Skilled Trades Ontario | Métiers spécialisés Ontario

Apprenticeship Curriculum Standard

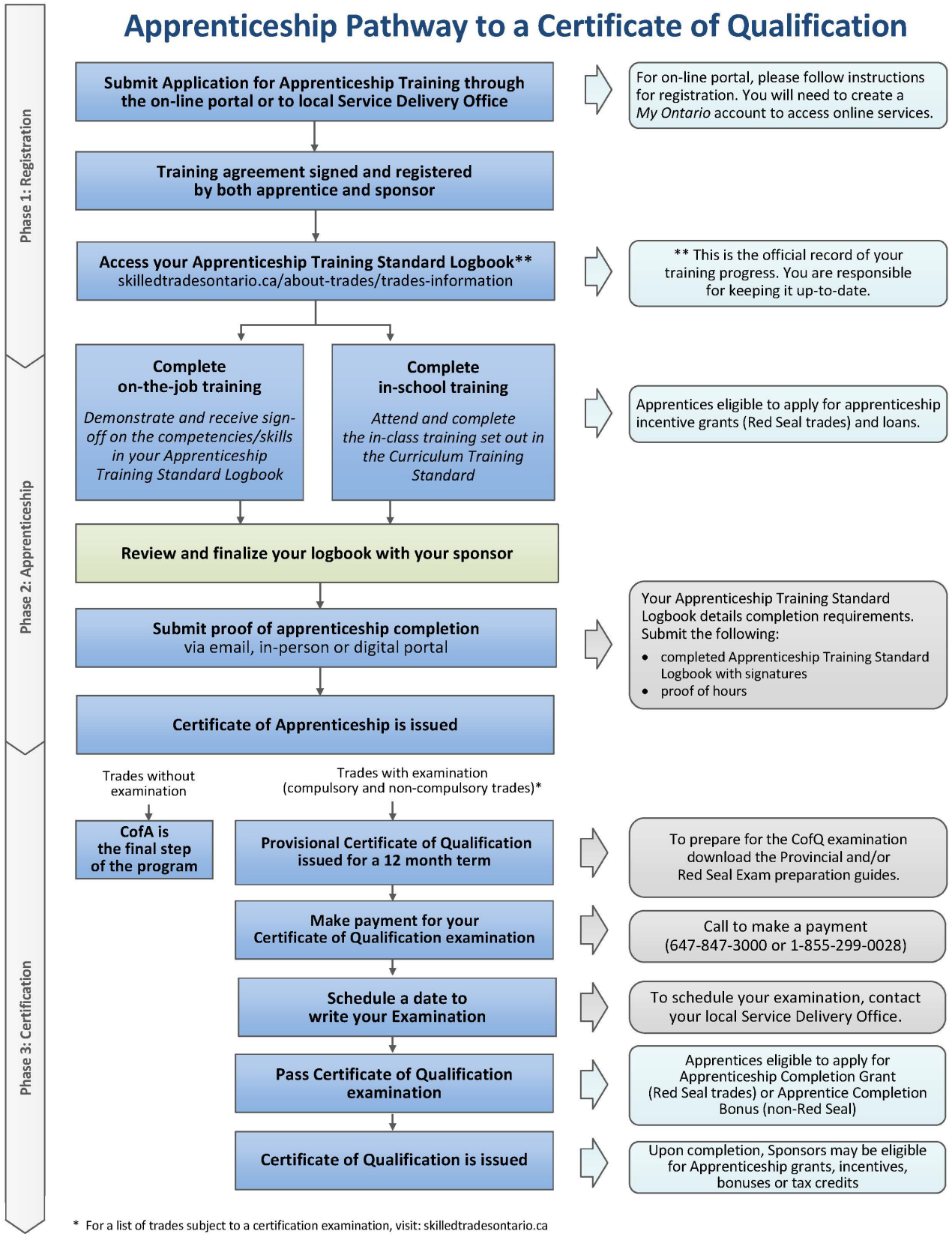
Facilities Technician

Level 1 Common Core
with Facilities Mechanic 255W
Includes Level 2 and Level 3 for 255B

255B

2005

Apprenticeship Pathway to a Certificate of Qualification



* For a list of trades subject to a certification examination, visit: skilledtradesontario.ca

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Please Note: This Standard has been revised to reflect the visual identity of Skilled Trades Ontario (STO) which replaced the Ontario College of Trades on January 1, 2022. The content of this Standard may refer to the former organization; however, all trade specific information or content remains relevant and accurate based on the original date of publishing.

Please refer to STO's website: **skilledtradesontario.ca** for the most accurate and up to date information. For information about BOSTA and its regulations, please visit ***Building Opportunities in the Skilled Trades Act, 2021* (BOSTA).**

Any updates to this publication are available on-line; to download this document in PDF format, please follow the link: Skilled Trades Ontario.ca.

Maintained with transfer to Skilled Trades Ontario 2005 (V100)

Preface

This curriculum standard for the Facilities Technician trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 3 levels of training. The Reportable Subjects Summary chart (located on page 6) summarizes the training hours for each reportable subject.

The curriculum identifies the learning that takes place in-school. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards.

Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on a work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to verify that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Please refer to Skilled Trades Ontario website (www.skilledtradesontario.ca) for the most accurate and up-to-date information about Skilled Trades Ontario. For information on *Building Opportunities in the Skilled Trades Act, 2021 (BOSTA)*) and its regulations, please visit Building Opportunities in the Skilled Trades Act, 2021, S.O. 2021, c. 28 - Bill 288 (ontario.ca)

Pre-requisites

In order to advance to Level 2 of the apprenticeship program, an individual must have completed all of the units outlined in Level 1. Similarly, in order to advance to Level 3 of the program, an individual must have completed all of the units outlined in Level 1 and 2.

Hours Disclaimer (if applicable)

It is agreed that Training Delivery Agents (TDAs) may need to make slight adjustments (with cause) according to particular apprentice needs and may deviate from the unit sequencing and the prescribed practical and theoretical hours shown within the standard. However, all TDAs will comply with the hours at the reportable subject level.

Personal and Safety Equipment: Personal protective equipment is at the discretion of the TDA who must conform to Ontario Provincial Health and Safety Regulations.

Introduction

This document is a revision of the May 1999 (printed February 2000) Facilities Systems Technician Apprenticeship In-School Curriculum Standard. The revisions are based on consultation and collaboration with the Industry Committee, Ministry of Training, Colleges and Universities - Program Development and Standards Unit, Project Steering Committee, Project Team and other industry partners. The continuous advancement of new technology, innovative techniques, and more complex equipment result in increased demands for trades persons who need to be skilled in the practical aspects of the trade, but also need sound theoretical knowledge of the operation, inspection, diagnoses, repair, and service requirements of facilities. Also, the trade name was changed to Facilities Technician. The name of the companion trade was changed to Facilities Mechanic.

In 2001, the Facilities Mechanic and Facilities Technician Apprenticeship programs were reviewed by the Facilities Operations Industry Committee and MTCU Program Co-coordinator, as it was apparent that the learning content of the programs overlapped, contained too much commonality, and content needed to be updated and modified. It was agreed that the Facilities Mechanic and Facilities Technician apprenticeships would be two distinct programs. In the May 1999 versions of the Curriculum Standards for Facilities Maintenance Mechanic and Facilities Systems Technician, Level 1 and Level 2 of each program were common. The Facilities Systems Technician program was an extension of the Facilities Maintenance Mechanic program with the addition of Level 3.

Originally, learning outcomes that would have been more appropriate to the Facilities Technician program had been moved to the Facilities Mechanic program due to constraints in hours. It was decided that this content would be moved back to the Facilities Technician program and additional required curriculum for the Facilities Mechanic program would be added. Both the Facilities Mechanic and Facilities Technician programs now have a common Level 1 since common core content for both programs is needed.

The changes to the Facilities Mechanic Program are as follows: (Additional content is highlighted as “**new**”).

Revised Reportable Subjects — Level 1:

Previous Units*	Hours	Revised Reportable Subjects	Hours
1.2 Health and Safety 1.2 Fire Safety Equipment 1.5 Tools and Equipment	20 10 12	1.1 Safety and Tools	30
1.3 Communications 1 2.8 Communications 2	12 20	1.2 Communications	24
1.4 Trade Calculations	18	1.3 Occupational Calculations	18
1.8 Plumbing 1 2.2 Plumbing 2	18 18	1.4 Plumbing	36
1.15 Custodial & Grounds Maintenance 1.6 Building Maintenance 1 2.1 Building Maintenance 2	18 18 30	1.5 Facilities Maintenance 1	48
1.13 Electrical 1 2.4 Electrical 2	18 30	1.6 Electricity	42
		1.7 Blueprint Practices (**new**)	18
2.10 Brazing and Welding	30	1.8 Brazing and Welding	24
		Total	**240**

*** Note:** All learning outcomes of previous curricula have been included in the new standards, but have been realigned. Hours listed may not accurately reflect previously assigned hours.

Revised Reportable Subjects — Level 2:

Previous Units*	Hours	Revised Reportable Subjects	Hours
1.11 Heating Systems 1	18	2.1 Heating Systems 1 (**revised**)	30
3.2 Air Compressors	30	2.2 Compressed Air Systems	24
3.8 Pumps and Pumping Sys.	18	2.3 Pumping Systems (**increased training hours**)	24
3.9 Plumbing 3	12	2.4 Plumbing 2 (**increased training hours**)	30
3.10 Electrical 3	21	2.5 Electrical Systems (**increased training hours**)	30
3.5 Emergency Power & Lighting Systems 3.4 Fire and Sprinkler Systems	15 15	2.6 Fire and Emergency Systems	30
		2.7 Water Treatment (**new**)	18
2.9 Preventive Maintenance	10	2.8 Preventive Maintenance (**increased training hours**)	18
1.7 Air Conditioning Sys.1 1.9 Ventilation Systems 1	18 18	2.9 Air Conditioning & Ventilation 1	36
		Total	**240**

*** Note:** All learning outcomes of previous curricula have been included in the new standards, but have been realigned. Hours listed may not accurately reflect previously assigned hours.

Revised Reportable Subjects — Level 3:

Previous Units*	Hours	Revised Reportable Subjects	Hours
3.6 Heating Systems 3	15	3.1 Heating Systems 2 (**revised**)	30
3.1 Ventilation and Air Conditioning 3	30	3.2 Air Conditioning & Ventilation 2 (**increased training hours**)	48
3.3 Chillers and Refrigeration	30	3.3 Chiller Systems and Refrigeration (**increased training hours**)	48
3.7 Low Pressure Boilers	15	3.4 Low Pressure Boilers (**increased training hours**)	36
3.12 Instrumentation and Controls	30	3.5 Sensing Devices	30
3.11 Power and Utilities	9	3.6 Power and Utilities Management (**increased training hours**)	30
		3.7 Project Management (**new**)	18
		Total	**240**

*** Note:** All learning outcomes of previous curricula have been included in the new standards, but have been realigned. Hours listed may not accurately reflect previously assigned hours.

Reportable Subjects Summary

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical	Prerequisite
Level 1 — Common Core with Facilities Mechanic					
1.1	Safety and Tools	30	25	5	
1.2	Communications	24	18	6	
1.3	Occupational Calculations	18	18	0	
1.4	Plumbing	36	24	12	
1.5	Facilities Maintenance 1	48	24	24	
1.6	Electricity	42	30	12	
1.7	Blueprint Practices	18	12	6	
1.8	Brazing and Welding	24	12	12	
	Total	**240**	**163**	**77**	
Level 2					
2.1	Heating Systems 1	30	20	10	1.1, 1.2, 1,3, 1.7
2.2	Compressed Air Systems	24	18	6	1.1, 1.2, 1,3, 1.7
2.3	Pumping Systems	24	16	8	1.1, 1.2, 1,3, 1.7
2.4	Plumbing 2	30	20	10	1.1, 1.2, 1,3, 1.4, 1.7
2.5	Electrical Systems	30	20	10	1.1, 1.2, 1,3, 1.6, 1.7
2.6	Fire and Emergency Systems	30	20	10	1.1, 1.2, 1,3, 1.6, 1.7
2.7	Water Treatment	18	12	6	1.1, 1.2, 1,3, 1.7
2.8	Preventive Maintenance	18	15	3	1.1, 1.2, 1,3, 1.5, 1.7
2.9	Air Conditioning and Ventilation 1	36	24	12	1.1, 1.2, 1,3, 1.7
	Total	**240**	**165**	**75**	
Level 3					
3.1	Heating Systems 2	30	20	10	2.1, 2.8
3.2	Air Conditioning and Ventilation 2	48	36	12	2.8, 2.9
3.3	Chiller Systems and Refrigeration	48	36	12	2.3, 2.4, 2.5, 2.7, 2.8
3.4	Low Pressure Boilers	36	24	12	2.3, 2.4, 2.7, 2.8
3.5	Sensing Devices	30	21	9	2.2, 2.5, 2.8, 2.9
3.6	Power and Utilities Management	30	24	6	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9
3.7	Project Management	18	18	0	2.8
	Total	**240**	**179**	**61**	

Program Summary

Level 1:	Reportable Subjects – 8	Theory Hours – 163	Practical Hours – 77
Level 2:	Reportable Subjects – 9	Theory Hours – 165	Practical Hours – 75
Level 3:	Reportable Subjects – 7	Theory Hours – 179	Practical Hours – 61
Totals:	Reportable Subjects – **24**	Theory Hours – **507**	Practical Hours – **213**

Evaluation

Regular evaluations of theory and application of apprentices‟ learning achievements are performed throughout the program to ensure consistency in learning. Methods used for evaluation include actual „hands on‟ testing methods and practical demonstration of component skills, multiple choice, and short answer questions. Frequency of testing depends upon the materials being covered. Generally, evaluations are carried out at the end of each learning unit. Weekly testing is recommended for material involving major memory recall or the development/refinement of practical skills. In all cases, evaluations tend to be short and frequent, as opposed to the one major test or evaluation at the end of the course of study.

Facilities Technician and Facilities Mechanic Level 1 Common Core

Reportable Subject Summary – Level 1 Common Core with Facilities Mechanic

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
1.1	Safety and Tools	30	25	5
1.2	Communications	24	18	6
1.3	Occupational Calculations	18	18	0
1.4	Plumbing	36	24	12
1.5	Facilities Maintenance 1	48	24	24
1.6	Electricity	42	30	12
1.7	Blueprint Practices	18	12	6
1.8	Brazing and Welding	24	12	12
	Total	**240**	**163**	**77**

This level is common core between the following trades/occupations:
Facilities Mechanic 255W.

Number:	1.1		
Title:	**Safety and Tools**		
Duration:	Total Hours: 30	Theory: 25	Practical: 5
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5090.0, 5091.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to explain the health hazards and safety risks that are present on the job site and equip themselves for personal protection and general safety. The apprentice is also able to select, use, and maintain hand and power tools.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.1.1 Apply safety legislation outlined in the Occupation Health and Safety Act.

1.1.2 Select, wear and maintain personal protective equipment, including respiratory protection.

1.1.3 Describe and operate emergency safety equipment.

1.1.4 Identify WHMIS labels and MSDS sheets and use safe handling and disposal procedures for hazardous materials.

1.1.5 Explain the use of and adjust and wear a fall arrest system.

1.1.6 Apply safety measures in the shop and on the jobsite by following good housekeeping practices.

1.1.7 Complete an accident report and describe the need for WSIB and Company insurance forms in case of an accident.

1.1.8 Identify confined spaces and describe safe work entry requirements.

1.1.9 Identify the need for foreign material exclusion in building systems.

1.1.10 Identify the need for electrical and mechanical lock out and tag out procedures.

1.1.11 Describe the use, care and storage of hoisting and lifting equipment.

1.1.12 Accessing information from the Ontario Building Code, operating manuals, and manufacturer' specification sheets, determine the frequency and interval for inspecting a fire safety system and related components.

1.1.13 Identify location and layout of all components of a fire safety system.

1.1.14 Inspect fire safety system and components on a regular schedule, complying with local by-laws and codes.

1.1.15 Identify and describe types of fire doors, fire access routes, stairwell emergency lighting, fire damper access ports, exit signs and "in case of fire" notification signs.

1.1.16 Replace bulbs in exit and emergency lights using required voltage/ wattage lamps.

1.1.17 Inspect and maintain batteries, connections and clamps.

1.1.18 Co-ordinate annual inspection of fire safety system.

1.1.19 Identify, use and maintain common hand and power tools.

1.1.20 Identify, describe the use of, and maintain precision measuring equipment.

1.1.21 Identify, describe, use and maintain lifting and hoisting devices following manufacturers' recommendations.

1.1.22 Maintain and use grounds maintenance equipment.

Learning Content

1.1.1 Apply safety legislation outlined in the *Occupational Health and Safety Act*.
- outline sections and describe the application on the work site of the *Occupational Health and Safety Act*

1.1.2 Select, wear and maintain personal protective equipment, including respiratory protection.
- select respiratory filter for different atmospheres
- identify protective equipment required for different hazards

1.1.3 Describe and operate emergency safety equipment.
- assess operating condition of safety equipment
- identify classes of fire extinguishers
- describe and operate fire extinguishers
- use fire blankets, stretchers, ropes, ladders and other evacuation equipment

1.1.4 Identify WHMIS labels and MSDS sheets and use safe handling and disposal procedures for hazardous materials.

1.1.5 Explain the use of and adjust and wear a fall arrest system.
- use fall arrest system when working above three meters or confined space

1.1.6 Apply safety measures in shop and on job by following good housekeeping practices.

1.1.7 Complete an accident report and describe the need for WSIB and Company insurance forms in case of an accident.

1.1.8 Identify confined spaces and describe safe work entry requirements.

1.1.9 Identify the need for foreign material exclusion in building systems.

1.1.10 Identify the need for electrical and mechanical lock out and tag out procedures.

1.1.11 Describe the use, care and storage of hoisting and lifting equipment.

1.1.12 Accessing information from the Ontario Building Code, operating manuals, and manufacturer' specification sheets, determine the frequency and interval for inspecting a fire safety system and related components.

1.1.13 Identify location and layout of all components of a fire safety system.

1.1.14 Inspect fire safety system and components on schedule, complying with local by-laws and codes.
- record inspection findings in Fire Log Book
- report inspection findings
- notify fire monitoring agency of problems that require taking notification system out of service

1.1.15 Identify and describe types of fire doors, fire access routes, stairwell emergency lighting, fire damper access ports, exit signs and "in case of fire" notification signs.

1.1.16 Replace bulbs in exit and emergency lights using required voltage/wattage lamps.

1.1.17 Inspect and maintain batteries, connections and clamps.
- using a hydrometer, check specific gravity of wet cells
- top up wet cells with distilled water

1.1.18 Co-ordinate annual inspection of fire safety system.
- identify an approved contractor

1.1.19 Identify, use and maintain common hand and power tools.
- list and describe hand tools such as hammers, saws, chisels, wrenches, screwdrivers, files, pliers, augers, punches, crowbars, and ratchets

1.1.20 Identify, describe the use of, and maintain precision measuring equipment.
- describe the use of micrometers, vernier, calipers, tapes, squares, and gauges
- clean, lubricate and store measuring tools

1.1.21 Identify, describe, use and maintain lifting and hoisting devices following manufacturers' recommendations.
- describe applications and limitations of lifting and hoisting devices such as lifts, fork trucks, hydra-lifts and scissor lifts
- demonstrate safe use of lifting and hoisting devices
- clean and store lifting and hoisting devices
- report to authorities any abnormalities with lifting or hoisting devices

1.1.22 Maintain and use grounds maintenance equipment.
- list and describe commonly used manual and power grounds maintenance equipment such as mowers, hedge trimmers, leaf blowers, snow blowers and rot tillers
- demonstrate safe use of grounds maintenance equipment
- clean, lubricate and store grounds equipment

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

MSDS information, WHMIS information, lock out and tagging procedures, hose cabinets, emergency lighting, sprinkler heads, extinguishers, hydrometers, common hand tools, general power tools, safety harness.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
80%	20%	100%

Number:	1.2		
Title:	**Communications**		
Duration:	Total Hours: 24	Theory: 18	Practical: 6
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5092.01, 5092.03 to 5092.06			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to demonstrate a general knowledge of business and communicate in writing by preparing basic business documents, writing reports, maintaining service documents, and preparing work orders. The apprentice is able to perform computer operations in the preparation of these basic business documents. The apprentice is also able to communicate orally, liaising with staff, tenants, and contractors and demonstrates human relation skills in the process.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.2.1 Using grammar and language conventions, communicate orally with fellow workers, supervisors, clients, contractors and within organizations.

1.2.2 Describe and use communication systems such as telephone/facsimile, postal/courier service, e-mail.

1.2.3 Describe the need for and complete written reports and business letters.

1.2.4 Complete service sheets, work order, equipment logs, parts lists, surveys.

1.2.5 Communicate effectively using interpersonal skills.

1.2.6 Create written documentation using a computer.

1.2.7 Prepare a career development plan and resume for work search.

1.2.8 Identify requirements of keeping service logs and documents for the equipment and service calls by outside trades persons and contractors.

1.2.9 Prepare a work order to schedule services based on work scope and trade required.

Learning Content

1.2.1 Using grammar and language conventions, communicate orally with fellow workers, supervisors, clients, contractors and within organizations.
- open and close a conversation

1.2.2 Describe and use communication systems such as telephone/facsimile, postal/courier service, e-mail.
- send fax, ensuring follow-up if required
- communicate via e-mail

1.2.3 Describe the need for and complete written reports and business letters.
- describe types of reports that building operators would use in carrying out their duties
- describe the use, need for, and requirements of logs and log books
- write a business letter
- write a health and safety report
- write a memo
- prepare a fax cover letter
- complete forms required by legislation including WSIB and Ministry of Labour reports

1.2.4 Complete forms such as service sheets, work order, equipment logs, parts lists, surveys.
- describe service sheets, work orders, equipment and parts logs
- prepare work order from maintenance schedule
- requisition parts
- prepare WSIB (Workplace Safety Insurance Board) forms
- explain Ministry of Labour reports commonly used in carrying out the requirements of a building operator

1.2.5 Communicate effectively using interpersonal skills.
- demonstrate active listening skills such as paraphrasing, questioning, clarifying, using minimal encouragers, giving constructive feedback
- describe and demonstrate assertiveness skills versus aggressive and passive aggressive communication
- communicate with individuals and groups of differing age and cultures
- resolve interpersonal conflicts by using a problem solving model

1.2.6 Create written documentation using a computer.
- demonstrate computer skills by creating documents, sending e-mails, inputting and retrieving equipment data for parts and inventory purposes

1.2.7 Prepare a career development plan and resume for work search.
- list interests, skills, past experience

1.2.8 Identify requirements of keeping service logs and documents for the equipment and service calls by outside trades persons and contractors.
- record equipment and operation data in approved log book
- complete service documents
- access information from government regulations regarding log books and service documents

1.2.9 Prepare a work order to schedule services based on work scope and trade required.
- prepare work orders to schedule services of qualified and licensed trades persons

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
50%	50%	100%

Number:	1.3		
Title:	**Occupational Calculations**		
Duration:	Total Hours: 18	Theory: 18	Practical: 0
Prerequisites:	None		
Co-requisites:	None		

Cross-Reference to Training Standard: There are no specific General Performance Objectives for this module.

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to solve trade related calculations and problems involving basic arithmetic, geometry and mathematical functions.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.3.1 Using basic arithmetic functions, add, subtract, multiply, and divide.

1.3.2 Calculate perimeters, area, and volume of geometric shapes and figures.

1.3.3 Measure angles, sides of objects and calculate using Pythagorean theorem.

1.3.4 Calculate basic algebraic functions with one unknown.

1.3.5 Using a hand-held calculator, perform required calculations.

1.3.6 Using imperial and metric measurement, calculate mass, volume and length.

1.3.7 Calculate using given formulae, basic trade related problems.

Learning Content

1.3.1 Using basic arithmetic functions, add, subtract, multiply, and divide.

1.3.2 Calculate perimeter, area, volume of geometric shapes and figures.
- calculate perimeters, areas and volumes of given plane figures

1.3.3 Measure angles, sides of objects, and calculate using Pythagorean theorem.
- define angle/angles, and accurately read angles using protractors
- calculate triangle components using the Pythagorean theorem

1.3.4 Calculate basic algebraic functions with one unknown.
- solve given algebraic equations/problems

1.3.5 Using a hand-held calculator, perform required calculations.

1.3.6 Using imperial and metric measurement, calculate mass, volume and length.
- transpose between both modes of measurement.

1.3.7 Calculate using given formulae, basic trade related problems.
- using formulae, solve for an unknown given pertinent data

Instructional/Delivery Strategies:

Reference Materials:

Minimal Equipment List:

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

Number:	1.4		
Title:	**Plumbing 1**		
Duration:	Total Hours: 36	Theory: 24	Practical: 12
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5106.0, 5107.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to install and maintain plumbing fixtures by accessing the plumbing code, reading and interpreting blueprints and schematics, identifying and locating defective area of plumbing system, inspecting water drains, and performing routine maintenance.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.4.1 Identify and describe plumbing system components.

1.4.2 Identify piping materials and explain the methods employed for connecting piping in plumbing systems.

1.4.3 Interpreting blueprints, drawings and piping schematics, identify layout and location of components in plumbing systems.

1.4.4 Select piping and tubing used for appliances according to Gas Utilization codes.

1.4.5 Install gas piping and tubing systems using pipe sizing charts and according to Gas Utilization codes.

1.4.6 Visually inspect components of plumbing systems.

1.4.7 Read and record temperatures, pressures, levels, flows, and other information and maintain a history of piping and plumbing system components.

1.4.8 Set pressure recording gauges, using master gauge.

1.4.9 Identify and explain types of plumbing systems.

1.4.10 Maintain and repair minor defects on hot water tank components and coordinate with contractor or trades person to repair more complex problems.

1.4.11 Identify and describe types of valves on plumbing systems.

1.4.12 Re-pack valves using manufacturers' approved procedures.

1.4.13 Identify and describe types of faucets used in sinks, vanities, bathtubs and repair defective or leaking faucets.

1.4.14 Explain the theory of operation of a flushometer, a water closet float valve and urinal gravity tanks.

1.4.15 Maintain, repair or replace p-traps on vanities and sinks.

Learning Content

1.4.1 Identify and describe plumbing system components.
- describe the function and application of plumbing system components for both drinking and potable water supply such as domestic water; hot water; drain-waste-vent piping systems, valves, faucets and taps; washroom components; circulating pumps and tanks; gages

1.4.2 Identify piping materials and explain the methods employed for connecting piping in plumbing systems.
- describe types of piping material such as copper, steel, plastic, galvanized steel, PVC, tubing
- state the application of pipe used in plumbing, including vents

1.4.3 Interpreting blueprints, drawings, and piping schematics, identify layout and location of components in plumbing systems.
- draw a sketch of a section of a plumbing system

1.4.4 Select piping and tubing used for appliances according to Gas Utilization codes.
- types of gas piping, tubing and material characteristics of copper, steel, plastic, flexible stainless steel tubing and hose
- utilize pipe sizing diagrams for pipe
- select piping for installation in underground, indoor and outdoor
- outline use of flexible piping

1.4.5 Install gas piping and tubing systems using pipe sizing charts and according to Gas Utilization codes.

- describe types of fittings, threaded, flare, welded, compression and brazing
- explain procedures for joining pipe together
- perform following procedures such as cutting pipe to meet size, bend tubing, thread pipe and solder pipe up to 2 inches, flare tubing
- install plastic pipe fittings

1.4.6 Visually inspect plumbing system components.

- manually close valves to isolate defective units, leaks and for preventive maintenance work
- use mechanical tag-out to ensure safety
- identify and record defects in plumbing
- complete plumbing work order
- arrange for emergency repair by plumber or contractor

1.4.7 Record temperatures, pressures, levels, flows, and other information and maintain a history of piping and plumbing system components.

- accurately read temperatures, pressures flows and levels
- record on approved log sheets

1.4.8 Set recording gauges using master gauge.

- adjust and calibrate floats, mixing valves, regulators and monitoring gauges

1.4.9 Identify and explain types of plumbing systems.

- describe function and purpose of domestic cold water down-flow, up-flow
- describe function and purpose of gravity, tank-less constant pressure
- describe function and purpose of domestic hot water down-flow, up-flow drain
- describe function and purpose of waste and vent (DWV)
- identify plumbing systems layouts

1.4.10 Maintain and repair minor defects on hot water tank components.

- test water tank relief valves
- flush tank, clean tank as required by the p.m. schedule
- co-ordinate with contractor or trades person to repair complex jobs

1.4.11 Identify and describe types of valves on plumbing systems.

- identify valve components such as gate valves, globe valves, ball valves, angle valves, sediment valves, check valves, and diaphragm valves

1.4.12 Re-pack valves using manufacturers' approved procedures.

1.4.13 Identify and describe types of faucets used in sinks, vanities, bathtubs and repair defective or leaking faucets.
- describe the types of faucets such as washer type, washer-less and cartridge type and state their applications in commercial buildings

1.4.14 Identify and explain the theory of operation of a flushometer, a water closet float valve and urinal gravity tanks and repair or replace defective parts.
- explain the theory of operation of flushometers, float valves and gravity tanks

1.4.15 Maintain, repair, or replace p-traps on vanities and sinks.
- identify p-traps
- clean p-traps
- perform preventive and regular maintenance on p-traps

Instructional/Delivery Strategies:

Reference Materials:

Minimal Equipment List:

Domestic water, hot water tank, drain-waste-vent piping systems, valves, faucets, washroom components, circulating pumps, gas piping and fittings.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
70%	30%	100%

Number:	1.5		
Title:	**Facilities Maintenance 1**		
Duration:	Total Hours: 48	Theory: 24	Practical: 24
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5109.0, 5110.0, 5111.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect, maintain and troubleshoot building envelope by accessing information; conducting visual and physical inspection; repairing/replacing doors/components and windows/components; planning and estimating replacement paint and wall coverings; preparing wall surfaces; applying paint and wall coverings; maintaining ceilings, interior surfaces, exterior brickwork, masonry, cladding, wall appendages, and floor coverings; performing general cleaning procedures; and performing scheduled maintenance on overhead suspended equipment. The apprentice is also able to perform grounds maintenance by accessing information; conducting a visual and physical inspection of exterior grounds; cleaning up grounds; maintaining ground facilities, lawn and garden equipment; maintaining lawns, plants, trees, flora, and shrubs; inspecting, maintaining, and testing irrigation systems, and inspecting and maintaining playground equipment.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.5.1 Conduct a visual inspection of exterior grounds, record deficiencies and issue work orders for repair or replacement of items or components that cannot be done in-house.

1.5.2 Identify and describe procedures for waste disposal, recycling, garbage removal, snow and ice removal, leaf and debris removal.

1.5.3 Identify and describe materials used in the upkeep of the building exterior, sidewalks, driveways, fences and patios.

1.5.4 Maintain and perform minor repairs to building exterior and grounds.

1.5.5 Identify and describe gardening procedures including layout, plant selection, plant care, weeding, fertilizing, watering and pest control.

1.5.6 Identify and describe use of trees and types of lawn cover and maintenance required.

1.5.7 Perform visual inspection of lawn equipment.

1.5.8 Identify and describe theory of operation of underground irrigation systems and components.

1.5.9 Prepare an annual maintenance start-up/shut-down procedure for lawn irrigation systems.

1.5.10 Identify and describe components of playground equipment and maintenance requirements, and maintain and perform minor repairs on playground equipment.

1.5.11 Perform maintenance for interior envelope such as doors and windows, painted and covered walls, ceiling tile, floors, carpets and railings.

1.5.12 Perform housekeeping and cleaning requirements.

1.5.13 Identify required maintenance and describe the repair procedures for components of the building envelope.

1.5.14 Prepare interior surfaces.

1.5.15 Identify and describe types and procedures for application of paints and adhesives used for interior and exterior coating.

1.5.16 Demonstrate procedure to apply coatings to interior and exterior surfaces.

1.5.17 Calculate paint/wall covering and labor requirements for interior and exterior applications.

1.5.18 Prepare building exterior surfaces for painting.

1.5.19 Select caulking for expansion joints and remove and apply caulking.

1.5.20 Remove deteriorated brick and mortar on exterior surfaces and repair.

1.5.21 Remove defective cladding and replace.

1.5.22 Describe and demonstrate maintenance requirements for eaves troughs and down spouts.

1.5.23 Identify, describe and demonstrate the procedures to clean interior and exterior surfaces.

1.5.24 Inspect components of building envelope, record deficiencies and issue work orders or long term maintenance requirements.

1.5.25 Identify types of windows and doors used in building construction and replace/repair defective components.

1.5.26 Remove old wall covering, prepare surfaces, select and apply new wall coverings.

1.5.27 Identify and describe types of ceilings, ceiling tiles, plaster and drywall and maintain and repair defective ceiling components, drywall, plaster, cement, block and other types of walls.

1.5.28 Identify and describe types of interior surfaces, maintain, and perform minor repairs to walls.

1.5.29 Select types of fasteners used in building construction, and install or replace fasteners used to hold handrails and shelving.

1.5.30 Identify and describe types of floor coverings used in buildings, perform minor floor repairs, and coordinate contractors to repair or replace major deficiencies in floor coverings.

1.5.31 Identify and describe suspended equipment, overhead door hardware, mechanical and electrical door components, tracks, springs, rollers, bearings and cables and maintain components.

1.5.32 Identify and describe types of roofs and interpret roofing blueprints and drawings.

1.5.33 Inspect/repair roof following building and OSHA guidelines.

Learning Content

1.5.1 Conduct a visual inspection of exterior grounds, record deficiencies and issue work orders for repair or replacement of items or components that cannot be done in-house.

- inspect weeds, crab grass, hedge trimming; condition of curbs, stones, sidewalks, driveways; condition and appearance of shrubs, flowers, trees; general landscape appearance
- arrange for contractors to perform required work
- describe how landscape features such as shrubs, flowers, and trees are used to provide a pleasant/aesthetic appearance

1.5.2 Identify and describe procedures for waste disposal, recycling, garbage removal, snow and ice removal, leaf and debris removal.

- explain the ways in which snow and ice are removed from walkways, driveways and building rooftops

1.5.3 Identify and describe materials used in the upkeep of the building exterior, sidewalks, driveways, fences and patios.
- describe methods used to perform repairs to components of building exterior

1.5.4 Maintain and perform minor repairs to building exterior and grounds.
- clean building exterior and grounds
- coordinate contractor or trades person for major repairs to building

1.5.5 Identify and describe gardening procedures including layout, plant selection, plant care, weeding, fertilizing, watering and pest control.
- name the commonly used types of plants and shrubbery utilized on building grounds
- describe methods used to control lawn weeds, lawn fertilizing

1.5.6 Identify and describe use of trees and types of lawn cover and maintenance required.
- describe different varieties of trees
- explain the use of trees and shrubs for shade, noise barriers and wind breaks
- describe maintenance such as cutting, fertilizing and pest control

1.5.7 Perform visual inspection of lawn equipment.
- check that lubrication and fuel are at satisfactory levels, blades will cut and not rip grass
- recognize that the inspection is to be carried out on lawn equipment prior to its use
- demonstrate the safe way to add fuel to lawn cutting and snow removal equipment

1.5.8 Identify and describe theory of operation of underground irrigation system and components.
- identify the components of an underground irrigation system
- describe maintenance requirements of underground irrigation systems

1.5.9 Prepare an annual maintenance and start-up/shut-down procedures for lawn irrigation systems.
- use preventive maintenance schedule to determine start up and shut down of irrigation system

1.5.10 Identify and describe components of playground equipment and maintenance requirements, and maintain and perform minor repairs on playground equipment.

- access manufacturers' specifications for maintenance and repair of playground equipment
- clean playground equipment
- eliminate play ground equipment defects immediately

1.5.11 Perform maintenance for interior envelope such as doors and windows, painted and covered walls, ceiling tile, floors, carpets and railings.

1.5.12 Perform housekeeping and cleaning requirements.

- vacuum premises
- strip and buff floors
- surface wash and polish
- accessing information on the safe use of chemicals and cleaning solvents from MSDS and WHMIS, clean and police area

1.5.13 Identify required maintenance and describe the repair procedures for components of the building envelope.

- repair doors, windows, glass/screens, security monitoring systems
- replace weather stripping
- demonstrate caulking procedures and screen replacement
- select and install/replace door hinges/locks, monitoring components such as cameras and screens

1.5.14 Prepare interior surfaces.

- describe procedures to prepare concrete, masonry, glass, tile and vinyl surfaces for painting, vinyl covering or plastering
- sand, prime, and paint interior surfaces

1.5.15 Identify and describe types and procedures for application of paints and adhesives used for interior and exterior coating.

- state the differences between, and specific applications for flat, semi-gloss, latex, alkyd and oil based paints
- describe types of adhesives used for interior and exterior wall coatings

1.5.16 Demonstrate procedure to apply coatings to interior and exterior surfaces.

- demonstrate ability to apply coatings by brush, rolling and paint sprayer
- tape and cover items not to be painted

1.5.17 Calculate paint/wall covering and labor requirements for interior and exterior applications.
- measure surface area to be covered or painted and calculate paint or covering required
- issue work order to contractor or trades person to complete large jobs

1.5.18 Prepare building exterior surfaces for painting.
- safely assemble scaffolding
- demonstrate safe use of ladders
- demonstrate use of power washer to clean exterior surfaces
- clean/scrape and prime exterior surface

1.5.19 Select caulking for expansion joints and remove and apply new caulking.
- apply caulking using both the hand and the power gun

1.5.20 Remove deteriorated brick and mortar and repair.
- describe the procedure for mixing amounts of mortar and apply to defective area

1.5.21 Remove defective cladding and replace.

1.5.22 Describe and demonstrate maintenance requirements for eaves troughs and down spouts.
- demonstrate use of ladders and scaffold equipment when accessing eaves trough and down spouts.
- clean eaves troughs by removing debris and leaves
- select sealant for sealing eaves and down spouts
- reseal joints using caulking or sealing material
- replace defective eaves and spout fasteners
- repair eaves troughs and down spouts

1.5.23 Identify, describe and demonstrate procedures to clean interior and exterior surfaces.
- describe terrazzo floors, concrete floors, cement walls
- describe equipment used to clean wall and floor surfaces
- shampoo carpets
- sandblast, acid wash and high pressure water wash concrete floors, brickwork, and cladding

1.5.24 Inspect components of building envelope, record deficiencies and issue work orders or long term maintenance requirements.
- record on log sheets, defects and deficiencies found
- prepare a preventive maintenance check list for the building envelope

1.5.25 Identify types of windows and doors used in building construction and replace/repair defective components.

- repair or replace operators, screens, broken window panes, door seals, hinges, door handles, bottom door sweeps
- adjust doors for closing
- replace doors
- replace/install door hinges
- select and apply caulking and sealant to windows, doors and openings

1.5.26 Remove old wall covering, prepare surfaces, select and apply new wall coverings.

- identify and demonstrate use of tools and equipment to remove old wall coverings
- prepare surfaces by filling holes, sanding, and repairing any cracks

1.5.27 Identify and describe types of ceilings, ceiling tiles, plaster, and drywall and maintain and repair defective ceiling components, drywall, plaster, cement, block and other types of walls.

- remove defective ceiling tiles
- describe types of ceiling tiles commonly used in facilities ceilings
- prepare surface, patch and repair plastered ceiling

1.5.28 Identify and describe types of interior surfaces, maintain and perform minor repairs to walls.

- recognize types of materials used for interior walls for cleaning
- clean walls using recommended cleaning solutions
- perform minor wall repairs to plaster, wallboard, baseboards, corners

1.5.29 Select types of fasteners used in building construction, and install or replace fasteners used to hold handrails and shelving.

- describe types of fasteners such as nails, screws, shelf brackets, handrail brackets, adhesives
- using tools and equipment such as brackets and fasteners, install handrails, shelving, and brackets

1.5.30 Identify and describe types of floor coverings used in buildings, perform minor floor repairs, and coordinate contractors to repair or replace major deficiencies in floor coverings.

- issue work orders for contractors for larger repairs

1.5.31 Identify and describe suspended equipment, overhead door hardware, mechanical and electrical door components, tracks, springs, rollers, bearings and cables and maintain components.

- clean and lubricate overhead components using ladders or scaffolding
- perform preventive maintenance on overhead equipment
- note defects and record in log for follow up

1.5.32 Identify and describe types of roofs and interpret roofing blueprints and drawings.

- interpret type of roof construction
- obtain information from Ontario Building Code Municipal bylaws and manufacturers' specifications
- identify type of roof to be accessed

1.5.33 Inspect/repair roof following building and OSHA guidelines.

- locate roof construction details from blueprints
- demonstrate use of safety harness when performing roof repairs
- describe requirements of installing roof barricades
- check for signs of deterioration, visible defects, damaged flashing, ripped shingles, ponding of water, plugged roof drains
- complete work order for repair and coordinate contractor for large repairs
- describe tools and equipment used for repair of roof shingles
- seal or patch damaged roof shingles and roof flashing applying sealants, caulking or patching compounds

Instructional/Delivery Strategies:

Reference Materials:

Minimum Tools and Equipment:

Doors, windows, weather stripping, caulking, lock replacement, irrigation equipment, playground equipment, safety barriers, curbing, landscape, roof construction layout, roof loads, required safety equipment, cants, curbs, flashing.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	1.6		
Title:	**Electricity**		
Duration:	Total Hours: 42	Theory: 30	Practical: 12
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5103.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect and maintain electrical systems by accessing information, reading and interpreting blueprints and shop drawings, inspecting electrical systems and components, maintaining breakers and fuses (maximum of 240 volts), and maintaining 120 volts, single phase electrical components and devices.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.6.1 Define the units of electrical measurement.

1.6.2 Using Ohm's and Joules' Laws, solve common electrical circuits.

1.6.3 Using theories of magnetism, explain the operation of electromagnetic devices.

1.6.4 Accessing information from Canadian Electrical Code, local bylaws, and company standards, identify safety procedures, specifications, and limitations for maintenance and repair of electrical systems.

1.6.5 Using blueprints and shop drawings, identify layout and location of main breakers, branch panels, transformers, and disconnects.

1.6.6 Visually inspect distribution system to determine voltage and system characteristics.

1.6.7 Visually inspect electrical components and use electrical lock-out tag/out procedure when taking a piece of equipment out of service for maintenance.

1.6.8 Identify and describe the application of meters used in electrical measurement.

1.6.9 Identify and describe types of electrical service metering devices and read, record, and calculate electrical consumption.

1.6.10 Identify and describe types of electrical control and isolation equipment.

1.6.11 Check circuit breakers and fuses (up to 240 volts) for correct operation.

1.6.12 Select and replace defective receptacles, switches and lamps sockets.

1.6.13 Select and replace defective or burnt out fluorescent ballasts and other components.

1.6.14 Reset motor starter, check and replace fuses in disconnects and perform current draw measurements while motor is operating.

1.6.15 Visually inspect main electrical room components.

Learning Content

1.6.1 Define the units of electrical measurement.

1.6.2 Using Ohm's and Joules' Laws, solve common electrical circuits.

1.6.3 Using theories of magnetism, explain the operation of electromagnetic devices.

1.6.4 Accessing information from Canadian Electrical Code, local bylaws, and company standards, identify safety procedures, specifications and limitations for maintenance and repair of electrical systems.

1.6.5 Using blueprints and shop drawings, identify layout and location of main breakers, branch panels, transformers, and disconnects.
- locate electrical components and wiring location

1.6.6 Visually inspect distribution system to determine voltage and system characteristics.
- identify single phase systems
- identify three phase systems
- determine safety precautions

1.6.7 Visually inspect electrical components and use the electrical lock-out tag/out procedure when taking a piece of equipment out of service for maintenance.
- record abnormal situations
- lock-out before inspecting electrical systems and equipment
- recognize and ensure compliance with trade limitations

1.6.8 Identify and describe the application of meters used in electrical measurement.
- describe fuse pullers, wire strippers, insulated pliers, linesman pliers, screwdrivers, voltage tester and other tools used

1.6.9 Identify and describe types of electrical service metering devices, read, record and calculate electrical consumption.
- demonstrate ability to use meter in safe manner
- measure voltage, amperage and resistance

1.6.10 Identify and describe types of electrical control and isolation equipment.
- identify and describe electrical safety equipment such as fuses, circuit breakers, ground fault interrupters, motor starters and disconnects

1.6.11 Check circuit breakers and fuses (up to 240 volts) for correct operation.
- describe circuit breakers and fuses
- use tools and equipment such as puller to remove fuses
- demonstrate use of multi-meters and clamp-on meter to test fuses and breakers
- test using a multi-meter
- replace with required fuse
- reset circuit breaker

1.6.12 Select and replace defective receptacles, switches and lamps sockets.
- use lock-out/tag-out procedure to safely isolate defective components
- use tools and materials to replace defective switches and receptacles

1.6.13 Select and replace defective or burnt out fluorescent ballasts and other components.
- identify ballast and light components
- visually inspect nameplate data on ballasts

1.6.14 Reset motor starter, check and replace fuses in disconnects and perform current draw measurements while motor is operating.
- use clamp-on ammeter to check current
- use multi-meter to check voltage
- test fuse and replace with required fuse if defective

1.6.15 Visually inspect main electrical room components.
- log electrical equipment readings and note deficiencies
- contact trades persons for repair

Instructional/Delivery Strategies:

Reference Materials:

Minimum Tools and Equipment:

Low voltage transformer, breakers, fuses, electrical panels – single phase and three phase, lighting fixtures, ballasts, motors and starters, common electrical hand tools, multimeter, clamp-on ammeter.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	1.7		
Title:	**Blueprint Practices**		
Duration:	Total Hours: 18	Theory: 12	Practical: 6
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5092.02			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to reference building codes, identify and interpret types of architectural, structural and mechanical drawings, sketch views and sections of building components.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.7.1 Identify and draw perspective, isometric, oblique and orthographic projections.

1.7.2 Identify and draw views and sections.

1.7.3 Identify the Alphabet of Lines including object lines, hidden lines, extension lines, centre lines, cutting plane lines, break lines.

1.7.4 Create orthographic drawings in one view, two views, and three views.

1.7.5 Name the features of a building in the plan and elevation views.

1.7.6 Explain the necessity of building codes in the industry.

1.7.7 Create basic drawings, using commercially available Computer Assisted Design (CAD) software.

Learning Content

1.7.1 Identify and draw perspective, isometric, oblique and orthographic projections.

- draw projections using scale rulers, triangles, compass and other related tools

1.7.2 Identify and draw views and sections.
- search components located in each of the different views
- draw views such as front view, side view, plan (top) view, sections and details, abbreviations, and title blocks

1.7.3 Identify and explain the Alphabet of Lines.
- explain use of lines
- explain object lines, hidden lines, extension lines, centre lines, cutting plane lines, break lines
- describe location of each type of line

1.7.4 Create orthographic drawings in one view, two views, and three views.
- use tools and Alphabet of Lines to create a drawing

1.7.5 Name the features of a building in the plan and elevation views.
- identify features using nomenclature

1.7.6 Explain the necessity of building codes in the industry.
- identify types of provincial building codes and municipal bylaws

1.7.7 Create basic drawings, using commercially available Computer Assisted Design (CAD) software.

Instructional/Delivery Strategies:

Reference Materials:

Minimum Tools and Equipment:

Drawings, CAD software and computer, drafting tools.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
50%	50%	100%

Number:	1.8		
Title:	**Brazing and Welding**		
Duration:	Total Hours: 24	Theory: 12	Practical: 12
Prerequisites:	None		
Co-requisites:	None		
Cross-Reference to Training Standard: 5112.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to set up and operate oxyacetylene and arc welding equipment. The apprentice will prepare weld surfaces, weld, then disconnect and store welding equipment.

Learning Outcomes

Upon successful completion, the apprentice is able to:

1.8.1 Identify and explain principles of oxyacetylene brazing and the arc welding operation.

1.8.2 Identify and describe equipment used in brazing and welding.

1.8.3 Select, adjust, and wear protective equipment.

1.8.4 Plan and organize welding or brazing operation.

1.8.5 Set up welding machine and select ground clamp locations, polarity and welding rods.

1.8.6 Using grinder and files, prepare welding surface, and identify and describe type of weld to be used.

1.8.7 Demonstrate arc welding, brazing, and cutting procedures.

1.8.8 Demonstrate safety procedures when welding and brazing.

1.8.9 Using storage techniques, safely store equipment, tools, parts and compressed gas cylinders, according to manufacturers' specifications and OHSA guidelines.

Learning Content

1.8.1 Identify and explain principles of oxyacetylene brazing and the arc welding operation.

1.8.2 Identify and describe equipment used in brazing and welding.
- describe torches, regulators, compressed oxygen and acetylene, arc welding machine, clamps, strikers, welding rods, brazing rods, fluxes, grinders, and other related devices
- describe care and use of brazing and welding equipment

1.8.3 Select, adjust, and wear protective equipment.
- demonstrate use of protective clothing and related personal safety equipment such as eye protection, welding shields, gloves, aprons and hearing protection

1.8.4 Plan and organize welding or brazing operation.
- read and interpret blueprints and shop drawings to plan out welding or brazing operation
- access work scope
- demonstrate use of tools and equipment
- select brazing and/or welding rods and flux
- select heat settings

1.8.5 Set up welding machine and select ground clamp locations, polarity and welding rods.
- access welding machine set up information from manufacturers' specifications and operating procedures
- ensure ground clamp locations, polarity and required welding rod is utilized
- demonstrate safe set up of welding machine
- test machine to verify settings

1.8.6 Using grinder and files, prepare welding surface and identify and describe type of weld to be used.
- describe types of welds commonly used such as butt, lap, groove, or filet weld

1.8.7 Demonstrate arc welding, brazing, and cutting procedures.

1.8.8 Demonstrate safety procedures when welding and brazing.
- keep area free of combustibles
- have fire extinguisher standing by
- use accepted OHSA guidelines
- describe the duties of safety/spark watcher during welding operations

1.8.9 Using storage techniques, safely store equipment, tools, parts and compressed gas cylinders, according to manufacturers' specifications, and OHSA guidelines.
- demonstrate disconnection and storage of welding equipment
- describe the requirements for the safe storage of gas cylinders

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Welding equipment, electric or oxyacetylene brazing.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
50%	50%	100%

Facilities Technician
Level 2

Reportable Subject Summary-Level 2

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
2.1	Heating Systems 1	30	20	10
2.2	Compressed Air Systems	24	18	6
2.3	Pumping Systems	24	16	8
2.4	Plumbing 2	30	20	10
2.5	Electrical Systems	30	20	10
2.6	Fire and Emergency Systems	30	20	10
2.7	Water Treatment	18	12	6
2.8	Preventive Maintenance	18	15	3
2.9	Air Conditioning and Ventilation 1	36	24	12
	Total	**240**	**165**	**75**

Number:	2.1		
Title:	**Heating Systems 1**		
Duration:	Total Hours: 30	Theory: 20	Practical: 10
Prerequisites:	1.1, 1.2, 1.3, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5100.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect, maintain and troubleshoot heating systems by accessing information, reading and interpreting blueprints and schematics, monitoring and recording gauge readings, checking system and components, maintaining controls and thermostats, checking and maintaining pumps and motors, and preparing for on- site inspections.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.1.1 Identify, and describe types of heating systems.

2.1.2 Identify, and describe components of heating systems.

2.1.3 Read and interpret blueprints and shop drawings of heating systems.

2.1.4 Record data on log sheets (e.g., temperatures, pressures, levels, flows, alarms, indicating lights, status) and interpret and compare with manufactures' specifications and operating procedures.

2.1.5 Adjust set-points on thermostats and aquastats.

2.1.6 Visually inspect components of boilers, heating systems and furnaces.

2.1.7 Coordinate with contractor or trades person any repair or deficiencies and arrange for re-inspection of component if required.

2.1.8 Identify and describe types of controls and thermostats used to maintain temperatures on types of heating systems.

2.1.9 Adjust, test, calibrate thermostats to set standards using manufacturers' specifications and repair manuals.

2.1.10 Repair and replace thermostats to set standards using manufacturers' specifications and repair manuals.

2.1.11 Identify and describe types of pumps used in heating systems.

2.1.12 Maintain heating system pumps.

Learning Content

2.1.1 Identify and describe types of heating systems.
- describe steam heating systems
- describe hot water heating systems
- describe forced warm air heating systems
- describe electric heating systems

2.1.2 Identify and describe components of heating systems.
- describe heating system components such as steam boilers, hot water boilers, convectors, radiators, circulating pumps, furnaces, blowers, electric baseboard heaters and expansion tanks

2.1.3 Read and interpret blueprints and shop drawings of heating systems.
- identify layout
- locate piping and ductwork associated with heating systems
- identify shut-off valves, dampers, control valves, thermostats, controllers and other auxiliary components of heating system

2.1.4 Record data on log sheets (e.g., temperatures, pressures, levels, flows, alarms, indicating lights, status) and interpret and compare with manufactures' specifications and operating procedures.
- read and interpret gauge reading pertaining to pressure, flow or level
- identify abnormal situations that may be found using equipment manual reference

2.1.5 Adjust set-points on thermostats and aquastats.
- record in daily log book any changes made
- demonstrate procedure to adjust set-points

2.1.6 Visually inspect components of boilers, heating systems and furnaces.
- assist in opening of boiler for inspection purposes
- issue work orders for any repairs or deficiencies as found by the inspector
- inspect and record abnormal situations and defects on forms

2.1.7 Coordinate with contractor or trades person any repair or deficiencies and arrange for re-inspection of component if required.
- assist tradesperson in repair of heating system deficiencies
- ensure procedures and specifications for repair are met

2.1.8 Identify and describe types of controls and thermostats used to maintain temperatures on types of heating systems.
- describe pneumatic, electric, and electronic and digital controls and thermostats

2.1.9 Adjust, test, calibrate thermostats to set standards, using manufacturers' specifications and repair manuals.
- test thermostats using required instruments

2.1.10 Repair and replace thermostats to set standards using manufacturers' specifications and repair manuals.
- demonstrate procedure to replace pneumatic and electric thermostats

2.1.11 Identify and describe types of pumps used in heating systems.
- locate pumps in heating systems
- describe the uses for positive displacement, centrifugal, and rotary pumps

2.1.12 Maintain heating system pumps.
- clean, lubricate heating system pumps
- change oil
- align heating system pumps
- clean strainers throughout the heating systems
- test safety relief valve on heating system pumps

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Steam boiler, hot water boiler, convectors, radiators, circulating pumps, expansion tanks, blowers, electric baseboard heaters, electric forced air furnace, unit heaters, radiators.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	2.2		
Title:	**Compressed Air Systems**		
Duration:	Total Hours: 24	Theory: 18	Practical: 6
Prerequisites:	1.1, 1.2, 1.3, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5095.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate, troubleshoot and maintain air compressors by accessing information; reading and interpreting blueprint, shop drawings and schematics; performing inspection of compressors and blowing down receivers; maintaining pneumatic systems and components; and coordinating the inspection of Pressure Vessels.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.2.1 Access information from codes, manuals, manufacturers' specifications, and determine air compressor component tolerances, limitations, safety procedures, replacement procedures and in house maintenance.

2.2.2 Read and interpret blueprints for compressed air systems.

2.2.3 Perform inspection of compressor and receiver.

2.2.4 Maintain air compressor parts and components.

2.2.5 Maintain pneumatic systems and components.

2.2.6 Coordinate the inspection of air receivers in compliance with the Pressure Vessels Act and Regulations.

Learning Content

2.2.1 Accessing information from codes, manuals, manufacturers' specifications, determine air compressor component tolerances, limitations, safety procedures, replacement procedures and in house maintenance.

- identify requirements from Boilers and Pressure Vessels Act and Regulations for the safe operation of an air compressor system

2.2.2 Read and interpret blueprints for compressed air systems.
- identify air compressor component layout and system layout including valves, regulation devices, and electrical components
- locate air compression components and air lines

2.2.3 Perform inspection of compressor and receiver.
- check condition of belts, pulleys, guards, and housing
- check status of oil level, colour and leaks
- check condition of intake and line filter
- check for abnormal noise, bearing noise and vibration
- check operating pressures and cycle timer air leaks
- record in logbook the condition of the compressor and components such belts, oil levels, filters, receivers, instrumentation and safety devices

2.2.4 Maintain air compressor parts and components.
- clear and clean automatic moisture drains
- remove/clean intake filters, traps and guards
- adjusting belt pulleys, pressure reducing valves
- replace belts; check safety devices and unloaders
- verify operation of pressure reducing valve
- visually inspect devices and check for air leaks and abnormal noise

2.2.5 Maintain pneumatic systems and components.
- perform testing of pneumatic systems and components
- select and perform replacement of defective components including regulating, temperature sensing devices, damper controls filters, valves and diaphragms
- adjust pneumatic components

2.2.6 Coordinate the inspection of air receivers in compliance with the Pressure Vessels Act and Regulations.
- assist Regulatory and/or Insurance Inspector in carrying out his/her duties during the inspection
- identify and access information from the Pressure Vessels Act in regards to air compressors and auxiliaries
- demonstrate procedure for shut down, electrical and mechanical lock out/tag out and preparation for inspection of air compressor
- provide logbooks and maintenance data for inspector to review

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Automatic drains, traps, guards, pressure reducing valves and unloaders, air compressor.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	2.3		
Title:	**Pumping Systems**		
Duration:	Total Hours: 24	Theory: 16	Practical: 8
Prerequisites:	1.1, 1.2, 1.3, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5101.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate, troubleshoot and maintain pumps and pumping systems by accessing information; reading and interpreting blueprints, shop drawings and schematics; performing inspections; troubleshooting pumping systems pumps and components; and performing system shut down and start up procedures.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.3.1 Identify and describe types of pumps and determine operating characteristics of pumps.

2.3.2 Read and interpret blueprints of pumping systems.

2.3.3 Inspect pumps and pumping systems.

2.3.4 Determine pump efficiency and record data on a log sheet or in a computer database.

2.3.5 Test, calibrate and adjust pump and pumping system controls, safety relief valves and alarms and record test results on preventive maintenance schedule log.

2.3.6 Perform preventive maintenance procedures on pumping systems.

2.3.7 Disassemble pump and inspect impeller, shaft, wear ring, and casing, and prepare pump for machine shop repairs.

2.3.8 Replace defective or worn pumping system components.

2.3.9 Align pump and motor using tool such as dial indicator, calliper, micrometer.

2.3.10 Demonstrate start up and shut down procedures for pump and pumping system.

2.3.11 Inspect pump and motor.

2.3.12 Select and replace packing in centrifugal pumps and check mechanical seals.

Learning Content

2.3.1 Identify and describe types of pumps and determine operating characteristics of pumps.

- access pump operating information data sheets and operating manuals
- determine parameters such as rpm, horsepower, temperature, volume, net positive suction head, and capacity

2.3.2 Read and interpret blueprints of pumping systems.

- locate, check layout and identify physical configuration of pumps and pumping systems
- identify performance characteristics, pump layout, piping configuration of pumps and pumping systems utilizing manufacturers' specifications
- identify valves and related components of pumping system

2.3.3 Inspect pumps and pumping systems.

- visually inspect pumps and pumping systems checking for abnormal noises, high temperatures on bearings, motors, and casings, and vibration and leaks
- record abnormalities on log sheets

2.3.4 Determine pump efficiency and record data on a log sheet or in computer database.

- check oil level in bearing reservoir and water flow to pump bearings that are water cooled
- compare suction and discharge pressures as well as temperatures
- record suction and discharge pressures, temperatures, oil levels, water flows and other pertinent data
- access information from logs or computer and compare to current situation to analyze problems

2.3.5 Test, calibrate and adjust pump controls, safety relief valves and alarms and record test results on preventive maintenance schedule log.

2.3.6 Perform preventive maintenance procedures on pumping systems.
- check air vents, bearings, belts, casing
- check valves, gaskets and control valves
- record inspection findings on log sheet
- perform minor maintenance and pump system inspection

2.3.7 Disassemble pump and inspect impeller, shaft, wear ring, and casing, and prepare pump for machine shop repairs.

2.3.8 Replace defective or worn pumping system components.
- remove and replace components such as valves, belts, couplings, pulleys
- check valves, pressure gauges, and other pump equipment
- select from stock or order pump parts and install parts
- align pump and motor using tools such as dial indicator, calliper, micrometer

2.3.9 Align pump and motor using tool such as dial indicator, calliper, micrometer.

2.3.10 Demonstrate start up and shut down procedures for pump and pumping system.
- lock out/tag out pump motor electrically and lock out/tag out mechanically all valves
- demonstrate lock out/tag out procedures prior to commencing pump service or repairs

2.3.11 Inspect pump and motor.
- check for leakage, vibration, bearing noise, abnormal temperature and flow, using inspection procedures

2.3.12 Select and replace packing in centrifugal pumps and check mechanical seals.
- remove worn packing
- obtain new packing according to manufacturers' specifications
- repack pump
- visually inspect mechanical seal for leakage, replace if necessary following manufacturers' guidelines
- issue work order if seal is leaking

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Circulating pumps, condenser pumps, chilled water pumps, sanitary pumps, storm sewer pumps, chemical feed pumps, and fire pumps.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
70%	30%	100%

Number:	2.4		
Title:	**Plumbing 2**		
Duration:	Total Hours: 30	Theory: 20	Practical: 10
Prerequisites:	1.1, 1.2, 1.3, 1.4, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5106.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate, inspect and monitor plumbing systems and components by accessing information, reading and interpreting blueprints, shop drawings, and schematics; troubleshooting and maintaining plumbing systems and components; and responding to emergency situations.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.4.1 Access and interpret information from Part 7 of the Ontario Building Code (Plumbing), the Canadian Standards Association (CSA) with regards to approved plumbing materials.

2.4.2 Identify and interpret plumbing blueprints of a building.

2.4.3 Perform visual inspections and record defects and code infractions of plumbing systems.

2.4.4 Maintain, repair or replace defective plumbing system components.

2.4.5 Identify complex plumbing and equipment problems and effect repairs.

2.4.6 Respond to emergency plumbing situations.

2.4.7 Explain the impact of cross connections, potential water hammer problems and piping corrosion problems.

2.4.8 Explain the principle of operation of septic systems and describe their maintenance requirements.

2.4.9 Access and interpret information from Section 8 of the plumbing code pertaining to septic systems.

Learning Content

2.4.1 Access and interpret information from Part 7 of the Ontario Building Code (Plumbing), the Canadian Standards Association (CSA) with regards to approved plumbing materials.
- explain plumbing terminology, and limitations of in-house work needed to be performed

2.4.2 Interpret plumbing blueprints of a building.
- perform a building plumbing fixture count
- identify piping
- identify elevations of plumbing, instrument readings
- identify calculations of grade used on building drain and sewer
- access isometric drawings
- identify plumbing code infractions

2.4.3 Perform visual inspections and record defects and code infractions of plumbing systems.
- inspect drainage and vent systems, water distribution system, and cross connectors
- identify potential plumbing problems(water hammer problems)
- identify piping corrosion areas
- obtain services of qualified plumber or contractor for major repair

2.4.4 Maintain, repair or replace defective plumbing system components.
- clean plumbing system components
- repair plumbing system components such as flushometers, float valve, o-rings, pipe identifiers, seals and seats, trap seal primers, sump pumps

2.4.5 Identify complex plumbing and equipment problems and effect repairs.
- coordinate with contractors or trades person to effect repairs
- issue work orders
- assist plumbing contractor or trades person by preparing plumbing system and equipment

2.4.6 Respond to emergency plumbing situations.
- demonstrate emergency response procedures
- locate and isolate leaking valves, close valves by accessing information from shop drawing or blueprint
- erect safety sign and barriers
- perform temporary repairs
- scope work required
- issue work order
- coordinate repair with contractor or trades person

2.4.7 Explain the impact of cross connections, potential water hammer problems and piping corrosion problems.
- identify cross connection points and contamination issues as outlined in CSAB64
- describe the purpose and function of backflow prevention devices

2.4.8 Explain the principle of operation of septic systems and describe their maintenance requirements.

2.4.9 Access and interpret information from Section 8 of the plumbing code pertaining to septic systems.

Instructional/Delivery Strategies:

Ontario Plumbing Code: Part 7 of OBC.

Reference Materials:

Minimum Equipment List:

Domestic water, hot water tank, drain-waste-vent piping systems, valves, faucets, and washroom components, circulating pumps, back flow preventers.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	2.5		
Title:	**Electrical Systems**		
Duration:	Total Hours: 30	Theory: 20	Practical: 10
Prerequisites:	1.1, 1.2, 1.3, 1.6, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5103.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate single phase electrical systems by accessing information; reading and interpreting blueprints, shop drawings and schematics; resetting and/or shutting down electrical systems and components; coordinating electrical repairs; and maintaining electrical motor components.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.5.1 Explain and demonstrate the rules and laws of electricity regarding circuits, power requirements and calculations.

2.5.2 Access and interpret information from the Canadian Electrical Code Part I and explain regulations pertaining to permits and inspection of electrical work.

2.5.3 Interpret electrical blueprint or riser diagrams of a commercial building.

2.5.4 Identify and describe procedures for the shut down and the start up of common electrical equipment.

2.5.5 Perform visual inspections of electrical equipment.

2.5.6 Maintain electrical systems in compliance with the Electrical Code.

2.5.7 Identify and describe the operation, and determine application and maintenance procedures of DC motors, single phase and three phase AC motors.

2.5.8 Interpret schematics and motor control drawings.

Learning Content

2.5.1 Explain and demonstrate the rules and laws of electricity regarding circuits, power requirements and calculations.

2.5.2 Access and interpret information from the Canadian Electrical Code Part I and explain regulations pertaining to electrical permits and inspection of electrical work.

- access information and technical data from manuals regarding electrical equipment installed in the building
- find specifications for each piece of electrical equipment

2.5.3 Interpret electrical blueprint or riser diagrams of a commercial building.

- locate main distribution system switchgear, risers and distribution buses
- identify lighting panel, power panels, sub-panels, and disconnects
- identify motor control centres, emergency systems, communication systems, fixture and device outlets

2.5.4 Identify and describe procedures for the shut down and the start up of common electrical equipment.

- demonstrate procedure for shut down and start up of electrical equipment such as transformers, load centres, and pumps and motors
- describe limitations due to voltage and phase i.e. single phase, and 240 volts

2.5.5 Perform visual inspections of electrical equipment.

- inspect electrical equipment and comply with the Canadian Electrical Code
- identify electrical code infractions
- isolate and shutdown defective hazardous electrical equipment
- contact personnel to repair

2.5.6 Maintain electrical systems in compliance with the Electrical Code.

- maintain a log book
- develop a routine maintenance schedule
- perform routine maintenance on common electrical equipment
- maintain tools and testers
- keep inventory of replacement parts
- notify certified electrician to repair defective equipment
- perform minor electrical repairs ensuring trade limitations
- using a multi-meter, measure amperage, voltage or resistance

2.5.7 Identify and describe the operation and determine applications and maintenance procedures of DC motors, single phase and three phase AC motors.
- identify the difference between a DC motor, single phase AC motor, and 3 phase AC motor
- perform minor preventive maintenance duties on electric motors

2.5.8 Interpret schematics and motor control drawings.
- locate control wiring and components, referencing schematics

Instructional/Delivery Strategies:

Reference Materials:

Canadian Electrical Code Part 1.

Minimum Equipment List:

Low voltage transformers, breakers, fuses, lighting fixtures, electrical panel – single phase and three phase, ballast, multimeters, electrical hand tools, clamp- on ammeter, motors and starters.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	2.6		
Title:	**Fire and Emergency Systems**		
Duration:	Total Hours: 30	Theory: 20	Practical: 10
Prerequisites:	1.1, 1.2, 1.3, 1.6, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5098.0, 5099.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect and verify all fire suppression, containment and sprinkler systems by accessing information; reading and interpreting blueprints, shop drawings and schematics; inspecting wet and dry sprinkler system and components; checking carbon dioxide, dry or wet chemical systems; checking fire fighting equipment; and maintaining fire separation doors, ventilation, fire damper, and fire panels. The apprentice is also able to inspect, test and verify emergency power and lighting systems by accessing information, testing and maintaining battery powered systems, inspecting generator powered systems, and coordinating seasonal maintenance schedule.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.6.1 Access information, safety standards and codes related to fire suppression systems, using Ontario Building Code, National Fire Prevention Association and OHSA standards.

2.6.2 Identify and describe types of fire suppression systems.

2.6.3 Identify and describe fire and emergency system components.

2.6.4 Read and interpret blueprints, shop drawings, and control schematics of fire suppression and emergency electrical systems.

2.6.5 Visually inspect wet and dry sprinkler systems.

2.6.6 Perform maintenance of fire system.

2.6.7 Replace nitrogen cylinder by closing valves ensuring dry system is not activated.

2.6.8 Identify and describe a carbon dioxide system.

2.6.9 Visually inspect components of a carbon dioxide system.

2.6.10 Identify and describe a wet or dry chemical extinguishing system.

2.6.11 Visually inspect components of a wet or dry chemical extinguishing system.

2.6.12 Inspect fire system components.

2.6.13 Describe and perform procedure to re-fold hoses, manually weigh and inspect fire extinguisher, test tamper and flow switches, test heat and smoke detector operation.

2.6.14 Visually inspect fire dampers and fire doors.

2.6.15 Clean fire dampers and fire doors.

2.6.16 Inspect fire alarm panels and enunciator panel.

2.6.17 Coordinate periodic testing and fire drills according to company standards, NFPA, local bylaws and government regulations.

2.6.18 Arrange for contractor to perform comprehensive test of all components of fire alarm, annunciation system, heat/smoke detectors, pull stations, remote monitoring relays, modems, tamper/flow switches, fire pump operation.

2.6.19 Accessing information from manuals, manufactures' specifications, NFPA, Ontario Building Code and OHSA, identify and describe emergency power and lighting systems.

2.6.20 Identify and describe battery powered lighting systems and components, fixed and portable emergency generators, transfer switches, uninterrupted power supply (UPS), and other emergency power systems.

2.6.21 Describe principles of operation of dry cell and wet cell batteries, and battery chargers and check for battery readiness.

2.6.22 Identify and describe the principle of operation of two and four cycle internal combustion engine, cooling system layout and oil lubrication system.

2.6.23 Inspect and adjust or repair emergency generator components.

2.6.24 Coordinate annual maintenance of generator and engine by a qualified contractor utilizing the preventive maintenance schedule checklist and identify the defective items requiring repair, adjustment or replacement.

2.6.25 Verify engine start up and bring up to operating speed according to manufacturers' specifications and technical data.

2.6.26 Verify output voltage so that voltage, amperage and rpm are consistent with control panel readings.

2.6.27 Using a Carbon Monoxide Analyzer, determine exhaust emissions in engine room and repair leaks in the exhaust system.

2.6.28 Inspect and maintain fuel tank.

Learning Content

2.6.1 Access information, safety standards and codes related to fire suppression systems by using Ontario Building Code, National Fire Prevention Association and OHSA standards.
- determine or check building fire code requirements

2.6.2 Identify and describe types of fire suppression systems.
- describe theory and operation of wet and dry sprinkler systems
- describe wet or dry chemical extinguishing systems
- describe theory and operation of carbon dioxide and halon systems
- indicate uses of systems, and where they are used

2.6.3 Identify and describe fire and emergency system components.
- describe fire hoses, stand pipes, extinguishers, fire dampers, fire separation doors, fire panel, pull stations, fire bells/sirens, smoke detectors, enunciators, sprinklers heads
- visually locate and describe purpose of fire system components

2.6.4 Read and interpret blueprints, shop drawings, and control schematics of fire suppression and emergency electrical systems.
- locate buildings' fire suppression system, layout and components

2.6.5 Visually inspect wet and dry sprinkler systems.
- check for leakage and physical damage, pressures, alarms and indicator lights
- record temperatures and pressures of dry and wet sprinkler

2.6.6 Perform maintenance of fire system.
- drain fire system air compressor receiver
- check belt condition and tightness
- check compressor oil level
- verify operation of dry sprinkler system

2.6.7 Replace nitrogen cylinder by closing valves ensuring dry system is not activated.
- check pressures of nitrogen cylinders
- describe purpose of using nitrogen cylinder on dry sprinkler system

2.6.8 Identify and describe a carbon dioxide system.
- describe theory of operation of a carbon dioxide system

2.6.9 Visually inspect components of carbon dioxide system.
- check gauges, piping nozzles, fusible links, manual stations, and tamper switches
- enter inspection data into log

2.6.10 Identify and describe a wet or dry chemical extinguishing system.
- describe theory of operation of wet and dry chemical extinguishing systems

2.6.11 Visually inspect components of wet or dry chemical extinguishing system.
- activate wet or dry chemical extinguishing systems

2.6.12 Inspect fire system components.
- inspect extinguishers, cabinets, fire hoses, Siamese connection and standpipe
- record in log sheet any abnormalities
- repair and replace defective or damaged components using tools and equipment and recognizing in-house limitations

2.6.13 Describe and perform procedures to re-fold hoses, manually weigh and inspect fire extinguisher, test tamper and flow switches, test heat and smoke detector operation.
- re-fold a fire hose and rack up according to specifications
- weigh a fire extinguisher and compare to normal standard
- physically test tamper switches and flow switches

2.6.14 Visually inspect fire dampers and fire doors.
- check fusible links, magnetic hold open devices and automatic releases

2.6.15 Clean fire dampers and fire doors.
- lubricate guides, rollers, bearings, dampers, door hardware, hinges and weather stripping

2.6.16 Inspect fire alarm panels and enunciator panel.
- check for normal mode of operation
- check AC power light on
- using lamp test button ensure lights functioning
- verify panel door access is locked
- repair/record defective conditions

2.6.17 Coordinate testing and fire drills according to company standards, NFPA, local by-laws and government regulations.
- organize and conduct a fire drill

2.6.18 Arrange for contractor to perform comprehensive test of all components of fire alarm, annunciation system, heat/smoke detectors, pull stations, remote monitoring relays, modems, tamper/flow switches, fire pump operation.
- record findings and forward verification report to Insurance company and Fire Marshall's office
- issue annual report on the facility fire safety system

2.6.19 Accessing information from manuals, manufactures' specification, NFPA, Ontario Building Code and OHSA, identify and describe emergency power and lighting systems.

2.6.20 Identify and describe battery powered lighting systems and related components; fixed and portable emergency generators; transfer switches; uninterrupted power supply (UPS) and other emergency power systems.
- identify and describe the operation and construction of the components of a battery powered emergency lighting system

2.6.21 Describe the principle of operation of dry cell and wet cell batteries and battery chargers and check for battery readiness.
- using a hydrometer, check specific gravity of electrolyte in a wet cell battery
- demonstrate safety procedures and wear personal protective equipment when working with acids or explosive gases from a wet cell battery
- describe why hydrogen gases are produced from wet cell batteries

2.6.22 Identify and describe the principle of operation of two and four cycle internal combustion engines, cooling system layouts and oil lubrication systems.

2.6.23 Perform inspections and adjustments or repair of emergency generator components.
- check fuel/oil/coolant levels, air intake filter, belts, gauges, bolts, mounts, vibration isolators, exhaust louvers, and generator fresh air supply for physical abnormalities
- using equipment, adjust and calibrate emergency generator components

2.6.24 Coordinate annual maintenance of generator and engine by qualified contractor.
- utilizing preventive maintenance schedule checklist, identify defective items requiring repair, adjustment or replacement

2.6.25 Verify engine start up and bring up to operating speed according to manufacturers' specifications and technical data.
- physically start engine, bring up to speed and put system back into full operational mode

2.6.26 Verify output voltage so that voltage, amperage and rpm are consistent with control panel readings.
- using calibrated multi meter, check voltage and amperage
- check rpm using a tachometer

2.6.27 Using a Carbon Monoxide Analyzer, determine exhaust emissions in engine room and repair leaks in the exhaust system.
- demonstrate safe procedure in using a Carbon Monoxide Analyzer
- visually check for cracks and leaks

2.6.28 Inspect and maintain fuel tanks.
- inspect for leaks, corrosion, or water in fuel tank
- utilize fuel delivery company to remove contaminated fuel and refill

Instructional/Delivery Strategies:

Reference Materials:

Ontario Building Code, NFPA25

Minimum Equipment List:

Emergency lighting, sprinkler heads, extinguishers, enunciators, fire panels, fire alarm system devices.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	2.7		
Title:	**Water Treatment**		
Duration:	Total Hours: 18	Theory: 12	Practical: 6
Prerequisites:	1.1, 1.2, 1.3, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5097.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect and maintain water treatment systems by accessing information; reading and interpreting blueprints and schematics; identifying, monitoring, and maintaining chemical balance of water system; and checking and maintaining components of water treatment system. The apprentice is also able to operate, monitor and maintain domestic water treatment systems, and heating and cooling water systems.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.7.1 Identify principal contaminants in water obtained from various sources, and explain how removal or treatment can provide desired benefits.

2.7.2 Accessing information, identify types of water treatment processes used in building for heating and cooling operations.

2.7.3 Read and interpret blueprints to identify layout and location of water treatment systems.

2.7.4 Identify and describe standard water tests.

2.7.5 Using safe procedures and supplier and OHSA guidelines, select and add water treatment chemicals to a closed loop system using a pot feeder.

2.7.6 Adjust, calibrate and set chemical injection rates using chemical pumps; adjust timer to ensure interval for chemical injection.

2.7.7 Record test data, pump injection rates, chemical inventory and other information in log book.

2.7.8 Clean or replace filters in closed loop systems and clean strainers on open loop system.

2.7.9 Identify water treatment needs for steam heating systems, hot water heating systems, chilled water systems, cooling towers, closed loop coolers, domestic water systems, humidification systems, pools and spas.

2.7.10 Collect water samples in accepted laboratory standard from sampling points, and test, record and interpret results of tests.

2.7.11 Using test results, add chemicals and adjust chemical pump feed rates.

2.7.12 Implement environmental regulations regarding chemical disposal, ventilation, and WHMIS regulations.

Learning Content

2.7.1 Identify principal contaminants in water obtained from various sources and explain how removal or treatment can provide desired benefits.
- state the types of water contaminants normally found in domestic water
- list and explain the common methods used to remove water impurities

2.7.2 Accessing information, identify types of water treatment processes used in buildings for heating and cooling operations.
- identify types of water filters and softeners

2.7.3 Read and interpret blueprints to identify layout and location of water treatment systems.
- identify location of water softeners, closed loop systems, filtration systems, de-aerators, pot feeders, chemical tanks and injection pumps

2.7.4 Identify and describe standard water tests.
- describe water tests such as Total Dissolved Solids (TDS), Hardness Test, pH test, Chlorine Residual test

2.7.5 Using safe procedures and supplier and OHSA guidelines, select and add water treatment chemicals to a closed loop system using a pot feeder.

2.7.6 Adjust, calibrate and set chemical injection rates using chemical pumps; adjust timer to ensure interval for chemical injection.
- set and adjust timers and controls according to specifications

2.7.7 Record test data, pump injection rates, chemical inventory and other information in a log book.
- perform water purity tests

2.7.8 Clean or replace filters in closed loop systems and clean strainers on open loop system.
- select and replace filters/strainers using tools

2.7.9 Identify water treatment needs for steam heating systems, hot water heating systems, chilled water systems, cooling towers, closed loop coolers, domestic water systems, and humidification systems.

2.7.10 Collect water samples in accepted laboratory standard from sampling points, and test, record and interpret results of tests.
- demonstrate water testing techniques as per water treatment chemical company standards
- interpret Chlorine level; Ph level; Iron and sulphur; Hardness; “P” Alkalinity; “M” alkalinity; Total Dissolved solids; Conductivity

2.7.11 Using test results, add chemicals, adjust chemical pump feed rates.
- calculate amount and type of chemicals needed for system

2.7.12 Implement environmental regulations regarding chemical disposal, ventilation, and WHMIS regulations.
- maintain material safety data systems (MSDS) information in close proximity to chemical storage and chemical addition equipment
- update WHMIS information and labels

Instructional/Delivery Strategies:

Reference Materials:

MSDS information, WHMIS information

Minimum Equipment List:

Timers, chemical feed pumps and associated control hardware, water testing equipment.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	2.8		
Title:	**Preventive Maintenance**		
Duration:	Total Hours: 18	Theory: 15	Practical: 3
Prerequisites:	1.1, 1.2, 1.3, 1.5, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5093.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to perform preventive and predictive maintenance procedures by accessing information; reading and interpreting blueprints, shop drawings and schematics; analyzing, planning, preparing and performing preventive maintenance duties; and coordinating outside contractors for inspections and corrective work.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.8.1 Access information from sources such as the Ontario Building code, company operating procedures manual, manufacturers' specifications and warranties, work order file system.

2.8.2 Prepare work orders for scheduled preventive maintenance work on equipment under the mechanic's care.

2.8.3 Determine in-house trade/maintenance limitations and outside trade or contract requirements for scheduled maintenance on equipment.

2.8.4 Interpret blueprints, shop drawings and schematics for location and layout of equipment listed in the preventive maintenance schedule.

2.8.5 Prepare and/or update building equipment survey, parts lists, manufacturers' locations, parts availability, manufacturers' specifications for all preventive maintenance equipment.

2.8.6 Prepare, update, add, remove, change preventive maintenance inspection routines, monthly work orders, log sheets, specialized tests, and check lists for equipment.

2.8.7 Schedule dates, times and frequency for preventive maintenance work.

2.8.8 Prepare cost analysis of work performed.

2.8.9 Perform scheduled preventive maintenance that is within limitations set by company standards or license/certification requirements.

2.8.10 Obtain required permits, certificates or specialized requirement for work to be performed and complete forms for inspection certificates, warranties and government regulations.

2.8.11 Ensure safety regulations are followed by outside trades people and contractors.

2.8.12 Inspect work performed by in-house staff, outside trades people, and contractors.

Learning Content

2.8.1 Access information from the Ontario Building code, company operating procedures manual, manufacturers' specifications and warranties, work order file system.
- create preventive maintenance schedules from accessed information in compliance with standards

2.8.2 Prepare work orders for scheduled preventive maintenance work on equipment under the mechanic's care.
- prepare work orders from information gathered from building equipment data base

2.8.3 Determine in-house trade/maintenance limitations and outside trade or contract requirements for scheduled maintenance on equipment.
- list in-house trade/maintenance requirements, outside contractor or trades person requirements

2.8.4 Interpret blueprints, shop drawings and schematics for location and layout of equipment listed in the preventive maintenance schedule.

2.8.5 Prepare and/or update building equipment survey, parts list, manufacturers' locations, parts availability, manufacturers' specifications for preventive maintenance equipment.
- identify parts by number and type

2.8.6 Prepare, update, add, remove, change preventive maintenance inspection routines, monthly work orders, log sheets, specialized tests and check lists for equipment.
- prepare and update inspection routines for preventive maintenance program
- describe documentation required for preventive maintenance program

2.8.7 Schedule dates, times and frequency for performing preventive maintenance work.
- prepare a schedule for preventive maintenance program

2.8.8 Prepare cost analysis of work performed.
- itemize parts, tools, labour and contractors

2.8.9 Perform scheduled preventive maintenance that is within limitations set by company standards or license/certification requirements.
- perform required checks, make adjustments/repairs where necessary

2.8.10 Obtain required permits, certificates or specialized requirement for work to be performed and complete forms for inspection certificates, warranties and government regulations.

2.8.11 Ensure safety regulations are followed by outside trades people and contractors.

2.8.12 Inspect work performed by in-house staff, outside trades people, and contractors.

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Operating and procedure manuals, blue prints, drawings and log sheets.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

Number:	2.9		
Title:	**Air Conditioning and Ventilation 1**		
Duration:	Total Hours: 36	Theory: 24	Practical: 12
Prerequisites:	1.1, 1.2, 1.3, 1.7		
Co-requisites:	None		
Cross Reference to Training Standards: 5094.01 to 5094.05			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect, maintain and troubleshoot ventilation system by accessing information; reading and interpreting blueprints and schematics; inspecting, troubleshooting, and maintaining ventilation systems and components; checking and cleaning ductwork and grills; inspecting and maintaining humidifier systems; and performing scheduled preventive maintenance procedures. The apprentice is also able to inspect and maintain air conditioning systems by accessing information; reading and interpreting blueprints and schematics; opening and unsealing window/wall units; maintaining system; monitoring and recording gauge readings; inspecting, cleaning, and winterizing coolant towers; adjusting and monitoring chemical feed pumps; checking for refrigerant leakage; closing in and sealing window or wall units; and preparing and assisting in start-up and shutdown procedures.

Learning Outcomes

Upon successful completion, the apprentice is able to:

2.9.1 Identify and describe the purpose and types of ventilation and air handling systems and components.

2.9.2 Analyze building air quality according to Ministry guidelines.

2.9.3 Read and interpret blueprints to identify layout and location of ventilation system components.

2.9.4 Visually inspect ventilation and air handling system components.

2.9.5 Identify and describe utilization of air conditioning in buildings and facilities.

2.9.6 Identify and calculate refrigeration and air conditioning capacities.

2.9.7 Identify and explain the theory of operation of types of air conditioning and refrigeration systems.

2.9.8 Explain the basic compression refrigeration cycle model.

2.9.9 Identify and explain the operation of types of compressors used in refrigeration systems.

2.9.10 Observe, monitor and record in log sheets, air conditioning data and compare to manufacturers' specifications.

2.9.11 Identify and explain the principle of operation of air handling systems.

2.9.12 Identify and describe types of air filter systems used to clean and purify building air flow.

2.9.13 Select and replace filters in a ventilation system.

2.9.14 Identify and describe types of coils found in air handling systems.

2.9.15 Maintain finned coils found in ventilation systems using solvents and chemical cleaners and ensure effluent is environmentally safe before dumping to drain.

2.9.16 Identify and describe types of humidification systems.

2.9.17 Maintain and replace components of humidifiers.

2.9.18 Identify and describe types of fan systems and components.

2.9.19 Select, replace, and adjust tension on belts used on fan systems and adjust misaligned pulleys.

2.9.20 Inspect fan and motor bearings for excessive vibrations, noise and abnormal temperature.

2.9.21 Coordinate contractor or trades person to perform a dynamic vibration analysis for fan systems.

Learning Content

2.9.1 Identify and describe the purpose and types of ventilation and air handling systems and components.

- describe distribution systems and exhaust systems
- describe components such as dampers, filters, coils humidifiers, fans, mixing boxes, and controls devices
- describe an air handling system
- describe the difference between an air distribution system and exhaust system

2.9.2 Analyze building air quality according to Ministry guidelines.
- describe the concept and necessity of acceptable indoor air quality
- access information from the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) for air quality standards
- prepare a building or site survey outlining potential air quality issues

2.9.3 Read and interpret blueprints to identify layout and location of ventilation system components.

2.9.4 Visually inspect ventilation and air handling system components.
- inspect filters, coils, humidifiers, fans, mixing boxes and related components
- record data
- issue work orders for repairs or deficiencies
- describe the methods and equipment used to ensure air is conditioned

2.9.5 Identify and describe utilization of air conditioning in building and facilities.
- state the need for building air conditioning
- state the need for refrigeration components in building air conditioning

2.9.6 Identify and calculate refrigeration and air conditioning capacities.
- given data, calculate heating and cooling loads
- perform a heating/cooling load survey

2.9.7 Identify and explain the theory of operation of types of air conditioning and refrigeration systems.
- explain unitary, central, zone; heat pump system, chilled water systems
- describe components needed to make air conditioning and refrigeration systems functional

2.9.8 Explain the basic compression refrigeration cycle model.
- describe components of the refrigeration cycle
- explain the interaction of components
- show temperatures and pressures for each area of the cycle

2.9.9 Identify and explain the operation of types of compressors used in refrigeration systems.
- explain reciprocating, rotary, screw, scroll and centrifugal compressors used in commercial applications

2.9.10 Observe, monitor, and record in log sheets, air conditioning data and compare to manufacturers' specifications.
- record temperatures, pressures, refrigerant levels, oil levels, alarms, indicating lights and related information
- describe safety devices normally found on an air conditioning system

2.9.11 Identify and explain the principle of operation of air handling systems.
- visually identify types of air handling systems
- explain dual duct and multi-zone systems
- explain terminal reheat systems
- explain 100% air make-up systems
- explain constant volume-variable temperature systems
- explain variable volume systems
- explain induction systems

2.9.12 Identify and describe types of air filter systems used to clean and purify building air flow.
- describe types of air filter systems based on material and efficiency of filtration
- perform test on building air to ensure its cleanliness

2.9.13 Select and replace filters in a ventilation system.
- order specific filters applicable to function
- restore/replace dirty filter bags, rolls, viscous media using tools and equipment to access filters

2.9.14 Identify and describe types of coils found in air handling systems.
- identify coils such as chilled water, hot water, glycol, direct expansion

2.9.15 Maintain finned coils found in ventilation systems using solvents and chemical cleaners and ensure effluent is environmentally safe before dumping to drain.
- clean and brush finned coils to ensure sufficient air flow at all times
- follow disposal procedure for solvents and chemical cleaners

2.9.16 Identify and describe types of humidification systems.
- describe heated pan type, steam grid, air washer and wetted element humidification systems
- explain relative humidity, and the need for humidification in building

2.9.17 Maintain and replace components of humidifiers.
- clean and lubricate humidification system components
- adjust float on pan type humidifiers
- perform preventive maintenance requirements

2.9.18 Identify and describe types of fan systems and components.
- describe centrifugal , axial types, and blade design fan systems
- describe components of fan systems such as pulleys, belts, guards, blades, bearings, and housings

2.9.19 Select, replace and adjust tension on belts used on fan systems.
- adjust misaligned pulleys using procedure to level and align components
- adjust belt tension according to manufacturers' specifications
- replace worn belts

2.9.20 Inspect fan and motor bearings for excessive vibrations, noise and abnormal temperature.
- check fan and motor bearings manually, using a temperature measuring device
- issue work order for defective bearing

2.9.21 Coordinate contractor or trades person to perform a dynamic vibration analysis for fan systems.
- coordinate contractor or trades person to replace defective bearings
- record results of dynamic vibration analysis
- correct deficiencies and balance fan if required

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Dampers, fans, coils, pulleys, belts, valves, motors, filters, humidifiers, laboratory trainer - refrigeration.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Facilities Technician
Level 3

Reportable Subject Summary-Level 3

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
3.1	Heating Systems 2	30	20	10
3.2	Air Conditioning and Ventilation 2	48	36	12
3.3	Chiller Systems and Refrigeration	48	36	12
3.4	Low Pressure Boilers	36	24	12
3.5	Sensing Devices	30	21	9
3.6	Power and Utilities Management	30	24	6
3.7	Project Management	18	18	0
	Total	**240**	**179**	**61**

Number:	3.1		
Title:	**Heating Systems 2**		
Duration:	Total Hours: 30	Theory: 20	Practical: 10
Prerequisites:	2.1, 2.8		
Co-requisites:	None		
Cross Reference to Training Standards: 5100.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate, monitor and maintain heating systems by accessing information; reading and interpreting blueprints, shop drawings and schematics; operating the heating system; maintaining unit heaters, convectors and/or radiators, terminal reheat coils, induction unit and low pressure heat exchangers.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.1.1 Identify and describe types and operation of heating systems.

3.1.2 Accessing manufacturers' specifications, codes, and related information, determine capacities and rated heating values of systems.

3.1.3 Read and interpret shop drawings, schematics and blueprints to locate heating systems and components.

3.1.4 Start up and shut down heating system according to manufacturers' specifications, local codes and government regulations.

3.1.5 Perform comparative analysis of heating system operation and efficiency to manufacturers' specified performance.

3.1.6 Check, calibrate, and adjust sensors, set points, controllers, thermostats and controlled devices.

3.1.7 Clean, lubricate and adjust components in unit heaters.

3.1.8 Maintain convectors, radiators, unit heaters and reheat coils.

3.1.9 Adjust and calibrate locally mounted thermostats and control valves found on heating units and replace defective parts.

3.1.10 Maintain high pressure induction units.

3.1.11 Maintain low pressure heat exchanger.

3.1.12 Inspect and repair condensate and steam traps and air vents on heat ex-changers.

Learning Content

3.1.1 Identify and describe types and operation of heating systems.
- identify forced warm air, hydronic (hot water), steam, and electric baseboard heating systems
- describe heating system layout including components of electric, steam and hydronic heating systems

3.1.2 Accessing manufacturers' specifications, codes, and related information, determine capacities and rated heating values of systems.
- using tables and formulae from technical data, determine heating system capacities
- calculate steam heating and hot water heating capacities, using formulae

3.1.3 Read and interpret shop drawings, schematics and blueprints to locate heating systems and components.
- determine elevation using piping riser diagrams
- identify location of control components using control schematics

3.1.4 Start up and shut down heating system according to manufacturers' specifications, local codes and government regulations.
- demonstrate procedure for start-up and shut down of steam heating, hot water heating and forced air heating systems

3.1.5 Perform comparative analysis of heating system operation and efficiency to manufacturers' specified performance.
- obtain data from heating system operation and compare with specifications

3.1.6 Check, calibrate, and adjust sensors, set points, controllers, thermostats and controlled devices.
- demonstrate adjustment and calibration procedures of controllers, thermostats and other devices

3.1.7 Clean, lubricate and adjust components in unit heaters.
- clean and lubricate components such as fans, motors, coils, louvers, bearing and dampers
- adjust safety devices and operating controls according to manufacturers' specifications

3.1.8 Maintain convectors, radiators, unit heaters and reheat coils.
- clean and brush finned coil tubes of heating units using equipment and cleaning solvents
- vacuum finned tubes
- demonstrate safe practices according to OHSA when using solvents

3.1.9 Adjust and calibrate locally mounted thermostats and control valves for heating units and replace defective parts.
- demonstrate procedure to adjust and calibrate locally mounted thermostats and control valves for heating units

3.1.10 Maintain high pressure induction units.
- clean components of high pressure induction units such as screens, fins, and air nozzles
- measure flows and pressures of high pressure induction units and compare with manufacturers' specifications

3.1.11 Maintain low pressure heat exchanger.
- clean low pressure heat ex-changers, both regular and finned tubes using cleaning tools and solvents in a safe and approved manner
- brush finned tubes
- vacuum heat exchanger

3.1.12 Inspect and repair condensate and steam traps and air vents on heat ex-changers.
- repair or replace traps as required
- use stethoscope or infrared detector to determine malfunctioning steam trap

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Steam boiler, hot water boiler, convectors, radiators, circulating pumps, expansion tanks, blowers, electric baseboard heaters, electric forced air furnace, unit heaters, radiators.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	3.2		
Title:	**Air Conditioning and Ventilation 2**		
Duration:	Total Hours: 48	Theory: 36	Practical: 12
Prerequisites:	2.8, 2.9		
Co-requisites:	None		
Cross Reference to Training Standards: 5094.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to inspect and maintain air conditioning system by accessing information; reading and interpreting blueprints and schematics; opening and unsealing window/wall units; maintaining system; monitoring and recording gauge readings; inspecting, cleaning and winterizing cooling tower; adjusting and monitoring chemical feeds and balances; checking for refrigerant leakage; closing in and sealing window/wall units; and, preparing and assisting in start-up and shut down procedures.

The apprentice is also able to operate, monitor and maintain air conditioning and ventilation systems; perform inspections; coordinate seasonal maintenance schedules; read and interpret blueprints, shop drawings to analyze malfunctioning systems.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.2.1 Maintain, adjust, repair or replace defective components accessing data from manufacturers' specifications and repair manuals.

3.2.2 Identify and explain the types and theory of operation of cooling towers and components.

3.2.3 Inspect cooling tower visually and record defects.

3.2.4 Perform preventive or annual maintenance for air conditioning equipment.

3.2.5 Access information from code books, manuals, manufacturers' specifications and recommendations for selected air conditioning and ventilation systems.

3.2.6 Identify air conditioning and ventilation systems location, layout, and technical data, utilizing blueprints, shop drawings and schematics and determine pipe and duct sizing and other information by accessing manufacturers' specifications.

3.2.7 Troubleshoot malfunctioning air conditioning systems using manuals and technical data.

3.2.8 Inspect air handling and ventilation components.

3.2.9 Maintain air handling and ventilation equipment and components.

3.2.10 Clean air distribution components using OHSA guide when using sealers, solvents, cleaning agents.

3.2.11 Check and effect repairs to terminal boxes, variable air volume boxes, dual duct mixing boxes, modulation units, unit ventilators and outside air terminals for damper movement, minimum and maximum settings, sensors and thermostat operation.

3.2.12 Schedule and coordinate maintenance for equipment.

3.2.13 Measure and adjust static, velocity and total pressure settings using calibrating and measuring instruments.

3.2.14 Test and calibrate pneumatic room thermostats, sensors and transmitters.

3.2.15 Ensure air quality standards.

3.2.16 Using psychrometric charts, calculate temperatures, humidity, heat quantities and air volumes.

3.2.17 Perform heat gain and loss calculations.

3.2.18 Using gain and loss calculations, determine air flow and equipment capacity requirements for a given environmental space.

Learning Content

3.2.1 Maintain, adjust, repair or replace defective components accessing data from manufacturers' specifications and repair manuals.
- clean and lubricate components
- complete work order for defects or deficiencies in the system

3.2.2 Identify and explain the types and theory of operation of cooling towers and components.
- describe fans, float valves, grating, nozzles, spargers, temperature sensors and baffle style water spray eliminators
- describe layout of components of cooling towers commonly used in buildings

3.2.3 Inspect cooling tower visually and record defects.
- check bearings and re-pack if needed
- issue work orders for work to be done by outside trades person

3.2.4 Perform preventive or annual maintenance requirements for air conditioning equipment.
- describe preventive or annual maintenance requirements for air conditioning systems such as rooftop units, heat pumps, chillers, cooling towers, condensers, evaporators, pumps and related equipment
- clean and winterized tower, remove and clean strainer, check bearings and fan belt, and replace components where necessary

3.2.5 Access information from code books, manuals, manufacturers' specifications and recommendations for selected air conditioning and ventilation systems.
- determine the varieties and types of air conditioning and ventilation systems commonly used in buildings

3.2.6 Identify air conditioning and ventilation systems location, layout, and technical data utilizing blueprints, shop drawings and schematics and determine pipe and duct sizing and other information by accessing manufacturers' specifications.
- access technical data on specific system components and parts

3.2.7 Troubleshoot malfunctioning air conditioning systems using manuals and technical data.
- perform a comparative analysis of systems actual operation against manufacturers' specifications using tools and equipment including tachometer, velocity meter, psychrometer, computer and reference manuals
- demonstrate safe use of tools and equipment such as tachometer, velocity meters and psychrometer charts

3.2.8 Inspect air handling and ventilation components.
- identify components such as dampers, fans, filters, bearings, coils, pulleys, belts, valves, and motor, shafts, safety devices, guards, housing, duct systems
- describe operation of sensor controls, vibration isolators and humidification units
- visually check for wear, vibration, unusual noises

3.2.9 Maintain air handling and ventilation equipment and components.

- clean and lubricate air handling components
- replace and adjust fan belts and pulleys according to manufacturers' specifications
- utilize tools such as grease guns, hand tools, calipers, tachometer and stethoscope

3.2.10 Clean air distribution components using OHSA guide when using sealers, solvents cleaning agents.

- clean intakes, mixing plenums, ducts and diffusers, using equipment, tools such as vacuums and brushes and cleaning solvents

3.2.11 Check and effect repairs to terminal boxes, variable air volume boxes, dual duct mixing boxes, modulation units, unit ventilators and outside air terminals.

- check for damper movement, minimum and maximum settings, sensors and thermostat operation
- demonstrate testing procedures for air handling
- replace worn or defective components using recommended parts

3.2.12 Schedule and coordinate maintenance for equipment.

- describe the work required that would be indicated on preventive maintenance schedule
- demonstrate electrical and mechanical lock out/tag procedure on air conditioning and ventilation systems prior to seasonal shutdown
- prepare a work order for maintenance
- replace parts
- verify maintenance is complete

3.2.13 Measure and adjust static, velocity and total pressure settings using calibrating and measuring instruments.

- perform measuring and testing of air pressures in duct work and air handling systems using measuring instruments and calibrating instruments such as velocity meter, Pitot tube, anemometers, hot wire and gauges
- adjust and calibrate static and velocity air pressures in duct by correcting variables in accordance with specifications

3.2.14 Test and calibrate pneumatic room thermostats, sensors and transmitters.

- check air lines and thermostat for proper operation
- demonstrate correct procedure for changing set points and calibrating pressure ranges, and reset controls to manufacturer's specifications

3.2.15 Ensure air quality standards.
- check air flow rates
- calculate air change rates by using technical data
- check cleanliness of duct systems
- test temperatures and humidity
- perform carbon dioxide tests
- adjust or repair to bring air quality and flow to standard

3.2.16 Using psychrometric charts, calculate temperatures, humidity, heat quantities and air volumes
- demonstrate use of psychrometric chart
- plot temperatures, humidity, enthalpy, and other psychrometric values on chart
- calculate enthalpy and specific volume calculations

3.2.17 Perform heat gain and loss calculations
- using data from a residential facility, calculate heat loss and heat gain
- using data from a commercial facility, calculate heat loss and heat gain

3.2.18 Using gain and loss calculations, determine air flow and equipment capacity requirements for a given environmental space.
- calculate cfm and horsepower requirements of fan
- determine sizing of fan and motor using fan curve data

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Laboratory trainer - air handler, dampers, fans, coils, pulleys, belts, valves, motors, shafts, filters, sensors, guards.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	3.3		
Title:	**Chiller Systems and Refrigeration**		
Duration:	Total Hours: 48	Theory: 36	Practical: 12
Prerequisites:	2.3, 2.4, 2.5, 2.7, 2.8		
Co-requisites:	None		
Cross Reference to Training Standards: 5096.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate, maintain, and troubleshoot chiller and refrigeration systems by accessing information; reading and interpreting blueprints, shop drawings and schematics; coordinating and assisting in seasonal maintenance schedule; maintaining chiller system and components; and monitoring and recording chiller and refrigeration operations.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.3.1 Accessing information from the Ontario Building Code, Canadian Standards Association (CSA), Technical Standards and Safety Authority (TSSA), manufacturers' specifications, limitations, and warranties, determine trade/ maintenance and license responsibilities.

3.3.2 Identify and describe preventive or annual maintenance requirements for chillers, cooling towers, condensers, evaporators, pumps and related equipment.

3.3.3 Read and interpret blueprints, shop drawings and schematics pertaining to chiller systems and related components.

3.3.4 Start up and shut down chiller and related components in accordance with manufacturers' specifications and company procedures.

3.3.5 Schedule seasonal maintenance of chiller and related components.

3.3.6 Perform seasonal maintenance and calibration on chiller equipment in conjunction with refrigeration mechanics.

3.3.7 Perform preventive maintenance on chillers and related components.

3.3.8 Record abnormal situations and troubleshoot malfunctioning situations.

3.3.9 Using electronic detectors or halide torch, locate refrigerant leaks.

3.3.10 Interpret results of chiller and refrigeration tests and initiate corrective action if required.

Learning Content

3.3.1 Accessing information from the Ontario Building Code, Canadian Standards Association (CSA), Technical Standards and Safety Authority (TSSA), manufacturers' specifications, limitations, and warranties, determine trade/ maintenance and license responsibilities.

- determine the allowed work to be performed by the various trades persons according to Pressure Vessels Act and the Mechanical Refrigeration Code B-52
- using warranties and manufacturers' specifications, determine operating and maintenance requirements

3.3.2 Identify and describe preventive or annual maintenance requirements for chillers, cooling towers, condensers, evaporators, pumps and related equipment.

- perform preventive maintenance on air conditioning systems
- clean and winterize tower, remove and clean strainer, check bearings and fan belt, and replace components
- lubricate chiller pumps according to manufacturers' specifications
- open and inspect water side of condenser and evaporator
- clean and brush tubes of condenser and evaporator

3.3.3 Read and interpret blueprints, shop drawings and schematics pertaining to chiller systems and related components.

- locate chiller components such as condenser, evaporator, cooling tower, pumps, motors, piping and valves

3.3.4 Start up and shut down chiller and related components in accordance with manufacturers' specifications and company procedures.

- isolate chiller, cooling tower and other components using electrical and mechanical lock out/tag out procedures
- demonstrate procedure for start up and shut down of reciprocating chiller, centrifugal chiller and rotary screw chiller

3.3.5 Schedule seasonal maintenance of chiller and related components.

- fill out work orders for seasonal maintenance on chiller and components
- identify required maintenance, personnel, tools and equipment needed to perform work
- utilize OHSA guidelines to ensure safety requirements are followed for lock out/tag out and confined space entries
- meet Ozone Depletion Potential (ODP)requirements

3.3.6 Perform seasonal maintenance and calibration on chiller equipment in conjunction with refrigeration mechanics.

- perform refrigeration maintenance and calibration under the direction of a journeyman refrigeration mechanic
- schedule diagnostic testing of chiller and components such as eddy current, motor insulation, refrigerant analysis and oil analysis
- ensure safety controls in working order under supervision of refrigeration mechanic

3.3.7 Perform preventive maintenance on chillers and related components.

- perform visual inspection of chiller and components while operating, including oil, refrigerant and water levels, unusual noises, vibrations and hot spots
- record pressures and temperatures, levels, flows on log sheet
- make minor adjustments of chiller and components within safe operating parameters

3.3.8 Record abnormal situations and troubleshoot malfunctioning situations.

- compare normal operating data of chiller with manufacturers' specifications
- analyze and troubleshoot abnormalities
- complete work order for any repairs

3.3.9 Using electronic detectors or halide torch, locate refrigerant leaks.

- record and issue work order for repair
- complete ozone depletion card for known leaks

3.3.10 Interpret results of chiller and refrigeration tests and initiate corrective action if required.

- describe procedure for carrying out oil analysis; refrigerant analysis; megohmeter test, Eddy current analysis, and vibration monitoring analysis
- assist specialist or technician in carrying out tests
- complete work orders

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Electronic leak detector, laboratory trainer- refrigeration, cooling tower

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	3.4		
Title:	**Low Pressure Boilers**		
Duration:	Total Hours: 36	Theory: 24	Practical: 12
Prerequisites:	2.3, 2.4, 2.7, 2.8		
Co-requisites:	None		
Cross Reference to Training Standards: 5102.0, 5108.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate and monitor low pressure boilers by accessing information; reading and interpreting blueprints, shop drawings and schematics; maintaining low pressure boiler controls and safety devices; inspecting condition of both the combustion and water side of boiler, boiler shell and setting refractory.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.4.1 Identify and explain requirements for testing water quality for boilers and heating systems, perform water tests, and adjust chemical and treatment requirements.

3.4.2 Identify, describe and test safety devices found on low pressure heating boilers as outlined by manufacturers' specifications.

3.4.3 Identify and describe the CSA-B51-97 code requirements for low pressure heating boilers.

3.4.4 Calculate boiler capacities.

3.4.5 Check location and layout of boiler and auxiliary equipment using blueprints, shop drawings and schematics.

3.4.6 Identify and describe the function of boiler auxiliary equipment.

3.4.7 Test safety devices on boilers and auxiliary equipment.

3.4.8 Adjust and calibrate safety devices within trade/maintenance and license limitations.

3.4.9 Perform routine operating procedures on low pressure heating boiler.

3.4.10 Verify operation of boiler operating control and compare with manufacturers' specifications.

3.4.11 Prepare boiler for inspection and annual maintenance.

3.4.12 Pressure test water side of low pressure heating boiler to specified pressure and determine if leaks or cracks are present.

3.4.13 Arrange for insurance inspector or Technical Standards and Safety Authority inspector to view boiler for certification.

3.4.14 Coordinate gas regulator and valve calibration, burner set-up, fuel gas analysis using gas fitter or contractor.

Learning Content

3.4.1 Identify and explain requirements for testing water quality for boilers and heating systems, perform water tests and adjust chemical and treatment requirements.

- demonstrate procedure for water testing of the heating system and boiler as set out by the treatment company
- record in log book results of water test
- interpret test results
- calculate type and amount of chemicals needed

3.4.2 Identify, describe and test safety devices found on low pressure heating boilers.

- describe safety devices used on boilers and heating systems such as low water cut-off, safety relief valve, safety pop valve, gauge glass, water column, low gas pressure cut-out, high water cut-out, low air flow switch and burner flame failure
- test safety devices as per schedule
- record test results in logbook as outlined in manufacturers' specifications
- perform duties stated in the preventive maintenance schedule

3.4.3 Identify and describe the CSA-B51-97 code requirements for low pressure heating boilers.

- describe construction and theory of operation of fire tube, tubular (coil tube, modular type, cast iron, sectional, water tube and electric boilers

3.4.4 Calculate boiler capacities using given formulae.
- calculate steam flow (pounds or kilograms of water per hour)
- calculate input and output
- calculate British Thermal units
- calculate boiler horsepower
- calculate volume in gallons of water
- calculate pressure and altitude
- calculate temperatures

3.4.5 Check location and layout of boiler and auxiliary equipment using blueprints, shop drawings and schematics.
- locate boiler piping, valves, pumps, control valves, temperature sensors, pressure sensors, level gauges, safety valves

3.4.6 Identify and describe the function of boiler auxiliary equipment.
- describe operation and construction of boiler auxiliary devices and safety control equipment such as expansion tank, draft fan, low water fuel cut out, safety relief valves, operation controls, and high limit switches

3.4.7 Test safety devices on boilers and auxiliary equipment.
- test safety devices such as low water cut out, flame detector, high limit, pressure relief valve, low gas pressure, low air cut-out and fan relay switch
- log all tests of safety devices in log book

3.4.8 Adjust and calibrate safety devices within trade/maintenance and license limitations.
- identify safety devices that can be adjusted by the Facilities Technician and those that require qualified tradespersons

3.4.9 Perform routine operating procedures on low pressure heating boiler.
- perform visual checks of boiler, valves, controls pumps, and fans
- monitor levels, pressures, temperatures and flows
- monitor and check boiler components and auxiliary equipment
- record water levels, pressures temperatures and flow in log book

3.4.10 Verify operation of boiler operating control, compare with manufacturers' specifications.
- verify boiler operation through a start up and shut down procedure
- access manufacturers specifications and technical data for comparison
- record abnormal condition
- facilitate repairs if required

3.4.11 Prepare boiler for inspection and annual maintenance; the water side of boilers.
- lock out/tag out a boiler and related equipment both electrically and mechanically
- visually inspect condition of combustion chamber, refractory, tubes, burner assembly, tube sheet, steam drum, mud drum and other combustion side components
- safely open hand holes and manholes
- inspect condition of tube or drum surfaces

3.4.12 Pressure test water side of low pressure heating boiler to specified pressure and determine if leaks or cracks are present.
- perform pressure test of boiler shell using equipment
- ensure pressure does not exceed maximum limitations

3.4.13 Arrange for insurance inspector or Technical Standards and Safety Authority inspector to view boiler for certification.
- assist inspector in performing a boiler inspection

3.4.14 Coordinate gas regulator and valve calibration, burner set-up, fuel gas analysis using gas fitter or contractor.
- prepare work scope or maintenance work order to facilitate combustion and gas repairs and adjustment according to in house trade and license limitations

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Fire tube, tubular (coil tube) modular type, cast iron sectional water and electric boiler mock-ups, laboratory trainer – boiler.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
60%	40%	100%

Number:	3.5		
Title:	**Sensing Devices**		
Duration:	Total Hours: 30	Theory: 21	Practical: 9
Prerequisites:	2.2, 2.5, 2.8, 2.9		
Co-requisites:	None		
Cross Reference to Training Standards: 5105.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate and maintain control systems and instrumentation by accessing information; reading and interpreting blueprints, shop drawings and schematics; operating building control system; troubleshooting control system operations; and maintaining control system and system components.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.5.1 Identify and describe types of control systems used in buildings.

3.5.2 Determine control system operating parameters and identify control system modes.

3.5.3 Read and interpret blueprints, shop drawings, and schematics to locate control system components, piping and controlled devices.

3.5.4 Prepare drawings and sketches of sensors, transmitters, controllers and controlled devices for control system.

3.5.5 Using blueprints, shop drawings, and manufacturers' specifications, identify safety devices and emergency controls for control systems.

3.5.6 Monitor, record and log temperatures, pressure and humidity and determine control system efficiency. Adjust set points to maintain the control system within its control parameters.

3.5.7 Identify malfunctions or operating problems with sensors, transmitters, controllers, controlled devices and computer hardware/software.

3.5.8 Troubleshoot problems that cannot be corrected by simple adjustment and calibration.

3.5.9 Repair, replace or refurbish control system components.

3.5.10 Maintain testing gauges, thermometers, pneumatic equipment, and multimeters.

3.5.11 Calibrate sensors, transmitters and controllers as per preventive maintenance schedule.

3.5.12 Access information/data on computer control systems.

3.5.13 Adjust set points on computer control systems and adjust control ranges and parameters.

3.5.14 Print log files from computer database.

3.5.15 Using database information, prepare trend graphs for control system temperatures, pressure, flows, levels and other data.

Learning Content

3.5.1 Identify and describe types of control systems used in buildings.
- describe types of control systems such as manual, pneumatic, electric, electronic, direct digital control (DDC) and hydraulic

3.5.2 Determine control system operating parameters and identify control system modes.
- identify system operating parameters for heating, cooling, ventilation, fire, security systems or combination systems
- describe each type of control system and categorize as open loop, closed loop, two position, proportional or proportional plus reset

3.5.3 Read and interpret blueprints, shop drawings, and schematics to locate control system components, piping and controlled devices.
- identify and locate control system components such as transmitters, controllers

3.5.4 Prepare drawings and sketches of sensors, transmitters, controllers and controlled devices for control system.

3.5.5 Using blueprints, shop drawings, and manufacturers' specifications, identify safety devices and emergency controls for control systems.

3.5.6 Monitor, record and log temperatures, pressure and humidity and determine control system efficiency and adjust set points to maintain the control system within its control parameters.

3.5.7 Identify malfunctions or operating problems with sensors, transmitters, controllers, controlled devices and computer hardware/software.

- record any malfunction or operating problems with the control system and related components
- using computer automation, determine operating system problems

3.5.8 Troubleshoot problems that cannot be corrected by simple adjustment and calibration.

- arrange for and assist qualified controls technician to correct problem by providing information and technical data for repair

3.5.9 Repair, replace or refurbish control system components.

- using tools and equipment, repair control system components such as valves, actuators, damper motors, transducers, sensors, thermostats and humidistats
- select from inventory or purchase control system component needing replacement

3.5.10 Maintain testing gauges, thermometers, pneumatic equipment and multimeters.

- store pneumatic testing tools
- calibrate and certify gauges and specialized measuring equipment such as analyzer by sending to a qualified agency

3.5.11 Calibrate sensors, transmitters and controllers as per preventive maintenance schedule.

- compare actual component reading with standard and adjust if necessary

3.5.12 Access information on computer control systems such as temperatures, pressures, humidity readings, levels flows, set points, ranges and other pertinent data.

- demonstrate ability to use computer software or control program to observe temperatures, pressures, humidity levels, flows and set points

3.5.13 Adjust set points on computer control systems and adjust control ranges and parameters.

- access computer programming mode and adjust control ranges and parameters

3.5.14 Print log files from computer database for temperature, pressures, humidity, levels and flows.

- prepare a database from temperature, humidity, pressure, level and flow readings gathered

3.5.15 Using data base information, prepare trend graphs for control system temperatures, pressure, flows, levels and other data.

- prepare a trend graph, pie graph or bar graph for analysis

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Building automation systems, thermostats, valves, dampers, humidistats, pneumatic control systems and devices.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	3.6		
Title:	**Power and Utilities Management**		
Duration:	Total Hours: 30	Theory: 24	Practical: 6
Prerequisites:	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9		
Co-requisites:	None		
Cross Reference to Training Standards: 5107.0			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to operate, monitor and analyze utility consumption by accessing information, reading and interpreting blueprints and schematics, recording, annualizing, and monitoring readings.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.6.1 Adjust, operate and maintain power equipment to control utility demand.

3.6.2 Using manufacturers' manuals, identify and read utility meters used in industrial/commercial applications.

3.6.3 Interpret blueprints and building single line diagrams to determine location of the meters.

3.6.4 Develop a maintenance history of electrical consumption and compare annual consumption reports as to their variances.

3.6.5 Prepare reports and log readings and forward to authorities according to local bylaws or company standards.

3.6.6 Prepare recommendation plans to reduce demand load and overall consumption of utilities.

Learning Content

3.6.1 Adjust, operate and maintain power equipment to control utility demand.

- describe optimum stop-start and peak demand shedding

3.6.2 Using manufacturers' manuals, identify and read utility meters used in industrial/commercial applications.
- describe types of meters used for gas, water and electricity
- describe metering regulations as pertains to calibration, adjustments, replacement and maintenance

3.6.3 Interpret blueprints and building single line diagrams to determine location of meters.
- describe type and size of meter

3.6.4 Develop a maintenance history of electrical consumption and compare annual consumption reports as to their variances.
- record consumption readings
- perform required calculations
- record data

3.6.5 Prepare reports and log readings and forward to authorities as determined by local bylaws or company standards.
- record readings and consumption figures and forward to proper authorities

3.6.6 Prepare recommendation plans to reduce demand load and overall consumption of utilities.

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

Number:	3.7		
Title:	**Project Management**		
Duration:	Total Hours: 18	Theory: 18	Practical: 0
Prerequisites:	2.8		
Co-requisites:	None		
Cross Reference to Training Standards: 5092.01, 5092.03 to U5092.06			

General Learning Outcomes

Upon successful completion of the reportable subject, the apprentice is able to demonstrate organizational skills, manage trades people, monitor contractors, ensure adherence to relevant codes, prepare and maintain records, prepare budgets, and track costs.

Learning Outcomes

Upon successful completion, the apprentice is able to:

3.7.1 Access information from the Ontario Building Code, company operating and procedures manual, manufacturers' specifications and warranties, work order file system, and equipment.

3.7.2 Schedule dates, times and frequency for preventive maintenance work.

3.7.3 Prepare cost analysis of work performed.

3.7.4 Perform scheduled preventive maintenance within limitations set by company standards or license/certification requirements.

3.7.5 Obtain required permits, certificates or specialized requirement for work to be performed and complete forms for inspection certificates, warranties and government regulations.

3.7.6 Schedule inspectors, trades people, contractors to fulfill preventive maintenance scheduled work that cannot be completed by in-house staff.

3.7.7 Ensure trades people and contractors are in compliance with applicable safety regulations.

3.7.8 Inspect work done by in-house staff and outside trades people and contractors.

3.7.9 Prepare cost analysis of repairs, renovations, and additions to physical plant.

Learning Content

3.7.1 Access information from the Ontario Building code, company operating and procedures manual, manufacturers' specifications and warranties, work order file system, and equipment.
- ensure preventive maintenance schedules are in compliance with the required standards

3.7.2 Schedule dates, times and frequency for preventive maintenance work.

3.7.3 Prepare cost analysis of work performed.
- itemize parts, tools, labour and contractors
- prepare cost analysis of job performed by a contractor
- determine parts, tooling, and labour cost for given work

3.7.4 Perform scheduled preventive maintenance within limitations set by company standards or license/certification requirements.
- perform required checks
- make adjustments/repairs where necessary

3.7.5 Obtain required permits, certificates or specialized requirement for work to be performed and complete documentation and forms for inspection certificates, warranties and government regulations.
- obtain permits for work to be performed by contractors

3.7.6 Schedule inspectors, trades people, contractors for preventive maintenance scheduled work that cannot be completed by in-house staff.
- demonstrate time management and interpersonal skills when scheduling inspections and contractors

3.7.7 Ensure trades people and contractors are in compliance with applicable safety regulations.
- ensure compliance with OSHA guidelines

3.7.8 Inspect work done by in-house staff and outside trades people and contractors.
- visually inspect and record work performed by in house and outside contractors in building log

3.7.9 Prepare cost analysis of repairs, renovations, and additions to physical plant.
- submit detailed cost analysis of needed repair found during routine preventive maintenance and/or emergency repair directly resulting from preventive maintenance
- prepare cost analysis for identified repair or project including parts and labour.

Instructional/Delivery Strategies:

Reference Materials:

Minimum Equipment List:

Computer, project management software.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

APPENDIX A: Acronyms List

AC	Alternating Current
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
CEC	Canadian Electrical Code
CSA	Canadian Standards Association
DC	Direct Current
DDC	Distributed Digital Control
DWV	Drain Waste Vent
ESA	Electrical Safety Authority
H_2O	Water
IC	Integrated Circuit
MSDS	Material Safety Data Sheet
NBC	National Building Code
NFPA	National Fire Protection Act OBC Ontario Building Code
OHSA	Occupational Health and Safety Act
PVC	Polyvinyl Chloride
SAE	Society of Automotive Engineers
TDS	Total Dissolved Solids
TSSA	Technical Standards and Safety Authority
WHMIS	Workplace Hazardous Material Information System
WSIB	Workplace Safety and Insurance Board

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