

APPENDIX A

WORK PROCESS SCHEDULE AND RELATED INSTRUCTION OUTLINE BOILERMAKER

**WORK PROCESS SCHEDULE
BOILERMAKER
O*NET-SOC CODE: 47-2011.00 RAPIDS CODE: 0040**

This Trade Schedule is attached to and a part of the Apprenticeship Standards for the above identified trade.

1. TERM OF APPRENTICESHIP

The term of apprenticeship shall be a period of four (4) years (not less than 6,000 hours) of on-the-job learning supplemented by the required minimum of 576 hours of related instruction.

2. RATIO OF APPRENTICES TO JOURNEYWORKERS

Each local lodge is required to register apprentices quarterly to meet a one (1) apprentice to five (5) journeyworker ratio based on man hours worked within the Local using the man-hours of the preceding year.

3. APPRENTICE WAGE SCHEDULE

Apprentices shall be paid a progressively increasing schedule of wages based on a percentage of the current journeyworker wage rate per the collective bargaining agreement.

4. SCHEDULE OF WORK EXPERIENCE (See attached Work Process Schedule.)

The Area Joint Apprenticeship Committee may modify the work processes to meet local needs prior to submitting these Standards to the appropriate Registration Agency for approval.

5. SCHEDULE OF RELATED INSTRUCTION (See attached Related Instruction Outline.)

**WORK PROCESS SCHEDULE
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The following are the major phases of the Boilermaker occupation in the field erection and repair industry. The work processes include the application of these operations on tank and water tower construction and repair, refinery construction and repair, boiler erection and repair, nuclear reactors, and reactor/boiler components erection and repair, and any other work related to the trade.

ON-THE-JOB LEARNING	APPROX. HOURS
I. Care and maintenance of tools and equipment	100
A. Learning names of tools and equipment	
B. Learning the use of tools and equipment	
C. Care and Maintenance	
D. Handing out tools and inventory	
II. Rigging and Bull Gang	1000
A. Unloading and handling	
B. Use of Hoisting Equipment	
1. Come-along	
2. Chain falls	
3. Erecting and dismantling derricks and cranes	
4. Working with derricks and cranes	
5. Use of signals and safety	
C. Use of Tackle	
1. Block and tackle	
2. Chokers, cables and slings	
3. Proper use of knots and splicing	
4. Proper use of clamps	
5. Safety	
D. Moving pieces	
1. Rollers	
2. Levers	
3. Use of tackle, come-along and chain falls	
4. Safety	
III. General Erection	1000
A. Steel Erection in our jurisdiction	
1. Designating location of members	
2. Raising in place	
3. Use of spud-wrench, bull, and drift-pins, jacks, wedges, clips, and saddles	
4. Alignment	
a. Use of level, plumb, tape and rule	

- 5. Connecting
 - a. Drilling, reaming, chipping, caulking and grinding
 - b. Bolting up
 - c. Welding (tack)
 - d. Riveting
 - B. Setting drums and headers
 - 1. Use of hoisting equipment and tackle
 - 2. Use of water level, plumb and measuring devices
- IV. Tube Installations **400**
- A. Entering
 - 1. Use of come-along and entering devices
 - 2. Lipping
 - B. Setting and Aligning
 - 1. Use of spacers
 - 2. Use of strong-backs
 - C. Getting proper stock
 - 1. Signals (sound and light)
 - 2. Come-along
 - 3. Piece of stock
 - 4. Boiler code
 - D. Rolling
 - 1. Use of erectors' guides, or
 - 2. Proper selection of the following:
 - a. Expanders, rollers, pins, and mandrels
 - 3. Use of rolling machines
 - a. Pneumatic, electric and ratchet
 - b. Lubricants
 - 4. Use of gauges and signals
 - 5. Heavy tube sheets
 - 6. Entering and connecting baffles
 - 7. Testing
 - a. Visual
 - b. Water (use of hydrostatic pump)
 - c. Air
 - d. Use of gauges
- V. Use of Blueprint and layout **400**
- A. Use of prints to designate the following:
 - 1. Locating parts at unloading
 - 2. Moving parts to job location
 - 3. Parts to be hoisted into position
 - 4. Use of bench mark
 - 5. Symbols

B.	Layout	
1.	Use of precision measuring devices	
2.	Marking for correction, re-cutting and fitting	
3.	Directing, cutting, and fitting of parts	
4.	Geometric measuring of parts, tube holes, etc.	
5.	Working with foreman	
VI.	Welding and Cutting	3000
A.	Any and all forms of electric welding	
1.	Proper adjustment of machines	
2.	Application and use of electrodes on all metals, ferrous and non-ferrous	
3.	Metal Spraying and hard facing	
B.	Acetylene	
1.	Proper adjustment, gauges and torch	
2.	Selection of tips	
3.	Handling of torch and application	
a.	Ferrous and non-ferrous metals	
C.	Cutting	
1.	Acetylene	
2.	Arc (cutting and gouging)	
3.	Machine Methods	
4.	Adjusting and operating of equipment	
a.	Ferrous	
b.	Non-ferrous	
VII.	Nuclear Plant Construction – Reactors	100
A.	Theory - Types	
1.	Power	
2.	Propulsion	
3.	Heating	
B.	Research	
C.	Problems peculiar to Atomic Energy	
1.	Those elements which would not be covered in other sections, i.e., radiation, radiation protection,	
2.	Requirements for joints of high integrity	
	TOTAL HOURS	6,000

**RELATED INSTRUCTION OUTLINE
BOILERMAKER
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The following is the related instruction that apprentices receiving training will be expected to successfully complete. A minimum of 576 hours is required during the program.

CURRICULUM SOURCE TEXT REFERENCE:

Text prepared by the Boilermakers National Apprenticeship Program Kansas City, Kansas

		<u>Total Hours</u>
<u>YEAR 1 - 144 HOURS</u>		144
I.	Rigging and Boilermaker Safety - Lesson 1-1	
	A. Protective Clothing	
	B. Safety with Lifting Equipment	
	C. Safety with Ladders and Staging	
	D. Safety with Tools	
	E. Fire Prevention and Control	
II.	Applied Math I - Lesson 1-2	
	A. The Language of Math	
	B. Counting	
	C. Place Value	
	D. Addition and Subtraction	
	E. Multiplication and Division	
	F. Multiples and Factors	
	G. Negative Factors	
	H. Other Number Concepts	
	I. Operating with Signed Numbers	
	J. Axioms and Laws	
III.	Applied Math II - Lesson 1-3	
	A. Fractions	
	B. Types of Fractions	
	C. Operations with Fractions	
	D. Decimal Fractions	
	E. Equivalent Decimals	
	F. Operation with Decimals	
IV.	Applied Math III - Lesson 1-4	
	A. Proportion	
	B. Percentage	
	C. Changing a Percent to a Decimal	
	D. The Three Percentage Cases	
	E. Fractional Percents	

- F. Calculating with Approximate Numbers
 - G. Prime Numbers
 - H. Exponents and Radicals
- V. Applied Math IV - Lesson 1-5
- A. Basics of Algebra
 - B. Multiplication
 - C. Division
 - D. Basics of Plane Geometry
 - E. Basics of Solid Geometry
 - F. Triangulation (Trigonometry)
- VI. Applied Math V - Lesson 1-6
- A. Measuring
 - B. Review of Decimals
 - C. Angular Measurements
 - D. Formulas and Equations in Review
 - E. Signs of Operations
 - F. Graphs
 - G. Math Aids
- VII. Applied Metric Math - Lesson 1-7
- A. Metrics (SI) in the United States
 - B. Advantages of Metrics
 - C. Metric (SI) Conversions
 - D. Metrics (SI) in Shop or Field
 - E. Metrics for the Boilermaker/Welder
 - F. The Transition Period and the Future of Metrics
- VIII. Rigging: Basic Principles - Lesson 1-8
- A. Basic Rigging Concepts
 - B. Simple Tools
- IX. Rigging: Ropes - Lesson 1-9
- A. Wire Rope
 - B. Fiber Rope
 - C. Chains
- X. Rigging: Tools - Lesson 1-10
- A. Slings
 - B. Rigging Hardware
 - C. Reeving
 - D. Hoists and Winches
 - E. Skids, Rollers, Jacks and Cribbing
 - F. Ladders and Scaffolding
- XI. Rigging: Cranes and Other Lifting Equipment - Lesson 1-11
- A. Mobile Cranes
 - B. Tower Cranes
 - C. Monorails and Underhung Cranes
 - D. Derricks

- E. Hoists
 - F. Overhead Cranes
 - G. Helicopter Cranes
- XII. Rigging: Equalizing and Distributing Loads - Lesson 1-12
- A. Distributing Weight to the Rigging
 - B. Basic Methods of Equalizing and Distributing Loads
 - C. Strength and Stability During Operation

YEAR 2 - 144 HOURS

- I. Mechanical Drawing: Tools and Lettering - Lesson 2-1
- A. Equipment
 - B. Drafting Materials
 - C. Basic Techniques of Drafting
 - D. Lettering
 - E. Styles of Lettering
 - F. Characteristics of Good Lettering
 - G. Tools of Lettering
- II. Mechanical Drawing: Geometric Construction - Lesson 2-2
- A. Methods of Bisecting a Straight Line
 - B. Bisecting an Arc
 - C. Drawing Perpendicular Lines
 - D. Drawing a Line Parallel to Another Given Line
 - E. Methods of Dividing a Line into Equal Parts
 - F. Drawing and Bisecting an Angle
 - G. Trisecting an Acute Angle
 - H. Finding the Center of a Circle
 - I. Bisecting an Angle with an Inaccessible Vertex
 - J. Constructing a Triangle Given Its Three Sides
 - K. Polygon Construction Tangency
 - L. Constructing Tangent Lines and Arcs
 - M. Geometric Solids
- III. Mechanical Drawing: Orthographic - Lesson 2-3
- A. Theory of Projection and Drawings
 - B. Theory of Orthographic Projection
 - C. Multi-View Line Projection
 - D. Surface Projection
 - E. Line Description
 - F. Orthographic Drawing Techniques
 - G. Projecting the Views on Paper
 - H. Sections
 - I. Reading Orthographic Drawings
 - J. Conventional Procedures on Orthographic Drawings
 - K. Accepted Violations of True Projection
 - L. Treatment of Unimportant Intersections
 - M. Aligned Views
 - N. Conventional Procedure for Radially Arranged Features
 - O. Representations of Fillets and Rounds

- P. Conventional Breaks
 - Q. Conventional Method of Alternative Positions
 - R. Conventional Representation
 - S. The Orthographic Drawing Plate
- IV. Mechanical Drawing: Isometric and Oblique - Lesson 2-4
- A. Pictorial Drawing
 - B. Isometric Projection
 - C. Isometric Drawing
 - D. Oblique Projection
 - E. Oblique Drawings
- V. Mechanical Drawing: Dimensioning - Lesson 2-5
- A. Theory of Dimensioning
 - B. The Language of Dimensioning
 - C. Units of Measurement Used in Dimensioning
 - D. Standard Dimensioning Practices
 - E. Dimensioning Application
 - F. Dimensioning Special Views
 - G. Limit Dimensioning
 - H. Welding Symbols
- VI. Mechanical Drawing: Field Sketching - Lesson 2-6
- A. Sketching Materials
 - B. Sketching Guidelines
 - C. Beginning Line Exercises
 - D. Multi view Orthographic Sketches
 - E. Orthographic Projection for Sketching
 - F. Pictorial Sketching
 - G. Oblique Sketches
 - H. Perspective Sketching
- VII. Layout Procedures and Techniques - Lesson 2-7
- A. Hammers, Sledges, and Mauls
 - B. Struck or Hammered Tools
 - C. Cutting Hand Tools
 - D. Taps and Dies
 - E. Screwdrivers
 - F. Holding Tools
 - G. Miscellaneous Hand Tools
- VIII. Boilermaker Hand Tools - Lesson 2-8
- A. Layout Tools
 - B. Layout Work
- IX. Boilermaker Power Tools - Lesson 2-9
- A. Electric Powered Tools
 - B. Air (Pneumatic Tools)
 - C. Tube Tools and Their Functions

- X. Construction Materials I - Lesson 2-10
 - A. Basic Construction Material
 - B. Metal Production
 - C. Metal - Processing Methods

- XI. Construction Materials II - Lesson 2-11
 - A. Mechanical Properties
 - B. Chemical Properties of Metals
 - C. Physical Properties of Metals
 - D. Fiberglass Reinforced Plastics

- XII. Blueprint Reading: Structural - Lesson 2-12
 - A. Structural Steel
 - B. Structural Drawings
 - C. Drawing Structural Steel Shapes
 - D. Connectors
 - E. Connections

YEAR 3 - 144 HOURS

- I. Boiler Systems and Components I - Lesson 3-1
 - A. The Boiler
 - B. Fire Tube Boilers
 - C. Water Tube Boilers
 - D. Water Tube Boiler Components
 - E. Fuels and Fuel Burning Systems

- II. Boiler Systems and Components II - Lesson 3-2
 - A. Boiler Circulation
 - B. Shop Assembled Boilers
 - C. Systems for the Pulp and Paper Industry
 - D. By Product Fueled Boilers
 - E. Waste Heat Boilers

- III. Nuclear Power - Lesson 3-3
 - A. The Principles of Nuclear Energy
 - B. Nuclear Fuels
 - C. Nuclear Reactors
 - D. Health Physics and Radiation Protection

- IV. Tanks, Vessels, and Other Components - Lesson 3-4
 - A. Field Erected Storage Tanks
 - B. Basic Construction Techniques
 - C. Stacks and Liners

- V. Blueprint Reading: Boilermaker - Lesson 3-5
 - A. Erection Plans
 - B. How Blueprints are Made

- VI. Boiler: Installation - Lesson 3-6
 - A. Field Inspection
 - B. Shop Fabrication
 - C. Site Preparation
 - D. Erecting Structural Steel Supports
 - E. Installing the Steam Drum
 - F. Installing Upper Headers
 - G. Installing Down comers
 - H. Installing Superheater and Reheater Modules
 - I. Installing Waterwalls
 - J. Installing the Windbox
 - K. Installing the Suction-Manifold
 - L. Installing the Preheater and Economizer
 - M. Installing Ductwork
 - N. Installing the Lower Waterwalls
 - O. Additional Construction
 - P. Preparing the Boiler for Testing
 - Q. Cleanliness of Boiler Components
 - R. Hydrostatic Testing
 - S. Installing Insulation and Casing

- VII. Boiler: Repair and Maintenance - Lesson 3-7
 - A. Repairs
 - B. Alterations
 - C. Fiberglass Reinforced Plastics

- VIII. Welding and Cutting: Basic - Lesson 3-8
 - A. Weldable Metals
 - B. The Welding Processes
 - C. Oxyfuel Gas Welding
 - D. Arc Welding
 - E. Resistance Welding
 - F. Thermit Welding
 - G. Brazing and Braze Welding
 - H. Soldering
 - I. Electron Beam Welding
 - J. Laser Beam Welding
 - K. Cutting Processes
 - L. Welded Joint Design
 - M. Types of Welds
 - N. Welding Position
 - O. Welders and Welding Operators

- IX. Welding and Cutting: Blueprint Reading - Lesson 3-9
 - A. Welding Symbols
 - B. Nonpreferred Symbols
 - C. Nondestructive Testing Symbols

- X. Welding and Cutting: Safety - Lesson 3-10
 - A. General Welding and Cutting Safety
 - B. The Welding Environment

- C. Fire Prevention and Protection
 - D. Tool and Equipment Usage
 - E. Other Safety Considerations
 - F. Safety in Welding and Cutting Processes
 - G. Gases Used in Arc Processes
 - H. First Aid
- XI. Metallurgy: Welding - Lesson 3-11
- A. Fundamentals of Metallurgy
 - B. Structure of Metal
 - C. Metallurgy and Heat Treating
 - D. Metallurgy of the Welded Metal
 - E. Welding Stresses, Warpage, Distorting, and Cracks
- XII. Metallurgy: Weldability of Metals - Lesson 3-12
- A. Classifying Code Systems for Metals
 - B. Identification of Metals
 - C. Filler Materials
 - D. Welding Characteristics of Metals and Alloys

YEAR 4 - 144 HOURS

- I. Arc Welding: Equipment - Lesson 4-1
- A. Power Sources
 - B. Arc Welding Consumables
- II. Arc Welding: Shielded Metal I - Lesson 4-2
- A. Shielded Metal Arc Welding Procedure
 - B. Weld Joints
- III. Arc Welding: Shielded Metal II - Lesson 4-3
- A. Heat Effects in Shielded Metal Arc Welding
 - B. Shielded Metal Arc Welding of Ferrous Metals
 - C. Shielded Metal Arc Welding of Nonferrous Metals
 - D. Troubleshooting when Welding with the SMAW Process
- IV. Arc Welding: Gas Tungsten (TIG) - Lesson 4-4
- A. Gas Tungsten Arc Welding Techniques
 - B. Metals and Gas Tungsten Arc Welding
- V. Arc Welding: Gas Metal (Metal Inert Gas) - Lesson 4-5
- A. Process Variations-Metal Transfer
 - B. Gas Metal Arc Welding Equipment
 - C. Consumables Used in Gas Metal Arc Welding
 - D. GMAW Process Variables
 - E. Weld Bead Characteristics
 - F. Welding Procedures
 - G. Welding Conditions
 - H. MIG Weld Defects - Their Causes and How to Correct Them
 - I. MIG Spot Welding
 - J. Vapor Shielded Arc Welding

- VI. Arc Welding: Other Processes - Lesson 4-6
 - A. Submerged Arc Welding
 - B. Flux Cored Arc Welding
 - C. Plasma Arc Welding

- VII. Cutting: Oxyfuel I - Lesson 4-7
 - A. Equipment and Supplies
 - B. Manual Cutting Procedures
 - C. Cutting in Steel Plate
 - D. Machine Torch Cutting

- VIII. Cutting: Oxyfuel II - Lesson 4-8
 - A. Quality of Cutting
 - B. Miscellaneous Uses of the Oxyfuel Gas Flames
 - C. Oxyfuel Gas Welding

- IX. Cutting: Arc -Lesson 4-9
 - A. Air Carbon Arc Cutting (AAC)
 - B. Carbon Arc Cutting (CAC)
 - C. Oxygen Arc Cutting (OAC)
 - D. Plasma Arc Cutting (PAC)
 - E. Metal Arc Cutting (MAC)

- X. Welding: Special Applications and Techniques - Lesson 4-10
 - A. Stud Welding
 - B. Tube and Pipe Welding
 - C. Field Erection of Pressure Vessels and Boilers
 - D. Field-Welded Storage Tanks
 - E. One-Side Welding
 - F. Underwater Welding and Cutting
 - G. Weld Repair and Surfacing

- XI. Welding: Design, Testing, and Inspection - Lesson 4-11
 - A. The Design of Welded Joints
 - B. Testing

- XII. Welding: Performance Qualifications - Lesson 4-12
 - Codes and Specifications