PACIFIC GAS AND ELECTRIC COMPANY

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July 22, 1983

Local Union No. 1245
International Brotherhood of
Electrical Workers, AFL-CIO
P.O. Box 4790
Walnut Creek, California 94596

Attention: Mr. Jack McNally, Business Manager

Gentlemen:

The General Construction Joint Apprenticeship Committee recommends adoption of the attached Guidelines for the Apprentice Welder Training Program, General Construction Gas Department.

As the Apprenticeship has been extended an additional six months, Company proposes the following wage schedule for the Apprentice Welder:

Start	-	$481.05 Per Week
End 6 Months	-	$496.65 Per Week
End 1 Year	-	$512.05 Per Week
End 18 Months	-	$527.50 Per Week
End 2 Years	-	$543.25 Per Week
End 30 Months	-	$559.15 Per Week

Company proposes that before any Apprentice Welder can progress to journeyman status, it will be necessary that the employee meet all academic and on-the-job Standards of Achievement.

As provided by the Master Apprenticeship Agreement, an employee will not be held at a wage progression step if the training is not timely or the employee could not be scheduled to a particular school, through no fault of the employee.

An employee who is hired directly into the Apprentice Welder classification will be required to pass the ACT within the first six months following the date of this agreement or from the date of employment. The employee will be allowed three opportunities in which to take the examination. The first examination must be taken at the completion of two months following the date of this agreement or date of employment, and if additional tests are requested, they shall be given at intervals of 30 days.

Employees in the 2627 Oxygen-Acetylene Welder and 2625 Arc Welder classifications will be considered as follows:

A. Current holders of the Oxygen-Acetylene Welder classification will be given a one-time option to either enroll in the General Construction Gas Department Apprentice Welder Training Program or be reclassified to the Street Fitter classification. The 2627 Oxygen-Acetylene Welder classification will be eliminated.

B. The Company will promote the following Arc Welders to the Welder classification upon final approval of the Apprentice Welder Training Program:

1. T. L. Bryant
2. G. Homer
3. R. N. Jordan
4. D. F. Kuryla
5. M. W. Smith
6. R. W. Murphy

C. The Company will promote the following Arc Welders to the Welder Classification when they have passed the necessary qualification tests as shown below. The Welder qualification tests will be given any time within 30 calendar days after the final approval of the Apprentice Welder Training Program. Employees will be notified of the test date at least 5 days in advance of their required tests. The welder qualification tests will be administered at a central location with one retest 10 calendar days after the first failure, if required. Failing the 2nd test the employee will have the option to remain permanently in the Arc Welder classification or to enter a selected portion(s) of the Apprentice Welder Training Program in order to improve their skills in the deficient area(s).

7. P. E. Anderson
   Needs the Low-hyd. butt and branch tests.

8. G. D. Phillips
   Needs the Low-hyd. butt and branch tests.

9. J. L. Turner
   Needs the Low-hyd. butt and branch and the 5P butt tests

D. The following Arc Welders will be given a one-time option to either enroll in a special 6 months training program or to remain permanently in the Arc Welder classification. Those entering into the 6 months program will be exposed to various work in order to upgrade their skills. During the 6 months or immediately after, they must pass the necessary qualification tests as shown below. They will be given one retest 10 calendar days after the first failure, if required. Failing the 2nd test the employee will have the option to remain permanently in the Arc Welder classification or to enter a selected portion (s) of the Apprentice Welder training Program in order to improve their skills in the deficient area (s).

10. D. K. Brum
    Needs the Low-hyd. butt and branch tests.

11. R. M. Currie
    Needs the Low-hyd. butt and branch and ASME tests.

12. G. D. Stinebaugh
    Needs retest on Low-hyd. butt and ASME tests.

13. R. A. Galati
    Needs the Low-hyd. butt and branch tests.

14. G. D. Hendrix
    Needs the Low-hyd. butt and branch and ASME tests.

15. L. Owens
Needs the Low-hyd. butt and branch and ASME tests.

16. M. C. Quitquit
Needs the Low-Hyd. butt and branch and ASME tests.

17. K. W. Rebitzke
Needs the Low-hyd. butt and branch and ASME tests.

18. R. C. Williamson
Needs the ASME tests.

Academic courses will be made available to Journeymen upon request. Test material will be loaned to the journeyman and must be returned to the instructor upon completion. If the journeyman successfully completes the course, he may retain the test material.

If you are in accord with the foregoing and the attachment and agree thereto, please so indicate in the space provided below and return one executed copy of this letter to the Company.

Yours very truly,

PACIFIC GAS AND ELECTRIC COMPANY

By _____
Manager of Industrial Relations

The Union is in accord with the foregoing and the attachment and it agrees thereto as of the date hereof.

LOCAL UNION NO. 1245, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, AFL-CIO

Aug 26, 1983

By _____
Business Manager

GENERAL CONSTRUCTION

GAS DEPARTMENT

APPRENTICE WELDER TRAINING PROGRAM

[redacted]

TRAIN/1

PROPOSED CHANGE TO EXHIBIT X (pages 95 & 96)

PACIFIC GAS AND ELECTRIC COMPANY

BASIC WAGE SCHEDULE - FORTY-HOUR WEEK BASIS

PHYSICAL EMPLOYEES

GENERAL CONSTRUCTION

FIELD CLASSIFICATIONS

CLASSIFICATION	PROGRESSION	PER WEEK
Apprentice Welder	Start	481.05
	End 6 Mos.	496.65
	End 12 Mos.	512.05
	End 18 Mos.	527.50
	End 24 Mos.	543.25
	End 30 Mos.	559.15
Welder		628.55

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APPRENTICE WELDER TRAINING PROGRAM

I. OBJECTIVE

The Gas Construction Department's Apprentice Welder Training Program is designed to provide the apprentice with the manipulative skills and technical knowledge to function fully and productively in the Welder classification. Throughout the apprenticeship, the apprentice will maintain a safe, responsible, and professional attitude about his work.

II. ADMINISTRATION

A. The training program is subject to the rules and conditions of the General Construction Master Apprenticeship Agreement and the Labor Agreement.

B. Under the direction of the Department Manager, the Program Supervisor is responsible for the overall administration and supervision of the Training Program. The Program Supervisor and/or a course instructor will organize, coordinate, and administer the Training Program.

The course instructor(s) will retain all test results and any other necessary files.

C. Crew Foremen are responsible for the on-the-job portion of
the training program.

D. General Foremen, Resident Engineers, Project Superintendents, Area Foremen, Foremen, Course Instructors, and the Program Supervisor will cooperate fully with one another and the apprentice to insure the success of the Training Program.

E. All training program records will be available for review, verification, updating, or counseling by the Training Instructor, Supervision, Union's Business representative, and the Apprentice.

III. TRAINING PROCEDURES

The apprentice training program is 36 months long, divided into 6 time periods with 6 related wage steps.

The apprentice training program consists of two coordinated parts:

1. Centralized training school, which combines in-class technical courses and in-shop welding practice lessons, and

2. On-the-job training and work experience

On-the-job field construction training and experience is an important tool of the program and will be stressed throughout. This training is intended to develop new skills, as well as support and refine in-class and in-shop training.

When an apprentice is transferred from one job headquarters to another, the apprentice's work records will be immediately forwarded to the new headquarters. The Foreman at the new headquarters will review the apprentice's work records with the apprentice as soon as possible after he (the Foreman) acquires such records. The Foreman will, whenever possible and job conditions permit, assign to the apprentice the work necessary to enable him to complete his required on-the-job training as soon as possible.

If the items in the On-the-Job Work Experience Records are not available to the apprentice, the reason(s) for such unavailability will be noted in the apprentice's record. An apprentice's progression through the step levels will not be delayed because of such work unavailability. Pertinate on-the-job work experiences not specifically covered in the apprentice program should be described on a separate sheet, and attached to the records.

At least once each month the Foreman will (1) review each apprentice's on-the-job work record for general progress; (2) give encouragement, advice and/or counseling to the apprentice; and (3) evaluate the apprentice's on-the-job work performance. The dates of such reviews/counseling/evaluations will be documented on the apprentice's On-the-Job Work Experience Record.

The Foreman will prepare a written evaluation report and update the on-the-job work records one month prior to the apprentice's scheduled progression to the next wage step. A copy of these reports and updates will be sent to the Program Supervisor. It is imperative that all apprentice records be maintained up-to-date, and adequately detail the type of work performed.

The Program Supervisor will be immediately notified whenever an apprentice is transferred.

The General Guidelines and Guidelines for Training Periods will be followed to the extent possible; lack of applicable work, classroom space and/or the apprentice's capabilities may be appropriate causes for temporarily deviating from such guidelines.

Any questions on the training program should be directed to the program supervisor or the apprentice's Foreman.

If the apprentice fails to meet the established Standards of Achievement for any step period, written notice of such failure will be given to the --Apprentice --his Foreman --Program Supervisor --General Construction Personnel Department --Union Business Representative --and the Department Manager's office.

The Company will provide all books and course materials. However, lost or damaged books will be replaced at the employee's expense. If an employee fails to complete the apprentice training program, all books and materials must be returned to the Company.

Apprentices will be responsible for maintaining the following records and charts:

- On-the-Job Work Experience Records
- In-Class Progress Chart
- In-Shop Progress Charts

The apprentice's Foreman will make entries, update, and verify the On-the Job Work Experience Records as the apprentice completes each activity. It is the responsibility of each Foreman to maintain whatever records are necessary to assure that each apprentice is afforded the opportunity to meet all standards of achievement.

The course instructor(s) will verify, update, and maintain the In-Class Progress Charts and In-Shop Progress Charts.

A. General Guidelines

1. Within the first month of each new wage step period, the apprentice will be assigned by the Company to the centralized school for training. Each session at the centralized training school will be one week in duration.

2. Training periods exclude any travel time needed to reach the place of training. However, such hours include time needed to prepare materials and equipment.

3. The apprentice will obtain on-the-job work experiences by working with a Foreman, and/or experienced Welder. The apprentice's on-the-job work experiences will grow in complexity and variety as he progresses through the training program. Each step period is meant to establish fundamental skills to build upon, expose the apprentice to the department's varied work situations, and to develop a comprehensive view of the welder's job responsibilities.

4. Assignments for on-the-job work duties in any period of training will be limited to those specified for that period or earlier period(s).

5. An apprentice may work without direct supervision as part of a work crew only after being fully instructed and trained in the work to be performed.

6. The apprentice may qualify to the code(s) and weld in the field with the assistance of an experienced Welder any time during his 36-month apprenticeship. Such qualification and welding work will not affect the apprentice's wage progression.

7. An apprentice's vacation time will be scheduled so that it will not interfere with the centralized training school periods.

8. Notices

   An apprentice who is scheduled to attend the centralized training school shall be notified by the Program Supervisor no later than 10 working days before their expected attendance.

B. Guidelines for Training Periods

1. 0 to 6 months step

   The in-class and in-shop instruction will consist of the following materials:

   In-Class Technical Courses

   Introduction and Outline of Apprentice Training Program

   Course 1.1 Rigging Fundamentals

Course 1.2 Welding Introduction: --Basic Welding Categories, --Sources of Heat Generation, and --Thermal Cutting processes.

Course 1.3 The Oxyacetylene Welding Process (OAW)

In-Shop Welding Practice Lessons (OAW)

Scope of OAW Training

Setup and Safe Operation of OAW Equipment

Lesson 1.1 Weld Joint Preparation: Weld joint surfaces and end preparation shall be prepared and cleaned prior to welding

Lesson 1.2 Bead-on-Plate

Lesson 1.3 Plate, Lap Joint, Fillet Weld

Lesson 1.4 Plate, Square-Groove, Open Root Butt Joint

Setup and Safe Operation of Oxyacetylene Flame Cutting Equipment

Lesson 1.5 Cutting, Beveling, and Piercing of Plate and Pipe

Lesson 1.6 Use and Care of External Line-up Clamps and Pipe Alignment Tools

1st Period Standards of Achievement

Pass the comprehensive technical course exam and satisfactory completion of all in-shop practice lessons for this period.

Perform all items in the On-the-Job Work Experience Records for this period of the training program.

2. 7 to 12 months step

The centralized training will cover the following items:

In-Class Technical Courses

Course 2.4 Basic Blueprint Reading

Course 2.5 Metals and Their Properties

In-Shop Welding Practice Lessons (OAW)

Lesson 2.7 Service Tee Connection Joint

Lesson 2.8 Pipe, 3/4", 2", and 4" Diameter, Standard Bevel, Single-V, Open Root Butt Joint

Lesson 2.9 Installation of Valves, Flanges, Gaskets, and Bolts (discussion & demo)

Lesson 2.10 Preheat, Interpass Temperature, and Postweld Heat Treatment (discussion & demo)

2nd Period Standards of Achievement

Pass the comprehensive technical course exam and satisfactory completion of all in-shop practice lessons for this period.

Perform all items in the On-the-Job Work Experience Record for this period of the training program.

Pass the following OAW qualification test to the API code:

2½ hours to complete the following:

a. 4" diameter x 0.156" w.t. pipe, standard bevel, single-v open root butt joint, in the horizontal fixed position(5G),

b. 4" diameter pipe, sleeve weld test, in the 5G position, and

c. 3/4" x 4.5" long EH service nipple beveled on 2", 3", or 4" diameter pipe, service tee-connection joint.

3. 13 to 18 months step

The centralized training will cover the following items:

In-Class Technical Courses

Course 3.6 The Shielded Metal-Arc Welding(SMAW) process

Course 3.7 Principles and Operation of Tapping and Plugging Equipment. Welding of Mueller and TDW Fittings. The Use and Care of Mueller Small Diameter (3/4", 1-1/4", and 2" Dia.) Tapping and Plugging Equipment.

In-Shop Welding Practice Lessons (SMAW)

Scope of SMAW Training

Setup and Safe Operation of SMAW Equipment

Lesson 3.11 Striking, Sustaining, and Breaking an Arc, Bead-on-plate, and Weave-on-plate

Lesson 3.12 Plate, Tee-Joint, Fillet Weld

Lesson 3.13 Plate, Square-Groove, Open Root Butt Joint

Lesson 3.14 Plate, Single-V, Open Root Butt Joint

Lesson 3.15 Prefab Meter Sets, Valve Sets, etc. (2" through 12" diameter, discussion & demo)

3rd Period Standards of Achievement

Pass the comprehensive technical course exam and satisfactory completion of all in-shop practice lessons for this period.

Perform all items in the On-the-Job Work Experience Records for this period of the training program.

4. 19 to 24 months step

The centralized training will cover the following items:

In-Class Technical Courses

Course 4.8 The Principles of and Welding Procedure for Branch Connections (Hot Tap Tee) with Reinforcement Pad or Full-encirclement Weld Sleeve (discussion, slides, & demo)

Course 4.9 The Principles of and Procedure for Hot and Cold Tie-ins (discussion & slides). Welding Procedure for Full-encirclement Tie-in Weld Sleeve.

Course 4.10 Repairs to Pipelines by Patches and Half Soles (discussion, slides, & demo).

In-Shop Welding Practice Lessons (SMAW)

Lesson 4.16 6" and 12" Diameter Pipe, Standard Bevel, Single-V, Open Root Butt Joint. Weld both sizes of pipe with the SMAW process using:

1) AWS E6010 electrode, downhill, in the 5G position, and

2) AWS E6010 electrode for the stringer & hot pass, downhill, and AWS E7018 fill and cap, uphill, in the 5G position.

3) AWS E6010 electrod for stringer & hot pass, and E7018 fill and cap in the vertical fixed 2G position.

4th Period Standards of Achievement

Pass the comprehensive technical course exam and satisfactory completion of all in-shop practice lessons for this period.

Perform all items in the On-the-Job Work Experience Records for this period of the training program.

Pass the following SMAW qualification tests to the API code:

a. 12" diameter pipe, standard bevel, single-v open root butt joint using:

1) 0.250" w.t. pipe, AWS E6010 electrode, downhill, in the 5G position (2½ hours to complete), and

2) 0.375" w.t. pipe, AWS E6010 electrode, stringer and hot pass, downhill, and E7018 electrode fill and cap, uphill, in the 5G position (4 hours to complete).

5. 25 to 30 Months Step

The centralized training will cover the following items:

In-Class Technical Courses

Course 5.11 Steel Pipe Layout, (lecture & demo):

a. Solution of Right Triangle. Meaning and Understanding Trigonometric Functions.

b. Finding the Run, Set, and Travel of an In-line and Rolling Offset.

c. Tools for Layout.

d. Full-Size Tee Connection.

e. Cut Lines for a 2, 3, and 4-piece 90° Miter Turn.

f. Cut Lines for a 2-piece 45° Miter Turn.

g. Various Smaller Fittings (segmented) From a 90° Elbow.

In-Shop Welding Practice Lessons

Lesson 5.17 Steel Pipe Layout, Cut, Fit, and Weld a Rolling Offset Using 4" Dia., 0.188" w.t.:

a. Written Solution of Problem.

b. Layout Cuts on Pipe.

c. Cut Pipe.

d. Weld Pipe to Form Offset.

Lesson 5.18 Layout, Cut, Fit, and Weld:

a. Two 8" x 8" Dia., 0.322" w.t. Full-Size Tee Connection Joints, Using AWS E6010 for 1st Joint and AWS E6010 and E7018 for the 2nd.

Lesson 5.19 Layout, Cut, Fit, and Weld the Following:

a. 2-piece 45° Miter Turn.

b. 3 and 4-piece 90° Miter Turn.

c. Segment a 90° Elbow.

5th Period Standards of Achievement

Pass the comprehensive technical course exam and satisfactory completion of all in-shop practice lessons for this period.

Perform all items in the On-the-Job Work Experience Records for this period of the training program.

Pass the following SMAW qualification tests to the API code:

a. Full-size Branch connection joint - Layout, cut, fit, and weld a 12" x 12" Dia. branch. The weld will be made with the run pipe axis fixed in the horizontal position and the branch pipe axis extending vertically downward from the run, using:

1) 0.250" w.t. pipe, AWS E6010 electrode downhill (8 hours to complete), and

2) 0.375" w.t. pipe, AWS E6010 electrode stringer and hot pass, and E7018 fill and cap (10 hours to complete).

6. 31 to 36 Months Step

The centralized training will cover the following items:

In-Class Technical Courses

Course 6.12 Welding Quality Control

Course 6.13 Gas Tungsten Arc Welding(GTAW), Gas Metal Arc Welding(GMAW), Flux Cored Arc Welding (FCAW), and Other Welding Processes

In-Shop Welding Practice Lessons

Lesson 6.20 4" Diameter Pipe, 0.375" w.t., Standard Bevel, Single-V, Open Root Butt Joint in the 6G position. GTAW (1st and 2nd pass) and Remainder with SMAW (low-hyd).

Lesson 6.21 2" Diameter Pipe, 0.250" w.t., Standard Bevel, Single-V, Butt Joint in the 6G position. GTAW, All Using a Consumable Insert for the Root.

6th Period Standards of Achievement

Pass the comprehensive technical course exam and satisfactory completion of all in-shop practice lessons for this period.

Perform all items in the On-the-Job Work Experience Records for this period of the training program.

Pass the following SMAW and GTAW qualification tests to the ASME code:

a. 6" Dia. x 0.864" w.t. pipe, standard bevel, single-v open root butt joint, in the 45° fixed (6G) position. Use the GTAW process for 1st and 2nd passes, and the SMAW process for the remainder of all welding, using AWS E7018 electrode (8 hours to complete), and

b. 2" Dia. x 0.250" w.t. pipe, standard bevel, single-v ~~open root~~ butt joint, in the 6G position. Use the GTAW process throughout test (5 hours to complete). with a consumable insert for the root

IV. EVALUATION QUESTIONNAIRE OF TRAINING PROGRAM

For the purpose of providing a continuing meaningful, effective, and innovative apprenticeship program, meeting management and employee needs, the apprentice will fill out an anonymous questionnaire evaluating the training program.

IN-CLASS

OUTLINE OF TECHNICAL COURSES

Introduction and Outline of Apprentice Training Program

A. Program objectives

To produce welders with the required basic technical knowledge, fundamental manipulative skills, and qualifications to make high-quality field pipeline welds. This program will also produce welders with enough skill and knowledge to be of immediate value to the Company. Gaining field experience they will progress to work of greater difficulty and responsibility required of the Welder classification.

B. Approach to entire program

The program will be 36-months long divided into 6 time periods. In each of the 6 time periods, a week will be spent at a centralized training location where the apprentice will receive both in-class technical and the in-shop manipulative training. After this week, the apprentice will return to their field headquarters' for on-the-job training.

1. Centralized training school.

   a. Format for presentation of in-class and self-study technical course.

   b. Format for in-shop manipulative welding practice lessons.

2. Format for on-the-job training and work experiences.

C. Required Standards of Achievement for each step period.

D. Responsibilities for care and filling-out of charts and records.

Course 1.1 Rigging Fundamentals

A. Introduction to the Fundamentals of Rigging

1. Calculating the weight of steel plate pipe, and shapes.

   a. Practice probelm solving.

2. Two methods for finding the center-of-gravity.

3. Basic simple machines for rigging.

   a. Lever - a rigid bar supported on a single point, where a force is applied on one end opposite the resistance end.

   b. Wheel and axle - is adapted from the lever which has limited motion, the wheel can continue idefinitely, such as a crane or chain hoist.

   c. Pulley (block and tackle) - this device is talking the wheel and axle ideal one step farther.

   d. Incline plane - using a smooth plank to move a heavy weight to a higher level.

   e. Screw - is a helical groove cut into and wound about a cylinder, like a screw scissor jack for lifting a car.

   f. Wedge - is a double incline plane, use as a holding or separating device.

B. Fiber Ropes

   1. Strength of fiber ropes: breaking strength, safety factor, and safe working load.

   2. Care, storage, and inspection.

C. Slings

   1. Sling types - chocker, bridle, double basket, etc.

   2. Hooks and shackles - a means of hauling or lifting loads without tying directly to the object.

   3. Safe working loads for slings - lift capacity (tab).

   4. Inspecting slings for safety.

D. Wire rope, chain hoist, uniform hoist signals, (APR), and hoisting safety.

Course 1.2 Welding Introduction

A. Four basic welding categories:

1. Fusion Joining Processes (heated until there is a liquid to liquid melt) - Shielded Metal-Arc Welding, Gas Metal-Arc Welding, Submerged Arc Welding (double-jointing), Oxy-Acetylene Welding, Flux Cored Arc Welding, and Thermit Welding.

2. Electrical-Resistance Welding Processes (heating by passing electric current followed be applied pressure) - Spot Welding.

3. Solid-Phase Bonding Processes (solid to solid bond without liquid filler metal with applied pressure) - Forge Welding.

4. Liquid-Solid-Phase Joining Processes (weld groove heated but not melted, and adding a molten filler metal to form a solid joint) - Silver-Brazing and Braze-welding.

B. Three basic sources of heat generation:

1. Electrical heat generation - sustained electrical discharge over a gaseous path between two contacts. Electric Arc and Electric Resistance.

2. Chemical heat generation - heat evolved from a chemical reaction between gases or solids. Thermit process and Oxy-Acetylene Welding.

3. Mechanical heat generation - friction from rubbing two surfaces together under proper combination of speed and presssure. Friction Welding.

C. Thermal cutting processes:

1. Oxygen-acetylene gas.

2. Air-carbon arc.

D. Fluxes, slags, and gases for shielding the molten metal from the air during the welding process.

1. Introduction - the atmosphere is composited of about four-fifths nitrogen and one-fifth oxygen. Most metals when exposed to air has a strong tendency to combine with oxygen and a lesser extent with nitrogen, especially in the molten condition. Oxide surface layers are weak, brittle, loose, and flaky, hindering the welding process.

2. The process by which steel is oxidized in air.

3. Methods of oxidation prevention - shielding slages, fluxes, controlled atmosphere, vacuum, deoxidizers, and surface coating or plating protection.

Course 1.3 The Oxyacetylene Welding Process (OAW)

A. Safety information, precautions, and hazards

1. Handling, storing, and use of oxygen and acetylene gases and cylinders

a. Film: "Oxyacetylene Safety" and quiz on film.

2. Work area safety.

3. Personal protective equipment and clothing.

4. First-aid of small thermal burn areas on fingers (toes), hand, or arm.

5. Adequate ventilation in confined spaces.

a. Natural-draft ventilation.

b. Forced-draft ventilation.

c. Personal filter respirators or air-supplied masks.

6. Backfires and flashbacks - flashback arrestors on cylinder or torch.

B. Oxyacetylene fusion welding of steel pipe.

1. PGandE's Gas Standards and Specifications.

a. D-20, Oxyacetylene Weld Procedure.

b. D-30, Welder Qualification for Under 20% of SMYS.

c. D-30.1, Oxyacetylene Welder Qualification for Over 20% of SMYS.

2. Pipe welding techniques and fundamentals.

a. Various welding positions - 2G and 5G.

b. Joint design - open root single vee butt weld, bevel angle, root face, and root opening.

c. Joint preparation (cleaning), alignment (fit-up), use of external line-up clamp, and tack welding.

d. Welding rod selection and diameter size.

e. Forehand direction - away from the completed portion of the weld.

f. Backhand direction - back against the completed portion of the weld.

3. Shielding the molten metal from oxidation during welding is accomplished by:

a. Combustion of oxygen and acetylene creates a stream of hot gases to shield the molten puddle.

b. Deoxidation ability of alloys in welding rod.

C. Filler material specifications and what they mean.

1. AWS A5.2 is the specification for "Iron and Steel Gas Welding Rods." Three classifications based on mechanical properties and chemical analysis - Class RG45, RG60, and RG65.

2. Filler metal selection based on physical properties and chemical analysis of the piping material and the service requirements.

D. Advantages of OAW process

1. Control of weld zone temperature, filler- metal deposition rates, and weld shape -- Joining thin sheet metal, thin wall tube, small pipe diameters, and assemblies with poor fit-up (heavy sections joined more economically with arc welding).

2. Equipment is versatile -- Preheat, postheating, fusion welding, braze welding, brazing, and cutting.

3. Low-cost and portable.

4. Most ferrous and non-ferrous metals can be gas welded.

5. Requires skill in manipulating the welding rod and torch flame.

Course 2.4 Basic Blueprint Reading

A. Why are blueprints used?

The blueprint is an universal language of standardized symbols and signs by which information on a print from a designer is related to the fabricator. The fabricator interprets the print, forming a mental picture of how the object looks when fabricated to the requirements of the designer.

B. Six major lines and how they are used in drafting - object, hidden, center, extension, dimension, and projection lines.

C. Drawing conventions

1. 3-view (Orthographic Views), 2-view, drawings, and auxiliary views - looking at each view(s) gives you the true shape and size of the object.

2. Isometric drawings - is a picture drawing where two or more surfaces are shown in one view at one time.

D. Piping System Drawings

1. Why do we use piping system drawings?

2. Schematic piping drawings - a diagram where piping layout is illustrated by using line, arrows, and standard symbols.

   a. Interpret detail piping sketches, GSandS N-90 - piping symbols for single line drawings.

3. Orthographic constructon drawings - usually a 2-view drawing showing the actual shape and size of the object to be fabricated.

4. Locating fabrication information on construction drawings.

5. Standard AWS welding symbols used in orthographic construction drawings are intended to convey welding information from the designer to the welder.

Course 2.5 Metals and Their Properties

A. Various Methods of steel pipe manufacturing.

1. Continuous butt welded.

2. Electric-resistance welded.

3. Electric-arc-fusion butt welded.

4. Spiral welded.

5. General view of the seamless steel pipe manufacturing operation.

   a. Piercing process - a piercing mandrel is forced into an advancing solid round heated bar or billet of proper length and diameter to make the desired size pipe.

6. American Petroleum Institute Specification for steel pipe.

   a. API Specification 5L for Line Pipe, Grade A and B.

   b. API Specification 5LX for High-Test Line Pipe, X42 to X70.

B. Classification and discussion of different carbon steels based upon the carbon content.

1. Increasing carbon content leads to marked increases in hardness and strength with lowered ductility.

2. Carbon steels - mixture of iron and carbon with small additions of manganese, sulfur, and phosphorus.

   a. Low-carbon, to 0.30% carbon.

   b. Medium-carbon, 0.30 to 0.45% carbon.

   c. High-carbon, more than 0.45% carbon.

3. High-strength low-allow steels - improvements to the properties of basic carbon steel by small additions of alloying elements such as nickel, chromium, molybdenum, vanadium, titanium, etc. depending on the specific mechanical property requirements.

4. Some ASTM Specifications for carbon steel.

5. Welding metallurgy of carbon steel.

   a. What is welding metallurgy?

      A series of metallurgical operations similar to steelmaking, but done very quickly on a small scale. During welding a volume of molten metal (melt or bath) is formed (cast) by the shielded metal-arc process within the confines of the solid base metal weld groove (mold). The striking difference between welding and the steelmaking process is the mass of metal being heated and the effect of the mass on the physical and metallurgical changes. Welding involves small masses which are heated very rapidly by an intense arc source and the rapid cooling from the large sourrounding mass of colder base metal.

   b. Changes to the physical structures and properties of the welded structure and the heat affected zones due to the highly localized and rapid heat of welding and subsequent cooling.

      Molten weld metal
      Solid weld metal
      Single pass weld
      Two or more pass weld
      Influence of cooling rate

C. Properties of metals.

   1. Why are mechanical, physical, and corrosion properties so important? Metal properties are important for material selection and determining service usefulness.

   2. Mechanical properties to be familiar with -- using a typical tensile stress-strain diagram for steel we have:

      a. Ultimate strength - maximum stress developed by the material based on the original cross-sectional area.

      b. Yield strength - is the stress at which the material exhibits a permanent deformation.

      c. Proportional limit - the range in which a metal is strained under load and then returns to its original size and shape when unloaded.

d. Fracture appearance (ductile or brittle) - metal fracture is classified into two general categories, 1) ductile and 2) brittle (% of Elongation and % of Area Reduction).

3. Mechanical property tests.

a. Tensile Strength - a metal's ability to resist change in shape and size when an external pulling force is applied (compressive and shear).

b. Hardness survey from macro-section--measures the resistance to penetration.

c. Guided-bend (ductility) - determines soundness, penetration, and fusion in the weld metal. It also measures the ductility.

d. Charpy V-notch impact (fracture toughness) - to determine the ability of the metal to withstand a shape, high velocity blow.

4. Physical properties to be familiar with:

a. Density (specific gravity) is the weight in pounds of 1 cubic inch of a metal.

b. Thermal conductivity is the rate of which heat is transmitted through a material by conduction.

c. Melting point or range is a indication of the strength of bonds between atoms, a stronger bond, a higher melting point.

d. Coefficient of thermal expansion is defined as the expansion and contraction of different substances over a range of temperatures.

D. Shortcomings of iron and why we add alloying elements to form steel.

1. Iron oxidizes at a fairly rapid rate by rusting and scaling even in a mildly corrosive media -- alloying elements can substantially improve the corrosion resistance of iron.

2. Iron's mechanical properties can be improved by adding carbon for increased hardness.

3. Alloying elements in steel and their general effects: Carbon, Manganese, Phorphorus, Sulfur, Silicon, Chromium, Nickel, Molybenum, Columbium, Titanium, Vanadium, Aluminum, Boron, Nitrogen, and Lead.

Course 3.6 The Shielded Metal-Arc Welding (SMAW) Process

A. Safety information, precautions, and hazards (refer to W50 Oxyacetylene Welding Process, Section A, for additional safety information).

1. Protection from electrical shocks.

2. "Resuscitation Manual - A Guide for Electric Utility Companies," May 1979, Edison Electric Institute. Treatment of electrical injuries (shock and burns).

3. Protective equipment and clothing to minimize or eliminate the effects of arc sparks, slag, ultraviolet, visible, infrared, and heat radiation -- welding hood and correct len shade, leather vs. fire retardent cotton and synethics.

4. Health hazards from the inhalation of chemical and physical substances in the welding environment.

a. Introduction: Increased awareness and a demand of those in industry for a safe and health working environment -- welding pollutants from the different welding processes, base metals, and consumables are unavoidable and should be the concern of both employers and employees.

b. Classifying these pollutants by their potential toxicity levels -- and the source of these pollutants. Exposure limits and their effects on the human body.

B. Basic Shielded Metal-Arc Welding Circuit

1. What is an arc? -- An arc is an electric current flowing between the electrode and the work through an ionized column of gas.

a. Direct Current Straight and Reverse Polarities.

b. Ohm, Ampere, and Voltage.

c. Welding electrode hold, cable, and ground clamps.

2. Power supplies.

   a. Selection factors - available power, available floor space, initial cost, location of operation (in a plant or in the field), maintenance of machines, versatility, required output, duty cycle, efficiency, and types of electrodes to be used.

   b. Constant-current output (drooping volt-ampere curve required for SMAW).

   c. Engine-driven generators are direct current power sources, all other welding power starts out as alternating current.

   d. Principal characteristics and advantages of DC to AC current and vice versa.

3. Metal transfer across the welding arc of a covered electrode.

C. Shielded Metal-Arc Welding of Steel Pipe

1. PGandE's Gas Standards and Specifications.

   a. D-22, Arc Welding Procedure - All stress levels.

   b. D-30.2, Arc Welder Qualification for Over 20% of SMYS (D-30, Welder Qualification for Under 20% of SMYS).

2. Vertical-down pipe welding techniques and fundamentals - this method is proven fast and economical (max. wall thickness limit) for welding cross country pipelines.

   a. Joint design - open root single-v butt weld, bevel angle, root face, and root opening.

   b. Welding positions (2G, 5G, and 6G).

   c. Joint preparation, fit-up, and tack welding - cleaning, use of external line-up clamps, and striking the arc.

   d. Electrode selection and diameter size.

   e. Welding current, arc length, and travel speeds - will depend upon root opening, wall thickness, length of pipe, and the appearance of the molten weld puddle.

2. Basic differences between Cellulose-type and Low-hydrogen electrodes.

3. AWS A5.1 is the specification for "Mild Steel Covered Arc-Welding Electrodes."

   a. Characteristics, mechanical, and chemical requirements of some pipeline welding electrodes: AWS E6010 and E7018.

4. AWS A5.5 is the specification for "Low-Alloy Steel Covered Arc-Welding Electrode.

   a. Characteristics, mechanical/chemical requirements of some pipeline welding electrodes: AWS E7010, E8010, and E8018.

5. Function of electrode covering materials.

   a. Arc stabilizer, deposition rate, depth of penetration, shape of deposit, and surface smoothness.

   b. Materials for generating protective shielding gases.

   c. Ingredients for fluxing agents and slag formers.

   d. Powdered metals and alloys (deoxidizers and alloying additions).

6. Proper handling, treatment, and storage for:

   a. Cellulose type electrodes.

   b. Low-hydrogen type electrodes.

E. Advantages and disadvantages of the SMAW process

1. Most versatile and widely used welding process.

2. Least complex, costly, and the equipment most portable of all other arc welding processes.

3. Joint quality and strength can be easily controlled.

4. Metals welded most easily are carbon and low-alloy steels, stainless steels, and heat-resisting alloys.

5. Lacks high-metal deposition-rate and deposition efficiency as compared to GMAW and SAW (electrode change after each length is consumed).

6. Requires slag removal between passes.

Course 3.7 Principles and Operation of Tapping and Plugging Equipment

The Welding of Mueller and T.D.W. Fittings. The Use and Care of Muller Small Diameter Tapping (3/4", 1-1/4", and 2" Dia.) and Plugging Equipment.

A. Divert, repair, or replacement of pipeline without interruption of flow. The obvious technique is to cut off the flow, purge the lines of gas, install new section, and recommission line. The other alterantive is perform the operation with the gas still flowing through, using the "hot-tapping" technique.

1. Outline of the typical operation and function; using both the T.D.W. and Mueller tapping and plugging equipment.

a. Pressure Control Fittings (C-15.2 to 16.5): Use and care of Mueller tapping machines, 2" Ø piper or less, screwed and 3" Ø pipe or greater, flanged.

B. Welding procedure used for the T.D.W. and Mueller fittings.

C. The Use and Care of Mueller small diameter (3/4", 1-1/4", and 2" Dia.) tapping and plugging equipment.

Course 4.8 The Prinicples of and Welding Procedure for Branch Connections (Hot Tap Tee) with Reinforcement Pad or Full-encirclement Weld Sleeve (discussion, slides, and demo).

Course 4.9 The Principles of and Procedure for Hot and Cold Tie-ins (discussion and slides). Welding Procedure for Full-encirclement Weld Sleeve.

Course 4.10 Repairs to Pipelines by Patches and Half Soles (discussion, slides, and demo).

Course 5.11 Steel Pipe Layout, (lecture and demo).

A. Solution of Right Triangle and Trigonometric Functions.

B. Finding the Run, Set, and Travel of an In-line and Rolling Offset.

C. Tools for Layout.

D. Full-Size Tee Connection.

E. Cut Lines for a 2, 3, and 4-piece 90° Miter Turn.

F. Cut Lines for a 2-pience 45° Miter Turn.

G. Various Smaller Fittings (segmented) from a 90° Elbow.

Course 6.12 Welding Quality Control

A. Quality Control

1. Codes and requirements that govern the welding of pipe in PGandE's Gas Construction Department.

   a. American Petroleum Institute, API 1104, Standard for Welding Pipe Lines and Related Facilities.

   b. PGandE's Gas Standards and Specifications, requirements on construction materials and procedures to be used throughout the Gas Department.

   c. Manufacturer's recommended guidelines for the use of their products.

2. How is a Welding Procedure Developed?

   a. Research, past experiences, educated guess, and trial and error.

   b. Written welding procedure specifications.

   c. Essential variables.

3. What is a Welding Procedure Qualification test to API 1104?

   a. Destructive testing - cut location, type and number of test specimens, specimen preparation, test methods, and acceptance requirements.

   b. Records.

4. What is the Welder Performance Qualification test to API 1104 and ASME Codes?

   a. Single/Multiple Qualification.

   b. Essential Variables.

c. Visual Examination and Destructive or Radiographic test.

d. Requalification and Records.

B. The role of inspection (Quality Assurance).

1. An explanation of Inspection methods before, during, and after welding.

a. Visual inspection.

b. Radiographic inspection.

c. Hydrostatic testing.

d. Skilled and qualified welders.

e. Other Nondestructive tests - Magnetic-particle, Dye-penetrant, and Ultrasonic examination.

C. Welding difficults and defects.

1. Introduction - There are no perfect welds. Some imperfection can always be found. NDT specialist term imperfections as discontinunities--variation in the normal average properties of the material. Discontinunities are defects when found to be damaging to the performance of the material or weldment. In making any weld, limit imperfections to harmless discontinunities.

2. Problems arising in heating for welding.

a. Arc strikes and starting porosity.

b. Inadequate joint penetration and incomplete fusion (root, interpass, and side-wall).

c. Absorption of gases by molten metal (oxygen, nitrogen, and hydrogen).

d. Surface contaminants.

e. Tack welding.

3. Difficulties during welding (manipulation).

a. Slag inclusions.

b. Undercutting and possible toe cracking.

c. Excessive weld spatter.

d. Overlapping (cold-lap).

e. Burn-through and excessive penetration.

f. Magnetic arc-blow.

g. Improper moisture content in electrodes.

h. Fingernailing of electrode tip.

i. Protection against environment (enclosure).

4. Difficulties during cooling.

a. Solidification shrinkage cracks.

b. Blowholes (worm holes) and subsurface porosity.

5. Cracking.

a. Crater cracking -- longitudinal and transverse cracking.

b. Root (stringer bead) cracking.

c. Fusion line and underbead cracking.

d. Cracking from hydrogen.

e. Cold cracking.

D. Minimize and control of welding distortion.

1. Introduction - A frequent problem in fabricating weldments is to be certain that the finished article conforms to the required dimensions. The inaccuracies in dimension or form is unavoidable because of localized heating by the welding process, but they can be minimized.

2. Terms and Definitions -

a. Shrinkage - weld metals shrinkages upon solidification, but this has little to do with the distortion problem in weldments. Some dishing or deformation of the weld face of the weld metal upon solidification but it can not generate stresses capable of decreasing the overall size or pull a portion of the weldment out of shape.

b. Contraction - contraction of solid metal during cooling can generate stress equal to or less than the yield strength of the weld metal at the particular temperature.

c. Distortion - is the deviation from a desired form. Distortion occurs as a results of welding from localized thermal expansion and contraction. If the magnitude of these welding stresses exceeds the member's yield strength, permanent dimensional change and/or a distortion will result. In some situations, strain occurs in the elastic range and stresses are contained internally within an undistorted weldment.

d. Residual stress - is the internal stress remaining in the weldment after the joining operation, having been generated by localized heating and cooling. These residual stresses within the elastic range are balanced in the overall weldment.

3. The behavior of a solid steel bar with and without restraint when uniformily heated and cooled will help in understanding how and why distortion occurs.

4. How properties of metals affect distortion - a knowledge of physical and mechanical property changes during heating and cooling may help to anticipate distortion problems.

   a. Coefficient of thermal expansion.

   b. Thermal conductivity.

   c. Yield strength.

5. Shrinkage of weldments.

   a. Shrinkage transverse to a butt weld (perpendicular to long axis of weld) - cumulative shrinkage of several circumferential butt welds could be enough to shorten the longitudinal dimension. The amount of shrinkage will depend on the cross-sectional area of the weld metal deposited.

b. Shrinkage longitudinal to a butt weld (parallel to weld axis) - longitudinal shrinkage is also a function of the cross-sectional area of the weld metal and the cooler surrounding base metal. This parallel shrinkage tends to reduce the diameter of the pipe.

6. Distortion of weldments - the distortion problem starts at the localized area along the path of the arc, thus distortion in varying degrees occur in all weldments.

   a. Angular distortion - angular distortion for single-bevel plate butt welds and T-sections from welding is the angular change of members extending from a weld area.

   b. Longitudinal bowing - longitudinal bowing of long members are caused by shrinkage forces from welding on one side of the neutral axis of the member.

   c. Buckling and twisting - this sheets often buckle and twist because of low-torsional resistance.

7. Methods to control and minimize distortion

   a. Avoid overwelding (minimum amount of weld metal deposited to gain desired strength).

   b. Avoid narrow root and wide face joint profile.

   c. Deposit weld metal in the fewest possible number of passes (use a high-deposition rate process), fewer passes with large electrode.

   d. Alterations to the essential variables of a qualified welding procedure may decrease or increase the distortion.

   e. Balance welding around the neutral axis of the weldment.

   f. Back-step welding method.

   g. Intermittent and staggered welding.

   h. Skip welding sequence.

   i. Copper backing bars.

j. Preset and preplace members at a slight angle out of position or space, opposite to the anticipated shrinkage force.

k. Use of clamps, jigs, fixtures, and strongbacks to maintain fitup and alignment.

l. Preheat, postheat treatment, and interpass temperatures (uniform heating and cooling reduces quench rate).

m. Thermal flame straightening (localized).

n. Peening (plastic deformation).

o. Minimize welding time; less heat input (optimum welding speed with maximum penetration).

Course 6.13 Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAN), Flux Cored Arc Welding (FCAW) and Other Welding Processess

Reference Materials

A. Welding terms and definitions

B. Weights of steels

C. Pipe dimensions and schedule chart

D. Welding symbols

OUTLINE OF IN-SHOP WELDING PRACTICE LESSONS

Scope of Oxyacetylene Training

Setup and Operation of OAW Equipment

A. Setup, operation, and safe practices in welding, cutting, and heating equipment.

1. Oxyacetylene apparatus/description, function, and setup of: gas cylinders, oxygen and acetylene pressure regulators, welding hoses, welding, torch handle, cutting attachement, cutting tips, welding tips, multi-flame heating nozzle, turning on cylinders, and gas pressures.

2. Lighting the torch and adjusting the flame.

   a. Lighting and extinguishing the torch.

   b. Three types of welding falmes--reducing, neutral, and oxidizing.

   c. Cone shape, color, sound, torch adjustment, gas pressure, and temperature for the different welding flames (tip cleaner).

3. Temporarily stopping work.

   a. Close cylinders.

   b. Bleed (relieve) gas pressure from hoese.

4. Stopping work.

   a. Disconnect pressure--reducing regulators.

   b. Replace safety cap on cylinder.

Lesson 1.1 Cleaning and Preparation of Weld Joint (D-20)

Lesson 1.2 Bead-on-Plate

A. Bead-on-flat-plate without burn through, without rod.

B. Edge and corner joint without rod in the flat position.

C. Bead-on-plate with welding rod.

1. Forehand technique in flat (1G), horizontal (2G), vertical (3G) and overhead (4G) positions.

2. Backhand technique in 1G, 2G, and 3G positions.

D. Slight-weave-on-plate with rod.

1. Forehand technique in 1G, 2G, 3G, and 4G positions.

2. Backhand technique in 1G, 2G, and 3G positions.

Lesson 1.3 Plate, Lap Joint, Fillet Weld

A. Fillet weld, 1/8" thick plate, single pass in the 1F, 2F, 3F, and 4F positions.

Lesson 1.4 Plate, Square-Groove, Open Root Butt Joint

A. Butt weld with 1/8" thick plate in the 1G, 2G, 3G, and 4G positions.

Setup and Safe Operation Oxyacetylene Flame Cutting Equipment

A. Setting-up cutting equipment.

1. Inspect all setting surfaces and "O" rings.

2. Connect cutting attachement to welding torch.

3. Insert proper size cutting tip.

4. Light and adjust the preheat and cutting flame.

B. Prinicpal and technique of cutting and beveling operation.

1. Quality cuts.

Lesson 1.5 Cutting, Beveling, and Piercing of Plate and Pipe

A. Manual plate and pipe, cutting and beveling.

B. Cutting and piercing holes.

C. Use of beveling band on pipe.

Lesson 1.6 Use and Care of External Line-up Clamps and Pipe Alignment Tools

Lesson 2.7 Service Tee-Connection Joint (D-30 and C-10-14)

A. 3/4" pipe nipple fillet welded to 2, 3, or 4" diameter pipe.

Lesson 2.8 3/4", 2", and 4" Diameter Pipe, Standard Pipe Bevel, Single-V Open Root Butt Joint

A. 1G position (horizontal axis, rolled during welding).

B. 2G position (vertical axis fixed) using the forehand method.

C. 5G position (horizontal axis fixed), uphill, using the forehand method.

Lesson 2.9 Installation of Valve (F-11-41.2), Flanges (B-41-44), Gaskets (B-45-45.1), and Bolts (B-46-46.1)

Lesson 2.10 Preheating, Interpass Temperature, and Postweld Heat Treatment

A. Preheating (vary from 100-1200°F) - prevent cold cracking, reduce residual stresses, improve notch toughness, and prevent cold cracking from welding at low ambient temperatures.

B. Interpass temperature (for multi-layered welds) - influence quench rate (susceptibility to cracking), residual stress, distortion, and grain size. Usually the minimum interpass temperature will correspond with the minimum preheat temperature.

C. Postweld stress-relief heat treatment - heating (below critical range 900-1250°F) holding (one hour per inch of thickness), and cooling done slowly and uniformly to relieve stresses, improve toughness, increase strength, improve corrosion resistance, and remove cold work.

D. Steel compositions with recommended preheat, interpass, and postweld heat treatment temperatures.

Lesson 3.15 Prefab Meter Sets, Valve Sets, Etc. 2" Ø through 12" Ø, (Slide, and Discussion and Demo)

OUTLINE OF IN-SHOP WELDING PRACTICE LESSONS

Scope of SMAW Training

Setup and Operation of SMAW Equipment

A. Safe practices and precautions.

B. Demonstration and adjustment of welding machine.

Lesson 3.11 Striking, Sustaining, and Breaking an Arc, Bead-on-Plate, and Weave-on-Plate Using AWS E6010 and AWS E7018 Type Electrodes

A. Striking, maintaining, and breaking an arc, AWS E6010 and E7018.

B. 3-bead-pad in the flat, (1G), horizontal (2G), horizontal fixed (3G), and overhead (4G) positions, using AWS E6010 both in the vertical-up and -down directions and E7018 in vertical-up.

C. Weave-bead in the 1G, 2G, 3G, and 4G positions, using AWS E6010 both in the vertical-up and -down directions and E7018 vertical-up.

Lesson 3.12 Plate Tee-Joint, Fillet Weld Using Both Cellulosic and Low-Hydrogen Electrodes

A. 3-pass fillet weld in 1F, 2F, 3F, and 4F positions, using AWS E6010 in the vertical-up and -down directions and E7018 vertical-up.

Lesson 3.13 Plate, Square-Groove Open Root Butt Joint Using AWS E6010

A. Weld joint in the 1G, 2G, 3G, and 4G positions, using AWS E6010 in the vertical-down direction.

Lesson 3.14 Plate, Single-V, Open Root Butt Joint Using AWS E6010

A. Weld joint in the 1G, 2G, 3G, and 4G positions, using AWS E6010 in the vertical-down direction.

Lesson 4.16 6" and 12" Diameter Pipe, Standard Bevel, Single-V Open Root Butt Joint

A. Weld 6" diameter pipe in the following positions:

1. Horizontal axis fixed (5G position) downhill using AWS E6010.

2. 5G position using AWS E6010 stringer and hot pass, downhill and AWS E7018 fill and cap uphill.

3. Vertical axis fixed (2G position) using AWS E6010 for stringer and hot passes, and E7018 fill and cap.

Lesson 5.17 Steel Pipe Layout, Cut, Fit, and Weld a Rolling Offset Using 4" Diameter, 0.188" w.t.

Lesson 5.18 Layout, Cut, Fit, and Weld Two 8" x 8" Diameter, 0.322" w.t. Full Size Tee Connection Joints, Using AWS E6010 for the 1st Joing and E6010 and E7010 for the 2nd Joint

Lesson 5.19 Layout, Cut, Fit, and Weld a 2-Piece 45°, 3- and 4-Piece 90 Miter Turns, and Segment a 90° Elbow

Lesson 6.20 4" Diameter Pipe, 0.375" w.t., Standard Bevel, Single-V, Open Root Butt Joint. GTAW (1st and 2nd pass) and remainder with SMAW (Low-Hyd.)

Lesson 6.21 2" Diameter Pipe, 0.250" w.t., Standard Bevel, Single-V, ~~Open Root~~ Butt Joint. GTAW throughout Using a Consumable Insert for the Root

ON-THE-JOB WORK EXPERIENCE RECORD
GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

OXYACETYLENE WELDING

0-to 12 MONTHS

TYPE OF WORK	DATE STARTED	DATE COMPLETED	JOB NUMBER	OBSERVER	COMMENTS
BUTT WELDS 3/4" DIA. PIPE					
BUTT WELDS 1 1/4" DIA. PIPE					
BUTT WELDS 2" DIA. PIPE					
BUTT WELDS 3" DIA. PIPE					
BUTT WELDS 4" DIA. PIPE					
WELD 3/4" DIA. STEEL SERVICE TEE-CONNECTION					
USE OF BEVELING BAND & TORCH ASSEMBLY FOR VARIOUS DIA. PIPE					

ON-THE-JOB WORK EXPERIENCE RECORD
GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

OXYACETYLENE WELDING 0 to 12 MONTHS

TYPE OF WORK	DATE STARTED	DATE COMPLETED	JOB NUMBER	OBSERVER	COMMENTS
USE MUELLER (M-2) TAPPING & PLUGGING EQUIPMENT FOR 3/4", 1 1/4", & 2" DIA. FITTINGS					
WELDING MUELLER (M-2) FITTINGS: 3/4", 2", 3", AND 4" DIA.					
INSTALL VALVES AND RELATED MATERIALS					

ON-THE-JOB WORK EXPERIENCE RECORD
GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

ARC WELDING: 13 to 24 MONTHS

TYPE OF WORK	DATE STARTED	DATE COMPLETED	JOB NUMBER	OBSERVER	COMMENTS
WELD ONE OR MORE BUTT JOINTS (ANY SIZE) ON A COLD TIE-IN					
WELD ONE OR MORE FULL-ENCIRCLEMENT SLEEVE FITTING ON A COLD TIE-IN					
WELD ONE OR MORE 3" MUELLER SPLIT FITTING					
WELD ONE OR MORE 4" MUELLER SPLIT FITTING					
WELD ONE OR MORE 6", 8", OR 12" MUELLER SPLIT FITTING					

ON-THE-JOB WORK EXPERIENCE RECORD
GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

ARC WELDING — 13 to 24 MONTHS

TYPE OF WORK	DATE STARTED	DATE COMPLETED	JOB NUMBER	OBSERVER	COMMENTS
BUTT WELDS FROM 4" to 12" DIA. AND					
FROM 0.156" to 0.500" WALL THICKNESS					
BUTT WELDS FROM 16" to 26" DIA. AND					
FROM 0.200 to 0.500" WALL THICKNESS					

ON-THE-JOB WORK EXPERIENCE RECORD
GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

ARC WELDING 25 to 36 MONTHS

TYPE OF WORK	DATE STARTED	DATE COMPLETED	JOB NUMBER	OBSERVER	COMMENTS
BUTT WELDS FROM 30" to 42" DIA. AND					
FROM 0.280" to 0.500" Wall thickness OR Greater					
WELD ONE OR MORE OF EACH SIZE: 2", 4", AND 6" DIA. HOT TAP TEES) WITH A REINFORCEMENT PAD OR FULL SLEEVE					
PREFAB A METER OR VALVE SET (ANY SIZE)					
ASSIGNMENT AT ONE OR MORE CIVIL-HYDRO WELDING RELATED JOB					

ON-THE-JOB WORK EXPERIENCE RECORD
GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

ARC WELDING — 25 to 36 MONTHS

TYPE OF WORK	DATE STARTED	DATE COMPLETED	JOB NUMBER	OBSERVER	COMMENTS
LAYOUT, CUT, AND WELD A ROLLING OFFSET TIE-IN PIECE (ANY SIZE)					
LAYOUT, CUT, AND WELD A SEGMENTED SMALLER FITTING FROM A 90° STD. ELBOW					
LAYOUT, CUT, AND WELD 2 OR MORE MITERED TURNS FOR A TIE-IN					
INTERPRET AND FOLLOW DETAILED PIPE SKETCHES FOR A FABRICATION JOB					
WELD ONE OR MORE FULL-ENCIRCLEMENT SLEEVE FITTING ON A HOT TIE-IN					
WELD 2 OR MORE BUTT JOINTS (ANY SIZE) ON A HOT TIE-IN					
ASSIGNMENT AT ONE OR MORE STATION (POWER PLANT) WELDING RELATED JOB					

IN-CLASS TECHNICAL COURSE PROGRESS CHART

GAS CONSTRUCTION WELDING
APPRENTICESHIP TRAINING PROGRAM

NAME _____
S.S.# _____

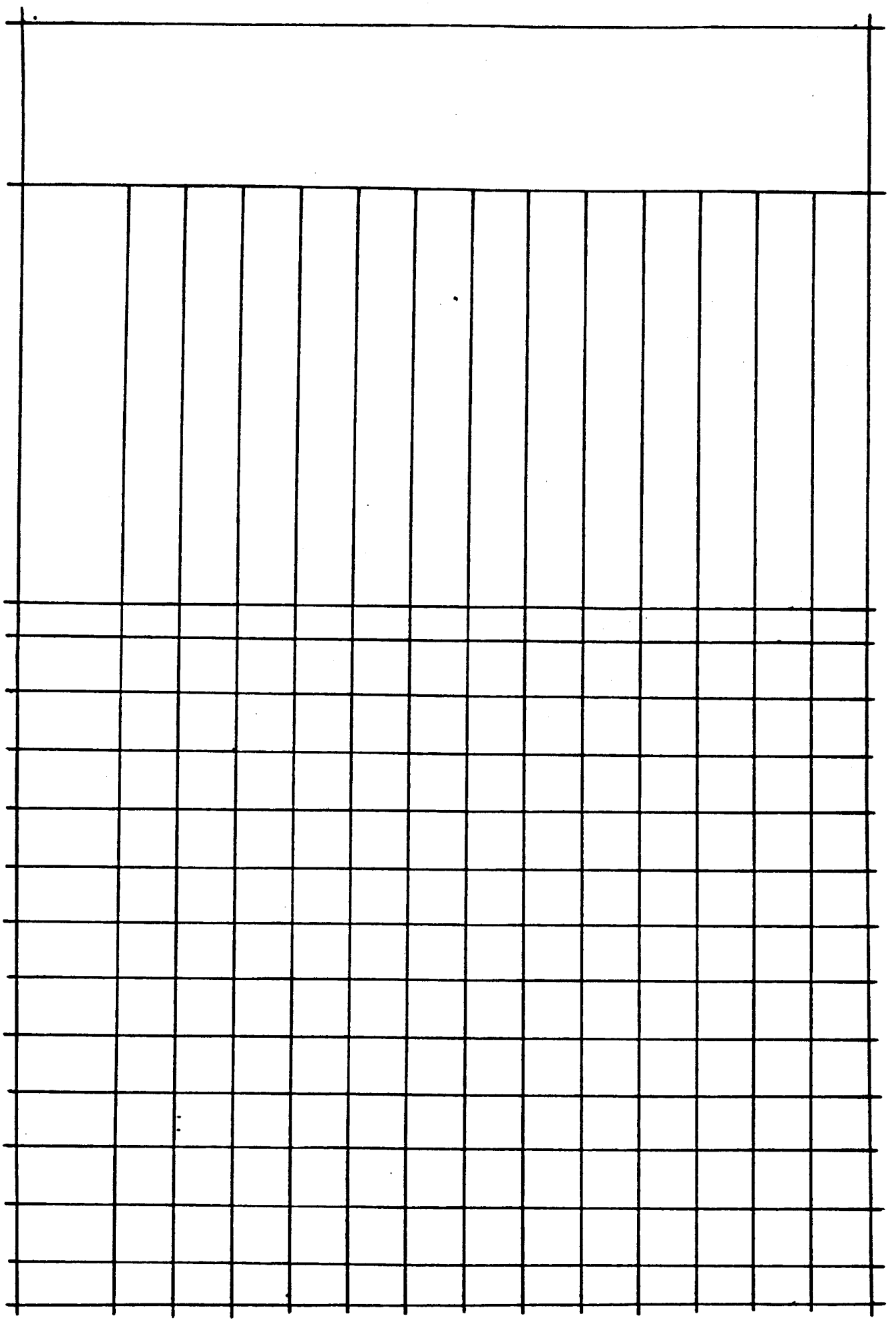
COURSES	TEST DATE	COMMENTS
Course 1.1 RIGGING FUNDAMENTALS		
Course 1.2 WELDING INTRODUCTION		
Course 1.3 THE OXYACETYLENE WELDING PROCESS		
Course 2.4 BASIC BLUEPRINT READING		
COURSE 2.5 METALS AND THEIR PROPERTIES		
COURSE 3.6 THE SHIELDED METAL ARC WELDING PROCESS		
COURSE 3.7 PRINCIPLE AND OPERATION OF TAP & PLUG EQUIPMENT		
COURSE 4.8 WELDING A HOT TAP TEE WITH REINFORCEMENT		
COURSE 4.9 HOT & COLD TIE-INS, FULL ENCIRCLEMENT WELDSLEEVE		
COURSE 4.10 REPAIRS TO PIPELINES		
COURSE 5.11 STEEL PIPE LAYOUT		
COURSE 6.12 WELDING QUALITY CONTROL		
COURSE 6.13 GTAW, GMAW, & OTHER WELDING PROCESSES		

IN-SHOP WELDING PRACTICE LESSON PROGRESS CHART
GAS CONSTRUCTION WELDING APPRENTICESHIP TRAINING PROGRAM

NAME _____ S.S.# _____

OXYACETYLENE WELDING

PRACTICE LESSONS	SETUP AND SAFE OPERATION OF OAW EQUIPMENT	WELD JOINT CLEANING AND PREPARATION	BEAD-ON-PLATE	PLATE, LAP JOINT, FILLET WELD	PLATE, SQUARE-GROOVE, OPEN ROOT BUTT JOINT	SETUP AND SAFE OPERATION OF CUTTING EQUIP. CUT, BEVEL, & PIERCE PLATE AND PIPE.	USE AND CARE OF EXTERNAL LINE-UP CLAMPS AND PIPE ALIGNMENT TOOLS	SERVICE TEE CONNECTION JOINT	PIPE, 3/4", 2", AND 4" DIA. STD. BEVEL SINGLE-V; OPEN ROOT BUTT JOINT	INSTALL VALVES, FLANGES, GASKETS, AND BOLTS (DEMO. & DISCUSSION)	PREHEAT, INTERPASS TEMPERATURE, AND POSTWELD HEAT TREATMENT		
DATES		1.1	1.2	1.3	1.4	1.5	1.6	2.7	2.8	2.9	2.10		



IN-SHOP WELDING PRACTICE LESSON PROGRESS CHART
GAS CONSTRUCTION WELDING APPRENTICESHIP TRAINING PROGRAM

NAME _____ S.S.# _____

ARC WELDING

PRACTICE LESSONS	SETUP AND SAFE OPERATION OF SMAW EQUIPMENT	STRIKE, SUSTAIN, AND BREAK ARC, BEAD-ON-PLATE, AND WEAVE-ON-PLATE	PLATE, TEE JOINT, FILLET WELD	PLATE, SQUARE-GROOVE, OPEN ROOT BUTT JOINT	PLATE, SINGLE-V, OPEN ROOT BUTT JOINT	PREFAB METER AND VALVE SETS 2" THRU 12" DIA. DEMO. AND DISCUSSION	6" DIA. PIPE, STD. BEVEL-SINGLE-V OPEN ROOT BUTT JOINT, E8010, DOWNHILL IN 5G POSITION.	12" DIA. PIPE, STD. BEVEL-SINGLE-V OPEN ROOT BUTT JOINT, E6010, DOWNHILL IN 5G POSITION	6" DIA PIPE, STD. BEVEL, OPEN ROOT BUTT JOINT, E8010 DOWNHILL AND E7018 UPHILL IN 5G POSITION	12" DIA. PIPE, STD. BEVEL, OPEN ROOT BUTT JOINT, E8010 DOWNHILL AND E7018 UPHILL IN 5G POSITION	6" DIA. PIPE, STD. BEVEL, OPEN ROOT BUTT JOINT, E8010 IN 2G POSITION	12 DIA. PIPE, STD. BEVEL, OPEN ROOT BUTT JOINT, E8010 AND E7018 IN 2G POSITION	
		3.11	3.12	3.13	3.14	3.15	4.16						

DATES	PRACTICE LESSONS
5.17	STEEL PIPE LAYOUT, CUT, FIT, AND WELD A ROLLING OFFSET
5.18	STEEL PIPE LAYOUT, CUT, FIT, AND WELD FULL-SIZE TEE CONNECTION USING E6010
	PIPE LAYOUT, CUT, FIT, AND WELD FULL-SIZE TEE CONNECTION USING E6010 AND E7018.
5.19	LAYOUT, CUT, FIT, AND WELD A 2-PIECE 45° MITER TURN
	LAYOUT, CUT, FIT, AND WELD 3 AND 4-PIECE 90° MITER TURN
	LAYOUT AND CUT (SEGMENT) A 90° ELBOW
6.20	4" DIA. PIPE, 0.375" Wt., STD. PIPE BEVEL, GTAW AND SMAW, OPEN ROOT BUTT JOINT IN 6G POSITION.
6.24	2" DIA. PIPE, 0.250" Wt., STD. PIPE BEVEL, GTAW WITH INSERT, BUTT JOINT IN 6G POSITION.