Apprenticeship Manitoba

Manitoba

Boilermaker
Level 3

Rev. Dec/16

Apprenticeship Manitoba

Boilermaker

Unit: **A6 Orientation II: Journeywork**

Level: Three

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

Boilermaker technical training offers an entry-level orientation to the challenges of apprenticeship learning. The present unit introduces senior apprentices to the responsibilities of workplace *teaching* that they will assume as supervising journeypersons. Tradeworkers have a particularly rich tradition of refreshing and sharing their skills from one generation of practitioners to the next. This unit orients senior apprentices to some of the practical and conceptual tools that can enable them to contribute to this trade heritage when they themselves become certified journeypersons. The journeyperson's obligation to assist trade learners to develop skills and knowledge is complex and challenging. It involves safety considerations, employer expectations, provincial regulations, as well as the tradition of skills stewardship that links modern practice with the long history of workplace teaching and learning that defines the apprenticeable trades. The ability to offer timely, appropriate support to apprentices is itself an important area of trade learning. This unit presents material intended to help refine this ability through reflection and discussion by senior apprentices, and dialogue with their instructor. The detailed descriptors under each unit objective reflect Manitoba and Canadian standards prescribed for journey-level supervisory capabilities, as well as key topics in current research on the importance of workplace teaching and learning in trades-apprenticeship systems. Thus, descriptors represent suggested focal points or guidelines for potentially worthwhile exploration. Delivery of this content will vary with the discretion of individual instructors, and with the experiences senior apprentices bring forward for group/individual reflection on the skills-stewardship dimension of their own future practice as journeypersons.

Objectives and Content: **Percent of Unit Mark (%)**

1. Describe the scope, substance, and significance of journey-level status. **10%**

a. Historical background, including trainee experiences
- Origin, definition, and examples of journey-level status
- Obligations to employers, trade clients, and apprentices
- Concept of skills stewardship, and its rationale
- Customary responsibilities of journeyperson as workplace trainer/supervisor
- Overview development of formal systems for regulating/recognizing journey-level competence in designated apprenticeable trades
- Contributions of 'unticketed journeymen' and other informally-qualified Boilermakers to workplace trade-learning
- Achievements/limitations of informal systems for workplace training
- Trends (e.g., succession planning in the trades; recognition of credentials and prior learning; defined standards for on-the-job trades education and training)

b. Regulatory/legal dimensions of journey-level status in designated trades
   - Manitoba provincial requirements [e.g., *Apprenticeship and Certification Act; General Regulation*; the *Boilermaker Trade Regulation*; relevant policies of the Apprenticeship and Certification Board]
   - Trade-specific requirements re: practical training supervision and documentation; importance of quality assurance and broad-scope coverage of prescribed task-content; ratios, etc.

c. Other (as may be specified by instructor)

2. Compare/contrast role-options and responsibilities of the supervising journeyperson. **20%**

a. Recognizing the variability of supervision assignments, situations, and roles
b. Source and specification of the supervision assignment
c. Formal vs. informal roles (e.g., mandated by an employer's succession plan)
d. Implicit vs. explicit standards and content: training goals are/are not codified; assessment measures are/are not used,
e. Accountability for results: subject/not subject to third-party notification; completion of supervision assignment itself is/is not assessed by third party; journeyperson is/is not required to prepare performance evaluation that could affect apprentice's employability or wage-rate, etc.
f. General vs. task- or job-specific supervision assignments: e.g., scope of expectations re: content of supervisory task(s)
g. Long-term vs. short-run supervision assignments – e.g., considerable latitude/little latitude for apprentice to learn from mistakes
h. Formally vs. informally structured – e.g., supervision assignment is part of a prescribed cycle of assignments involving coordination among multiple journeypersons; apprentice is trained according to an individual training plan negotiated with employer
i. Typology of common supervisory role-options and what is implied by each:
   - Coach role: is often initiated by someone other than apprentice, and limited to a particular skill set, task, or production requirement
   - Mentor role : often initiated by apprentice, and relatively open-ended regarding content, duration, etc.
   - Peer role: typically involves individual upgrading or cross-training of one journeyperson by another; can include senior apprentice assisting less-experienced trade learner
   - Managerial role(s): can shade over into hire/fire issues as lead-hand or site-boss
   - Coordinator role: often a senior-level journeyperson appointed by an organization to assume responsibilities for monitoring progression of groups of apprentices
   - Other roles: may be improvised by journeyperson
j. Possibilities, perils, and likelihood of role-overlap in 'real-life' trade practice
k. Importance of clarifying all roles, expectations, and implications involved in accepting a supervision assignment
l. Role of Apprenticeship Training Coordinator (ATC), Apprenticeship Manitoba
m Resources for developing skills and knowledge re: providing journey-level supervision
   - Books and journals (not always trade-specific)
   - Websites
   - Conversation with trade instructors, journeypersons, and peers
   - Workshops
n. Other (as may be specified by instructor

3. Describe/demonstrate common requirements re: providing journey-level supervision. **20%**

a. Review Unit content re: challenges/opportunities opportunities of Apprenticeship learning adapted to journey-level supervision assignments and a journey-level standpoint
   - Application of adult education concepts to trades teaching/learning (e.g., responsibilities and expectations of adult learners)
   - Practical significance of 'styles' of adult learning and teaching
   - Helping apprentices to integrate technical training (in school) and practical training (on-the-job) learning experiences
   - Providing help and guidance re: new tasks and skills
   - Providing help and guidance re: fixing mistakes
   - Learning/teaching "the ropes" – socialization of learner within a community of trade practice (e.g., how to borrow a tool, interrupt a journeyperson, 'recruit' an advisor)
   - Coverage/documentation of prescribed tasks and subtasks (Boilermaker NOA), including responsibility re: logbook sign-off (where applicable)
   - Consultation with Apprenticeship Training Coordinator (ATC), Apprenticeship Manitoba
   - Communicating with apprentices and employers about supervision assignments and assignment specifications, including the limits of the trainers' own responsibilities and competence (e.g., substance-abuse intervention)
   - Benefits of maintaining a personal record of achievements, ideas, and needs as a workplace trainer

b. Individual reflection and guided group discussion re: personal experiences of workplace learning as an apprentice
   - Identification of best and worst practices of supervising journeypersons
   - Assessment of personal experiences (if any) to date in supervising, coaching, or guiding other people to learn or improve their skills (e.g., entry-level apprentices, members of athletic team, younger family members, etc.), and how this might compare/contrast with the journey-level support of apprenticeship learning
   - Identification of workplace and other factors that can contribute to good and bad trades teaching/learning experiences
   - Development of personal standards re: responsibility to share one's knowledge and skill with others in the workplace (e.g., use/misuse of humour, rigour, discretion, craft-pride, etc.)

c. Comparison/contrast of discussion results with current knowledge/resources re: workplace skills coaching methods as applicable to journey-level supervision assignments
   - Qualities of a good workplace coach
   - Components of workplace skills coaching
   - Processes and recommended practices re: workplace coaching
   - Troubleshooting problems re: supervision assignments

d. Other (as may be specified by instructor)

4. Complete Modules 1 to 3, *Workplace Coaching Skills* (Burnaby, BC: 1995), ISBN 1-55139-030-2. (or equivalent). **25%**

a. Identifying purpose of the lesson
   - Explaining the point of the lesson
   - Role of the coach in specific coaching situation
   - Other (specified by instructor)

b. Linking the lesson
   - Learner needs

- Lesson sequence
- Focus on learner
- Selection/timing of coaching opportunities

c. Demonstration of skill/task to be learned
- Starting the coaching session
- Demonstration
- Hands-on trial
- Recap for learner

5. Complete Modules 4 to 6, *Workplace Coaching Skills* (or equivalent). 25%

a. Practice of skill/task to be learned
- Nature and importance of practice
- Setting up for learner practice
- Types of practice
- Recycling and reinforcing skill/task learning

b. Providing feedback to the learner
- Value of feedback
- Kinds of feedback
- Guidelines and tips

c. Assessment
- Value of assessing learner progress
- Assessing level of skill
- Planning further steps toward skill/task mastery

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Apprenticeship Manitoba

Boilermaker

Unit: A7 Pre-IP Examination Review

Level: Four
Duration: 11 hours
Theory: 11 hours
Practical: 0 hours

Overview:

This unit offers senior Boilermaker apprentices a systematic review of skills and knowledge required to pass the Inter-Provincial Examination. It promotes a purposeful personal synthesis between on-the-job learning and the content of in-school technical training. The unit includes information about the significance of Inter-Provincial certification and the features of the Inter-Provincial Examination. ***Note: No percentage-weightings for test purposes are prescribed for this unit's objectives. Instead, a 'Pass/Fail" grade will be recorded for the unit in its entirety.***

Objectives and Content:	**Percent of Unit Mark (%)**

1. Describe the significance, format and general content of Inter-Provincial Examinations for the trade of Boilermaker. — **n/a**

a. Scope and aims of certification; value of certifications
b. Obligations of candidates for Inter-Provincial certification
   - Relevance of Inter-Provincial Examinations to current, accepted trade practices; industry-based provincial validation of test items
   - Supplemental Policy (retesting)
   - Confidentiality of examination content
c. Multiple-choice format (four-option) item format, Apprenticeship Manitoba standards for acceptable test items
d. Government materials relevant to the Certification Examinations for apprentice Boilermaker
   - Inter-Provincial Occupational Analysis (NOA); prescribed scope of the skills and knowledge which comprise the trade
   - NOA "Pie-chart" and its relationship to content distribution of Inter-Provincial Examination items
   - Apprenticeship Manitoba technical training package.

2. Identify resources, strategies and other considerations for maximizing successful completion of written examinations. — **n/a**

a. Personal preparedness
   - Rest
   - Nutrition

- Personal study regimen
- Prior experience in test situations (e.g., Unit Tests)

c. Self-assessment, consultation and personal study plan
   - Self-assessment of individual strengths/weaknesses in trade related skills and knowledge
   - Approved textbooks
   - Study groups

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Apprenticeship Manitoba

Boilermaker

Unit: **A8 Business Practices**

Level: Three

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

This unit presents information on how to apply worksite business practices.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify the purpose of the following general work related documents. a. Invoices. b. Work orders. c. Purchase orders. d. Shipping and receiving slips. e. Requisition orders. f. Time keeping and payroll, cheques. g. Project progress reports.	**10%**
2. Demonstrate coaching and mentoring skills.	**10%**
3. Demonstrate effective listening and speaking skills.	**10%**
4. Plant tours (choice of some of the following): a. Steel fabrication shops (vessel and structural) b. Rolling mills (available types). c. Operational job sites (with permitting authority). d. Foundries (when and where time permits).	**10%**
5. Guest speakers: a. Unions. b. Management. c. Apprenticeship and trade certification. d. Industry representatives.	**10%**
6. Define the role and mission of the labour union organization.	**10%**

7.	**Describe various industry work environments.**	**10%**
8.	**Orientation to the Red Seal National Occupational Analysis.**	**10%**
9.	**Demonstrate respect in the workplace.**	**10%**
10.	**Identify the value of diversity in the workplace.**	**10%**

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Apprenticeship Manitoba

Boilermaker

Unit: **B7 Advanced Block and Tackle**

Level: Three

Duration: 12 hours

Theory: 12 hours

Practical: 0 hours

Overview:

This unit presents information on block and tackle systems. The safety subject matter taught in this section must also be stressed in the appropriate sections throughout the Boilermaker training program. Reference should be made to OH & S when applicable.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Determine the lead line pull when the number of parts and load weight including rope size are known.	**25%**
2. Identify the factors that determine the amount of wire rope needed for a reeving system.	**25%**
3. Name types of shaves, friction bearings and the coefficient of friction expressed in percent.	**25%**
4. Demonstrate the ability to raise and lower a load using a reeved system.	**25%**

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Apprenticeship Manitoba

Boilermaker

Unit: **B8 Advanced Cranes**

Level: Three

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

This unit presents information on cranes and signals. The safety subject matter taught in this section must also be stressed in the appropriate sections throughout the Boilermaker training program. Reference should be made to OH & S when applicable.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Demonstrate or describe the following items related to cranes: a. General uses. b. Use of tables/load charts. c. Load radius. d. Boom deflection and pendant line stretch. e. Net and gross loads. f. Static and dynamic loads. g. Signals. h. Components. i. Breakdown for transportation. j. Safety precautions.	**25%**
2. Determine the basic procedures for the crane boom assembly, installation, removal and disassembly.	**20%**
3. Determine the positioning of all pins at boom assembly.	**10%**
4. Describe and determine load reduction when jib is fitted on the boom.	**10%**
5. Determine in degrees the jib offset allowance in reference to the centerline.	**10%**
6. Describe the implications when a crane is out of level.	**15%**
7. Identify high capacity cranes and new technologies.	**10%**

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Apprenticeship Manitoba

Boilermaker

Unit: **B9 Hoisting and Jacking Equipment and Engineered Lifts**

Level: Three

Duration: 13 hours

Theory: 13 hours

Practical: 0 hours

Overview:

This unit presents information on hoisting and jacking equipment. This unit also presents information on the ability to interpret engineered lift drawings. This unit emphasizes the application of safe work practices and procedures when working with hoisting and jacking equipment.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe the safe use of hoisting and jacking equipment.	**7%**
2. Explain load stress and precautions in the use of high lines.	**7%**
3. Perform rigging, hoisting and jacking operations in a safe and responsible manner.	**7%**
4. Rig loads safely and correctly for: a. Straight lifts. b. Drifting. c. Turning.	**16%**
5. Determine the location and anchorage points required for tuggers.	**7%**
6. Identify the air system requirements for tuggers.	**7%**
7. Describe the placement of blocks in a tugger hoisting system.	**7%**
8. Demonstrate the ability to perform a walk around inspection in a tugger system.	**7%**
9. Identify different jacking systems. a. Hydraulic.	**7%**

b. Mechanical.
c. Air bags.
d. New technologies.

10. Describe and/or demonstrate the use of skates, rollers and cribbing. 7%

11. Demonstrate the ability to interpret engineered lift drawings. 7%

12. Identify the requirements and regulations for a critical lift. 7%

13. List the topics discussed in prelift / postlift meetings. 7%

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Apprenticeship Manitoba

Boilermaker

Unit: **C7 Drawing Interpretation Two**

Level: Three

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

This unit presents information on drawing interpretation.

Objectives and Content: **Percent of Unit Mark (%)**

1. Interpret fabrication and erection drawings for the following: **100%**

a. Vessels.
b. Tanks.
c. Boilers.
d. Structural steel.
e. Heat exchanges.
f. Precipitators.
g. Duct work.
h. Other heavy industry components.

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Apprenticeship Manitoba

Boilermaker

Unit:	**C8 Layout**		
Level:	Three		
Duration:	30 hours		
	Theory:	0	hours
	Practical:	30	hours

Overview:

This unit presents information on how to perform advanced layout.

Percent of
Objectives and Content:

Unit Mark (%)

1. **Interpret drawings to layout and fabricate square, round and elliptical h**

2. **Demonstrate the ability to develop and utilize a template using geometr lines, radial lines and triangulation.**

3. **Demonstrate the ability to develop a template for various objects made using the triangulation method:**
   a. Oblique pyramid.
   b. Oblique cone.
   c. Square to round transition.
   d. Round to square transition.
   e. Round to rotated square transition.
   f. Square to round oblique transition.

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Apprenticeship Manitoba

Boilermaker

Unit: **E12 Inspection/Testing of Materials**

Level: Three

Duration: 20 hours

Theory: 20 hours

Practical: 0 hours

Overview:

This unit presents information on drawing interpretation.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Differentiate between destructive (DT) and non-destructive testing (NDT) of material.	**7%**
2. Describe the following types of destructive testing: a. Tensile test. b. Impact test.	**7%**
3. Describe the guided bend test used in weld testing.	**7%**
4. Describe the following types of non-destructive testing: a. Visual. b. Magnetic particle. c. Radiographic. d. Ultrasonic. e. Dye penetrate. f. Hydrostatic. g. Vacuum and air	**7%**
5. Perform a dye penetrate test on defective materials.	**7%**
6. Perform magnetic particle testing on defective materials.	**7%**
7. Describe applications and limitations of vacuum and air testing.	**7%**
8. Perform visual inspection on a welded specimen and summarize the results.	**7%**

9. Inspect and interpret material and welds with reference to: **9%**

a. Soundness, size and shape.
b. Plate thickness and prescribe quality of material.
c. Positions of circumferential and longitudinal seams.
d. Heads, their opening and reinforcement.
e. Skirt, diameters and minimum thickness.
f. Base rings and anchor bolt chairs.
g. Saddles.
h. Shell openings, limitations and reinforcement.
i. Fixed and removable internals.
j. Internal/external piping and flanges.
k. Ladders, platform and lugs.
l. All fabrication tolerances.

10. Identify the characteristics of acceptable quality of components and parts based on: **7%**

a. Code specifications.
b. Drawing requirements.
c. General usage.

11. List the factors contingent to production flow in fabrication and assembly of pressure vessels. **7%**

12. List three stages of product quality control systems: **7%**

a. Incoming inspection.
b. In-process inspection.
c. Final inspection.

13. Describe methods that can be used to improve production and productivity of fabrication processes. **7%**

14. Describe the preparation for shipment of a final product with respect to the following components: **7%**

a. Finished inside and outside surfaces.
b. Flanged openings.
c. Threaded openings.
d. Bolts and nuts.
e. Small pats and loose internals.
f. Loading and securing the vessel.
g. Markings and special instructions.

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Apprenticeship Manitoba

Boilermaker

Unit: **E13 Fitting**

Level: Three

Duration: 30 hours

Theory:	30	hours
Practical:	0	hours

Overview:

This unit presents information on describing and performing advanced layout and fitting techniques.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe and/or demonstrate the layout and fit up of the following: a. Circumferential seams. b. Longitudinal seams. c. Shells of equal thickness. d. Shells of unequal thickness. e. Shells to heads. f. Reinforcing pads to nozzle and shell. g. Repads to heads. h. Nozzles, couplings and structural components to the shell and head. i. Vessel base ring and skirt openings. j. Absorbing tower trays and downcomers.	**40%**
2. Describe how to fabricate and assemble davit parts for vertical and horizontal openings including hinges.	**30%**
3. Describe how to install a tangential nozzle.	**30%**

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Apprenticeship Manitoba

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Unit: **E14 Trade Mathematics Three**

Level: Three

Duration: 20 hours

Theory: 20 hours

Practical: 0 hours

Overview:

This unit presents information on solving trade mathematical problems.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Calculate the surface of: a. Regular shaped solids, tanks and cylinders. b. Pyramids and cones c. Prisms and cylinders. d. Areas, radii, arc length, circumferences, central angles and diameters of circles. e. Altitudes and bases of common polygons. f. Circular sectors and segments. g. Common polygons, given bases and altitudes. h. More complex figures consisting of two or more common polygons.	**40%**
2. Calculate volume, capacity and weight of: a. Prisms and cylinders. b. Pyramids and cones. c. Spheres.	**20%**
3. Solve advanced linear measurement problems using the Imperial and Metric measurement systems: a. Calculate length. b. Calculate weights and capacities. c. Calculate area. d. Calculate volume. e. Perform practical application calculations using various units of measure. f. Calculate conversions from Imperial to Metric and visa versa.	**40%**

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Apprenticeship Manitoba

Boilermaker

Unit: **E 15 Advanced Metallurgy**

Level: Three
Duration: 10 hours
Theory: 10 hours
Practical: 0 hours

Overview:

This unit presents advanced information and knowledge of physical and mechanical properties of metal.

Objectives and Content:	**Percent of Unit Mark (%)**

Objectives and Content:		**Percent of Unit Mark (%)**
1.	**Explain the mechanical properties of plain carbon steel.**	**10%**
2.	**Describe the physical properties of plain carbon steel.**	**5%**
3.	**List the four basic types of carbon steel.**	**5%**
4.	**List the five groups of steel.**	**5%**
5.	**Describe how the amount of carbon in ferrous material determines whether a material is steel or cast iron.**	**5%**
6.	**Describe how low-alloy, high-tensile steels differ from low carbon steels.**	**5%**
7.	**Explain the main advantage of low-alloy steel.**	**5%**
8.	**Explain the significance of AISI steel numbers.**	**5%**
9.	**Explain the application of different types of steel for specific use.**	**5%**
10.	**Name the basic mechanic and physical properties of metals.**	**10%**
11.	**Describe the following metals:**	**5%**

a. White cast iron.
b. Gray cast iron.
c. Low carbon steel.
d. High carbon steel.
e. Chromium-nickel steel (stainless)
f. High manganese steel.
g. Copper.
h. Aluminum.

12. Explain how welding (heating) influence the internal structure of steel. 10%

13. Explain methods of preventing, controlling and correcting distortion. 15%

14. Describe the effect of carbon in its relationship to the weldability and flame cutting of steel. 5%

15. Explain heat straightening. 5%

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Apprenticeship Manitoba

Boilermaker

Unit: **F1 Boilers**

Level: Three

Duration: 30 hours

Theory: 20 hours

Practical: 10 hours

Overview:

This unit presents information on the basics of boilers and their components.

Objectives and Content: **Percent of Unit Mark (%)**

1. Describe erection and assembly procedures for the following Boiler components: 10%

a. Structure.
b. Drums.
c. Headers.
d. Tubes.
e. Platens.
f. Buck stays.
g. Casing.
h. Fire door.
i. Super heater elements.
j. Economizer.
k. Air heater.
l. deaerator.
m. Water treatment.

2. Describe the working operation of water tube boilers: 5%

a. Sub-critical
b. Super critical

3. Identify and describe boiler tube installation procedures for the following: 10%

a. Preparation of tube sheets.
b. Tube sizes.
c. Tube material.
d. Expanding limits.
e. Fit up of tube.
f. Tube bending.
g. Seal welding.

h. Tack tubes.
i. Self feed expander.
j. Retractive expander.
k. Lubrication.
l. Mandrels.
m. Over rolling.
n. Under rolling.
o. Micrometers and gauges.
p. Belling
q. Ferrules.
r. Repairing leaks
s. Testing.

4. Identify the following steam generator components and state their function, material grade, and any special features: **10%**

a. Drums and headers.
b. Platen and buckstays.
c. Super heater and reheater.
d. Economizer and air heater.
e. Deaerator.
f. Air ducts.
g. Stacks and breaching.
h. Condenser.
i. Fans, I.D. and F.D.
j. Intake and discharge lines.
k. Precipitators.
l. Wet and dry electrostatic precipitators.
m. Stokers.
n. Burners.
o. Bag houses.
p. Scrubbers.
q. Selective catayalic reducers.
r. Air-cooled condensers (ACC).
s. Testing and codes.
t. Flue gas desulphurization units (FGD)

5. Describe the function of tubes in various arrangements: **2%**

a. Bifurcated.
b. Swaged.
c. Bending.

6. Identify the two basic methods used to fabricate tubes. **2%**

7. Determine the tube bending procedures with reference to: **2%**

a. Long radius bends.
b. Short radius bends.
c. Very short radius bends (super heater section).
d. Using field type equipment.

8. List methods of tube attachments. 5%

9. Describe basic procedures for watertube boiler tube installation including the preparation and cleaning process. 5%

10. Explain the principle of tube expansion including the theory involving the flow of tube material. 5%

11. Describe tube expanding procedures stating the upper and lower limitations of rolling. 3%

12. List tube expanding checking and measuring devices used. 3%

13. Define the purpose of tack tubes. 3%

14. Identify the following tube expansion practices: 5%

a. Expanded and beaded.
b. Beaded and seal welded.
c. Expanded and welded.
d. Expanded and bevel welded.
e. Expanded and flared.
f. Prosser method.
g. Expanded with ferrules.

15. Set-up and perform tube rolling operations. 10%

16. Set-up and perform tube bending operations. 0%

17. Set-up and perform tube installations and tube removals. 10%

18. Describe and/or perform procedures for tube repair(s): 10%

a. Knowledge of Boiler code and local regulations.
b. Identify tubes(s) to be repaired.
c. Mark tubes(s) for cutting.
d. Cut out tube(s).
e. Prevent tube blockage.
f. Prepare existing tube ends.
g. Prepare replacement tube(s).
h. Fit and tack replacement tube (tubes).
i. Variation of tube repair.
j. Window weld.
k. Appropriate preparation for different wall thickness.

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Apprenticeship Manitoba

Boilermaker

Unit: **F2 Condensers and Exchangers**

Level: Three

Duration: 30 hours

Theory: 30 hours

Practical: 0 hours

Overview:

This unit presents information on condensers and exchangers. This unit should be complemented by erection and maintenance practice, where suitable shop equipment and time will permit.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify and describe different types of exchangers as listed below: a. Single pass. b. Multi pass. c. Split flow. d. Double split flow. e. Divided flow. f. Cross flow. g. Kettle type reboiler. h. Plate.	**5%**
2. Identify different designs of heat exchangers as classified by the T.E.M.A with reference to: a. Front stationary. b. Rear head. c. Types of material and job application. d. Material designation. e. Standard sizes and gauges. f. Tolerances. g. Fabrication and bending procedures.	**5%**
3. Explain the following terms which are associated with the tube hole arrangement: a. **Circumferential pitch.** b. **Ligament.** c. **Pitch.** d. **Removal space.** e. **Longitudinal pitch.** f. **Diagonal pitch.**	**3%**

4. Set-up and perform tube rolling. **3%**

5. Identify baffle and tubes with respect to: **3%**

a. Types of baffles, their function and installation procedures.
b. Four different tube sheet layouts and state their preference of application.
c. Pitch for a triangular tube sheet layout.
d. Various qualities of material for different applications.

6. Explain the following types of heads: **3%**

a. Channel and removable cover.
b. Bonnet.
c. Channel integral with tube sheet.
d. Pull through and floating head.
e. Outside packed floating head.

7. Describe tube expanding procedures for condensers and exchangers: **3%**

a. Tube sheet layout.
b. Number of tubes.
c. Types of metals.
d. Length of tubes.
e. Diameter of tube (O.D.)
f. Thickness of tubes.
g. Tube sheet or header thickness.
h. Expansion required.
i. Lubrication.

8. List the basic steps associated with tube installation. **3%**

9. State the recommended tube expansion sequences with reference to tube sheet layout, its area and shape. **3%**

10. Demonstrate the ability to measure the inside diameter of a tube. **3%**

11. Demonstrate the ability to calculate the expanded diameter of a tube. **3%**

12. Demonstrate the ability to determine the percentage wall reduction as recommended for ferrous and non-ferrous materials. **3%**

13. List recommended lubricants. **3%**

14. Identify the optimum length of expanded seat. **3%**

15. Explain the reason for grooved seats. **3%**

16. Identify the factors affecting the quality of an expanded joint with reference to: **3%**

a. Surface of hole.
b. Roundness of hole
c. Cleanliness of hole
d. Expansion past the inner edge of the tube sheet.
e. Overheating.

f. Roller speed.
g. Mechanical properties of tube and tube sheet.
h. Lubrication or lack of it.
i. Over expansion and indication of it.

17. Describe or demonstrate the ability to use the tube equipment listed: 3%

a. Tube guide.
b. Compressor.
c. Air motor.
d. Electric motor.
e. Tube end mills.
f. Tube expanders.
g. Fly cutters.
h. Tube cutters.
i. Tube cleaning.
j. Tube removal tools.
k. Micrometers and gauges.
l. Torque wrench.

18. Describe the operational relationship of the mandrel and rolls. 3%

19. State the purpose of bell roll(s). 3%

20. Identify the propulsive type of expander. 3%

21. Explain the principle involving explosive tube expansions. 3%

22. Perform tube expansions into tube sheet using air powered expander drives. 3%

23. Perform tube flaring using flaring tools. 3%

24. Describe the procedure to locate, remove, replace and test for defects when making repairs to exchangers. 3%

25. Inspect for tube leakage involving removal of: 3%

a. Cover or bonnet.
b. Shell cover and floating head.
c. Channel.

26. Describe hydrostatic test of shell using test ring (on types S & T). 3%

27. Remove the tube bundles, inspect and replace it. 3%

28. Assemble the heat exchanger and perform proper stud tightening procedures. 3%

29. Describe or demonstrate tube plug installation procedures. 3%

30. Identify plug material compatibility related to the tube. 3%

31. Identify the safety features associated with heat exchangers, testing inspections and repairs. 3%

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Apprenticeship Manitoba

Boilermaker

Unit: **F3 Tanks**

Level: Three

Duration: 30 hours

Theory:	30	hours
Practical:	0	hours

Overview:

This unit presents information on the knowledge of all tank components and erection and erection procedures. All tank components and erection practical will be performed where possible and if time permits. This unit will be complemented by the drawing interpretation unit.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe the differences of the following types of tanks. a. Vertical and horizontal (cylindrical). b. Closed top or open (vented). c. Include code question –OHI.	**6%**
2. Identify and describe the different types of materials used to fabricate tanks. a. Carbon steel b. Alloy steel. c. Nonferrous metals. d. Gauges and plates. e. Mesh and screen.	**4%**
3. Determine the plate standards used for shells and decks with reference to the API specification.	**3%**
4. Distinguish between the scope of A.P.I. 650 and / or A.P.I.620 standard and tank repair code A.P.I 651 or A.P.I.653.	**3%**
5. State the general condition of tank foundation and list negative effects encountered during erection due to uneven surfaces.	**3%**
6. Identify the typical horizontal, vertical and spherical type of tank settings.	**3%**

7.	**Describe or demonstrate the uses of balance beams, knee braces, key plates, clamps, dogs and wedges, hickey bars, leaf springs, finger bars and pins, wedges and dogs, clamps and nuts as used in tank construction.**	**6%**
8.	**Identify the difference between a flat (butt or lap) floor, orange peel floor and a hopper floor.**	**3%**
9.	**Describe the steps in laying out flat tank floor.**	**3%**
10.	**Demonstrate the ability to layout and fit up a typical flat bottom lap joint.**	**3%**
11.	**Describe the procedures involving minimum flat lap welding and flushing lapped. Plates.**	**3%**
12.	**Identify the type of welding and joint preparation for a tank bottom, shell and deck.**	**3%**
13.	**Identify the fit-up and welding sequence for vertical and horizontal seam.**	**3%**
14.	**Demonstrate the ability to prep, fit up and align tank horizontal and vertical seams.**	**3%**
15.	**Describe the layout procedure for key plate lugs on the shell plate sections.**	**3%**
16.	**Demonstrate the ability to layout shell plate with reference to the vertical seams staggering.**	**3%**
17.	**Demonstrate the ability to layout and erect typical tank scaffolding.**	**3%**
18.	**Demonstrate the ability to layout and erect the first shell ring.**	**3%**
19.	**Demonstrate the ability to erect and properly space the succeeding rings.**	**3%**
20.	**Demonstrate or describe the layout and fit up of the top angle.**	**3%**
21.	**Describe the following type of weld used on joining, roof to top angle, bottom to shell, shell to top angle.**	**3%**
22.	**Demonstrate or describe the layout and fit up a conical self-supported roof.**	**3%**
23.	**Describe the difference between a cone roof, hemispherical roof and a floating roof.**	**3%**
24.	**Explain the following terms associated with floating roofs:** a. Hard top floater. b. Pontoon floater. c. Double-deck floater.	**3%**
25.	**Describe the environmental and economic advantages of closed top tank design.**	**3%**
26.	**Describe the layout and fit up of shell, roof and bottom openings for a given:** a. Manway. b. Cleanout. c. Water or fluid drawoff elbow.	**3%**

d. Drawoff sump.
e. Inlet outlet.
f. Overflow venting.
g. Walkway, stairway and ladders.

27. Describe how to test tank bottom, shell and roof using one or two of the approved methods. **3%**

28. Define visual and surface weld inspection. **3%**

29. Differentiate inspection requirement for large and small tanks specified by the API.650 and API.620. **3%**

30. Describe cathodic protection. **3%**

31. Describe and/or demonstrate the complete tank erection procedures of the components listed: **3%**

Site preparation.
Floor
First shell ring.
Succeeding rings.
Top angle.
Roof supports.
Roof plates.
Ladders, stairways and platforms, etc.
Shell fittings.
Testing and repairs if required.

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Apprenticeship Manitoba

Boilermaker

Unit: **F4 Introduction to Other Heavy Industries**

Level: Three

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

This unit presents information on identifying and describing other heavy industry.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe the production of electricity by hydro generation.	**12%**
2. Identify the components in a hydro generating station.	**12%**
3. Identify the practices used in the erection of penstocks and surge tanks.	**12%**
4. Identify the function of all components needed for the erection of penstocks and surge tanks: a. Footings. b. Tie bars. c. Spiders. d. Tie straps.	**12%**
5. Describe nuclear generation.	**12%**
6. Identify the components in a nuclear generating station.	**12%**
7. **Identify special procedures used when working on nuclear plants and components.** a. Problems specific to nuclear plants. b. Material that cannot be used. c. Difference in metals. d. Quality control. e. Special materials. f. Radiation. g. Radiation hazards. h. Welding requirements. i. Expanding requirements.	**12%**

8.	**Describe the production of pulp and paper.**	**12%**
9.	**Identify the components in a pulp and paper mill.**	**2%**
10.	**Describe oil sand production.**	**1%**
11.	**Identify the components in oil sand production.**	**1%**

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