

SKILLED**TRADES**<sup>BC</sup>

PROGRAM OUTLINE

Gasfitter – Class B

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# **GASFITTER – CLASS B PROGRAM OUTLINE**

**APPROVED BY INDUSTRY  
SEPTEMBER 2017**

**Developed by  
SkilledTradesBC  
Province of British Columbia**

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**Section 1**  
**INTRODUCTION**  
**Gasfitter – Class B**

## Foreword

The Gasfitter - Class B Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on British Columbia industry and instructor subject matter experts.

Practical instruction by demonstration and student participation should be integrated with classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship.

This Program Outline includes a list of recommended reference textbooks that are available to support the learning objectives and the minimum shop requirements needed to support instruction.

The Program Outline was prepared with the advice and assistance of British Columbia industry and instructor subject matter experts and will form the basis for further updating of the British Columbia Gasfitter – Class B Program and learning resources.

Each competency is to be evaluated through the use of written examination in which the learner must achieve a minimum of 70% in order to receive a passing grade. The types of questions used on these exams must reflect the cognitive level indicated by the learning objectives and the learning tasks listed in the related competencies.

Achievement Criteria are included for those competencies that require a practical component. The intent of including Achievement Criteria in the Program Outline is to ensure consistency in training across training institutions in British Columbia. Their purpose is to reinforce the theory and to provide a mechanism for evaluation of the individual's ability to apply the theory to practice. It is important that these performances be observable and measurable and that they reflect the skills spelled out in the competency as those required as competent journey person. The conditions under which these performances will be observed and measured must be clear to the individual as well as the criteria by which the individual will be evaluated. The individual must also be given the level of expectation of success.

The performance spelled out in the Achievement Criteria is a suggested performance and is not meant to stifle flexibility of delivery. Training providers are welcome to substitute other practical performances that measure skills and attainment of the competency. Multiple performances may also be used to replace individual performances where appropriate.

### **Important Program Information:**

Due to the high level of skill required in Math and Physics for the Gasfitter B program, industry and instructors **strongly advise apprentices to upgrade their Math and Physics skills** prior to registration for technical training in this program.

#### **SAFETY ADVISORY**

Be advised that references to the WorkSafe BC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: <http://www.worksafebc.com>). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.

## **Acknowledgements**

This Program Outline was prepared with the advice and direction of an industry steering committee convened initially by SkilledTradesBC (SkilledTradesBC). Members include:

- Michael Pizzolato, Cannepp (Canadian Engineered Products & Sales)
- Richard Doerksen, Apex Steel and Gas
- Glen Ohs, Corix Utilities
- Rob Marchiori, Ram Mechanical
- Ray Bollinger, Just Mechanical
- Shane Richardson, Resilient Plumbing
- Paul Bach, PJB Mechanical
- Kent O'Sullivan, Fortis BC
- Brad Wyatt, Technical Safety BC (formerly known as BC Safety Authority)

Industry and Instructor Subject Matter Experts retained to assist in the development of Program Outline content:

- Marty Old, TRU
- Brian Sweet, BCIT
- Rick Vanier, PVC
- Glen Ohs, Corix Utilities
- Rob Marchiori, Ram Mechanical
- Richard Doerksen, Apex Steel and Gas
- Michael Pizzolato, Cannepp (Canadian Engineered Products & Sales)
- Carl Kunic, Resilient Plumbing

Industry Subject Matter Experts and Instructors retained as outline reviewers:

- Marty Old, Marty Old Consulting
- Glen Ohs, Corix Utilities
- Brian Sweet, BCIT

Facilitators:

- Angela Caughy

SkilledTradesBC would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Gasfitter – Class B occupation.

## How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
<b>Program Credentialing Model</b>	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
<b>OAC</b>	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
<b>Training Topics and Suggested Time Allocation</b>	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	NA
<b>Program Content</b>	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
<b>Training Provider Standards</b>	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment

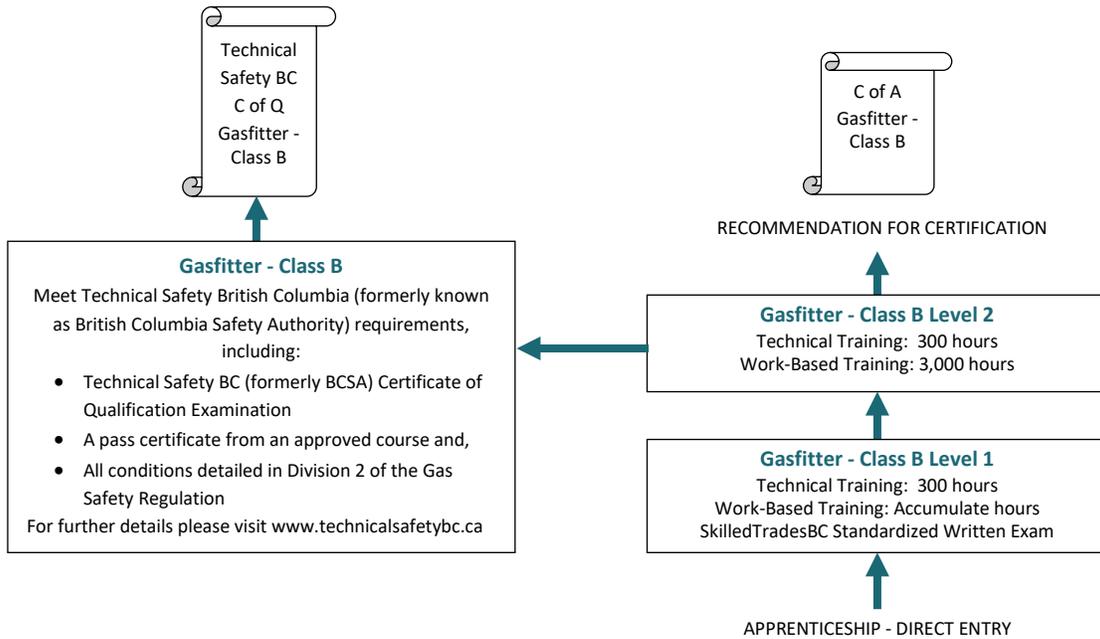
<b>Section</b>	<b>Training Providers</b>	<b>Employers/ Sponsors</b>	<b>Apprentices</b>	<b>Challengers</b>
<b>Assessment Guidelines</b>	Understand the relative weightings of various competencies of the occupation on which assessment is based	Understand the relative weightings of various competencies of the occupation on which assessment is based	Understand the relative weightings of various competencies of the occupation on which assessment is based	Understand the relative weightings of various competencies of the occupation on which assessment is based
<b>Appendix – Glossary of Terms</b>	Defines program specific terms			

**Section 2**  
**PROGRAM OVERVIEW**  
**Gasfitter – Class B**

## Program Credentialing Model

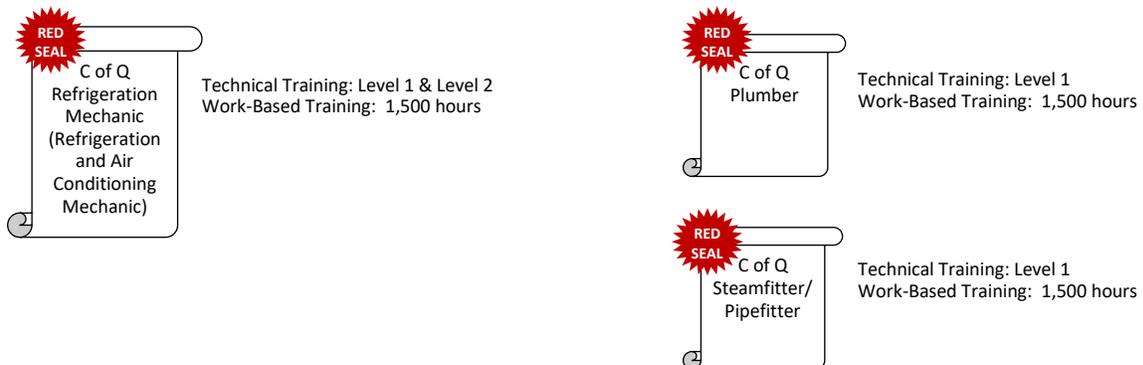
### Gasfitter - Class B

*C of Q = Certificate of Qualification  
C of A = Certificate of Apprenticeship  
WBT = Work-Based Training*



#### CROSS-PROGRAM CREDITS

Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program



## Occupational Analysis Chart

### GASFITTER – CLASS B

Gasfitters – Class B design, install, test, adjust, maintain and repair lines, appliances, equipment and accessories in various sectors. Fuels may include natural gas, manufactured gas, liquefied petroleum gas, digester gas, landfill gas, biogas or a mixture or dilution of any of these gases and Hydrogen. Appliances and equipment include those that do not exceed 400 000 Btuh (British Thermal Units per hour) or 120 kW (kilowatts) such as boilers, burners, makeup air units, furnaces, process burners, and various other gas-fired equipment.

Gasfitters – Class A design, install, test, adjust, maintain and repair lines, appliances, equipment and accessories in various sectors. Fuels may include natural gas, manufactured gas, liquefied petroleum gas, digester gas, landfill gas, biogas or a mixture or dilution of any of these gases and Hydrogen. Appliances and equipment include those exceeding 400 000 Btuh (British Thermal Units per hour) or 120 kW (kilowatts) such as boilers, burners, makeup air units, furnaces, process burners, and various other gas-fired equipment.

*Gas B = Level 1,2; Gas A= Level A-1, A-2*

<b>USE COMMON OCCUPATIONAL SKILLS</b> A	Control workplace hazards A1	Use drawings and specifications A2	Use common tools and access equipment A3	Use technical instruments and testers A4	Use codes, regulations and standards A5	Organize work and maintain records A6
	1	1     A-1	1	1   2   A-1   A-2	1   2   A-1   A-2	1   2   A-1
<b>APPLY FUNDAMENTALS OF GAS UTILIZATION</b> B	Apply gas properties B1	Apply combustion theory B2	Apply draft theory B3	Interpret heating, cooling and process systems B4	Apply knowledge of mechanical safety devices B5	Apply alternate-fuel theory B6
	1	1     A-1   A-2	1     A-1	1   2   A-1	1   2   A-1	2   A-1
<b>APPLY ELECTRICAL CONCEPTS</b> C	Use the principles of electricity and electronics C1	Use electrical wiring diagrams and schematics C2	Use the Canadian Electrical Code (CEC) C3	Apply single phase motor theory C4	Apply three phase motor theory C5	Apply Variable Frequency Drive (VFD) and Electronically Commutated Motors (ECM) technology C6
	1   2   A-1	1   2   A-1   A-2	1   2   A-1	1   2	1     A-1	2   A-1
	Apply wiring practices C7	Troubleshoot electrical circuits C8	Apply communication and networking technology C9			
	1   2   A-1	2   A-1	2   A-1   A-2			

**Program Overview**

<b>PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS</b> <b>D</b>	Size piping and tubing systems D1 1     A-1	Select regulators, valves, and valve train components D2 1   2   A-1   A-2	Plan propane system installations D3   2   A-1	Size venting systems D4   2   A-1	Size air supply systems D5   2   A-1	Select gas-fired appliances D6 1   2   A-1
	Select burners D7 1   2   A-1	Select flame safeguards D8 1   2   A-1	Select combustion, safety and operating controls D9   2   A-1	Select electrical components D10 1     A-1	Select automation and instrumentation control systems D11   2     A-2	Plan a project D12 1   2   A-1   A-2
<b>INSTALL GAS-FIRED SYSTEMS</b> <b>E</b>	Install piping and tubing systems E1 1	Install regulators, valves, and valve train components E2 1   2   A-1	Install LPG, LNG, CNG, vaporizing and mixing systems E3   2   A-1	Install venting systems E4   2   A-1	Install air supply systems E5 1   2   A-1	Install draft control systems E6   2   A-1
	Install burners E7       A-2	Install flame safeguards E8     A-1	Install combustion, safety and operating controls E9     A-1	Install automation and instrumentation control systems E10   2     A-2	Install boilers and ancillary equipment E11   2   A-1	Install air heating appliances and equipment E12   2     A-2
<b>COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT</b> <b>F</b>	Commission fuel/air delivery systems F1 1   2   A-1   A-2	Perform appliance start-up procedures F2   2     A-2	Interpret gas metering devices F3   2     A-2	Perform combustion analysis F4   2   A-1   A-2	Commission boilers and ancillary equipment F5   2     A-2	Commission direct-fired make-up air heaters F6       A-2
	Commission furnaces and ovens F7   2     A-2	Program temperature, pressure and operating controls F8   2     A-2	Program combustion control systems F9       A-2	Program PLCs F10       A-2	Commission draft control systems F11   2     A-2	Training and handover of gas-fired equipment F12   2     A-2

**Program Overview**

**MAINTAIN AND  
SERVICE GAS-FIRED  
APPLIANCES AND  
EQUIPMENT** **G**

Service gas distribution systems					G1
	2		A-2		

Service gas burners and ancillary equipment					G2
	2		A-2		

Maintain boilers and ancillary equipment					G3
	2		A-2		

Maintain gas-fired appliances					G4
	2		A-2		

Maintain gas-fired refrigeration equipment					G5
	2		A-2		

Service fuel/air delivery systems					G6
	2		A-2		

Service and repair control systems					G7
	2		A-2		

Repair and replace furnace refractory					G8
		A-1			

Decommission and disconnect gas-fired appliances and equipment					G9
	2		A-2		

## Training Topics and Suggested Time Allocation: Level 1

### GASFITTER – CLASS B – LEVEL 1

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line A</b>	<b>Use Common Occupational Skills</b>	<b>20%</b>	<b>85%</b>	<b>15%</b>	<b>100%</b>
A1	Control workplace hazards		✓		
A2	Use drawings and specifications		✓	✓	
A3	Use common tools and access equipment		✓	✓	
A4	Use technical instruments and testers		✓	✓	
A5	Use codes, regulations, and standards		✓	✓	
A6	Organize work and maintain records		✓	✓	
<b>Line B</b>	<b>Apply Fundamentals of Gas Utilization</b>	<b>14%</b>	<b>90%</b>	<b>10%</b>	<b>100%</b>
B1	Apply gas properties		✓		
B2	Apply combustion theory		✓		
B3	Apply draft theory		✓	✓	
B4	Interpret heating, cooling and process systems		✓		
B5	Apply knowledge of mechanical safety devices		✓	✓	
<b>Line C</b>	<b>Apply Electrical Concepts</b>	<b>24%</b>	<b>85%</b>	<b>15%</b>	<b>100%</b>
C1	Use the principles of electricity and electronics		✓		
C2	Use electrical wiring diagrams and schematics		✓	✓	
C3	Use the Canadian Electrical Code (CEC)		✓		
C4	Apply single phase motor theory		✓		
C5	Apply three phase motor theory		✓		
C7	Apply wiring practices		✓	✓	
<b>Line D</b>	<b>Plan Gas-Fired Appliance System Installations</b>	<b>24%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
D1	Size piping and tubing systems		✓	✓	
D2	Select regulators, valves, and valve train components		✓		
D6	Select gas-fired appliances		✓		
D7	Select burners		✓		
D8	Select flame safeguards		✓		
D10	Select electrical components		✓	✓	
D12	Plan a project		✓	✓	
<b>Line E</b>	<b>Install Gas-Fired Systems</b>	<b>14%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
E1	Install piping and tubing systems		✓		
E2	Install regulators, valves, and valve train components		✓		
E5	Install air supply systems		✓		
<b>Line F</b>	<b>Commission Gas-Fired Appliances and Equipment</b>	<b>4%</b>	<b>90%</b>	<b>10%</b>	<b>100%</b>
F1	Commission fuel/air delivery systems		✓	✓	
<b>Total Percentage for Gasfitter – Class B Level 1</b>		<b>100%</b>			

## Training Topics and Suggested Time Allocation: Level 2

### GASFITTER – CLASS B – LEVEL 2

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line A</b>	<b>Use Common Occupational Skills</b>	<b>8%</b>	<b>90%</b>	<b>10%</b>	<b>100%</b>
A4	Use technical instruments and testers		✓		
A5	Use codes, regulations, and standards		✓		
A6	Organize work and maintain records		✓		
<b>Line B</b>	<b>Apply Fundamentals of Gas Utilization</b>	<b>8%</b>	<b>85%</b>	<b>15%</b>	<b>100%</b>
B4	Interpret heating, cooling and process systems		✓		
B5	Apply knowledge of mechanical safety devices		✓	✓	
B6	Apply alternate-fuel theory		✓	✓	
<b>Line C</b>	<b>Apply Electrical Concepts</b>	<b>24%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
C1	Use the principles of electricity and electronics		✓		
C2	Use electrical wiring diagrams and schematics		✓	✓	
C3	Use the Canadian Electrical Code (CEC)		✓		
C4	Apply single phase motor theory		✓		
C6	Apply Variable Frequency (VFD) and Electronically Commutated Motors (ECM) technology		✓		
C7	Apply wiring practices		✓		
C8	Troubleshoot electrical circuits		✓		
C9	Apply communication and networking technology		✓		
<b>Line D</b>	<b>Plan Gas-Fired Appliance System Installations</b>	<b>24%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
D2	Select regulators, valves, and valve train components		✓		
D3	Plan propane system installations		✓		
D4	Size venting systems		✓		
D5	Size air supply systems		✓		
D6	Select gas-fired appliances		✓		
D7	Select burners		✓		
D8	Select flame safeguards		✓		
D9	Select combustion, safety and operating controls		✓		
D11	Select automation and instrumentation control systems		✓		
D12	Plan a project		✓		
<b>Line E</b>	<b>Install Gas-Fired Systems</b>	<b>16%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
E2	Install regulators, valves and valve train components		✓		
E3	Install LPG, LNG, CNG vaporizing and mixing systems		✓		
E4	Install venting systems		✓		
E5	Install air supply systems		✓		
E6	Install draft control systems		✓		
E10	Install automation and instrumentation control systems		✓		
E11	Install boilers and ancillary equipment		✓		

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
E12	Install air heating appliances and equipment		✓		
<b>Line F</b>	<b>Commission Gas-Fired Appliances and Equipment</b>	<b>16%</b>	<b>50%</b>	<b>50%</b>	<b>100%</b>
F1	Commission fuel/air delivery systems		✓		
F2	Perform appliance start-up procedures		✓	✓	
F3	Interpret gas metering devices		✓		
F4	Perform combustion analysis		✓		
F5	Commission boilers and ancillary equipment		✓	✓	
F7	Commission furnaces and ovens		✓	✓	
F8	Program temperature, pressure and operating controls		✓		
F11	Commission draft control systems		✓		
F12	Training and handover of gas-fired equipment		✓		
<b>Line G</b>	<b>Maintain and Service Gas-Fired Appliances and Equipment</b>	<b>4%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
G1	Service gas distribution systems		✓		
G2	Service gas burners and ancillary equipment		✓		
G3	Maintain boilers and ancillary equipment		✓		
G4	Maintain gas-fired appliances		✓		
G5	Maintain gas-fired refrigeration equipment		✓		
G6	Service fuel/air delivery systems		✓		
G7	Service and repair control systems		✓		
G9	Decommission and disconnect gas-fired appliances and equipment		✓		
<b>Total Percentage for Gasfitter – Class B Level 2</b>		<b>100%</b>			

**Section 3**  
**PROGRAM CONTENT**  
**Gasfitter – Class B**

# **Level 1**

## **Gasfitter – Class B**

**Line (GAC): A USE COMMON OCCUPATIONAL SKILLS**

**Competency: A1 Control workplace hazards**

**Objectives**

To be competent in this area, the individual must be able to:

- Assess and manage workplace hazards.
- Apply OHS regulations and WorkSafe BC standards.
- Use WHMIS.

**LEARNING TASKS**

1. Describe common workplace hazards

2. Manage workplace hazards

3. Describe lock-out and tag-out procedures

**CONTENT**

- Short term hazards
  - Confined space
  - Elevations
  - Electrical
  - Compressed gas
  - Explosive material (dust)
  - Air quality
- Long term hazards
  - Respiratory disease
  - Repetitive strain injuries
  - Hearing loss
  - Chemical exposure
- Constant awareness of surroundings
  - Safe attitude
  - Housekeeping
  - Site conditions
- WHMIS
- TDG
- OHS regulation
- WorkSafe BC standards
- Personal Protective Equipment (PPE)
- Emergency shutoffs
- Fire prevention
- Chemical hazard response
  - Eye wash facilities
  - Emergency shower
- Evacuation plan
  - Marshalling/mustering areas
  - Emergency exits
  - Emergency contact/phone numbers
- Understanding of system operation
- Components requiring lock-out
- Identification requirements

**LEARNING TASKS**

**CONTENT**

- Situations where lock-out is required
- Lock-out equipment
  - Chains
  - Tags
  - Locks
  - Blind flanges
  - Spectacle

**Achievement Criteria - (Workplace)**

Performance	The learner is aware of WHMIS and that it is a required certification.
Conditions	To be assessed in the workplace.
Criteria	Tasks must be performed within specifications and time frames acceptable to industry.



**Line (GAC):           A    USE COMMON OCCUPATIONAL SKILLS**

**Competency:         A3   Use common tools and access equipment**

**Objectives**

To be competent in this area, the individual must be able to:

- Use and maintain hand and power tools.
- Use cutting, soldering and brazing equipment.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Use and maintain hand and power tools</li> <br/> <li>2. Use access equipment</li> <br/> <li>3. Use cutting, soldering and brazing equipment</li> <br/> <li>4. Describe rigging and hoisting equipment</li> </ol> | <ul style="list-style-type: none"> <li>• Trade specific hand and power tools               <ul style="list-style-type: none"> <li>○ See tools and equipment list in appendix</li> </ul> </li> <br/> <li>• Ladders</li> <li>• Platforms</li> <li>• Lifts</li> <li>• Safety</li> <br/> <li>• Oxy-acetylene equipment</li> <li>• Air acetylene equipment</li> <li>• Maintenance/storage</li> <li>• Safety</li> <br/> <li>• Selection               <ul style="list-style-type: none"> <li>○ Tirsors</li> <li>○ Genie lift</li> <li>○ Slings</li> <li>○ Shackles</li> </ul> </li> <li>• Ratings</li> <li>• Inspection</li> <li>• Storage and maintenance</li> </ul> |
|--|---|



**LEARNING TASKS**

4. Interpret pressure readings
  
5. Describe temperature measuring instruments
  
6. Use temperature measuring instruments
  
7. Describe electrical testing meters
  
8. Use electrical test meters
  
9. Use combustible gas indicator (CGI)

**CONTENT**

- Code B149.1
- Manufacturer's specifications
- Diagnostics
  - Pressure tests
  - Leak detection
- Tightness of closure
- Thermometer
- Pyrometer
- Thermocouple
- Thermistor
- Scales
- Calibration
- Check readings
- Applications
- Types
  - Multi-meter
  - Ammeter
  - Ohm-meter
  - Volt-meter
  - Micro-ammeter
  - Milli-ammeter
- Check voltage
- Check current
- Check resistance
- Check for continuity
- Types
  - Electronic
  - Laser
  - Draeger
  - Flame ionization
- Applications

**Line (GAC):           A    USE COMMON OCCUPATIONAL SKILLS**

**Competency:         A5   Use codes, regulations, and standards**

**Objectives**

To be competent in this area, the individual must be able to:

- Interpret B149.1 sections 1, 2, 3, 4, 6, Annex A & B.
- Interpret the Safety Standards Act, Safety Standards General Regulation and Gas Safety Regulation.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| 1. Describe code implications                | <ul style="list-style-type: none"> <li>• Design</li> <li>• Planning</li> <li>• Installation</li> <li>• Maintenance</li> <li>• Decommissioning</li> </ul>  |
| 2. Describe the B149 Gas Code series         | <ul style="list-style-type: none"> <li>• B149.1, B149.2, B149.3</li> <li>• Layout</li> <li>• Sections</li> <li>• Contents</li> <li>• Index</li> <li>• Annexes</li> <li>• Tables</li> <li>• Definitions</li> <li>• Scope</li> <li>• Revisions</li> </ul>   |
| 3. Interpret Sections of the B149.1 Gas Code | <ul style="list-style-type: none"> <li>• Scope</li> <li>• Reference Publications</li> <li>• Definitions</li> <li>• General</li> <li>• Piping and Tubing Systems, Hose, and Fittings</li> <li>• Annexes A &amp; B</li> </ul>   |
| 4. Use Gas Regulations                       | <ul style="list-style-type: none"> <li>• Role of Technical Safety BC (formally known as BC Safety Authority)</li> <li>• Safety Standards Act</li> <li>• Safety Standards General Regulation</li> <li>• Gas Safety Regulation</li> <li>• Permits</li> <li>• Notification of Completion</li> <li>• Approvals</li> <li>• Variations to the National Gas Code</li> <li>• Bulletins, Directives and Safety Orders</li> </ul> |

**Line (GAC):           A    USE COMMON OCCUPATIONAL SKILLS**

**Competency:         A6   Organize work and maintain records**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe information contained in manufacturer and supplier documentation.
- Describe how to source manufacturer’s documentation.
- Describe record management.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Describe information contained in manufacturer and supplier documentation</li> <br/> <li>2. Describe how to source manufacturer’s documentation</li> <br/> <li>3. Describe record management</li> </ol> | <ul style="list-style-type: none"> <li>• Installation instructions and requirements</li> <li>• Operation and maintenance manuals</li> <li>• Product specifications               <ul style="list-style-type: none"> <li>○ Certification agencies</li> </ul> </li> <li>• Warranty information</li> <li>• Appliance rating plates</li> <li>• Manufacturer’s web-sites</li> <li>• Contact manufacturer</li> <li>• Local agencies</li> <li>• Paper based filing</li> <li>• Electronic filing</li> <li>• Service reports</li> <li>• Invoices</li> <li>• Time sheets</li> <li>• Purchase orders</li> <li>• Vehicle logs</li> <li>• Maintenance logs</li> <li>• Inventory</li> <li>• Permits</li> <li>• Statements of completion</li> </ul> |
|---|--|





**Line (GAC):**        **B    APPLY FUNDAMENTALS OF GAS UTILIZATION**

**Competency:**     **B3    Apply draft theory**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe draft.
- Describe the building as a system.

**LEARNING TASKS**

1. Describe draft

2. Describe the building as a system

**CONTENT**

- Natural draft
  - Buoyancy
  - Temperature
  - Height
- Terms
  - Stack effect
  - Stack draft
  - Natural draft
  - Chimney effect
- Mechanical draft
- Negative air pressure
- Exhaust equipment
- Air supply equipment
- Building envelope
- Building ventilation
  - Air exchange equipment
- Regional location
- Type of building
- Code requirements
  - B149.1
  - Building Code

**Line (GAC): B APPLY FUNDAMENTALS OF GAS UTILIZATION**

**Competency: B4 Interpret heating, cooling and process systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Perform process heat load calculations.
- Describe the operation of hydronic heating systems.
- Describe the operation of residential forced air systems.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <p>1. Describe the properties of matter</p>                                  | <ul style="list-style-type: none"> <li>• States (Phases)               <ul style="list-style-type: none"> <li>○ Solids</li> <li>○ Liquids</li> <li>○ Gases</li> </ul> </li> <li>• Changes of state               <ul style="list-style-type: none"> <li>○ Physical</li> <li>○ Chemical</li> </ul> </li> </ul>   |
| <p>2. Describe methods of heat transfer</p>                                  | <ul style="list-style-type: none"> <li>• Conduction</li> <li>• Convection</li> <li>• Radiation</li> </ul>   |
| <p>3. Describe process heat calculations</p>                                 | <ul style="list-style-type: none"> <li>• Sensible, latent &amp; specific heat</li> <li>• British thermal unit (Btu)</li> <li>• KiloWatts (kW)</li> </ul>  |
| <p>4. Perform process heat load calculations for liquids, solids and air</p> | <ul style="list-style-type: none"> <li>• Sensible, latent &amp; specific heat</li> <li>• British thermal unit (Btu)</li> <li>• KiloWatts (kW)</li> </ul>  |
| <p>5. Calculate volumetric thermal expansion</p>                             | <ul style="list-style-type: none"> <li>• Expansion coefficients</li> <li>• Temperature               <ul style="list-style-type: none"> <li>○ <math>\Delta T</math></li> </ul> </li> <li>• Volume</li> </ul>  |
| <p>6. Describe the operation of residential hydronic heating systems</p>     | <ul style="list-style-type: none"> <li>• Purpose</li> <li>• Volumetric thermal expansion               <ul style="list-style-type: none"> <li>○ Expansion coefficients</li> <li>○ Temperature                   <ul style="list-style-type: none"> <li>– <math>\Delta T</math></li> </ul> </li> <li>○ Volume</li> </ul> </li> <li>• Components               <ul style="list-style-type: none"> <li>○ Expansion tank</li> <li>○ Mixing valves</li> <li>○ Air separator</li> <li>○ Zone headers</li> <li>○ Zone valves</li> <li>○ Pumps</li> </ul> </li> </ul> |

**LEARNING TASKS**

**CONTENT**

7. Describe the operation of residential forced air systems

- Temperature indicators
- Air vents
- Feed water
- Water treatment
- Piping system configurations
  - Zoning
  - Supply water
  - Return water
  - Balancing
  - High-temperature
  - Low-temperature
  - Mixing
- Heating and cooling generating equipment
  - Boilers
    - High mass
    - Low mass
    - Fire tube
    - Water tube
  - Heat pumps
  - Heat exchangers
    - Plate
    - Tube and shell
  - Solar panels
- Process Flow Diagrams (PFD)
- Controls
- Heat transfer units
- Safety considerations
- Purpose
- Components
- Ducting configurations
  - Supply air
  - Return air
  - Zoning
- Controls
- Balancing

**Line (GAC):            B    APPLY FUNDAMENTALS OF GAS UTILIZATION**

**Competency:        B5    Apply knowledge of mechanical safety devices**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe mechanical safety devices.

**LEARNING TASKS**

1. Describe Mechanical Safety Devices

**CONTENT**

- Pressure relief valves
- Temperature relief valves
- Safety valves
  - Pop Safety (PSV)
- Safety Relief valves (SRV)
- Ratings
- Vacuum relief

**Line (GAC): C APPLY ELECTRICAL CONCEPTS**

**Competency: C1 Use the principles of electricity and electronics**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe electrical concepts.
- Solve simple problems using Ohm's and Kirchhoff's Laws.
- Describe single phase and three phase power supplies.
- Identify transformers.

**LEARNING TASKS**

1. Describe the fundamentals of electricity

2. Describe electrical circuits

**CONTENT**

- Basic principles
  - Atomic theory
  - Electron flow
  - Conductors - insulators
  - Kinds of electricity
    - AC current
    - DC current
    - Static electricity
  - Cathodic protection
    - Anode
    - Cathode
- Properties of wire
  - Resistance
  - Calculating resistance
  - Effect of temperature
  - Types of wires and cables
- Electrical sources
  - AC
    - Single phase
    - Three phase
  - DC
- Parts of a circuit
  - Source
  - Switch
  - Load
- DC circuits and measurements
  - Ohm's Law
  - Measurement of voltage and amperage
  - Resistors in parallel and series
  - Power and energy
  - Closing and opening DC circuits
- AC circuits and measurements

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <p>3. Use laws and formulas</p> <p>4. Describe single phase power characteristics</p> <p>5. Describe three phase power characteristics</p> <p>6. Identify transformers</p> | <ul style="list-style-type: none"> <li>○ Inductance</li> <li>○ AC amperage</li> <li>○ Resistance</li> <li>○ Impedance</li> <li>○ Capacitance</li> <li>○ Power factor</li> <li>● Fundamentals of magnetism             <ul style="list-style-type: none"> <li>○ Natural and artificial magnets</li> <li>○ Magnetic fields</li> <li>○ Strength of field</li> <li>○ Force on two wires</li> </ul> </li> <li>● Permeability</li> <li>● Ohm's Law</li> <li>● Kirchoff's Law</li> <li>● Solve simple problems</li> <li>● AC power distribution             <ul style="list-style-type: none"> <li>○ Generation and transmission</li> <li>○ Voltage drop</li> <li>○ Step-down transformer</li> </ul> </li> <li>● Power available</li> <li>● Single phase power supply             <ul style="list-style-type: none"> <li>○ 3-wire, dual voltage</li> </ul> </li> <li>● Circuit protection             <ul style="list-style-type: none"> <li>○ Fuses</li> <li>○ Circuit breakers</li> </ul> </li> <li>● AC power distribution             <ul style="list-style-type: none"> <li>○ Generation and transmission</li> <li>○ Voltage drop</li> <li>○ Step-down transformer</li> </ul> </li> <li>● Power available</li> <li>● Three phase power supply             <ul style="list-style-type: none"> <li>○ Delta</li> <li>○ Wye</li> </ul> </li> <li>● Type of transformers             <ul style="list-style-type: none"> <li>○ Step-up</li> <li>○ Step-down</li> <li>○ Isolation</li> </ul> </li> <li>● Primary winding</li> <li>● Secondary winding</li> <li>● Tappings</li> </ul> |
|--|---|



**Line (GAC): C APPLY ELECTRICAL CONCEPTS**

**Competency: C3 Use the Canadian Electrical Code (CEC)**

**Objectives**

To be competent in this area, the individual must be able to:

- Interpret the Canadian Electrical Code Part 1.
- Interpret the Electrical Safety Regulations.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Describe the Canadian Electrical Code Part 1</li> <br/> <li>2. Interpret the Electrical Safety Regulations</li> <br/> <li>3. Size conductors</li> <br/> <li>4. Describe wiring installation</li> <br/> <li>5. Describe grounding and bonding techniques</li> </ol> | <ul style="list-style-type: none"> <li>• Section             <ul style="list-style-type: none"> <li>○ 0,2,4,8,10,12</li> <li>○ Appendix B</li> <li>○ Appendix D</li> </ul> </li> <br/> <li>• Technical Safety BC (formerly BC Safety Authority (BCSA))</li> <br/> <li>• Section 4 CEC</li> <br/> <li>• Section 12 CEC</li> <br/> <li>• Section 10 CEC</li> </ul> |
|--|--|

**Line (GAC):** C APPLY ELECTRICAL CONCEPTS

**Competency:** C4 Apply single phase motor theory

**Objectives**

To be competent in this area, the individual must be able to:

- Describe single phase motors.

**LEARNING TASKS**

1. Identify motor components
2. Describe characteristics and operation of single phase motors

**CONTENT**

- Types of components
- AC theory
  - Electromagnetic theory
  - Induction motors

**Line (GAC):** C APPLY ELECTRICAL CONCEPTS

**Competency:** C5 Apply three phase motor theory

**Objectives**

To be competent in this area, the individual must be able to:

- Describe three phase motors.

**LEARNING TASKS**

1. Describe three phase motors

**CONTENT**

- Three phase supplies
  - Delta supply
  - Wye (Y) supply
- Characteristics
- Components
- Operation





**LEARNING TASKS**

**CONTENT**

4. Size piping and tubing systems

- Corrugated stainless steel tubing (CSST)
- Hoses
- Flexible connectors
- Schedules and grades
- Pressure ratings
- Nominal sizes
- Protective coatings
- Cathodic protection
- Identification markings
- Types
  - Black iron pipe
  - Copper tubing
  - Corrugated stainless steel tubing (CSST)
- Pressures
  - Low pressure
  - 2 psig (14 kPa)
  - High pressure
- Sizing factors
  - Appliance Rating
  - Distance
  - Allowable pressure drop
  - Piping or tubing type
  - Type of gas
  - Fittings
- Code requirements
- Procedures



**LEARNING TASKS**

4. Describe gas valve train for appliances 400 MBH or less
  
  
  
  
  
  
  
  
  
  
5. Describe the operation of a gas valve train

**CONTENT**

- Parts
- Operating principles
- Applications
- Regulators
- Gas valves
- Manual valves
  - A-cock
  - B-cock
  - Test firing
- Flow control
- Electric valves
  - Solenoid
  - Diaphragm
  - Combination
- Non-electric valves
  - Rod and tube
  - Hydraulic
- Pilot safety valve
- Regulators

**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D6 Select gas-fired appliances**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe gas-fired appliances.

**LEARNING TASKS**

1. Describe gas-fired appliances

**CONTENT**

- Types
  - Boilers
    - Hot water
    - Steam
    - High mass
    - Low mass
  - Direct fired make-up air heaters
  - Direct vent appliances
  - Decorative appliances
    - Fireplace
    - Fire pit
  - Furnaces
  - Radiant heaters
    - Low intensity
    - High intensity
  - Ranges and/or Commercial cooking equipment
  - Rooftop units
  - Unit heaters
  - Water heaters
    - Tankless
    - Storage type
  - Gas fired refrigerators
- Characteristics
  - Appliance design
  - Direct-fired
  - Indirect-fired
- Applications
- Approval agencies

**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D7 Select burners**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe burners.
- Describe the operation of atmospheric burners.
- Describe burner orifices.

**LEARNING TASKS**

1. Describe burners

2. Describe atmospheric burners

**CONTENT**

- Terminology
  - Turndown
  - High fire
  - Low fire
  - Modulation
  - Port loading
- Types
  - Forced draft
  - Fan assisted
  - Atmospheric
  - Insperating
  - Asperating
- Gas Properties
- Flame Characteristics
  - Aerated
    - Oxidizing
    - Carbonizing
    - Neutral
  - Non-aerated
  - Bunsen
  - Luminous
  - Impingment
  - Flame retention
- High installations
- Pilot
  - Continuous
  - Intermittent
- Interrupted
- Types
  - Main burners
  - Pilot burners
- Parts
  - Burner port
  - Mixing tube

**LEARNING TASKS**

3. Describe burner orifices

**CONTENT**

- Burner head
- Operation
  - Venturi effect (Bernoulli's principle)
  - Primary air control
  - Fuel control
- Application
- Types
  - Plug
  - Cap
  - Adjustable
- Sizing
  - Tables
  - Calculations
    - Orifice flow formula
  - Drilling
- Drill index





**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D12 Plan a project**

**Objectives**

To be competent in this area, the individual must be able to:

- Plan a residential piping installation.

**LEARNING TASKS**

1. Determine load
  
2. Layout the system
  
3. Size the system
  
4. Determine material take-off

**CONTENT**

- Appliance rating plates
- Manufacturer’s documentation
  
- Pressure
- System Regulators
- Regulator locations
- Hangers and supports
- Valve placement
- Drip legs
- Routing
  
- Piping material
- Pressure
  - 7-14 in WC
  - 2 psig
- Lengths
- Type of gas
- Pressure drop
- Fittings
- Valves
- Hangers and supports
- Regulators
- Pipe and tubing
- Consumables

**Achievement Criteria**

Performance	The learner will be able to: <ul style="list-style-type: none"><li>• Plan a layout of a residential piping installation</li><li>• Sketch an isometric piping drawing</li><li>• Size the piping system</li><li>• Generate a tool and material list.</li></ul>
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none"><li>• Residential floor plan with meter and appliance location</li><li>• Appliance documentation</li><li>• Sketching equipment</li><li>• Delivery pressure.</li></ul>
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"><li>• Material take-off<ul style="list-style-type: none"><li>○ Accuracy</li></ul></li><li>• Isometric drawing<ul style="list-style-type: none"><li>○ Neatness</li><li>○ Accuracy</li></ul></li><li>• Code compliance<ul style="list-style-type: none"><li>○ Sizing</li><li>○ Hanger spacing</li><li>○ Valves</li><li>○ Drip legs</li><li>○ Swing joints</li><li>○ Pipe identification.</li></ul></li></ul>

**Line (GAC): E INSTALL GAS-FIRED SYSTEMS**

**Competency: E1 Install piping and tubing systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Join pipe and tubing using threading and flaring.
- Perform tube bending.
- Size piping and tubing systems, low pressure and 2 psig (14 kPa).

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Properties of piping materials</li> <br/> <li>2. Calculate the linear thermal expansion and contraction of various materials</li> <br/> <li>3. Describe hangers and supports</li> <br/> <li>4. Join pipe and tubing</li> <br/> <li>5. Perform tube bending</li> <br/> <li>6. Install piping, tubing and hoses</li> </ol> | <ul style="list-style-type: none"> <li>• Tensile strength</li> <li>• Malleability</li> <li>• Elasticity</li> <br/> <li>• Ferrous</li> <li>• Non-ferrous</li> <li>• Thermoplastic</li> <br/> <li>• Types</li> <li>• Construction</li> <li>• Uses</li> <li>• Expansion</li> <li>• Seismic restraint</li> <li>• Protective materials               <ul style="list-style-type: none"> <li>○ Electrolysis</li> </ul> </li> <li>• Spacing</li> <li>• Inserts and fasteners</li> <li>• Installation procedures</li> <br/> <li>• Safety</li> <li>• Methods               <ul style="list-style-type: none"> <li>○ Welding</li> <li>○ Threading</li> <li>○ Flaring</li> <li>○ Compression fittings</li> <li>○ Brazing</li> <li>○ Fusion (PE)</li> </ul> </li> <li>• Procedure</li> <li>• Hot taps</li> <li>• Tools</li> <li>• Fittings</li> <br/> <li>• Tools</li> <li>• Technique</li> <br/> <li>• Types</li> </ul> |
|--|--|

**LEARNING TASKS**

**CONTENT**

- Methods
- Code requirements
- Identification
- Procedures
- Fittings
- Valves
- Prohibited practice
- Location limitations
- Structural penetrations
  - Fire stopping
- Outlets
- Drip or dirt pockets
- Between buildings
- Concealment
  - Protection plates
- In concrete
- Protective coatings
- Underground
- Support
- Tools
- Connectors

**Line (GAC):**        **E    INSTALL GAS-FIRED SYSTEMS**  
**Competency:**     **E2   Install regulators, valves, and valve train components**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe manual shut-off valves installation.
- Describe gas pressure regulator installation.

**LEARNING TASKS**

1. Describe the installation of manual shut-off valves
  
2. Describe the installation of gas pressure regulators

**CONTENT**

- Code requirements
- Manufacturer’s specifications
- Procedures
  - 2 piece ball valves
- Code requirements
- Manufacturer’s specifications
- Procedures

**Line (GAC):**        **E    INSTALL GAS-FIRED SYSTEMS**

**Competency:**     **E5    Install air supply systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe installation of passive air supply systems.

**LEARNING TASKS**

1. Describe installation of passive air supply

**CONTENT**

- Code requirements
- Structural penetrations
- Sealing
- Sheet metal assembly
  - Drive cleats
  - Esses
  - Tools
- Opening and ducts
  - Terminations
- Traps
- Weather
- Equivalent length of air supply

**Line (GAC): F COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency: F1 Commission fuel/air delivery systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe testing and purging procedures for pipe under 4 inch diameter.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <p>1. Describe piping and tubing testing requirements</p>                         | <ul style="list-style-type: none"> <li>• B149.1</li> <li>• Pressure</li> <li>• Duration</li> <li>• Equipment</li> </ul>   |
| <p>2. Describe piping and tubing pressure testing procedures</p>                  | <ul style="list-style-type: none"> <li>• Air               <ul style="list-style-type: none"> <li>○ Tools</li> <li>○ Equipment</li> <li>○ Spools</li> <li>○ System isolation                   <ul style="list-style-type: none"> <li>– Lockout</li> </ul> </li> </ul> </li> <li>• Inert gases               <ul style="list-style-type: none"> <li>○ Tools</li> <li>○ Equipment</li> <li>○ Spools</li> <li>○ System isolation                   <ul style="list-style-type: none"> <li>– Lockout</li> </ul> </li> <li>○ Calculations</li> </ul> </li> <li>• Leak (integrity) testing               <ul style="list-style-type: none"> <li>○ Soap test</li> <li>○ After appliance connection</li> </ul> </li> <li>• Valve tightness of closure testing</li> </ul> |
| <p>3. Describe purging procedures for piping and tubing under 4 inch diameter</p> | <ul style="list-style-type: none"> <li>• Code requirements               <ul style="list-style-type: none"> <li>○ Locations</li> <li>○ Equipment</li> <li>○ Duration</li> </ul> </li> </ul>   |

# **Level 2**

## **Gasfitter – Class B**

**Line (GAC):           A    USE COMMON OCCUPATIONAL SKILLS**

**Competency:         A4   Use technical instruments and testers**

**Objectives**

To be competent in this area, the individual must be able to:

- Use manometers and mechanical gauges and interpret pressure readings.
- Use electrical test meters and interpret readings.

**LEARNING TASKS**

1. Describe digital manometers and digital pressure gauges
  
2. Use digital manometers and digital pressure gauges
  
3. Use incline manometer
  
4. Describe flue gas analyzers

**CONTENT**

- Types
- Applications
- Storage
- Calibration
- Zero
- Connection
  - Positive pressure
  - Negative pressure
  - Pressure differential
- Scale/range
- Zero
- Connection
  - Positive pressure
  - Negative pressure
  - Pressure differential
- Sg of measuring fluid
- Types
- Sampling location
- Combustion yield formula
- Composition percentages
  - CO<sub>2</sub>
  - O<sub>2</sub>
- CO ppm
- Combustion efficiencies
- Stack temperatures
- Appliance efficiencies
- Burner type
  - Mechanical
  - Atmospheric
- Application
- Zeroing
- Parts
  - Desiccant
  - Gas cells
  - Water traps
  - Filters
  - Pump
  - Probe

**Line (GAC):           A    USE COMMON OCCUPATIONAL SKILLS**

**Competency:         A5   Use codes, regulations, and standards**

**Objectives**

To be competent in this area, the individual must be able to:

- Interpret code rules and regulations applicable to the Gasfitter B certification.
- Apply Section 7 of the B149.1 Gas Code.

**LEARNING TASKS**

1. Interpret Sections 4, 5, 6, 7, 8 and Annex C of the B149.1 Gas Code
  
2. Interpret the B149.2 Gas Code
  
3. Apply Section 7 of the B149.1 Gas Code to appliance installation and commissioning

**CONTENT**

- General
- Pressure Controls
- Piping and Tubing Systems, Hose, and Fittings
- Installation of Specific Types of Appliances
- Venting Systems and Air Supply for Appliances
- Vent Sizing Tables for Category 1 Appliances
  
- Layout
- Sections
- Contents
- Index
- Annexes
- Tables
- Definitions
- Scope
- Revisions
  
- Design
- Planning
- Installation
- Commissioning
- Maintenance
- Decommissioning

**Line (GAC):           A    USE COMMON OCCUPATIONAL SKILLS**

**Competency:         A6   Organize work and maintain records**

**Objectives**

To be competent in this area, the individual must be able to:

- Apply records management.

**LEARNING TASKS**

1. Describe commissioning documentation
  
2. Describe appliance handover
  
3. Apply records management

**CONTENT**

- Commissioning report
- Regulatory responsibilities
  
- As-built drawings and operator manuals
- Instructions to customer
  
- Paper based filing
- Electronic filing
- Service reports
- Invoices
- Time sheets
- Purchase orders
- Vehicle logs
- Maintenance logs
- Inventory
- Permits
- Statements of completion







**Line (GAC):** C **APPLY ELECTRICAL CONCEPTS**  
**Competency:** C1 **Use the principles of electricity and electronics**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe and select single-phase transformers.
- Describe millivolt circuits.
- Identify resistors.
- Describe proportional control operation.
- Describe variable resistors.

**LEARNING TASKS**

1. Determine electrical loads
2. Select single-phase transformers
3. Describe the installation of single-phase transformers
4. Describe millivolt circuits
5. Identify resistors
6. Describe proportional control operation
7. Describe variable resistors

**CONTENT**

- Transformer secondary
- Ratings
  - Amps
- Sizing
- Ratings
  - Watts
  - VA
- Phasing
  - Grounding
- Power generation
  - Thermocouple
  - Thermopiles
- Switches
- Loads
- Application
- Installation
- Types
- Colour coding
- Types used by series
- Method of control
  - Electric
  - Electronic
- Thermistors
  - Effects of heat and resistance
- Anticipators
- Potentiometers

**Line (GAC):** C **APPLY ELECTRICAL CONCEPTS**  
**Competency:** C2 **Use electrical wiring diagrams and schematics**

**Objectives**

To be competent in this area, the individual must be able to:

- Design a wire diagram for a hydronic heating system.
- Describe the sequence of operation for a furnace and hydronic heating system.
- Create a control narrative from a wiring diagram for a hydronic system.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Describe circuit components</li> <br/> <li>2. Describe sequence of appliance operation</li> <br/> <li>3. Design wire diagram</li> <br/> <li>4. Create a control narrative from a wiring diagram for a hydronic heating system</li> </ol> | <ul style="list-style-type: none"> <li>• Transformer</li> <li>• Limits</li> <li>• Safety devices</li> <li>• Controls</li> <li>• Permissives</li> <li>• Interlocks</li> <br/> <li>• Control narratives</li> <li>• Components</li> <li>• Appliances</li> <li>• Wiring diagrams</li> <br/> <li>• Control narrative</li> <br/> <li>• Diagram types               <ul style="list-style-type: none"> <li>○ Schematic</li> <li>○ Ladder</li> <li>○ Process flow diagram</li> </ul> </li> </ul> |
|--|--|

**Achievement Criteria 1**

- |                    |   |
|--------------------|---|
| <b>Performance</b> | The learner will be able to design a wire diagram for a high-temp 4 zone hydronic heating system.   |
| <b>Conditions</b>  | To be assessed during technical training.<br>The learner will be given: <ul style="list-style-type: none"> <li>• Electrical data</li> <li>• Sketching materials</li> <li>• System component requirements</li> </ul> |
| <b>Criteria</b>    | The learner will be evaluated on: <ul style="list-style-type: none"> <li>• Accuracy</li> <li>• Completeness</li> <li>• Use of symbols</li> <li>• Sequence of operation</li> </ul>                                   |

**Achievement Criteria 2**

**Performance** The learner will be able to create a control narrative from wiring diagrams.

**Conditions** To be assessed during technical training.

The learner will be given:

- Ladder diagram
- Schematic diagram

**Criteria** The learner will be evaluated on:

- Accuracy
- Completeness
- Sequence of operation

**Line (GAC): C APPLY ELECTRICAL CONCEPTS**

**Competency: C3 Use the Canadian Electrical Code (CEC)**

**Objectives**

To be competent in this area, the individual must be able to:

- Interpret the Canadian Electrical Code Part 1, sections 14, 16, 26 and 28.

**LEARNING TASKS**

**CONTENT**

- |  |              |
|--|--------------|
| 1. Describe CEC code requirements that apply to protection and control         | • Section 14 |
| 2. Describe CEC code requirements that apply to class 1 and 2 circuits         | • Section 16 |
| 3. Describe CEC code requirements for the installation of electrical equipment | • Section 26 |
| 4. Describe CEC code requirements that apply to motors and generators          | • Section 28 |



**Line (GAC):** C **APPLY ELECTRICAL CONCEPTS**  
**Competency:** C6 **Apply Variable Frequency (VFD) and Electronically Commutated Motors (ECM) technology**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe variable frequency drives (VFD).
- Describe electronically commutated motors (ECM).

**LEARNING TASKS**

1. Describe variable frequency drives (VFD)
  
2. Describe electronically commutated motors (ECM)

**CONTENT**

- Application
- Operation
- Protection
- Limitations
  
- Application
- Operation
  - DIP switch setting
  - External static pressure
- Troubleshooting





**Line (GAC): C APPLY ELECTRICAL CONCEPTS**

**Competency: C9 Apply communication and networking technology**

**Objectives**

To be competent in this area, the individual must be able to:

- Identify network protocols and cable connectors.

**LEARNING TASKS**

1. Identify network protocols
  
2. Identify network cable connectors
  
3. Describe wireless communication devices

**CONTENT**

- Modbus
- BACnet
- Local Operation Network (LON)
- Types of connectors
  - USB
  - 9 pin, 25 pin serial port
  - RJ45
  - RJ11
- WiFi
- Bluetooth
- Satellite
- Cellular

**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D2 Select regulators, valves, and valve train components**

**Objectives**

To be competent in this area, the individual must be able to:

- Size regulators.

**LEARNING TASKS**

1. Describe pressure regulators

**CONTENT**

- Types
  - Direct operated
  - Lever operated
  - Zero governors
  - Propane
    - First stage
    - Second stage
- Operating elements
  - Loading
  - Measuring
  - Restricting
- Parts
  - Internal pressure relief
- Operating principles
  - Droop/offset
  - Lock-up
  - Set point
  - Critical flow
- Applications
- Types
  - Level operated
  - Direct operated
  - Integrated/combination
  - Zero governors
- Application
- Manufacturer's documentation
- Sizing tables
  - Flow rate
  - Pressure drop
  - Orifice selection
  - Spring selection
- Pipe size
- Types of fuel
- Code
- Over pressure protection (OPP)

2. Size regulators



**LEARNING TASKS**

3. Describe the inspection of propane cylinders

**CONTENT**

- Maintenance
- Vehicle
- Security/fencing
- Containment
- Visual inspection
  - Damage
  - Corrosion
- Components
  - Valves
  - Reliefs
- Rating plates
  - Expiry/service dates
- Organize requalification

**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D4 Size venting systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Size venting.

**LEARNING TASKS**

1. Describe appliance categories
2. Describe venting materials
3. Describe types of venting systems
4. Size Category 1 venting
5. Size special venting

**CONTENT**

- Category 1, 2, 3 and 4
  - Vent pressure
  - Appliance efficiencies
- Types
  - Single wall venting (C vent)
  - A vent
  - B vent
  - L vent
  - BH vent
    - Class 1, 2, 3 and 4
  - BW vent
- Mechanical
  - Forced
  - Induced
- Passive
- Vent pressures
- Codes
  - B149.1
  - National Building Code
- Appliance type
- Building type
- Vent connector
- Common vents
- Engineering
- Category
- Codes
  - B149.1
  - National Building Code
- Design registry
- Manufacturer’s documentation
- Types
  - Classifications
  - Materials
  - Mechanical
  - Passive

**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D5 Size air supply systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Size passive air supply systems.

**LEARNING TASKS**

1. Describe methods of combustion air supply
  
2. Describe gas appliance air supply requirements
  
3. Determine combustion air requirements for gas appliances installations

**CONTENT**

- Passive air supply
- Mechanical air supply
  - Code requirements
  - Interlocks
- Purpose
  - Combustion air
    - Primary air
    - Secondary air
    - Excess air
  - Dilution air
  - Ventilation air
- Openings and ducts
  - Terminations
- Code requirements
- Sizing procedures for combined input of up to and including 400 MBH and exceeding 400 MBH
  - Code requirements
  - Building envelope and construction
  - Category of the appliance
  - Draft control
    - Dilution air requirements
  - Air requirement calculations
    - Combustion
    - Ventilation
    - Flue gas dilution
  - Table selection
  - Grills and louvers
    - Types
    - Sizing
    - Free area calculations
  - Air ducts
    - Length
    - Size

**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D6 Select gas-fired appliances**

**Objectives**

To be competent in this area, the individual must be able to:

- Select gas fired appliances rated at 400 MBH or less.

**LEARNING TASKS**

1. Selection criteria for gas-fired appliances

**CONTENT**

- Impact of type of building construction on installation requirements
- Altitude rating requirement
- Code and Regulation requirements
- Manufacturer's' requirements
  - Rating plate requirements
- Appliance sizing
  - Appliance input
  - Appliance output
  - Appliance efficiencies
  - Thermal efficiencies
- Site preparation
- Clearances
- Installer's responsibilities



**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D8 Select flame safeguards**

**Objectives**

To be competent in this area, the individual must be able to:

- Select flame safe guards.

**LEARNING TASKS**

1. Describe flame detectors
  
2. Describe ignition systems
  
3. Describe flame safe guards

**CONTENT**

- Thermocouple
- Thermopile
- Flame rectification (flame rod)
- UV/IR
- Pilot types
  - Continuous
  - Intermittent
  - Interrupted
- Pilot
- Direct spark ignition (DSI)
- Hot surface ignition (HSI)
- Common manufacturers
  - Honeywell
  - Fenwall
  - Siemens
  - Johnson Controls
- Wiring diagrams
- Sequence of operation
- Applications
- Component compatibility
- System compatibility
- Conversions





**Line (GAC): D PLAN GAS-FIRED APPLIANCE SYSTEM INSTALLATIONS**

**Competency: D12 Plan a project**

**Objectives**

To be competent in this area, the individual must be able to:

- Create commissioning documentation for a high efficiency furnace and a condensing boiler.

**LEARNING TASKS**

1. Complete commissioning documentation for a high efficiency furnace and a condensing boiler

**CONTENT**

- Commissioning report
- Statement of completion
- Regulatory responsibilities
- As-built drawings and operator manuals
- Instructions to customer

**Achievement Criteria**

**Performance** The learner will be able to create post-commissioning paperwork for a high efficiency furnace and a condensing boiler.

**Conditions** To be assessed during technical training.  
The learner will be given conditions as noted from:

- F5 - Commission boilers and ancillary equipment
- F7 - Commission furnaces and ovens

**Criteria** The learner will be evaluated on:

- Commissioning report
  - Report accuracy
  - Report Completeness
  - Operating according to manufacturer's specifications

**Line (GAC):**        **E**    **INSTALL GAS-FIRED SYSTEMS**  
**Competency:**    **E2**    **Install regulators, valves, and valve trains**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the installation of regulator venting.

**LEARNING TASKS**

1. Describe the installation of regulator venting

**CONTENT**

- Vent attachments
  - Lines
  - Limiting orifices
  - Surge arrestors
- Sizing
- Orientation
- Termination
- Code requirements



**LEARNING TASKS**

**CONTENT**

- Operation
- Maintenance
- Valves and accessories for liquid withdrawal applications
  - Description
  - Operation
  - Maintenance
- Valves and accessories for filling applications
  - Description
  - Operation
  - Maintenance



**Line (GAC): E INSTALL GAS-FIRED SYSTEMS**

**Competency: E5 Install air supply systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the installation of mechanical air supply systems.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <p>1. Describe mechanical air supply systems</p>                     | <ul style="list-style-type: none"> <li>• Ducts               <ul style="list-style-type: none"> <li>○ Sizes</li> <li>○ Location</li> <li>○ Lengths</li> <li>○ Fittings</li> </ul> </li> <li>• Fans               <ul style="list-style-type: none"> <li>○ Types</li> <li>○ Location</li> </ul> </li> <li>• Engineered systems</li> <li>• Manufacturer’s documentation</li> <li>• Code requirements</li> </ul> |
| <p>2. Describe the installation of mechanical air supply systems</p> | <ul style="list-style-type: none"> <li>• Code requirements</li> <li>• Structural penetrations</li> <li>• Sealing</li> <li>• Opening and ducts               <ul style="list-style-type: none"> <li>○ Terminations</li> </ul> </li> <li>• Weather</li> <li>• Interlocks</li> </ul>   |



**Line (GAC):**            **E    INSTALL GAS-FIRED SYSTEMS**  
**Competency:**        **E10  Install automation and instrumentation control systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the installation of outdoor reset controls.

**LEARNING TASKS**

1. Describe the installation of outdoor reset controls

**CONTENT**

- Sensors
  - Location
- Cabling termination and bonding
- Wiring connections
- Manufacturer's documentation

**Line (GAC): E INSTALL GAS-FIRED SYSTEMS**

**Competency: E11 Install boilers and ancillary equipment**

**Objectives**

To be competent in this area, the individual must be able to:

- Install boilers.

**LEARNING TASKS**

1. Install boilers

**CONTENT**

- Seismic restraint
- Placement considerations
  - Venting
  - Air supply
  - Access
  - Electrical
    - Clearance
    - Isolation switches
  - Clearance
  - Manufacturer’s documentation
  - Codes
  - Drainage
  - Water supply
- Materials
- Ancillary equipment
  - Valves
    - Zone
    - Mixing
    - Diverting
    - Isolation
    - Dead boiler drain
    - Blow down
    - Flow control/balancing
    - Vacuum reliefs
  - Circulators
  - Expansion tanks
  - Feed water
  - Water treatment

**Line (GAC):** E **INSTALL GAS-FIRED SYSTEMS**  
**Competency:** E12 **Install air heating appliances and equipment**

**Objectives**

To be competent in this area, the individual must be able to:

- Install air heating appliances.

**LEARNING TASKS**

1. Install air heating appliances

**CONTENT**

- Mounting
- Seismic restraint
- Placement considerations
  - Venting
  - Ducting
    - Assembly
    - Installation
    - Vibration isolation
    - Zoning
    - External static pressures
  - Air supply
  - Access
  - Electrical
    - Clearance
    - Isolation switches
  - Clearance
  - Manufacturer’s documentation
  - Drainage
- Materials
- Ancillary equipment
  - Electronic air cleaners
  - Pumps
  - Humidifiers
  - Water treatment
    - Neutralizing tanks

**Line (GAC): F COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency: F1 Commission fuel/air delivery systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Commission regulators.
- Describe purging procedures for pipe 4 inch diameter and larger.
- Use gas metering devices.

**LEARNING TASKS**

1. Describe purging procedures for pipe 4 inch diameter and larger
  
2. Commission regulators
  
3. Size burner orifices
  
4. Use gas metering devices

**CONTENT**

- Code requirements
- Inert gases
- Applications
- Purpose
- Equipment
  - Approved burners
  - Gauges
  - Regulators
- Pressures
- Velocity
- Droop
- Lock up pressure
- Inlet pressure
- Downstream set point pressure
- Location of test gauges
- Codes
- Types of fuel gases
- Tables
- Calculations
  - Orifice flow formula
  - Fuel gas conversions
- Drilling
- Drill index
- Low pressure clocking
- High pressure clocking
- High altitude appliance derating









**LEARNING TASKS**

**CONTENT**

- Return water temperature
- Feed water temperature
- Pressure set point
- Purging and flushing
- Water treatment
- Relief piping
- Draft
- Spillage
- Air inlet openings
- Water flow rates
  - Circulator speed
  - Balancing valves
- Condensate neutralization and disposal
- Combustion analysis

**Achievement Criteria**

- |             |  |
|-------------|--|
| Performance | The learner will be able to: <ul style="list-style-type: none"> <li>• Commission a condensing boiler</li> </ul>  |
| Conditions  | To be assessed during technical training.<br>The learner will be given: <ul style="list-style-type: none"> <li>• Condensing boiler</li> <li>• Manufacturer’s documentation</li> <li>• Tools and testing equipment</li> <li>• Applicable equipment</li> </ul> |
| Criteria    | The learner will be evaluated on: <ul style="list-style-type: none"> <li>• Appliance meeting manufacturer’s specifications</li> <li>• Appliance operating safety and efficiency</li> <li>• Code compliance</li> </ul>  |



**LEARNING TASKS**

4. Commission a high efficiency furnace

**CONTENT**

- Heat exchanger temperature rise
- External static pressure (ESP)
- Condensate trap
- Condensate pump
- Condensate neutralizing tank
- Air cleaners
- Temperature set points
- Flame safeguard
  - Sequence timing
  - Hot surface igniter (HSI amp draw)
  - Flame rod current
  - Flame failure response
- Blower speed and operation
- Check condition of heat exchanger
- Combustion analysis

**Achievement Criteria**

Performance	The learner will be able to: <ul style="list-style-type: none"> <li>• Commission a high efficiency furnace</li> </ul>
Conditions	To be assessed during technical training. The learner will be given: <ul style="list-style-type: none"> <li>• High efficiency furnace</li> <li>• Manufacturer’s documentation</li> <li>• Tools and testing equipment</li> <li>• Applicable equipment</li> </ul>
Criteria	The learner will be evaluated on: <ul style="list-style-type: none"> <li>• Appliance meeting manufacturer’s specifications</li> <li>• Appliance operating safety and efficiency</li> <li>• Code compliance</li> </ul>

**Line (GAC): F COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency: F8 Program temperature, pressure and operating controls**

**Objectives**

To be competent in this area, the individual must be able to:

- Program a programmable thermostat.

**LEARNING TASKS**

1. Describe programmable thermostats
  
2. Describe multi-purpose controls
  
3. Program a programmable thermostat

**CONTENT**

- Types
- Functions
- Applications
  
- Types
  - Burner modulating
  - Lead-lag
- Tekmar
- Honeywell
- Manufacturer's documentation
- Set point adjustment
- Night set back settings
- Home/away settings

**Line (GAC):** F COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT

**Competency:** F11 Commission draft control systems

**Objectives**

To be competent in this area, the individual must be able to:

- Adjust a barometric draft regulator.

**LEARNING TASKS**

1. Describe barometric draft regulator
2. Adjust barometric draft regulator

**CONTENT**

- Purpose
- Principles of operation
- Burner's draft requirements
- Draft measurement
- Dilution air adjustment

**Line (GAC):** F COMMISSION GAS-FIRED APPLIANCES AND EQUIPMENT

**Competency:** F12 Training and handover of gas-fired equipment

**Objectives**

To be competent in this area, the individual must be able to:

- Transfer appliance operation to end user.

**LEARNING TASKS**

1. Transfer documentation
2. Describe appliance end user training

**CONTENT**

- Regulatory responsibilities
- Operator manuals
- Instructions to customer
- Light up instructions
- Systems maintenance instructions

**Line (GAC):            G    MAINTAIN AND SERVICE GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency:           G1   Service gas distribution systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the service procedures for distribution piping.

**LEARNING TASKS**

1. Describe the inspection of a gas distribution system
  
2. Describe the repair procedures for a gas distribution system

**CONTENT**

- Leak detection
- Pressure testing
- Cathodic protection
- Identify damage or defect
- Isolate system
  - Lockout procedures
- Inform customer
- Plan repair
- Purge piping
- Remove/replace components
- Pressure testing
- Purging and gasifying

**Line (GAC):            G    MAINTAIN AND SERVICE GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency:           G2   Service gas burners and ancillary equipment**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the procedures for servicing gas burners.

**LEARNING TASKS**

1. Describe the procedures for servicing gas burners.

2. Describe the inspection of ancillary equipment

3. Describe replacement procedures for ancillary equipment

**CONTENT**

- Service schedule
- Inspection
  - Appearance
  - Performance
  - Signs of flame impingement
  - Sooting
- Cleaning
- Reassembly
- Recommission
  - Firing
  - Clocking
  - Combustion analysis
- HSI
  - Amperage check
  - Resistance check
  - Placement
- Ignition electrode
  - Inspection of ceramic
  - Gap to ground
  - Surface contaminants
  - Placement
- Flame rod
  - Inspection of ceramic
  - Placement
  - Surface contaminants
  - Short to ground check
  - Flame signal reading
- Identify faulty component
- Source correct replacement component
- Replace component
- Confirm component operation



**LEARNING TASKS**

**CONTENT**

4. Service condensing boilers and tank-less heaters

- Fans
  - Auxiliary fans
  - Exhaust fans
- Steam control valves
- Steam traps
- Pressure reducing valves
- Flue gas exhaust systems
- Inspect
  - Condensate trap
  - Condensate pump
  - Neutralize tank
  - Heat exchanger
  - Water flow rates
    - Flow balancing
    - Pumps
      - Primary
      - Secondary
- Verify
  - Water treatment
  - Temperature set points
  - Supply and return water temperatures
  - Make-up water
  - Expansion tank pressure





**Line (GAC):            G    MAINTAIN AND SERVICE GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency:         G5    Maintain gas-fired refrigeration equipment**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the maintenance of gas-fired refrigeration equipment.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Describe the refrigeration process of gas-fired appliances</li> <li>2. Describe the installation requirements of gas-fired refrigeration equipment</li> <li>3. Describe troubleshooting procedures</li> <li>4. Describe burner maintenance procedures</li> </ol> | <ul style="list-style-type: none"> <li>• Terminology</li> <li>• Adsorption refrigeration</li> <li>• B.149.1 code requirements</li> <li>• Manufacturer’s documentation</li> <li>• Leveling</li> <li>• Air circulation</li> <li>• Clearances</li> <li>• Venting requirements</li> <li>• Heat input</li> <li>• Air circulation</li> <li>• Leveling</li> <li>• Annual maintenance</li> <li>• Burner cleaning</li> <li>• Orifice cleaning</li> <li>• Manifold pressure</li> <li>• Gas supply tube cleaning</li> <li>• Chimney and boiler tube cleaning</li> </ul> |
|--|--|

**Line (GAC):**            **G    MAINTAIN AND SERVICE GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency:**        **G6    Service fuel/air delivery systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the servicing procedures for fuel/air delivery systems.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <p>1. Describe gas regulator troubleshooting procedures</p> | <ul style="list-style-type: none"> <li>• Manufacturer’s documentation</li> <li>• Disconnect vent line connection</li> <li>• Verify regulator performance               <ul style="list-style-type: none"> <li>○ Setpoint</li> <li>○ Droop</li> <li>○ Lock up</li> </ul> </li> <li>• Confirm orifice size</li> <li>• Confirm regulator application</li> <li>• Confirm internal relief operation</li> </ul> |
| <p>2. Describe gas regulator repair procedures</p>          | <ul style="list-style-type: none"> <li>• Manufacturer’s documentation</li> <li>• Testing</li> <li>• Adjustments</li> <li>• Vent line sizing</li> <li>• Parts replacement</li> </ul>   |

**Line (GAC):            G    MAINTAIN AND SERVICE GAS-FIRED APPLIANCES AND EQUIPMENT**

**Competency:           G7   Service and repair control systems**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe service and repair procedures for control systems.

**LEARNING TASKS**

**CONTENT**

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Describe troubleshooting procedures for flame safe guards</li> <br/> <li>2. Describe troubleshooting procedures for combination gas valves</li> </ol> | <ul style="list-style-type: none"> <li>• Cycle appliance</li> <li>• Confirm control sequence</li> <li>• Confirm control terminal voltage</li> <br/> <li>• Cycle appliance</li> <li>• Confirm operation               <ul style="list-style-type: none"> <li>○ Pilot</li> <li>○ Main burner</li> </ul> </li> <li>• Confirm pressure regulation</li> <li>• Tightness of closure</li> </ul> |
|---|--|



# **Section 4**

## **ASSESSMENT GUIDELINES**

## Assessment Guidelines – Level 1

### Level 1 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		GASFITTER – CLASS B LEVEL 1	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Use Common Occupational Skills	2%	0%
B	Apply Fundamentals of Gas Utilization	10%	0%
C	Apply Electrical Concepts	33%	0%
D	Plan Gas-Fired Appliance System Installations	27%	100%
E	Install Gas-Fired Systems	3%	0%
F	Commission Gas-Fired Appliances	25%	0%
	<b>Total</b>	<b>100%</b>	<b>100%</b>
<b>In-school theory / practical subject competency weighting</b>		85%	15%
<b>Final in-school mark</b> Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Gasfitter B Standardized Level exam		IN-SCHOOL %	

<b>In-school Mark</b> Combined theory and practical subject competency multiplied by	80%
<b>Standard Level Exam Mark</b> The exam score is multiplied by	20%
<b>Final Level Mark</b>	FINAL%

## Assessment Guidelines – Level 2

### Level 2 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:		GASFITTER – CLASS B LEVEL 2	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Use Common Occupational Skills	2%	0%
B	Apply Fundamentals of Gas Utilization	30%	0%
C	Apply Electrical Concepts	20%	5%
D	Plan Gas-Fired Appliance System Installations	22%	5%
E	Install Gas-Fired Systems	8%	0%
F	Commission Gas-Fired Appliances	12%	90%
G	Maintain and Service Gas-Fired Appliances and Equipment	6%	0%
	<b>Total</b>	<b>100%</b>	<b>100%</b>
<b>In-school theory / practical subject competency weighting</b>		75%	25%
<b>Final in-school mark</b> Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Technical Safety BC (formally known as BC Safety Authority) Certificate of Qualification Examination.		IN-SCHOOL %	

All apprentices who complete Level 2 of the Gasfitter – Class B program with a FINAL level percentage score of 70% or greater will write the Technical Safety BC (formally known as BC Safety Authority) Certificate of Qualification Examination as their final assessment.

SkilledTradesBC will enter the apprentices’ Gasfitter – Class B Technical Safety BC (formally known as BC Safety Authority) Certificate of Qualification Examination percentage score into SkilledTradesBC Portal. A minimum percentage score of 70% on the examination is required for a pass.

# **Section 5**

## **TRAINING PROVIDER STANDARDS**

## Facility Requirements

### Classroom Area

- Minimum 10 square feet per student
- Comfortable seating and tables suitable for learning
- Compliance with the local and national fire code and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Overhead and multimedia projectors with a projection screen
- Whiteboard with marking pens and erasers
- Lighting controls to allow easy visibility of the projection screen while allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating/Air conditioning for comfort all year round
- The acoustics in the room must allow the students to be able to hear the instructor

### Shop Area

- Minimum 3000 square feet of shop area including a tool crib and work stations
- Minimum 8 foot ceiling height in shop areas
- Minimum 8 foot ceiling in lab areas
- Adequate heating, lighting, ventilation (including make up air), drainage and water supply
- Refuse and recycling bins for used shop materials
- First-aid equipment
- Shops will support practical requirements as outlined in the program outline
- Shop facilities will support gas fitting practical training

### Lab Requirements

- See shop area requirements

### Student Facilities

- Adequate eating area as per WorkSafeBC requirements (4.84 OHS Regulation and Guidelines)
- Adequate washroom facilities as per WorkSafeBC requirements (4.84 OHS Regulation and Guidelines)

### Instructor's Office Space

- Adequate office space for student consultation
- Desk and filing space
- Computer
- Internet access
- Printer
- Adequate storage facilities for material and training aids
- Access to photocopier
- Telephone

## Tools and Equipment

### Shop (Facility) Tools

#### *Power Tools*

- Air compressor
- Cordless drills
- Mini grinder
- Power drills
- Portable band saw (hack saw)
- Power threading machine
- Reciprocating saw
- Rotary hammer
- Task lighting equipment

#### *Cutting and Joining Equipment*

- Half round file
- Flaring tools
- Hand operated oiler
- Oxy-acetylene equipment
- Pipe cutter
- Pipe reamer
- Pipe roller
- Pipe stand
- Pipe threader
- Pipe vise
- Power vise
- Tube bender
- Tube cutter

#### *Testing and Measuring Equipment*

- Nitrogen bottles and regulators
- Computer
- Drafting equipment
- Electronic Flue gas analyzer
- Electronic leak detector
- Draft gauge
- Hand pump and accessories
- Hydrostatic pump and gauge (manual and power)
- Laser level
- Magnahelic gauge
- Manometers (incline, digital and U-tube)
- Measuring tape and markers
- Multimeter

#### *Personal Protective and Safety Equipment*

- Eye wash kit
- Face shield
- Fire extinguisher
- First aid kit
- Gloves (leather)
- Hearing protection
- Lock-out devices
- Overalls
- Safety harness, lanyard and life line

#### *Standard Tools*

- Adjustable wrench
- Ball-peen hammer
- Orifice drill sets
- Pipe wrench

- Combination wrench
- Fuse puller
- Files
- Flashlight
- Hacksaw
- Electrical knock out sets
- Hex Keys (set), metric and imperial
- Step drill bits
- Knife
- Levels
- Nut drivers
- Pliers (lineman, needle nose, water pump, channel lock)
- Screwdrivers (complete set)
- Socket set (imperial and metric)
- Striker
- Threading hand dies
- Tin snips (set)
- Wire strippers
- Tri-square
- Wire crimpers
- Wire brushes
- Wire cutters

***Hoisting, Rigging and Access Tools and Equipment***

- Come-a-longs and Talfors
- Ladders
- Rope/cable
- Shackles
- Slings and chokers
- Snatch blocks

**Student Tools (supplied by student)**

***Required***

- Calculator
- Hard hat
- Safety boots
- Safety goggles/glasses

***Recommended***

- N/A

## Reference Materials

### Required Reference Materials

- CAN/ CSA B149.1 current
- CAN/ CSA B149.2 current
- CAN/ CSA C22.1 current
- Safety Standards General Regulation
- Gas Safety Regulation

### Recommended Resources

- CSA Gas Trade Training Modules, ISBN 978-1-4883-0127-8
- Low Pressure Boilers, Frederick M. Steingrass, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4365-1
- High Pressure Boilers, Frederick M. Steingrass, Harold J. Frost, Daryl R. Walker, American Technical Publishers, ISBN 978-0-8269-4315-6
- IPT's Pipe Trades Handbook, ISBN 978-0-920855-18-8
- IPT's Guide to Blueprint Interpretation, ISBN: 978-0-920855-42-3
- CAN/ CSA B.214 Installation of Hydronic Heating Systems
- Modern Hydronic Heating – John Seigenthaler, ISBN
- Fundamentals of Gas Utilization – John Dutton, ISBN 978-0-9198-5235-8
- Design of Fluid Systems – Spirax Sarco, ISBN
- Electricity & Controls for HVAC/R – Herman/Sparkman, ISBN 978-1133-2782-07

### Suggested Texts/Websites

- Technical Safety BC (formally known as BC Safety Authority), [www.technicalsaftybc.ca](http://www.technicalsaftybc.ca)
- TECA, Thermal Environmental Comfort Association, [www.teca.ca](http://www.teca.ca)
- SkilledTradesBC [www.skilledtradesbc.ca](http://www.skilledtradesbc.ca)
- CSA, [www.csagroup.org](http://www.csagroup.org)
- Red Seal, [www.red-seal.ca](http://www.red-seal.ca)
- WorkSafeBC, [www.worksafebc.com](http://www.worksafebc.com)

**NOTE:**

This list of Reference Materials is for training providers. Apprentices should contact their preferred training provider for a list of recommended or required texts for this program.

## **Instructor Requirements**

### **Occupation Qualification**

The instructor must possess one of the following:

- Current BC Certificate of Competency/Qualification in Gasfitting B
- Certificate must be equal or greater than the level of instruction

### **Work Experience**

A minimum of 5 years' experience working in the industry as a Class B Gasfitter. This experience requirement may be varied based on:

- Type of experience and scope of exposure to the industry
- Other related credentials
- Specialized experience

### **Instructional Experience and Education**

It is preferred that the instructor also possesses one of the following:

- Instructor Diploma or equivalent
- Bachelor's Degree in Education
- Master's Degree in Education

# Appendices

## Appendix A Technical Safety BC Requirements

### Gasfitter – Class B Exam administered by Technical Safety BC:

- Successful completion of Technical Training in Levels 1 and 2
- SkilledTradesBC transcript demonstrating a minimum 1,500 work based training hours (3,000 total); **OR**
- Be registered on an official class list provided by an approved training institution for their **final** level (**Gasfitter – Class B Level 2**) technical training

### Tools and Equipment

*(to be used in coordination with the program Tools and Equipment list beginning on page 124)*

#### Level One (Class B) Apprenticeship

- 1 threading machine (power drive with threading attachment) for every 4 students
- 1 oxy/acetylene cutting outfit for every 8 students
- 1 fuel/air brazing unit for every 4 students
- 1 flaring tool for every 8 students
- 1 tubing bender for every 8 students

#### Level Two (Class B) Apprenticeship

- 1 multimeter for every 2 students
- 1 flue gas analyzer capable of measuring CO<sub>2</sub>, CO, O<sub>2</sub>, stack temperature and excess air for every 8 students
- 1 liquid filled manometer for every 4 students
- 1 digital manometer for every 4 students
- 1 incline manometer for every 16 students
- Necessary hand and power tools to service furnaces, boilers and domestic water heaters
- 1 forced-air furnace for every 4 students
- 1 hot water boiler for every 4 students
- 1 tankless water heater for every 8 students
- 1 storage type water heater for every 8 students 1 residential range for every 16 students
- 1 residential dryer for every 16 students
- 1 unit heater for every 16 students
- All appliances to have an input of 120 kW or less

**Appendix B  
Glossary of Acronyms**

<b>AHJ</b>	Authority having jurisdiction
<b>ANSI</b>	American National Standards Institute
<b>ASME</b>	American Society of Mechanical Engineers
<b>ASOPE</b>	American Society of Power Engineers
<b>AST</b>	Aboveground storage tank
<b>ASTM</b>	American Society of Testing and Materials
<b>BCSA</b>	British Columbia Safety Authority
<b>BHP</b>	Boiler horse power
<b>Btuh</b>	British thermal units per hour
<b>CAPS</b>	Combustion Air Proving Switch
<b>CEC</b>	Canadian Electrical Code
<b>CEMS</b>	Continuous emissions monitoring system
<b>CPVC</b>	Chlorinated polyvinyl chloride
<b>CSA</b>	Canadian Standards Association
<b>CSST</b>	Corrugated Stainless Steel Tubing
<b>DFMA</b>	Direct-Fired Make-up Air
<b>ECM</b>	Electronically commutated motors
<b>ESP</b>	External static pressure
<b>EXV</b>	Electronic expansion valve
<b>FGR</b>	Flue gas recirculation
<b>HGPS</b>	High gas pressure switch
<b>HMI</b>	Human-machine interface
<b>HRT</b>	Horizontal return tubular (boiler)
<b>ICI</b>	Industrial, commercial and institutional
<b>IR</b>	Infrared
<b>ISO</b>	International Organization for Standardization
<b>kW</b>	kilowatts
<b>LAER</b>	Lowest achievable emission rate
<b>LEED</b>	Leadership in Energy and Environmental Design
<b>LGPS</b>	Low gas pressure switch
<b>LON</b>	Local operation network
<b>LP Gas</b>	Liquified Petroleum Gas
<b>mA</b>	milliamps
<b>MAWP</b>	Maximum allowable working pressure
<b>MCC</b>	Motor control centre
<b>MTFI</b>	Mainflame Trial For Ignition
<b>mV</b>	millivolts
<b>MSDS</b>	Material safety data sheet
<b>MSW</b>	Municipal solid waste
<b>NAAQS</b>	National Ambient Air Quality Standards
<b>NAPE</b>	National Association of Power Engineers
<b>NBC</b>	National Building Code
<b>NEMA</b>	National Electrical Manufacturer's Association

<b>NFPA</b>	National Fire Protection Association
<b>NSPS</b>	New Source Performance Standards
<b>NRR</b>	Noise reduction rating number
<b>OH&amp;S</b>	Occupational Health and Safety
<b>OS&amp;Y</b>	Outside stem and yoke (valve)
<b>PLC</b>	Programmable logic controller
<b>PPE</b>	Personal protective equipment
<b>PRV</b>	Pressure reducing valve
<b>PTFI</b>	Pilot trial for ignition
<b>PVC</b>	Programmable logic controller
<b>RPM</b>	Revolutions per minute
<b>RTD</b>	Resistance temperature detector
<b>SCR</b>	Selective catalytic reduction
<b>TDG</b>	Transportation of dangerous goods
<b>TXV</b>	Thermostatic expansion valve
<b>UL</b>	Underwriters Laboratories
<b>ULC</b>	Underwriters Laboratories of Canada
<b>UST</b>	Underground storage tank
<b>VFD</b>	Variable frequency drive
<b>VSD</b>	Variable speed drive
<b>WHMIS</b>	Workplace Hazardous Materials Information System

## Appendix C Previous Contributors

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