RECOMMENDED PRACTICE FOR ASSESSING PIPING DESIGNER BASELINE SKILLS AND COMPETENCIES

SPED RECOMMENDED PRACTICE 001

Society of Piping Engineers and Designers

Promoting Excellence and Quality in Piping Design

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Society of Piping Engineers and Designers, 9668 Westheimer Road, Suite 200-242, Houston, Texas 77063. or email spedexec@spedweb.com

ACKNOWLEDGMETS

This Recommended Practice was drafted by the Professional Piping Designer Advisory Committee (PPDAC). The PPDAC is charged with oversight of SPED's PPD Certification Program.

William G. Beazley	Anton Dooley	Greg Kemp	Steve Slimmon
Lynn Bishop	William Dornfeld	Carol McComb	Ronald Waldon
Paul Bowers	Jacques C de Fortier	Lee Morgan	Jerry Tunis
Don Bokemeyer	Martin Fournier	Kevin Noakes	Albert Worth
Ron Burrow	John L. Gay	Gib Ortiz	Jim Weeks
Michael Conaway	Lee Jewell	Kerry Pritchard	Manolo Valle

SPED would like to acknowledge the help of two PPDAC subcommittees in developing major parts of this RP.Level II Criteria Subcommittee. Led by Ron Waldon and Lee Jewell, both of C&I Engineering and Keith McKinney of Piping Layout Consultants Inc., the team focused on what skills are expected of a piper with four years of on-the-job experience routing pipe and examining it in the field. As a result, the criteria for Levels I and III were also revised as greater competency in beginner skills were established and so routing skills were pulled back from the equipment layout skills of Level III.

Level IV Criteria Subcommittee. Led by Albert Worth, and assisted by Richard Beale of Cenovus Energy, Paul Bowers of SNC Lavalin and James Pennock (retired). Beale and Bowers (with Peter Smith) have authored a recent book, The Planning Guide to Piping Design. Pennock authored the classic book, Piping Engineering Leadership for Process Plant Projects. Both books greatly influenced the new criteria and are considered textbooks for preparing for Level IV exams. Finally, they has been much input from industry on these criteria, particularly from members of SPED's 100% Club, which has pledged to PPD certify 100% on pipers in at least one office. As they make good on this commitment, they have helped sharpen the criteria used for PPD certification.

CONTENTS

Abbreviations

API	American Petroleum Institute
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAD	Computer Aided Design
Chap/Ch/Chp	Chapter
EPC	Engineering/Procurement/Construction
ISA	Instrument Society of America
ISO	Isometric
MAWP	Maximum Allowable Working Pressure
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
O/Os	Owner/Operators
OTJ	On the job training
P&ID	Process and Instrument Diagram
PFD	Process Flow Diagram
PPD	Professional Piping Designer
PSV	Pressure Safety Valve
Publ	Publication
RP	Recommended Practice
Std	Standard

1.0 GENERAL

1.1 Purpose

The purpose of this recommended practice is to assemble into one document criteria for assessing the preparation and status of baseline skills and competencies for piping designers. This will promote the consistent assessment of designers, guide them in career development and insure consistent presentation of baseline skills as proposed staff on projects. This publication is only a guide and requires the application of sound engineering and human resources judgment. Furthermore, it is not intended to override or otherwise supersede any existing code or governmental rule or regulation, nor is it intended as a comprehensive document containing all useful and appropriate information.

1.2 Scope

This document recommends minimum requirements and guidelines for the assessment of piping design staff for baseline skills and competencies. Piping designers are normally tasked with equipment layout and pipe routing in accordance with various engineering and design documents, with due consideration of fabrication, assembly, construction, operation and maintenance practices and available materials. They must preserve the engineering intent of piping engineering design and anticipate their needs where possible.

As currently written, this recommended practice does not provide criteria for assessment of work and commercial ethics.

1.3 Industry Codes, Practices, and Standards

Various organizations have developed numerous codes, practices and standards that have substantial acceptance by industry and governmental bodies. Codes, practices, and standards useful in the assessment of piping designers and engineers of process facilities are listed in Appendix C. These references are not to be considered a part of this recommended practice except for those specific sections of documents referenced elsewhere in this recommended practice.

1.4 Government Codes, Rules, and Regulations

Government regulatory agencies have established certain requirements for the design, fabrication, installation, layout and operation of process facilities.

These requirements may supersede the recommendations of this document. Refer to Appendix D for applicable government codes, rules and regulations related to the engineering design of process facilities in the United States.

1.5 Organization of Technical Content

The technical content of this recommended practice is arranged as follows:

Section 2 Introduction. Presents an overview of the general principles of assessing piping designers.

Section 3 Prerequisite Skills and Competencies.

Section 4. CAD Operator

Section 5. Pipe Routing

Section 6. Pipe Routing Assurance

Section 7. Equipment Layout

Section 8. Piping Design Leadership

Appendix A Industry Codes, Guides and Standards.

Appendix B Government Codes, Rules and Regulations.

Appendix C Example Assessment Form for PPD Level I - Pipe Routing

Appendix D Example Piping Sketch Assessment

2.0 INTRODUCTION

2.1 The Need Addressed by this Recommended Practice

Most Owner/Operators (O/Os) employing Engineering/Procurement/Construction (EPC) firms for design ask for documentation on key personnel put forth for their jobs. The standard practice is to supply resumes of key personnel to comply. Better EPCs have credentialing programs that track the type of experience, knowledge and competence of their staff.

Normally, resumes provide an excellent summary of a person's experience, credentials and professional activities. The resume as a sole document, has some flaws:

- Most are authored by the subject and many are not substantially checked by the EPC;
- Terminology on task, roles and responsibilities can vary widely;
- Titles are often inflated as alternative compensation:
- Levels of competency shown on listed tasks are often not clear or greatly exaggerated.
- Mere assignment to tasks does not imply acquisition of technical insight into technologies involved.

While, EPC's win work on their perceived competency, many do not have a formal credentialing program. Most count on employees themselves to manage their credentials, such as Professional Engineering Registration and Continuing Education. Some make little or no effort to track credentials, particularly with contract personnel. Others, particularly in high accountability professions or tasks such as engineering, code welding, use software to track and manage licenses, certifications, clearances, fitness, skills, education and registrations. Some include credentials in their compensation plans.

It is always difficult to extend a credentialing program down to all levels of project staff. As piping design is now considered a professional rather than a support position, its credentials should also be tracked for compensation, compliance and qualification.

2.2 Application to SPED's Professional Piping Designer Certification Program

SPED uses assessment of this Recommend Practice in its Professional Piping Designer (PPD) Certification Program. The program has been in use since 2003 based on criteria developed by a consensus of senior pipers and perfected by hundreds of trainees and test takers.

SPED's PPD program has four distinct levels:

PPD Level I	Piping Drafting plus extended knowledge of "ilities" impacting pipe routing.
PPD Level II	PPD Level I plus ability to assure preparation, correctness, and completeness of pipe routings in CAD on drawings and in the field.
PPD Level III	PPD Level II plus ability to place, elevate, orient and separate equipment considering applicable functions and "ilities".
PPD Level IV	PPD Level III plus ability to plan, schedule, cost, supervise and assure piping tasks from FEED to closeout for greenfield and brownfield projects, pipe routing to key equipment nozzles considering operations and maintenance plus years of experience.

2.3 Application to Career Planning

The Assessment Criteria can be used to construct career paths by employers of piping designers. One example is shown in Appendix C :

TABLE 2-1. PIPING DESIGNER LEVELS OF COMPETENCE

Level of Competence	Content	Typical Source
Prepared to Learn Piping Design	Elements of Physics, Chemistry, Algebra, Geometry, Descriptive Geometry and CAD	Selected 2 year Associate Degrees in CAD
Piping Design Drafter or Operator	Preparation plus Piping specific drafting/deliverables and Plant CAD applications.	Dedicated 2 year Associate Degrees, extended training through certificate programs or vendor application training
PPD Level I	Piping Drafting plus extended knowledge of "ilities" impacting pipe routing.	SPED Piper Bootcamp, Company training programs, OTJ Experience.
PPD Level II	PPD Level I plus ability to assure preparation, correctness, and completeness of pipe routings in CAD on drawings and in the field	4 years of OTJ Pipe Routing Experience and Mentoring from supervisors and checkers.
PPD Level III	PPD Level II plus ability to place, elevate, orient and separate equipment considering applicable functions and "ilities".	SPED Process Plant Layout and 4 years of OTJ Equipment Layout Experience and Mentoring from supervisors and checkers.
PPD Level IV	PPD Level II plus ability to plan, schedule, cost, supervise and assure piping tasks from FEED to closeout for greenfield and brownfield projects.	4 years of OTJ "full scope" planning, supervisory or assurance Experience and Mentoring from supervisors and discipline leads.
Licensed Professional	Official licensing to do specified Piping Design Calculation(s), "that is the routine application of industry recognized codes, standards, procedures and practices using established engineering or applied science principles and methods of problem solving."	6 years of technical study/preparation, including 2 years' work experience in proposed scope of practice, completed under the supervision and control of a licensed professional.

As clients ask for higher levels of competency on job staff, piping designer credentials are increasingly scrutinized. Including designers in an EPC's Credentialing Program will help satisfy this demand.

3.0 SECTION 3 PREREQUISITE SKILLS AND COMPETENCIES.

Prerequisite Skills and Competencies refer to knowledge considered essential to further specialized training in piping design. SPED has identified six areas of prerequisite knowledge:

1. Algebra
2. Geometry
3. Physics
4. Chemistry
5. Descriptive Geometry
6. General CAD

Each area has been broken down into subtopics with applications to piping design. SPED's new Piper Boot Camp online course includes a self-assessment for each

3.1 Algebra

The following Algebra skills are required for Piping Design and Drafting

TABLE 3-1 ALGEBRA SKILLS ARE REQUIRED FOR PIPING DESIGN AND DRAFTING

Skill	Piping Application Example
Numeric Fractions	Adding or subtracting two fractions
Decimal numbers	Feet inches to decimal
Power of 10	Using scientific notation
Rounding	Most significant digits
Operations with Signed Numbers	Subtracting coordinates, reference line dimensioning
Exponents and Operations on Exponents	Equivalent length for pipe components
Divisibility and Prime Numbers	pi constant
Roman Numerals, Number Systems and Notations	Feet/inches, quarts/gallons/barrels, tons/metric tons
Inverse Operations for Addition and Multiplication, Reciprocals	Unit Conversion
Evaluation of Expressions, Parentheses	Plugging data into formulas, spreadsheet formulas
Distributive, Associative, Commutative Properties	Adding pipe segments before applying weight per foot.
Equations Inequalities, Trichotomy	Comparing NPSHR to NPSHA
Linear Equations, Graphs, Slope	Sloped pipe, distributing expansion displacements along a pipe run, reading vendor data
Proportions Percentage and Pie Charts	Interpolating between two values of vendor data
Number Line	Adding, Subtracting Northings/Southings, Eastings/Westings. Convert absolute to gauge pressure
Average	Finding average temperature of multiple pipe segments

3.2 Geometry

The following Geometry skills are required for Piping Design and Drafting

TABLE 3-2 GEOMETRY SKILLS REQUIRED FOR PIPING DESIGN AND DRAFTING

Skill	Piping Application Example
Points, Lines, Line Segments and Rays	CAD handles, centerlines, out vectors
Parallel and Perpendicular Lines and Planes	projections, true size, Top of Steel Calculations
Angles	depicting angles
Quadrilaterals, Parallelograms, Trapezoids	Subdivision of Plates, support/structural detailing, Drain Area Layout
Circles/Radii, Chords and Diameters	Sizing Pipe, Ells and Bends
Circles/Arcs, Tangents	Vessel Head Geometry, valve actuator clearance and ergonomics
Perimeters, Areas, Volumes	Weld estimates, painted areas, pipe and vessel volumes
Prisms, Pyramids, Spheres	Modeling of Components and Equipment in CAD
Polygons	Area Approximation, Polylines/Volumes of Revolution in CAD
Angles: Interior and Exteriors	Polygonal furnace manifolds, ring supports
Angles: Complementary, Supplementary, Vertical	Spacing cleanouts in Underground Piping
Pythagorean Theorem: Distance and Triangles	Pipe pup length between offset ells
Constructions	finding piercing points of runs through bulkheads and floors
Coordinate Geometry	Coordinate Conventions for Equipment, CAD data input,
Trigonometry: Solving Triangles	Rise/Run Calculations for Offsets
Special Right Triangles	Valve Flange bolt hole offsets for clearance

3.3 Physics

The following Physics skills are required for Piping Design and Drafting

Table 3-3 Physics skills required for Piping Design and Drafting

Skill	Piping Application Example
Units S.I. units	Unit Conversion
Kinematics Displacement, velocity, acceleration	Earthquake, Sea State Forces on Pipe
Force Newton's 3 Laws of Motion	Water Hammer Loads
Friction and the Normal Force	Pipe Supports
Work Force times distance	Positive Displacement Pumps
Energy, potential to do Work	Hydraulic Head
Elastic Behavior, Springs	Variable Spring Supports
Gravity universal force of attraction	Weight and CG of Spools and Equipment
Circular Motion	Centrifugal Pump Affinity Laws
Torque	Forces, Moments on Piping
Periodic Motion, Waves, Sound	Compressor Pulsation Control
Fluids, Bernouli's Equation,	Flow Head losses and NPSH Calculations
Gas Laws	Partial Pressures, Relief Pipe Sizing
Thermodynamics, States of Matter, Phase Change	Heat Exchanger Sizing, Steam Tracing, Steam Traps
Electricity Charge, current, electric fields	Galvanic Corrosion
Magnetism Magnetic dipoles, magnetic fields	Magnetic Flow Meters
Electronics Resistance, voltage, capacitance, inductance	Current Control Signals, Pump Motor Sizing
Optics Light, lasers etc.	Laser Scanning for CAD

3.4 Chemistry

The following Chemistry skills are required for Piping Design and Drafting

TABLE 3-4 CHEMISTRY SKILLS ARE REQUIRED FOR PIPING DESIGN AND DRAFTING

Skill	Piping Application Example
Properties, Changes, Classification of Matter	Interpreting PFD Process Variables
Atomic Structure	Interpreting PFD Process Reactions
Chemical Reactions: Compounds and Bonding	Interpreting PFD Process Reactions
Naming Substances, Formulas and Numbers	Interpreting Process Substances
Chemical equations	Interpreting PFD Process Streams
Energy changes in chemical reactions	Reactor Heating and Cooling, Pressure Relief
Properties of Solutions Acids and Bases	Interpretation of Material Specs, Hazards Analysis
Thermodynamics, States of Matter, Phase Change	Heat Exchanger Sizing, Steam Tracing, Steam Traps
Gas Laws	Partial Pressures, Relief Pipe Sizing
Chemical Equilibrium	P&ID Control Systems, Tower Reflux

3.5 Descriptive Geometry

The following Descriptive Geometry skills are required for Piping Design and Drafting

TABLE 3-5 DESCRIPTIVE GEOMETRY SKILLS REQUIRED FOR PIPING DESIGN AND DRAFTING

Skill	Piping Application Example
Orthographic, six standard principal views (Front; Right Side; Left Side; Top; Bottom; Rear),	General Arrangements, Equipment and Piping Layouts
True length of a line (i.e., full size, not foreshortened)	Determine the location of their shortest connector (common perpendicular) between two skew pipes in general positions
Point view (end view) of a line	finding piercing points of runs through bulkheads and floors
True shape of a plane (i.e., full size to scale, or not foreshortened)	Area Approximation
Edge view of a plane (i.e., view of a plane with the line of sight perpendicular to the line of sight associated with the line of sight for producing the true shape of a plane)	Angle determination, Maintenance Clearances
Isometric projection	Isometrics of pipe runs and spools
Dimensioning and symbols on plane	Reference Line Dimensioning
Dimensioning and symbols on Isometrics	Isometric Centerline Dimensioning
Schematics of Distribution Systems	P&IDs, One-Lines, Ladder, PFDs.
Non-Standard Projections and Diagrams	Vessel layouts, Pipe Fabrication Templates

3.6 General CAD

The following General CAD skills are required for Piping Design and Drafting

TABLE 3-6 GENERAL CAD SKILLS REQUIRED FOR PIPING DESIGN AND DRAFTING

Skill	Piping Application Example
Creating, Saving, Plotting a Simple Drawing	General Arrangements, Equipment and Piping Layouts
Basic Drawing and Editing Commands	Basic Pipe and Related Drafting
Drawing Organization and Information, Layers	Managing Multiple Disciplines and Alternative Data
Getting Drawing Information, Dimensions	Verifying, Rendering Drawings as Paper
Moving, Rotating, Duplication	Reuse of Information
Inserting Editing, Reporting Blocks & Attributes	P&ID Schematics, Bill of Materials
Model/Drawing Layout	Rendering a Single Model for Multiple Users
Annotation, Text, Hatching	Improving Clarity, Adding Instructions and Information
Global, User Coordinate Systems, Positioning	Improving Productivity for Pipe Routing, Data Entry
Selection Sets	Differentiating Among Model Objects
Extruded, Revolved, Constructed Solids	Constructing Pipe and Equipment Models
Connection Nodes, Schematics	Model Topology
Referencing and Sharing Information	Reference Drawings, Shared Models
Drawing Standards and System Setup	Assure Consistent Units, Model Quality
Macros and Custom Routines	Automate Repeated Tasks, Support Discipline Practices

4.0 CAD OPERATOR

4.1 Overall Objective of CAD Operator

Most CAD Vendors offer a course in using their applications to route pipe, model equipment, manage project data. The overall object of this assessment it to assure that a CAD operator can route piping in accordance with the methods and conventions of the CAD application, such that additions, edits renderings and assurances will integrate and add-on applications will operate correctly

4.2 Specific Assessments of CAD Operator

The specific assessments of

Explain and demonstrate the application workspace, including main menus, command lines, status lines, pallets, view space(s), opening/saving project data in files/directories and other high level application user interfaces.
Properly set up the application for first use, including selecting spec, component and other project data fines: standard pallet and menus, templates, units, text and line fonts, dimension styles, etc.
For each viewing interface provided in the application, demonstrate navigation, viewing, selection, movement and drag and drop. Viewing interfaces include but are not limited to 2D, 3D orthogonal, 3D isometric, with grids on or off and using Cartesian coordinates in absolute, local and relative (incremental) mode.
Explain and demonstrate the applications' method for setting, changing and coordinating line spec, line size, insulation for a run and how that is displayed correctly on the line in views and in source and rendered drawings (i.e. P&IDs and piping layout/generate ISOs).
Demonstrate the applications' principal commands for inserting in-line piping components and the application's methods for managing position, orientation, connectivity, alignment, "hard" (physical) volume, "soft" (access) volume, automatic insertion in routed centerlines, tags and descriptions.
Explain and demonstrate the applications' method for creating in-line piping components and equipment models using the application's conventions for managing position, orientation, connectivity, alignment, "hard" (physical) volume, "soft" (access) volume, tags and descriptions and common appurtenances (platforms, stairs, handrails, etc.).
Explain and demonstrate extra methods and data added to pipe, components and equipment to support use by normally included add-on applications, such as ISOGEN®, Navisworx®, structural tools, instrumentation tools, CAESAR II®, InTools, etc.
Explain and demonstrate use of Paper Space, including the placement, scaling and rendering of views, dimensioning and annotation of model components, points, planes, edges, etc., in Paper Space font size, etc.

5.0 SECTION 5. PIPE ROUTING

5.1 Overall Objective of Pipe Routing

Pipe routing refers to the ability to route pipe from nozzle to nozzle in accordance with the P&ID. Design requires that the designer obey certain standards and practices, avoid other equipment, support the pipe and select material from the designated pipe class.

5.2 Specific assessments for Pipe Router

TABLE 5-1 SKILLS FOR PPD LEVEL I

Pipe Routing Tasks and Deliverables Can explain and define those immediately utilized for pipe routing (equipment plan, equipment dwgs, specs, P&IDs)
Equipment Function and O&M Access, explain the Basic Function plus Operational and Maintenance Access Requirements of common in-line items (valves, strainers, instruments, centrifugal pumps, etc.)
Spool & Field Pipe Fabrication, processes, tools, components, Joints,
Plant Assembly, can give overview of filed pipe assembly, rigging,, lifts, weight and CG
PFDs, correctly interpret and use data from
P&IDs, correctly interpret symbols and lines use
Equipment Data Sheets & Drawings, correctly interpret, use data to develop 3D equipment models from Vendor drawings using solid primitives and standard CAD commands
Item Data Sheets or dimensional standards, correctly interpret, use information from (Instruments, valves, etc.) for inline pipe routes
Equipment Layouts, correctly interpret and use information from (i.e. point to point distances, relative orientations, etc.)
Piping Material Specification, correctly interpret and use information from (correct fittings, branch table, etc.) for routing purposes
Understands and can develop Piping layouts with assistance from senior designer Can develop ortho views from isometric sketches
Pipe Supports, proper use of span tables to screen for additional support.
Piping Fabrication Isometrics, generation from piping layouts and extract BOMs

Pipe Racks, explain basic terminology, routing to and along assigned zones.
Can alter piping layouts from drawing markups with assistance from senior designers.
P&ID/Pipe Routing, implementation (Correct components in right order and orientation, fulfillment of all instructions and notes, etc.)
Pipe Route to ISO extraction from 3D model or scale layout using standard methods, conventions and symbols.
Maintenance-Isolatable equipment, identification of P&ID representations, common abbreviations and explain the function of items shown and design per standard details and project examples.
Piping CAD, Basic CAD literacy (3D Models, Model/paper space, blocks/libraries, rendering plotting.)

6.0 SECTION 6.PIPE ROUTING ASSURANCE

6.1 Overall Objectives for Pipe Routing Assurance

Pipe Routing Assurance criteria are used in SPED PPD Level II. Routing assurance refers to the ability to gather all the required information to route pipe, check the work and confirm it in the field.

6.2 Specific assessments for Pipe Routing Assurance

TABLE 6-1 SPECIFIC ASSESSMENTS FOR PIPE ROUTING ASSURANCE

Pipe Routing Tasks and Deliverables Can explain and define all related to (PFDs. P&IDs, SPECS, Data Sheets, Layouts, ISOs, Spools)
Equipment Function and O&M Access, explain the Basic Function plus Operational and Maintenance Access Requirements of non-major Equipment (pumps, drums, tanks, exchangers) as Placed (typical nozzles, manways, “soft volumes”) with attention to safety concerns
Pipe Spool & Field Pipe Fabrication, testing and inspection
Plant Assembly, plan and sequence lifts, field and fit-up welds, explain hydrotest, insulation, labeling,
PFDs Q/A drafting information from
P&IDs, explain functional purpose of items shown and Q/A information from
Equipment Data Sheets & Drawings, correctly interpret, use and Q/A information from (Vessels, Pumps, etc.) to build 3D models compatible with Plant CAD system, using available macros and commands.
Item Data Sheets or dimensional standards, correctly interpret, extend and Q/A information from (Instruments, valves, etc.) to build 3D models compatible with Plant CAD system, using available macros and commands.
Equipment Layouts, explain the general layout process, correctly interpret, use and Q/A information from (i.e. point to point distances, relative orientations, etc.) and infer access provided for construction, operations and maintenance..
Piping Material Specification, correctly interpret and Q/A information from and repupose into CAD and similar systems.
Piping Layouts, correctly interpret, use and Q/A information from (ISO from 2 views) while anticipating fabrication, erection, inspection and testing. (High Point Vents, Low Point Drains, sloped lines, no pockets, no flat turns, etc.)
Pipe Supports, proper use of and correct placement of standard types of pipe supports (Pipe Shoes, Dummy Legs, Pipe Stands/Stanchions, Anchors and Guides, Hangers
Specialized Piping Systems, consider commonly encountered system needs (Underground Piping, Steam and Condensate,

Cooling Water Supply and Return, Air Systems (Instrument, Plant), Flare System, Utility Station) and apply standard details.
Piping Fabrication Isometrics, correctly interpret, use and Q/A information from
Pipe Racks, management of available space and preferential assignment of pipe to zones
Equipment Identification and Field Measurements, accurately determine using manual methods and utilize laser data for design (sufficiency for tie-in, clash free routing, confirmable reference points, point clouds, etc.)
P&ID/Pipe Route Checking of completed routes (Correct components in right order and orientation, fulfillment of all instructions and notes, etc.)
Pipe Route to ISO Sufficiency (Dimension determined and per standards, indication of FW & FFW's), Flange orientations to match equipment, etc.)
Maintenance-Isolatable equipment, design piping, bypass, block/bleed, blow-downs/drains, etc., per accepted practice (CV Station, Centrifugal Pump, Relief Valve, etc.)
Piping CAD, Piping DB concepts (connectivity, alignment, clash check, hard/soft volumes, reference models, library backup, point clouds, etc.)

7.0 SECTION 7. EQUIPMENT LAYOUT

7.1 Overall Objective for Equipment Layout

The piper should demonstrate the ability to place, space and orient process equipment. It should also demonstrate the ability to prepare for and work independently and to assure the quality of that work without excessive oversight.

7.2 Specific assessments for Equipment Layout

Can explain and define all tasks related to Equipment Layout and target users. (roles & responsibilities)
Site-wide Layout Considerations. Can explain and apply practices applicable to all equipment: Roads, rack placement, prevailing winds, transportation, standardized steps platforms, access, drop zones, etc.)
Applicable Standards and Practices - identifies situations requiring the application of publicly available and customer furnished plant layout design standards, including those specifying minimum and/or maximum spacing, recommended elevations, placing of handrails/platforms, etc.
Greenfield Layout – Explain and demonstrate use of P&ID and Equipment footprints to prepare an initial layout of equipment groups and main piping
Brownfield Layout – Explain and demonstrate specialized techniques for Equipment layout in existing plans, including laser scanning, tie-ins, rack and structure extensions, etc.
Pipe Stress – Perform dead weight and expansion stress screening and loop sizing. Explain the application of B31.3 and 16.5 design checks.
Small Project Leadership – Able to check, estimate manpower and support completion of documents application to pipe routing of typical process equipment.
Equipment-Specific Knowledge - - correctly orient basic process equipment, their nozzles and other points of connection, attachment, assembly, access, inspection, and maintenance. Orientation should demonstrate knowledge of the internal workings of equipment and its impact on inspection, maintenance and construction.
Compressors –(Demonstrate Equipment-Specific Knowledge)
Pump –(Demonstrate Equipment-Specific Knowledge)
Drums–(Demonstrate Equipment-Specific Knowledge)
Exchangers–(Demonstrate Equipment-Specific Knowledge)
Cooling Towers–(Demonstrate Equipment-Specific Knowledge)
Furnaces–(Demonstrate Equipment-Specific Knowledge)
Reactors–(Demonstrate Equipment-Specific Knowledge)
Distillation Towers–(Demonstrate Equipment-Specific Knowledge)
Structures–(Demonstrate Equipment-Specific Knowledge)
Fire and Waste Systems–(Demonstrate Equipment-Specific Knowledge)
Storage Tanks–(Demonstrate Equipment-Specific Knowledge)

8.0 SECTION 8. PIPING DESIGN LEADERSHIP

8.1 Overall Objective for Piping Design Leadership

Piper should demonstrate full scope responsibility for process equipment layout and design. Typical experience includes work as checker, estimator, piping lead, project manager and piping discipline management.

8.2 Specific Assessment for Piping Design Leadership

Can explain and define all tasks related to piping design. (Project piping roles & responsibilities)
Can write scope of work for all piping design tasks and identify resulting deliverables. (Project piping execution)
Schedule, scope and quality assure field data collection where appropriate. (Work's independently in office or field)
Prepare and revise project piping design labor hour and material cost estimates. (Project piping estimating)
Plan and organize all project piping design activities and execution schedules. (Project piping scheduling)
Set the requirements for IT support of piping design tasks. (Project piping planning)
Define the staffing needs as skills and staffing curves against project schedules. (Project piping personnel direction)
Assign available personnel to fulfill staffing needs and adapt schedules to availability of staff. (Project piping controlling work)
Estimate degree or percent of completion of project deliverables using corporate per policy and experience. (Knows project requirements for client/company procedures plus has knowledge & experience)
Coordinate and check fulfillment of client data deliverable requirements and cross references. (Project reporting)
Prepare Requests for Quotations piping documents of sufficient detail for Fabricators, suppliers, Inspectors, constructors and similar entities. (Knows project requirements for vendors, inspections & construction support)
For piping design changes and scope creep, determine the effect on documents, tasks and disciplines. (Controlling change)
Satisfaction of client project piping design completion/closeout/data delivery procedures and requirements. (Project completion)

9.0 APPENDIX A INDUSTRY CODES, GUIDES AND STANDARDS.

- API American Petroleum Institute
- ANSI American National Standards Institute
- ASME American Society of Mechanical Engineers
- ASTM American Society for Testing and Materials
- BS British Standards
- ISO - International Organization for Standardization,
- DIN - Deutsches Institut für Normung,
- IEC - International Electro technical Commission and others.
- NFPA - National Fire Protection Association
- API VOCATIONAL BOOK 1
- Vocational Training - Book 1 - Introduction to Oil and Gas Production - Fifth Edition
- API VOCATIONAL BOOK 3
- Vocational Training - Book 3 - Subsurface Salt Water Injection and Disposal - Third
- EEMUA PUB NO 193
- EEMUA Recommendations for the Training, Development, and Competency Assessment of Inspection Personnel - Edition 2

10.0APPENDIX B GOVERNMENT CODES, RULES AND REGULATIONS.

Occupational Safety & Health Administration

11.0APPENDIX C EXAMPLE ASSESSMENT FORM FOR PPD LEVEL I - PIPE ROUTING

Professional Piping Designer Level I Evaluation Form

Please consider Level I evaluation for the following candidate:_____

Candidate's Phone Number: _____ Candidate's Email address: _____

How long have you worked with the applicant? _____ Months. From: ___/___ To: ___/___ (mo. /yr.)

In what capacity? Employer __ Supervisor __ Mentor__ Co-Worker__ Client__ Other _____

Instructions to Evaluator: With the skills and knowledge below, rate the candidate of the scale shown per your direct observation –

1	2	3	4	5	
1					No knowledge demonstrated.
	2				Prepared for but not done
		3			Performed task
			4		Performs task independently
				5	Mentors others on task.
					Skills for PPD Level I
					Pipe Routing Tasks and Deliverables Can explain and define those immediately utilized for pipe routing (equipment plan, equipment dwgs, specs, P&IDs)
					Equipment Function and O&M Access, explain the Basic Function plus Operational and Maintenance Access Requirements of common in-line items (valves, strainers, instruments, centrifugal pumps, etc.)
					Spool & Field Pipe Fabrication, processes, tools, components, Joints,
					Plant Assembly, can give overview of filed pipe assembly, rigging,, lifts, weight and CG
					PFDs, correctly interpret and use data from
					P&IDs, correctly interpret symbols and lines use
					Equipment Data Sheets & Drawings, correctly interpret, use data to develop 3D equipment models from Vendor drawings using solid primitives and standard CAD commands
					Item Data Sheets or dimensional standards, correctly interpret, use information from (Instruments, valves, etc.) for inline pipe routes
					Equipment Layouts, correctly interpret and use information from (i.e. point to point distances, relative orientations, etc.)
					Piping Material Specification, correctly interpret and use information from (correct fittings, branch table, etc.) for routing purposes
					Understands and can develop Piping layouts with assistance from senior designer Can develop ortho views from isometric sketches
					Pipe Supports, proper use of span tables to screen for additional support.
					Piping Fabrication Isometrics, generation from piping layouts and extract BOMs

					Pipe Racks, explain basic terminology, routing to and along assigned zones.
					Can alter piping layouts from drawing markups with assistance from senior designers.
					P&ID/Pipe Routing, implementation (Correct components in right order and orientation, fulfillment of all instructions and notes, etc.)
					Pipe Route to ISO extraction from 3D model or scale layout using standard methods, conventions and symbols.
					Maintenance-Isolatable equipment, identification of P&ID representations, common abbreviations and explain the function of items shown and design per standard details and project examples.
					Piping CAD, Basic CAD literacy (3D Models, Model/paper space, blocks/libraries, rendering plotting.)

I would rate the candidate as accumulating _____ years' of experience showing the competencies listed above.

In the space provided below please share any professional or personal comments regarding the candidate's experience or character:

Evaluator's Name, Company Employed at Presently (location) & Date of your Signature:

_____

Evaluator's Phone Number: _____

Evaluator's Email Address: _____

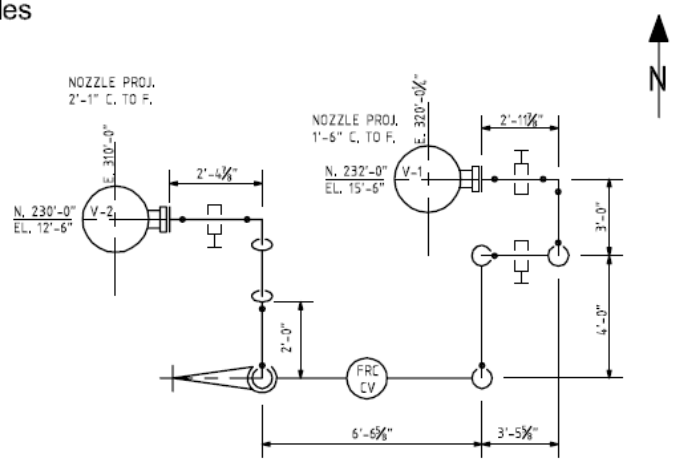
12.0APPENDIX D EXAMPLE PIPING SKETCH ASSESSMENT

PPD Level I

Piping Layout Sketch 1

Using the three views of this control valve station, sketch the Isometric not to scale. Ignore dimension values but show all:

- components,
- welds,
- pipe route offsets with angles,
- gaskets gaps, and
- vessel nozzles



PLAN

March 3rd 2014 Rev 0

Grading Standard for Piping Designers

Below is the Branding standard for this question:

Flanged Components and nozzles appear in correct orientation: 6 (1 point each)

Gasket Gaps shown: 7 (1 point each)

Pipe route segments shown in correct orientation 15 (1 point each)

Welds shown delineating components 33 (10 points minus missing or incorrect)