 Bolt tensioning now refers to DEP 31.38.01.11-Gen., and not DEP 70.08.10.11-Gen.

3.9 The explanation of how to use rating class 300 components in rating class 150 is no longer relevant and has been removed.

4. DN-to-inch conversion table has been removed.
Differences between SIOP and SIEP piping classes have been simplified.

5. Reference list has been updated.

APPENDIX 1 LGCO, LICC, LICS, LICT, PREQ and TICQ have been removed from the table (they are no longer in piping classes).

APPENDIX 1-1 Slimline valves have been added.

APPENDIX 1-3 Slimline valves have been added.

APPENDIX 1-4 Slimline valves have been added.
Items 'D', 'E' and 'H' have been corrected to show lap joint flanges.

APPENDIX 1-5 Simplified and corrected in line with the changes in Appendix 1.

2. GENERAL

Each piping class consists of a collection of piping components that, under stated service conditions and limits, are compatible and fit for purpose. Piping classes serve to standardize materials and piping components to maximise variety control, improve reliability, and attain consistency in piping design and maintenance.

When applying piping classes, DEP 31.38.01.11-Gen. shall also be applied. Proper use of the piping class system can only be made when the underlying principles and design rules are fully understood. This is particularly important when circumstances dictate deviation from the standard piping classes. For reasons of standardization, deviation from the piping classes should be avoided.

An explanation of the piping class numbering system is given in (2.1) and a description of the contents of each piping class is given in (2.2).

Section (2.3) explains how to select a piping class for a particular service.

The design basis of the piping classes is explained in (3).

2.1 IDENTIFICATION OF PIPING CLASSES

The piping class number comprises two parts.

First part		**Second part**			

The **first part** indicates the ASME rating class as follows:

1 for ASME rating class 150
3 for ASME rating class 300
6 for ASME rating class 600
9 for ASME rating class 900
15 for ASME rating class 1500
25 for ASME rating class 2500

The **second part** is related to the materials selection. Guidelines how to establish this second part are given in (2.3).

The *first digit* indicates the general group of selected materials, i.e.

1 - Carbon steels
2 - Low and intermediate alloy steels
3 - Stainless steels
4 - Aluminium and aluminium alloys
5 - Copper and copper alloys
6 - Nickel and nickel base alloys
7 - Non-metallic materials
8 - Carbon steel, lined or galvanised

The *next three digits* are randomly chosen and have no specific meaning.

For example, piping class **15 3 050** is ASME rating class 1500, stainless steel.

2.2 DESCRIPTION OF PIPING CLASSES

Piping classes consist of 5 pages per class. A short description of the contents of each page is given below:

page 1:

- Summary block giving class details and revision status.
- Mechanical design limits, indicating the pressure ratings at coincident temperatures.
- Notes, giving additional design background and application guidelines/restrictions.

- Branch table, giving construction details for 90° branch connections, suitable within the design limits.
- Table of schedules, giving the selected pipe wall thickness (schedule number or actual thickness) for each nominal pipe diameter in the piping class concerned.

page 2:

- Short materials descriptions for piping components used in the piping class concerned, referring to external standards.

page 3 and 4:

- Components and their MESC codes.

page 5:

Amended per Circular 33/99

- Ranges of bolt sets for various types of flanged joints.
- Assemblies for vents, drains and instrument connections. Assemblies for instrument connections are in accordance with DEP 32.31.00.32-Gen. and DEP 32.37.10.11-Gen. Figure numbers shown in the assemblies refer to those given in Appendix 1 of this DEP.

2.3 SELECTION OF PIPING CLASSES

The "Service Index" in DEP 31.38.01.12-Gen. and the “Piping Class Selection Guide” in DEP 31.38.01.15-Gen. identifies which piping class (without the ASME rating class prefix) to select for the listed services. The temperature range indicated is that for which experience has been gained in applying the material or for which it is known to be suitable.

The "Index of Piping Classes” in DEP 31.38.01.12-Gen. and DEP 31.38.01.15-Gen. identifies the main characteristics (e.g. materials, valves, gaskets and bolting) of all piping classes.

To select a piping class, the "Service Index" (for DEP 31.38.01.12-Gen.) or the “Piping Class Selection Guide” (for DEP 31.38.01.15-Gen.) should be screened to see whether the intended service is listed. If so, the appropriate ASME rating class shall then be identified by matching the required operating pressure and temperature with the design limits given in the piping classes. The "Summary of Issued Piping Classes" (for DEP 31.38.01.12-Gen.) and the SIEP Piping Classes Summary List (for DEP 31.38.01.15-Gen.) shows which ASME rating classes are available. For services where more than one piping class can be selected from the "Service Index" or the “Piping Class Selection Guide”, the selection can be further narrowed down on the component selection within a class. For final selection, the responsible materials and corrosion engineer shall be consulted.

For services not in the "Service Index" or the “Piping Class Selection Guide”, the "Index of Piping Classes” can be screened to see whether a class is available in which the materials are considered suitable for the intended service (see 3.1). If more than one piping class is available, the final selection can be based the component selection within those piping classes.

NOTES:
1. The temperature limits mentioned in the piping classes themselves are based on mechanical design, not corrosion resistance. The temperature ranges given in the "Service Index" or the “Piping Class Selection Guide” shall not be exceeded without approval of the materials engineer of the Principal.
2. Piping classes for services not mentioned in the "Service Index" or the “Piping Class Selection Guide” shall only be used with approval of the Principal.

The indication "Low Temp" in the piping class heading means that the valves have extended bonnets to make them suitable for continuous low temperature service.

3. DESIGN PRINCIPLES

3.1 SELECTION OF BASIC MATERIAL

The composition and properties of the medium shall be specified by the process designer.

In consultation with the process designer or process engineer, the materials and corrosion engineer shall establish the preferred materials selection based on the process requirements such as medium, pressure, temperature, flow and the environment of the process facility. Also design life and cost considerations shall be taken in account.

After selection of the basic material for the specified service, a suitable piping class shall be selected (2.3) for the design pressure and temperature.

NOTE: The primary selection of the piping classes will be governed by the characteristics of individual process streams. However, the total number of selected piping classes should be assessed for possible standardization, limitation of component varieties, spare part and stock holding optimisation, and the risk of mixing similar materials.

For additional information, the following DEPs should be consulted:

DEP 30.10.02.11-Gen., DEP 30.10.02.13-Gen. and DEP 30.10.02.31-Gen.

3.2 DESIGN CODES

Piping classes have been designed in accordance with ASME B31.3.

The design limits specified in the piping classes have been derived from the pressure/temperature (P/T) ratings for flanges given in ASME B16.5 unless otherwise stated in the piping class notes. There are no piping classes for pressures higher than allowed by the ASME B16.5 rating class 2500 for the specified design temperature and material. For materials listed, the relevant values listed in table 2 of ASME B16.5 apply. For comparable materials not listed, the P/T rating is established in accordance with annex D of ASME B16.5.

Where specified by ASME B31.3, bolting calculations have been performed to verify the ability to seat the selected gasket and to maintain a sealed joint under the given P/T rating; ASME VIII division 1 appendix 2 has been followed for this.

Allowable internal pressures for pipe and fittings have been verified in accordance with ASME B31.3 paragraph 304.1.2 equation (3a) in order to meet the design limits of piping classes.

The lowest pressure at coinciding temperature selected from the above P/T ratings is governing for the piping class P/T rating. In the piping class notes it is stated which factor(s) are governing

Nominal wall thicknesses of pipe, as specified in the piping classes, are in accordance with ASME B36.10M and ASME B36.19M. Pipe outside diameters correspond to those in B36.10M and B36.19M, nominal pipe sizes in classes are stated in DN, and the equivalent nominal inch sizes are given in (4.1).

Where possible, components used in the piping classes have been selected from external standards. The applicable standards and relevant MESC Specifications are referenced in the MESC buying descriptions. The P/T ratings given in those standards can be governing for the piping class design limits.

3.3 ALLOWABLE STRESSES

Allowable stresses for the materials specifications contained in the piping classes have been established in line with ASME B31.3, paragraph 302.3.

3.4 BRANCH CONNECTIONS

For SIOP piping classes (DEP 31.38.01.12-Gen.):

Reinforcement requirements for 90 degree pipe-to-pipe branch connections have been checked against the design limits of the piping class. The check calculations were

performed in accordance with ASME B31.3, paragraphs 304.3.2 and 304.3.3. The additional reinforcement of the welds is not taken into account.

In each piping class a diagram is given in order to select the proper type of branch connection for the design limits of the class. Branch fittings or butt welding fittings have been specified for all connections where pipe-to-pipe connections would need additional reinforcement. The branch fitting outlet and the butt welding fittings as listed on page 4 of the piping class could replace the welded pipe-to-pipe connections.

For SIEP piping classes (DEP 31.38.01.15-Gen.):

No branch reinforcement calculations are performed as the EP piping classes specify only 100% reinforced branch fittings.

3.5 INTERNAL DIAMETER DIFFERENCES

For welding fittings and pipe within a piping class, identical wall thicknesses have been selected to prevent internal diameter differences at weld positions.

3.6 SOUR SERVICE

Amended per Circular 11/98

See DEP 31.38.01.11-Gen., Appendix 10.6 for the definition and categories of sour service.

DEP 31.38.01.12-Gen. and DEP 31.38.01.15-Gen. include piping classes for these categories.

3.7 HEAT TREATMENT

Some piping classes have been designed for services that require post-weld heat treatment. These classes are identified by the notation "PWHT" on page 1 of the piping class.

3.8 BOLT TENSIONING

DEP 31.38.01.11-Gen. recommends the use of bolt tensioning in certain circumstances. The use of bolt tensioning requires additional bolt length.

In the piping classes, this additional bolt length has been incorporated only for the sizes and ASME rating classes that are always recommended to be bolt-tensioned. These are shown below:

BOLT DIAMETER	ASME RATING CLASS
≥ 1½ inch	1500 and 2500
≥ 2 inch	All

4. SUMMARY OF DIFFERENCES BETWEEN SIOP AND SIEP PIPING CLASSES

The major differences between the SIOP and SIEP piping classes are shown below:

SIOP piping classes	SIEP piping classes
Ball valves (BS 5351) available only in ASME rating classes 150 and 300. Gate valves are used for larger sizes, and for higher ASME rating classes.	Ball valves available in all ASME rating classes (BS 5351 for ASME rating class 150 and API 6D for ASME rating classes 300 and higher).
Check valves are not lug type.	Check valves are lug-type where available in API 594.
Pipe-to-pipe branch connections are used where permitted by ASME B31.3.	Only fully-reinforced branch connections are used.

5. REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

Amended per Circular 33/99

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Metallic materials - Selected standards	DEP 30.10.02.11-Gen.
Non-metallic materials - Selection and application	DEP 30.10.02.13-Gen.
Metallic materials - prevention of brittle fracture	DEP 30.10.02.31-Gen.
Pressure vessels (Amendments/Supplements to ASME VIII - division 1 and division 2)	DEP 31.22.20.31-Gen.
Piping - general requirements	DEP 31.38.01.11-Gen.
SIOP piping classes	DEP 31.38.01.12-Gen.
SIEP piping classes	DEP 31.38.01.15-Gen.
Specification for piping systems	DEP 31.38.01.21-Gen.
Instruments for measurement and control	DEP 32.31.00.32-Gen.
Instrument impulse lines	DEP 32.37.10.11-Gen.

AMERICAN STANDARDS

Specification for pipeline valves (gate, plug, ball, and check valves)	API 6D
Wafer and wafer-lug check valves	API 594

Issued by:
American Petroleum Institute
Publications and Distribution Section
1220 L Street Northwest
Washington DC 20005
USA.

Pipe flanges and flanged fittings, steel, nickel alloys and other special alloys.	ASME B16.5 (1996 edition)
Chemical plant and petroleum refinery piping	ASME B31.3 (1996 edition including addenda B31.3a - 1996 and B31.3b - 1997)
Welded and seamless wrought steel pipe	ASME B36.10M
Stainless steel pipe	ASME B36.19M
ASME Boiler and pressure vessel code: Section VIII Division 1 - Rules for construction of pressure vessels	ASME VIII

Issued by:
American Society of Mechanical Engineers
345 East 47th Street
New York NY 10017
USA.

BRITISH STANDARDS

Steel ball valves for the petroleum, petrochemical and allied industries	BS 5351

Issued by:
British Standards Institution
389 Chiswick High Road
London W4 4AL
UK

APPENDIX 1 ASSEMBLIES

This appendix contains sketches of assembly configurations. The assemblies available in a piping class are listed on page 5 of the piping class.

Shown below is an example of how an assembly appears on page 5 of a piping class (figures in brackets have been added here for explanation).

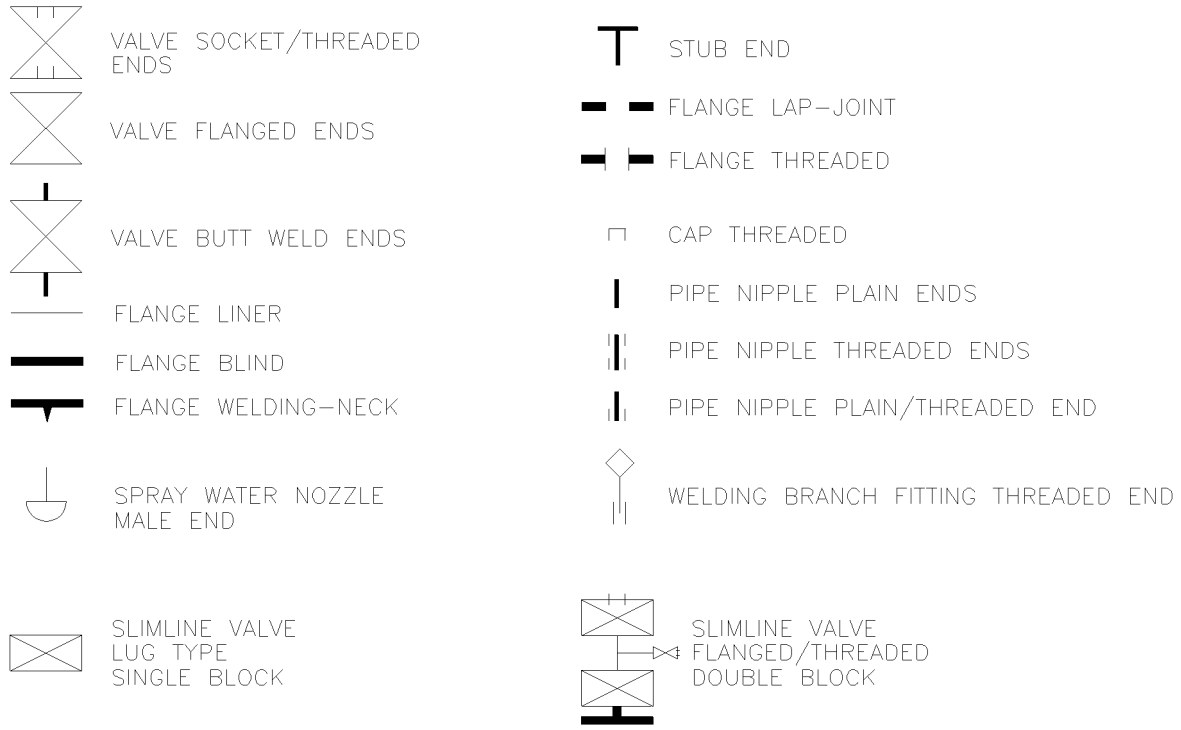
* (1)DRAIN POINT	DN 20(2)	FIG.2H(3)	DN 40 -600(4)
Branch:S(5) (N=table page 1, S=BNIF)		1(7)	(PIPING COMP.)
(6)BALL VALVE RED.BORE	FLANGED	1(7)	77.00.00.104.1(8)
(6)BLIND FLANGE		1(7)	76.62.11.112.1(8)
(6)GASKET, RAISED FACE		2(7)	85.31.02.106.1(8)
(6)STUD BOLT WITH NUTS		8(7)	81.38.61.268.1(8)

Explanation of the above example:

(1) Assembly description (refer to table below for a listing of available assemblies).
(2) Nominal size of the assembly.
(3) Figure number (a two digit code listed with the assembly figure).
(4) Nominal run size (range) for which the assembly is valid.
(5) Code for type of branch to be used .
(6) Description of the items used in the assembly.
(7) Quantity of items required.
(8) MESC number for the specified item.

DRAWING NAME	ASSEMBLY DESCRIPTION
DRAI	Drain connection
MRIC	Pressure instrument connection on meter run
ORIC	Pressure instrument connection on orifice flanges
PRIC	Pressure instrument connection on piping
SWAA	Spray water assembly Type 1
SWAB	Spray water assembly Type 2
SWAC	Spray water assembly Type 3
SWAD	Spray water assembly Type 4
TICO	Temperature instrument connections on piping
VENT	Vent connection

APPENDIX 1-1 SYMBOL LEGEND



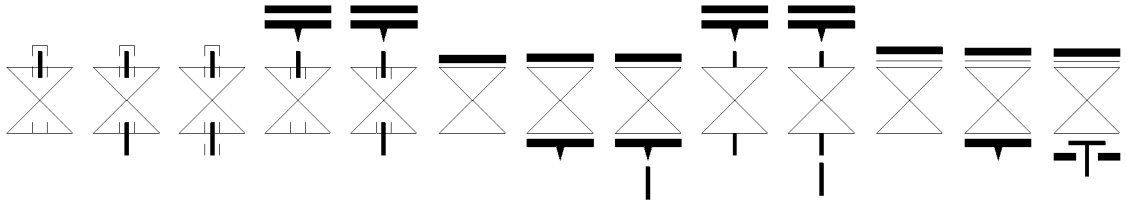
APPENDIX 1-2 VALVE TYPE IDENTIFICATION LEGEND

Based on the valve type selected, the "*****" in the figure letter in (Appendix 1-3, 1-4, 1-5) shall be replaced as follows:

0: GATE VALVE (except threaded ends)
1: GLOBE VALVE (except threaded ends)
2: REDUCED BORE BALL VALVE
3: FULL BORE BALL VALVE
4: PLUG VALVE
5: BALL VALVE, in combination with o-ring groove in counter flange
6: THREADED GLOBE / GATE VALVE
7: DIAPHRAGM VALVE

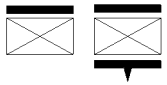
APPENDIX 1-3 VENT AND DRAIN POINTS

VENT CONNECTIONS (VENT)



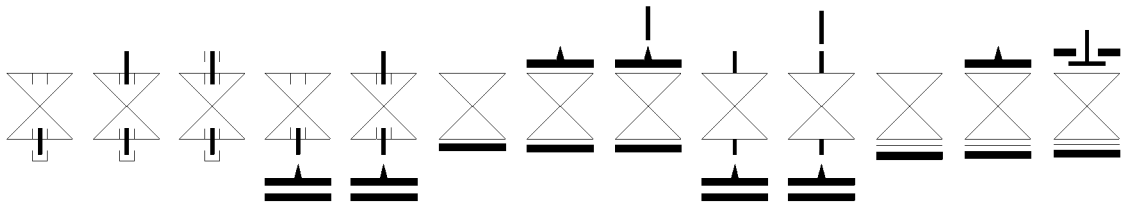
*A *B *C *D *E *H *I *J *M *N *Q *R *V

VENT CONNECTIONS (VENT)
SLIM LINE VALVES



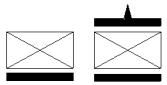
DE DF

DRAIN CONNECTIONS (DRAI)



*A *B *C *D *E *H *I *J *M *N *Q *R *V

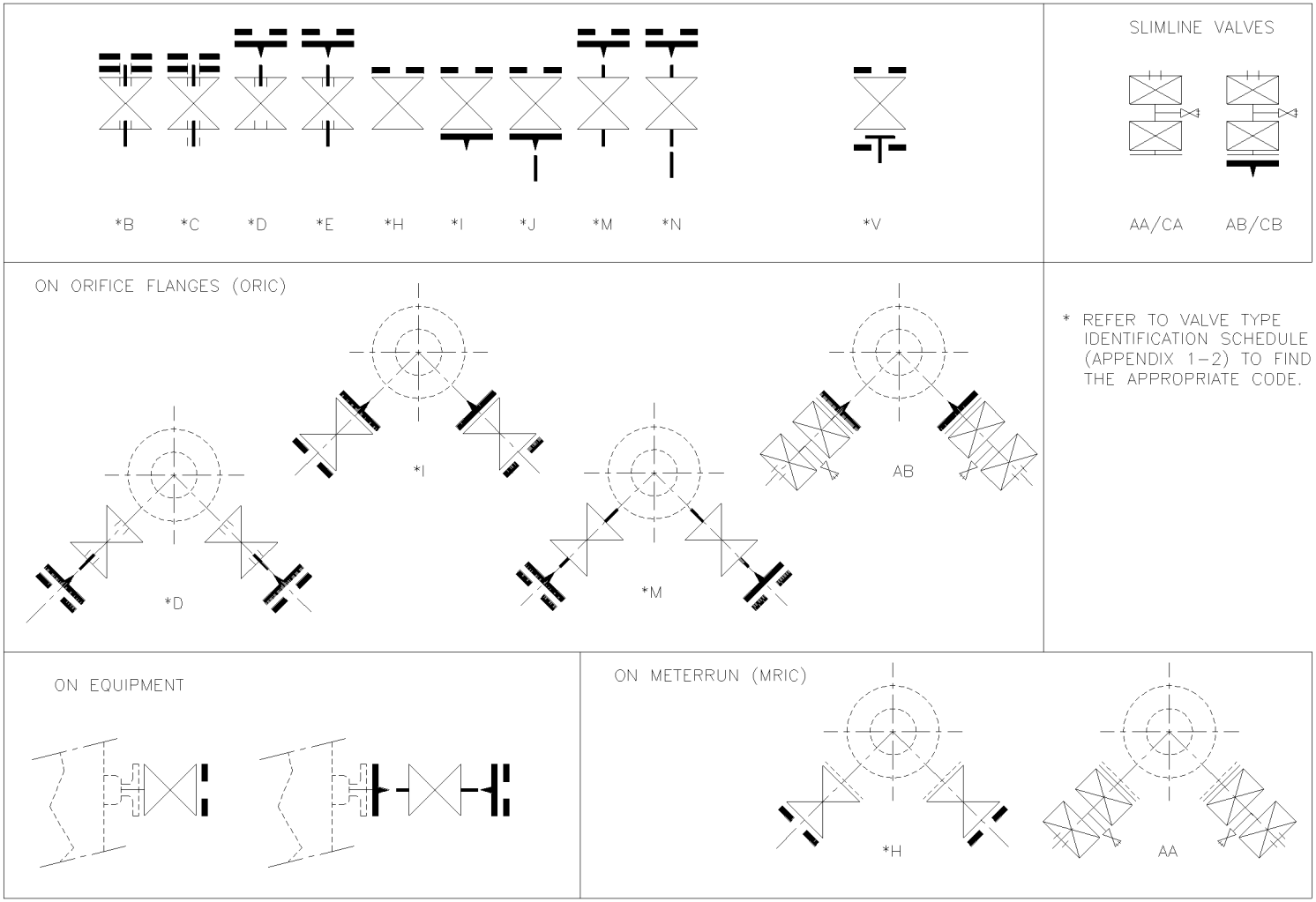
DRAIN CONNECTIONS (DRAI)
SLIM LINE VALVES



DE DF

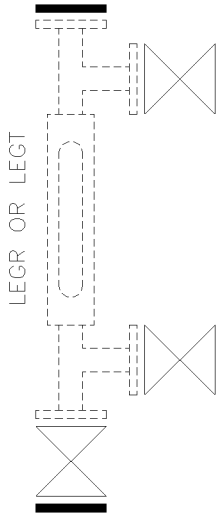
* REFER TO VALVE TYPE IDENTIFICATION SCHEDULE (APPENDIX 1–2) TO FIND THE APPROPRIATE CODE.

APPENDIX 1-4 PRESSURE INSTRUMENT CONNECTIONS

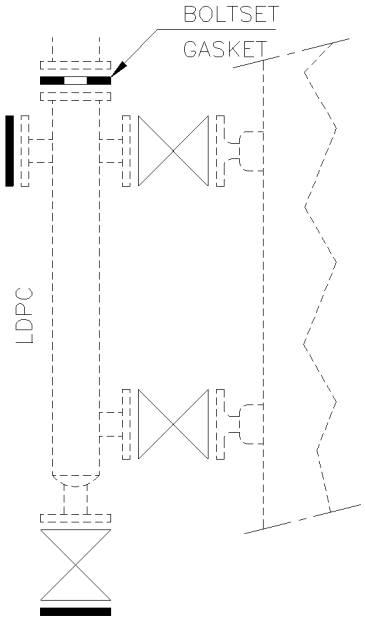


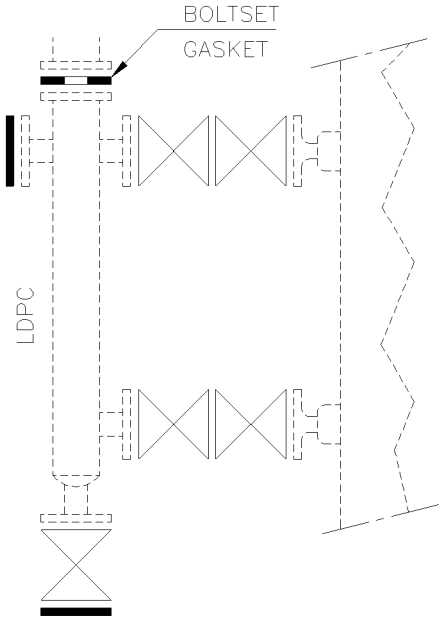
APPENDIX 1-5 LEVEL MEASUREMENT DEVICES

LEVEL GAUGE CONNECTION



LEVEL INSTRUMENT *)





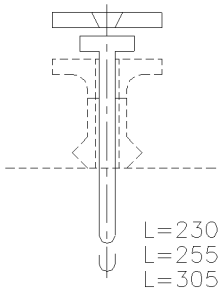
LEGT = LEVEL GAUGE, THROUGH VISION TYPE
LEGR = LEVEL GAUGE, REFLEX TYPE
LDPC = LEVEL DISPLACER CHAMBER

FOR VALVES SELECT BALL OR GATE IN ACCORDANCE WITH RELEVANT PIPING CLASS.

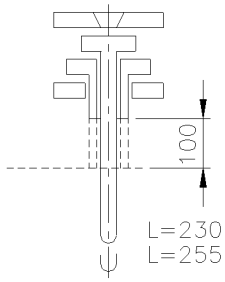
*) FOR APPLICATION OF BLOCK VALVES SEE DEP 31.38.01.11–Gen.

APPENDIX 1-6 TEMPERATURE INSTRUMENT CONNECTIONS

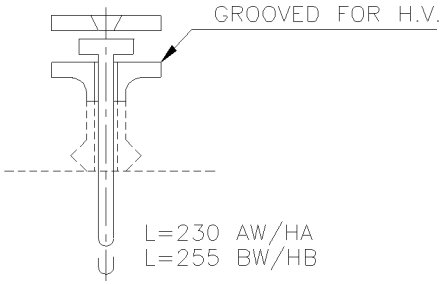
ON PIPING (TICO)



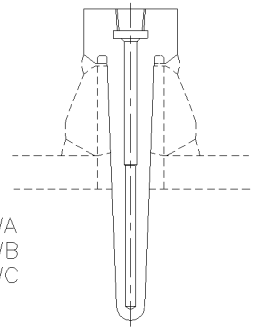
L=230 AA
L=255 BB
L=305 CC



L=230 AS
L=255 BS

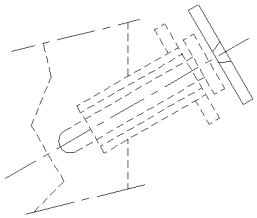


L=230 AW/HA
L=255 BW/HB



L=115 WA
L=135 WB
L=165 WC

ON EQUIPMENT



APPENDIX 1-7 SPRAY WATER ASSEMBLIES