PROGRAM PROGRAMME
EXCELLENCE
RED SEAL · SCEAU ROUGE

Interprovincial Program Guide

Gasfitter - Class A

2016

CANADIAN STANDARD OF EXCELLENCE
FOR SKILLED TRADES

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Interprovincial Program Guide

GASFITTER - CLASS A

2016

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Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Interprovincial Program Guide (IPG) as the national curriculum for the occupation of Gasfitter - Class A.

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards Red Seal Program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 22 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the CCDA embarked on a process for the development of national IPGs for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of the key activities in moving towards a more cohesive apprenticeship system.

With the support of Employment and Social Development Canada (ESDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.

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In addition to the representatives above, various federal, provincial and territorial representatives contributed to the development of this document including the host province of Manitoba.

As this program guide will be amended periodically, comments or suggestions for improvement should be directed to:

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PROGRAM CONTENT

User Guide

According to the Canadian Apprenticeship Forum, the IPG is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the National Occupational Analysis (NOA), and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the NOAs and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans of training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The IPG does not dictate study materials, textbooks or learning activities to be used in delivery.

The IPG document includes a recommended levelling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

Structure

The IPG is divided into units which are identified by unique codes. The unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Each unit consists of *Learning Outcomes, NOA References* and *Objectives and Content.*

The *Learning Outcomes* are the specific performances that must be evaluated. Wording of the learning outcomes, "Demonstrate knowledge of…", acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which learning outcomes are evaluated; theoretically, practically or a combination of both.

The *Objectives and Content* for the unit details the information to be covered in order to achieve the performances specified in the Learning Outcomes. These objectives can be either theoretical or practical in nature, based on the requirements identified through the industry consultation process. The learning activities used to cover the objectives are at the discretion of the jurisdiction; however, practically worded objective statements have been used where industry indicated a need for the apprentices to receive exposure to performing the task or skill outlined while attending technical training. For example, this exposure could be done through instructor demonstration or individual or group performance of the skill or task. This practical training will help to reinforce the theoretical component of the technical training.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The content listed within the IPG document is **not** intended to represent an inclusive list; rather, it is included to illustrate the intended direction for the objective. Content may be added or extended in jurisdictional training plans as required.

Jurisdictions are free to deliver the IPG units one at a time or concurrently, provided that all Learning Outcomes are met. The IPG does not indicate the amount of time to be spent on a particular unit as the length of time required to deliver the *Learning Outcomes* successfully will depend upon the learning activities and teaching methods used.

IPG Glossary of Terms

These definitions are intended as a guide to how language is used in the IPGs.

ADJUST	To put in good working order; regulate; bring to a proper state or position.
APPLICATION	The use to which something is put and/or the circumstance in which you would use it.
CHARACTERISTIC	A feature that helps to identify, tell apart, or describe recognizably; a distinguishing mark or trait.
COMPONENT	A part that can be separated from, or attached to, a system; a segment or unit.
DEFINE	To state the meaning of (a word, phrase, etc.).
DEMONSTRATE	To show or explain verbally, in written form, or by practical application.
DESCRIBE	To give a verbal account of; tell about in detail.
DIAGNOSE	To analyze or identify a problem or malfunction.
EXPLAIN	To make plain or clear; illustrate; rationalize.
IDENTIFY	To point out or name objectives or types.
INTERPRET	To translate information from observation, charts, tables, graphs, and written material.
MAINTAIN	To keep in a condition of good repair or efficiency.
METHOD	A means or manner of doing something that has procedures attached to it.

OPERATE	How an object works; to control or direct the functioning of.
PROCEDURE	A prescribed series of steps taken to accomplish an end.
PURPOSE	The reason for which something exists or is done, made or used.
SERVICE	Routine inspection and replacement of worn or deteriorating parts. An act or business function provided to a customer in the course of one's profession. (e.g., haircut).
TECHNIQUE	Within a procedure, the manner in which technical skills are applied.
TEST	v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality. n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.
TROUBLESHOOT	To follow a systematic procedure to identify and locate a problem or malfunction and its cause.

Essential Skills Profiles

Essential Skills are the skills needed for work, learning and life. They provide the foundation for learning all the other skills that enable people to evolve within their jobs and adapt to workplace change.

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit Employment and Social Development Canada's website at:

http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml

Profile Chart

COMMON OCCUPATIONAL SKILLS			
GFA-100 Safety	GFA-145 Tools, Equipment and Testing Instruments	GFA-105 Drawings and Blueprint Reading 3	GFA-210 Drawings and Blueprint Reading 4
GFA-110 Gas Codes 3	GFA-200 Gas Codes 4	GFA-220 Job Planning	GFA-140 Hoisting, Lifting, and Rigging
GFA-135 Access Equipment			
GAS PIPING PREPARATION AND ASSEMBLY			
GFA-120 Tube and Tubing Systems	GFA-115 Steel Pipe and Fittings	GFA-125 Plastic Pipe and Fittings	
VENTING AND AIR SUPPLY SYSTEMS			
GFA-150 Industrial/Commercial/ Institutional (ICI) Venting Systems	GFA-235 Equipment Conversion and Combustion	GFA-155 Air Supply Systems	
CONTROL AND ELECTRICAL SYSTEMS			
GFA-130 Electrical Systems and Controls 3	GFA-205 Electrical Systems and Controls 4		
INSTALLATION AND SERVICING OF SYSTEMS AND EQUIPMENT			
GFA-225 Installation of Systems and Equipment	GFA-215 Gas Equipment	GFA-160 Propane Storage and Handling Systems	GFA-240 Dual and Alternate Fuels
TESTING AND COMMISSIONING OF GAS-FIRED SYSTEMS			
GFA-245 Testing ICI Appliances and Equipment	GFA-250 ICI Commissioning and Decommissioning		
SERVICING GAS-FIRED SYSTEMS			
GFA-230 ICI Service, Maintenance and Repair			

Recommended Level Structure

2014 NOA Sub-task to IPG Unit Comparison

NOA Sub-task		IPG Unit	
Task 1 - Performs safety-related functions.			
1.01	Uses personal protective equipment (PPE) and safety equipment.	GFA-100	Safety
1.02	Maintains safe work environment.	GFA-100	Safety
Task 2 - Maintains and uses tools and equipment.			
2.01	Maintains hand, power and powder-actuated tools.	GFA-145	Tools, Equipment and Testing Instruments
2.02	Uses technical instruments and testers.	GFA-145	Tools, Equipment and Testing Instruments
		GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
2.03	Uses access equipment.	GFA-135	Access Equipment
2.04	Operates lifting, rigging and hoisting equipment.	GFA-140	Hoisting, Lifting and Rigging
Task 3 - Plans and prepares for installation, service and maintenance.			
3.01	Interprets drawings and codes.	GFA-105	Drawings and Blueprint Reading 3
		GFA-210	Drawings and Blueprint Reading 4
		GFA-110	Gas Codes 3
		GFA-200	Gas Codes 4
3.02	Selects systems, equipment and components.	GFA-220	Job Planning
3.03	Organizes work.	GFA-220	Job Planning
Task 4 - Fits tube and tubing for gas piping systems.			
4.01	Prepares tube and tubing for fitting.	GFA-120	Tube and Tubing Systems
4.02	Bends tube and tubing for gas piping systems.	GFA-120	Tube and Tubing Systems
4.03	Connects tube and tubing for gas piping systems.	GFA-120	Tube and Tubing Systems
Task 5 - Fits plastic pipe for gas piping systems.			
5.01	Prepares plastic pipe for fitting.	GFA-125	Plastic Pipe and Fittings
5.02	Connects plastic pipe for gas piping systems.	GFA-125	Plastic Pipe and Fittings
Task 6 - Fits steel pipe for gas piping systems.			
6.01	Prepares steel pipe for fitting.	GFA-115	Steel Pipe and Fittings
6.02	Connects steel pipe for gas piping systems.	GFA-115	Steel Pipe and Fittings

NOA Sub-task		IPG Unit	
Task 7 - Installs venting.			
7.01	Lays out venting.	GFA-150	ICI Venting Systems
7.02	Prepares venting material for assembly.	GFA-150	ICI Venting Systems
7.03	Connects material for venting.	GFA-150	ICI Venting Systems
Task 8 - Installs air supply system.			
8.01	Lays out air supply system.	GFA-155	Air Supply Systems
8.02	Connects air supply systems.	GFA-155	Air Supply Systems
Task 9 - Installs draft control systems.			
9.01	Installs natural draft control systems.	GFA-150	ICI Venting Systems
9.02	Installs mechanical draft control systems.	GFA-150	ICI Venting Systems
Task 10 - Selects and installs electronic components.			
10.01	Performs selection and installation of combustion controls.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
		GFA-235	Equipment Conversion and Combustion
10.02	Performs selection and installation of flame safeguards.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
10.03	Performs selection and installation of safety and operating controls.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
Task 11 - Selects and installs electrical components.			
11.01	Selects electrical components.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
11.02	Performs assembly and connection of electrical components.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
Task 12 - Installs automation and instrumentation control systems.			
12.01	Performs selection of automation and instrumentation control systems.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4
12.02	Performs assembly and connection of automation and instrumentation control systems.	GFA-130	Electrical Systems and Controls 3
		GFA-205	Electrical Systems and Controls 4

NOA Sub-task		IPG Unit	
Task 13 - Installs gas-fired system piping and equipment.			
13.01	Installs gas-fired equipment.	GFA-225	Installation of Systems and Equipment
		GFA-215	Gas Equipment
13.02	Installs gas piping equipment.	GFA-225	Installation of Systems and Equipment
		GFA-115	Steel Pipe and Fittings
13.03	Connects gas supply to equipment.	GFA-225	Installation of Systems and Equipment
		GFA-215	Gas Equipment
		GFA-240	Dual and Alternate Fuels
13.04	Connects equipment to energy distribution systems.	GFA-225	Installation of Systems and Equipment
		GFA-215	Gas Equipment
Task 14 - Installs gas-fired system components.			
14.01	Installs valve trains.	GFA-225	Installation of Systems and Equipment
		GFA-215	Gas Equipment
		GFA-235	Equipment Conversion and Combustion
14.02	Installs accessories.	GFA-225	Installation of Systems and Equipment
		GFA-215	Gas Equipment
		GFA-115	Steel Pipe and Fittings
		GFA-120	Tube and Tubing Systems
		GFA-125	Plastic Pipe and Fittings
Task 15 - Installs propane storage and handling systems.			
15.01	Installs propane storage systems.	GFA-160	Propane Storage and Handling Systems
15.02	Installs propane handling systems.	GFA-160	Propane Storage and Handling Systems
Task 16 - Tests gas-fired systems.			
16.01	Tests gas piping systems.	GFA-245	Testing ICI and Appliances and Equipment
16.02	Performs start-up procedures.	GFA-245	Testing ICI and Appliances and Equipment
Task 17 - Commissions gas-fired systems			
17.01	Performs testing, adjusting and balancing procedures.	GFA-225	Installation of Systems and Equipment
		GFA-245	Testing ICI and Appliances and Equipment
17.02	Completes commissioning report and handover.	GFA-250	ICI Commissioning and Decommissioning

NOA Sub-task		IPG Unit	
Task 18 - Maintains gas-fired systems.			
18.01	Inspects system components and operation.	GFA-230	ICI Service, Maintenance and Repair
18.02	Performs maintenance activities.	GFA-230	ICI Service, Maintenance and Repair
Task 19 - Repairs gas-fired systems.			
19.01	Diagnoses gas-fired equipment and components.	GFA-230	ICI Service, Maintenance and Repair
19.02	Selects replacement components.	GFA-230	ICI Service, Maintenance and Repair
		GFA-235	Equipment Conversion and Combustion
19.03	Replaces components.	GFA-230	ICI Service, Maintenance and Repair
		GFA-235	Equipment Conversion and Combustion
19.04	Verifies operation.	GFA-230	ICI Service, Maintenance and Repair
		GFA-235	Equipment Conversion and Combustion
Task 20 - Decommissions gas-fired systems.			
20.01	Disconnects appliances and accessories.	GFA-250	ICI Commissioning and Decommissioning
20.02	Removes gas-fired systems and components.	GFA-250	ICI Commissioning and Decommissioning

LEVEL 1

GFA-100 Safety

Learning Outcomes:

- Demonstrate knowledge of safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

2014 National Occupational Analysis Reference:

1.01 Uses personal protective equipment (PPE) and safety equipment.
1.02 Maintains safe work environment.

Objectives and Content:

1. Define terminology associated with safety.

2. Identify and describe workplace safety and health regulations.
   - i) federal
     - Material Safety Data Sheets (MSDS)
     - Workplace Hazardous Material Information System (WHMIS)
     - Transportation of Dangerous Goods (TDG)
   - ii) provincial/territorial
     - Occupational Health and Safety (OH&S)
   - iii) municipal

3. Identify types of personal protective equipment (PPE) and clothing and describe their applications and limitations.

4. Describe the procedures used to care for and maintain PPE.

5. Identify hazards and describe safe work practices.
   - i) personal
   - ii) workplace
     - job hazard assessment procedures
     - tools and equipment
     - lock out/tag out
     - hot work and fire watch
     - confined space awareness
     - trenches and excavations
     - explosion and fire

- ventilation
- fall protection
- housekeeping

iii) hazardous materials
- solvents
- toxic materials
- fuel gases
- fumes
- asbestos
- lead-based paint

iv) environmental contamination

6. Identify hazards and describe safe work practices pertaining to fuel gases.

GFA-105 Drawings and Blueprint Reading 3

Learning Outcomes:

- Demonstrate knowledge of technical manuals, specifications, drawings and graphs.
- Demonstrate knowledge of drawings and their applications.
- Demonstrate knowledge of interpreting and extracting information from drawings.

2014 National Occupational Analysis Reference:

3.01 Interprets drawings and codes.

Objectives and Content:

1. Identify types of trade related documentation and describe their applications and procedures for use.
   - i) technical manuals
   - ii) manufacturers' specifications
   - iii) mechanical drawings and specifications
   - iv) graphs and charts

2. Describe the procedures used for the care, handling and storage of drawings.

3. Identify documentation related to drawings and describe their applications.
   - i) change orders
   - ii) addenda
   - iii) as-builts
   - iv) specifications

4. Describe equipment detail drawings, their applications and procedures for use.

GFA-110 Gas Codes 3

Learning Outcomes:

- Demonstrate knowledge of codes, *Acts* and regulations specific to the gas industry.

2014 National Occupational Analysis Reference:

3.01 Interprets drawings and codes.

Objectives and Content:

1. Define terminology associated with gas codes.

2. Identify agencies and bodies for governing gas installations and describe their authority and agencies of operation.
   - i) American National Standards Institute (ANSI)
   - ii) American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
   - iii) American Society of Mechanical Engineers (ASME)
     - CSD-1 Controls and Safety Devices
   - iv) American Society of Testing and Materials (ASTM)
   - v) Canadian Standards Association
     - CSA B149.1 Natural Gas and Propane Installation Code
     - CSA B149.2 Propane Storage and Handling Code
     - CSA B149.3 Field Approval of Fuel Related Components on Appliances and Equipment Code
     - CSA B149.6 Bio-generation and Utilization Code
     - CSA B139.9 Installation Code for Oil-Burning Equipment
   - vi) National Building Code of Canada (NBC)
   - vii) National Fire Protection Association (NFPA)
   - viii) Underwriters Laboratories Canada (ULC)
   - ix) Canadian Electrical Code (CEC)
     - C22.1

3. Identify the authorities responsible for authorizing permits in the appropriate jurisdiction.

4. Identify and interpret regulations pertaining to fuel gases and combustion.

GFA-115 Steel Pipe and Fittings

Learning Outcomes:

- Demonstrate knowledge of threaded, flanged, and welded steel pipe and fittings.
- Demonstrate knowledge of the procedures to join steel pipe.

2014 National Occupational Analysis Reference:

6.01 Prepares steel pipe for fitting.
6.02 Connects steel pipe for gas piping systems.
13.02 Installs gas piping equipment.
14.02 Installs accessories.

Objectives and Content:

1. Define terminology associated with steel pipe and fittings.

2. Identify hazards and describe safe work practices pertaining to steel pipe and fittings.

3. Interpret codes, standards and regulations pertaining to steel pipe and fittings.

4. Identify tools and equipment used to prepare and thread steel pipe, and describe their applications and procedures for use.

5. Identify tools and equipment used for welding and joining steel pipe, and describe their applications and procedures for their use.

6. Describe the procedures used to calculate piping offsets.

7. Identify the factors to consider for selecting steel pipe.
   i) schedule numbers and grades
   ii) pressure ratings
   iii) pipe sizes and lengths
   iv) protective coatings and linings
   v) cathodic protection
   vi) codes and regulations
   vii) manufacturers' specifications
   viii) manufacturing techniques
   ix) approved alternate piping products

8. Identify types of threaded pipe fittings, and describe their characteristics and applications.
   i) malleable
   ii) steel
   iii) stainless

9. Describe the procedures used to join threaded pipe and install fittings on pipe.

10. Describe the procedures used to prepare steel pipe to be welded.

11. Describe the procedures used to pressure test steel piping systems.
   i) inspections
   ii) equipment required
   iii) calculations

12. Describe the procedures used to purge steel piping systems.
   i) equipment required
   ii) calculations
   iii) purge point openings
   iv) inert gas

13. Describe procedures used to install steel piping.
   i) installation
   ii) code requirements
   iii) protection
   iv) manufacturers' specifications

14. Describe procedures for sizing steel piping.

GFA-120 Tube and Tubing Systems

Learning Outcomes:

- Demonstrate knowledge of tube and tubing systems, their applications, maintenance and procedures for use.
- Demonstrate knowledge of tube bending equipment and techniques.

2014 National Occupational Analysis Reference:

4.01 Prepares tube and tubing for fitting.
4.02 Bends tube and tubing for gas piping systems.
4.03 Connects tube and tubing for gas piping systems.
14.02 Installs accessories.

Objectives and Content:

1. Define terminology associated with tube and tubing systems.

2. Identify hazards and describe safe work practices associated with tube and tubing systems as well as pertaining to bending tube.

3. Interpret codes, standards and regulations associated with tube and tubing systems as well as pertaining to bending tube.

4. Identify tools and equipment relating to tube and tubing systems and bending, and describe their applications and procedures for use.

5. Identify types of connections, fittings and valves and describe their applications.
   i) brazed
   ii) mechanical

6. Identify types of tube and tubing systems and describe their applications.

7. Identify the factors to consider for selecting tube and tubing systems for bending.

8. Describe procedures used to install tube and tubing.
   i) sizing
   ii) installation
   iii) code requirements

iv) protection
v) manufacturers' specifications

9. Describe the procedures used to pressure test tube and tubing system.
   i) inspections
   ii) equipment required

10. Describe the procedures used to purge tube and tubing systems.

11. Describe procedures for sizing tube and tubing.

GFA-125 Plastic Pipe and Fittings

Learning Outcomes:

- Demonstrate knowledge of plastic pipe and fittings, and their associated joining techniques.

2014 National Occupational Analysis Reference:

5.01 Prepares plastic pipe for fitting.
5.02 Connects plastic pipe for gas piping systems.
14.02 Installs accessories.

Objectives and Content:

1. Define terminology associated with plastic pipe and fittings.

2. Identify hazards and describe safe work practices pertaining to plastic pipe and fittings.

3. Interpret codes, standards, regulations and AHJ requirements pertaining to plastic pipe and fittings.

4. Identify the factors to consider for selecting plastic pipe and fittings.
   i) types
   ii) pressure and temperature ratings
   iii) sizes
   iv) manufacturers' specifications/certification requirements
   v) approved alternate piping products

5. Identify tools and equipment relating to plastic pipe and fittings, and describe their applications and procedures for use.

6. Identify the types of fittings used with plastic pipe, and describe their applications.

7. Describe the procedures used to join plastic pipe.
   i) safety requirements
   ii) fabrication process and materials
   iii) drilling and cleaning
   iv) assembly

v) testing
vi) allowing for pipe expansion and contraction

8. Describe the procedures used to handle and store plastic pipe and fittings.

9. Describe procedures for sizing plastic piping.

GFA-130 Electrical Systems and Controls 3

Learning Outcomes:

- Demonstrate knowledge of electrical controls, their applications, maintenance, servicing and procedures for use.
- Demonstrate knowledge of electrical control circuits, their applications, maintenance, servicing and procedures for testing.
- Demonstrate knowledge of motors, their applications, maintenance, and procedures for use and testing.
- Demonstrate knowledge of communications automation and instrumentation control systems.

2014 National Occupational Analysis Reference:

2.02 Uses technical instruments and testers.
10.01 Performs selection and installation of combustion controls.
10.02 Performs selection and installation of flame safeguards
10.03 Performs selection and installation of safety and operating controls.
11.01 Selects electrical components.
11.02 Performs assembly and connection of electrical components.
12.01 Performs selection of automation and instrumentation control systems.
12.02 Performs assembly and connection of automation and instrumentation control systems.

Objectives and Content:

1. Define terminology associated with electrical controls.

2. Identify and interpret codes and regulations pertaining to electrical controls.

3. Describe types of controls and their components, application, operation and procedures for use.
   i) operating controllers
   ii) limit and safety controllers
   iii) combustion and safety controls
   iv) ignition control modules
   v) flame safeguard

4. Describe the procedures used to test and troubleshoot control circuits.
    i) diagrams
    ii) auxiliary devices
    iii) polarity
    iv) electrical sequence of operation

5. Interpret information on drawings and create advanced electrical wiring diagrams.

6. Describe the procedures used to test, service, maintain and troubleshoot controls, control systems and their components.

7. Describe motors and their components, application, operation and procedures for use.
    i) AC motors
        - three-phase
        - single-phase
            - start-up
            - overload devices
    ii) DC motors
        - variable speed

8. Explain the operation of the electrical circuits in an appliance.

9. Describe control signals, standards and protocols.
    i) analog
    ii) digital

10. Describe communication protocols and standards.
    i) RS-232, RS-485
    ii) Modbus
    iii) BACnet
    iv) Ethernet
    v) protocol translators

11. Describe power and control circuits found on industrial/commercial/institutional (ICI) appliances and equipment.

12. Identify the different electro/mechanical controls and instrumentation on ICI appliances and equipment.
    i) pressure controls and transducers
    ii) temperature controls and resistance temperature detectors (RTD)
    iii) fluid controls
    iv) combustion controls
    v) proportional controls
    vi) supervisory systems
    vii) end switches and interlocks
    viii) operation
    ix) ratings
    x) adjustable/non-adjustable parameters

13. Describe the procedures for the installation of control systems for ICI appliances and equipment.

14. Describe the procedures for the installation of flame safeguard controls.

15. Describe the different types of flame sensing devices.
    i) flame rod
    ii) UV
    iii) infrared

GFA-135 Access Equipment

Learning Outcomes:

- Demonstrate knowledge of the selection, assembly and procedures for using access equipment.

2014 National Occupational Analysis Reference:

2.03 Uses access equipment.

Objectives and Content:

1. Define terminology associated with access equipment.

2. Identify hazards and describe safe work practices pertaining to access equipment.

3. Identify codes and regulations pertaining to access equipment.
   i) training and certification requirements
   ii) job site specific requirements

4. Identify types of access equipment and describe their characteristics and applications.

5. Describe the procedures used to erect and dismantle access equipment.

6. Describe the procedures used to inspect, maintain and store access equipment.

GFA-140 Hoisting, Lifting and Rigging

Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting and rigging equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of the procedures used to perform hoisting and lifting operations.
- Demonstrate knowledge of calculations required when performing hoisting and lifting operations.

2014 National Occupational Analysis Reference:

2.04 Operates lifting, rigging and hoisting equipment.

Objectives and Content:

1. Define terminology associated with hoisting, lifting and rigging.

2. Identify hazards and describe safe work practices pertaining to hoisting, lifting and rigging.

3. Identify codes and regulations pertaining to hoisting, lifting and rigging.

4. Identify types of rigging equipment and accessories and describe their limitations, applications and procedures for use.
   i) jacks
   ii) hoists
   iii) cranes
      - overhead travelling cranes (OTC)
      - gantry (A-frame)

5. Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.

6. Identify types of knots, hitches and bends and describe the applications and procedures used to tie them.

7. Describe the procedures used to ensure the work area is safe for lifting.
   i) supervision of lift
   ii) securing work area
   iii) communication

iv) load placement
v) post-lift inspection

8. Identify and describe procedure used to communicate during hoisting, lifting and rigging operations.
   i) hand signals
   ii) electronic communications
   iii) audible/visual

9. Identify the factors to consider when selecting rigging equipment.
   i) load characteristics
   ii) sling angle
   iii) environment
      - chemical hazards
      - grounding requirements
      - weather conditions
   iv) working load limit

10. Describe the procedures used for attaching rigging equipment to the load.

GFA-145 Tools, Equipment and Testing Instruments

Learning Outcomes:

- Demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of testing instruments, their applications, maintenance and procedures for use.

2014 National Occupational Analysis Reference:

2.01 Maintains hand, power and powder-actuated tools.
2.02 Uses technical instruments and testers.

Objectives and Content:

1. Define terminology associated with tools, equipment and testing instruments.

2. Identify hazards and describe safe work practices pertaining to tools and equipment.

3. Identify types of hand tools and describe their applications and procedures for use.

4. Describe the procedures used to inspect, maintain and store hand tools.

5. Identify types of power tools and describe their applications and procedures for use.
   i) electric
   ii) hydraulic
   iii) pneumatic
   iv) gas powered
   v) powder-actuated

6. Identify power tool attachments and consumables and describe their applications and procedures for use.

7. Identify types of measuring tools and describe their applications and procedures for use.
8. Describe the procedures used to calibrate, recalibrate, inspect, maintain and store measuring tools and equipment according to manufacturer's specifications.

9. Identify types of testing instruments and equipment and describe their applications and procedures for use.

10. Describe the procedures used to inspect, maintain and store testing instruments and equipment according to manufacturer's specifications.

11. Identify types of combustible gas indicators and describe their applications and procedures for use.

12. Describe pressure measuring tools.
    i) manometers
    ii) mechanical gauges

13. Identify different types of gas pressures that are measured using pressure measuring tools.
    i) standing line pressures
    ii) operating line pressures
    iii) gauge pressures
    iv) absolute pressures
    v) conversion between different pressures

GFA-150 Industrial/Commercial/Institutional (ICI) Venting Systems

Learning Outcomes:

- Demonstrate knowledge of industrial/commercial/institutional (ICI) venting systems, their components, applications and operation.
- Demonstrate knowledge of the procedures used to install and maintain ICI venting systems.

2014 National Occupational Analysis Reference:

7.01 Lays out venting.
7.02 Prepares venting material for assembly.
7.03 Connects material for venting.
9.01 Installs natural draft control systems.
9.02 Installs mechanical draft control systems.

Objectives and Content:

1. Define terminology associated with ICI venting systems.

2. Interpret codes and regulations pertaining to ICI venting systems.

3. Identify ICI venting system types and components and describe their application, operation and procedures for use.
   i) appliances
   ii) vents
   iii) terminations
   iv) ancillary devices
   v) special venting systems

4. Describe the procedures used to design, install, maintain and inspect ICI venting systems.
   i) venting requirements
   ii) sizing tables
   iii) appliance types
   iv) chimneys and liners
   v) terminations
   vi) BH venting systems
   vii) draft calculations and verification

5. Describe the procedures used to determine ICI venting requirements.
    i) building types
    ii) equipment

GFA-155 Air Supply Systems

Learning Outcomes:

- Demonstrate knowledge of requirements for combustion, dilution and ventilation air.
- Demonstrate knowledge of sizing and installation of air supply systems.

2014 National Occupational Analysis Reference:

8.01 Lays out air supply system.
8.02 Connects air supply control systems.

Objectives and Content:

1. Identify codes and industry standards that apply to air supply.

2. Describe the effects that different building components have on air supply.

3. Explain the operation of the combustion air and ventilation air system.

4. Describe the function of interlock components of mechanical combustion air systems.

5. Explain service and adjustment procedures for mechanical combustion air systems.

6. Explain the calculations used to determine air supply requirements.

7. Identify manufacturers' specifications for the conditioning of air supply.

8. Describe types and installation of air supply systems.

GFA-160 Propane Storage and Handling Systems

Learning Outcomes:

- Demonstrate knowledge of properties and characteristics of liquid propane.
- Demonstrate knowledge of storage and vaporization.

2014 National Occupational Analysis Reference:

15.01 Installs propane storage systems.
15.02 Installs propane handling systems.

Objectives and Content:

1. Define terminology associated with propane storage and handling systems.

2. Identify hazards and describe safe work practices pertaining to propane storage and handling systems.

3. Identify codes and regulations pertaining to propane storage and handling systems.

4. Describe propane systems.
   i) liquid meters
   ii) mixing equipment
   iii) trucks
   iv) rail
   v) storage facilities
   vi) pipeline and supply storage
   vii) gas supply systems

5. Describe the installation and maintenance of propane transport equipment and storage facilities.
   i) pumps
   ii) compressors
   iii) vaporizers
   iv) air fuel mixers

6. Describe liquid propane systems installation.

7. Describe the protection and maintenance of distribution systems.

LEVEL 2

GFA-200 Gas Codes 4

Learning Outcomes:

- Demonstrate knowledge of codes, *Acts* and regulations specific to the gas industry.

2014 National Occupational Analysis Reference:

3.01 Interprets drawings and codes.

Objectives and Content:

1. Define advanced terminology associated with gas codes.

2. Interpret codes applicable to gas installations.
   i) CSA B149.1 Natural Gas and Propane Installation Code
   ii) CSA B149.2 Propane Storage and Handling Code
   iii) CSA B149.3 Field Approval of Fuel Related Components on Appliances and Equipment Code

3. Identify regulations governing Gasfitter - Class A scope of responsibilities and limitations.

4. Identify and interpret regulations pertaining to fuel gases and combustion.

5. Identify changes that affect the building or systems requirements.

GFA-205 Electrical Systems and Controls 4

Learning Outcomes:

- Demonstrate knowledge of advanced electrical controls, their applications, maintenance, servicing and procedures for use.
- Demonstrate knowledge of advanced electrical control circuits, their applications, maintenance, servicing and procedures for testing.
- Demonstrate knowledge of motors, their applications, maintenance, and procedures for use and testing.
- Demonstrate knowledge of communications automation and instrumentation control systems.

2014 National Occupational Analysis Reference:

2.02 Uses technical instruments and testers.
10.01 Performs selection and installation of combustion controls.
10.02 Performs selection and installation of flame safeguards
10.03 Performs selection and installation of safety and operating controls.
11.01 Selects electrical components.
11.02 Performs assembly and connection of electrical components.
12.01 Performs selection of automation and instrumentation control systems.
12.02 Performs assembly and connection of automation and instrumentation control systems.

Objectives and Content:

1. Define terminology associated with electrical controls.

2. Identify hazards and safe work practices pertaining to electrical systems and controls.

3. Identify and interpret codes and regulations pertaining to electrical controls.

4. Describe types of controls and their components, application, operation and procedures for use.

5. Describe the procedures used to test and troubleshoot control circuits.

6. Design advanced electrical wiring diagrams.
   i) integration of control systems
   ii) modifications to existing systems

7. Describe the procedures used to test, service, maintain and troubleshoot advanced controls, control systems and their components.

8. Describe motors and their components, application, operation and procedures for use.

9. Explain the operation of the electrical circuits in an appliance.

10. Describe control signals, standards and protocols.

11. Describe communication protocols and standards.
   i) RS-232, RS-485
   ii) Modbus
   iii) BACnet
   iv) Ethernet
   v) protocol translators
   vi) BMS and PLC Systems

12. Describe power and advanced control circuits found on industrial/commercial/institutional (ICI) appliances and equipment.

13. Describe the procedures for the installation of control systems for ICI appliances and equipment.

14. Describe the programming and configuration of different electro/mechanical controls and instrumentation on ICI appliances and equipment.

15. Describe the procedures for the installation of flame safeguard controls.

16. Describe the procedures for pre-checks, start-up and commissioning of electrical and control systems.

GFA-210 Drawings and Blueprint Reading 4

Learning Outcomes:

- Demonstrate knowledge of the procedures to complete and label drawings of typical installations.
- Demonstrate knowledge of the procedures to develop a material list from information contained in construction drawings.

2014 National Occupational Analysis Reference:

3.01 Interprets drawings and codes.

Objectives and Content:

1. Describe the procedures used to modify drawings to create as-built drawings.

2. Identify criteria used to estimate job requirements.

GFA-215 Gas Equipment

Learning Outcomes:

- Demonstrate advanced knowledge of gas equipment, their components, application and operation.
- Demonstrate knowledge of the procedures used to install, convert and reactivate gas appliances.

2014 National Occupational Analysis Reference:

13.01 Installs gas-fired equipment.
13.03 Connects gas supply to equipment.
13.04 Connects equipment to energy distribution systems.
14.01 Installs valve trains.
14.02 Installs accessories.

Objectives and Content:

1. Define terminology associated with gas equipment.

2. Identify and interpret regulations, codes and standards pertaining to gas equipment.

3. Identify hazards and describe safe work practices pertaining to gas equipment.

4. Describe ICI gas equipment and their components and describe their application, operation and procedures for use.
   i) burners
   ii) ignition systems
   iii) flame sensing devices
   iv) control and safeties

5. Identify types of ICI burners, their classifications and performance characteristics.
   i) gun style
   ii) premix
   iii) nozzle mix
   iv) register style

6. Identify types of non-vented gas equipment and describe their components and operation.

7. Identify different types of gas burning equipment.
   i) makeup air (MUA)
      - direct
      - indirect
   ii) boilers
   iii) process burners
   iv) combustion air heater

8. Describe flow rate calculation.
   i) orifice flow calculations

9. Describe the procedures for installing a meter.
   i) installation criteria
   ii) manufacturers' requirements
   iii) applications

10. Describe the installation of advanced valve train components and their operation.

11. Describe different types of flow controllers.
   i) ratio controllers
   ii) metering orifices

GFA-220 Job Planning

Learning Outcomes:

- Demonstrate knowledge of the procedures used to plan and organize jobs.

2014 National Occupational Analysis Reference:

3.02 Selects systems, equipment and components.
3.03 Organizes work.

Objectives and Content:

1. Define terminology associated with job planning activities.

2. Identify sources of information relevant to job planning.
   i) documentation
   ii) drawings
   iii) related professionals
   iv) clients

3. Identify the factors to consider for determining job requirements.
   i) personnel
   ii) tools and equipment
   iii) materials
   iv) permits
   v) safety planning

4. Describe the procedures used to plan job tasks.
   i) scheduling
   ii) estimating
   iii) coordinating site access

5. Describe the procedures used to receive and verify delivered materials.

6. Describe the procedures used to store, organize and maintain inventory.

7. Identify the purpose of submittals and shop drawings, and describe the procedures used to interpret them.

8. Identify the types of material take-offs lists, and describe their applications and the procedures used to produce them.
   i) material estimation
   ii) material installation

9. Describe the procedures used to prepare work sites.
   i) erecting barricades and flagging
   ii) identifying hazards
   iii) locating service points
   iv) locating isolation points

GFA-225 Installation of Systems and Equipment

Learning Outcomes:

- Demonstrate knowledge of the installation of ICI equipment and piping.
- Demonstrate knowledge of installing ICI gas-system components.
- Demonstrate knowledge of installing appliance accessory devices and equipment.

2014 National Occupational Analysis Reference:

13.01 Installs gas-fired equipment.
13.02 Installs gas piping equipment.
13.03 Connects gas supply to equipment.
13.04 Connects equipment to energy distribution systems.
14.01 Installs valve trains.
14.02 Installs accessories.
17.01 Performs testing, adjusting and balancing procedures.

Objectives and Content:

1. Define terminology associated with the installation of systems and equipment.

2. Identify hazards and describe safe work practices pertaining to installation of systems and equipment.

3. Identify codes and regulations pertaining to installation of systems and equipment.

4. Identify the types of tools and equipment used in installation of systems and equipment.

5. Describe the procedures used to select the appropriate appliance for different types of applications.

6. Describe the procedures used to select the appropriate piping for the application.

7. Describe energy efficiency as it relates to appliances.

8. Describe the procedures used to install appliances and equipment.

9. Identify the different types of ICI appliances.
   i) boilers/gas fired hot water boosters
   ii) commercial cooking equipment
   iii) commercial clothes dryers
   iv) construction heaters
   v) catalytic heaters
   vi) carbon dioxide generators
   vii) air handling units/roof-top units

10. Describe the operation of different types of pressure regulators.
   i) pilot operated
   ii) direct operated
   iii) lever operated
   iv) single ported balanced
   v) double ported balanced
   vi) zero governors
   vii) proportional
   viii) two-stage regulator system (propane)

11. Describe the selection, installation and maintenance requirements for pressure regulators.

12. Describe requirements for venting.
   i) pressure regulators
   ii) over pressure relief
   iii) pressure switches

13. Describe ICI ancillary devices and equipment, their installation, application, operation and procedures for use.
   i) O_2 trim
   ii) draft control
   iii) linkage less combustion (FARC)
   iv) variable frequency drives (VFD)
   v) emission control
      - flue gas recirculation (FGR)

14. Describe the procedure to purge piping and equipment before start-up.

GFA-230 ICI Service, Maintenance and Repair

Learning Outcomes:

- Demonstrate advanced knowledge of maintaining appliances and equipment.
- Demonstrate advanced knowledge of repairing appliances and equipment.

2014 National Occupational Analysis Reference:

18.01 Inspects system components and operation.
18.02 Performs maintenance activities.
19.01 Diagnoses gas-fired equipment and components.
19.02 Selects replacement components.
19.03 Replaces components.
19.04 Verifies operation.

Objectives and Content:

1. Define terminology associated with servicing, maintaining and repairing appliances and equipment.

2. Identify hazards and describe safe work practices pertaining to servicing, maintaining and repairing appliances and equipment.

3. Identify codes and regulations pertaining to servicing, maintaining and repairing appliances and equipment.

4. Identify tools, equipment and materials used to assist in servicing, maintaining and repairing appliances and equipment.

5. Describe troubleshooting and testing as it applies to equipment ladder/schematic and pictorial/wiring diagrams.

6. Describe troubleshooting and testing procedures as they apply to servicing, maintaining and repairing appliances and equipment.
   i) sequence of operations

7. Describe the procedures to repair and replace components.

8. Describe the different types of servicing ICI appliances.
   i) annual
   ii) emergency
   iii) preventative

9. Describe troubleshooting and repairing pressure regulators.

10. Describe performance of flame sensing components.
   i) scanner check
   ii) flame signal
   iii) ignition spark response
   iv) pilot drop out
   v) pilot turn down
   vi) flame failure response

11. Describe the procedures used to purge existing system or components after repair.

12. Describe the procedure to purge piping and equipment before start-up.

GFA-235 Equipment Conversion and Combustion

Learning Outcomes:

- Demonstrate knowledge of gas equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of conversion equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of orifices, the procedures used for sizing and conversion.

2014 National Occupational Analysis Reference:

10.01 Performs selection and installation of combustion controls.
14.01 Installs valve trains.
19.02 Selects replacement components.
19.03 Replaces components.
19.04 Verifies operation.

Objectives and Content:

1. Define terminology associated with gas equipment, conversion burners and orifices, their application, maintenance and procedures for use.

2. Identify codes and regulations pertaining to conversions.

3. Identify the requirements of combustion theory and chemical processes involved in combustion.

4. Describe incomplete combustion, its causes, products and implications.

5. Describe combustion in commercial/industrial gas burners.

6. Determine suitability of appliance for conversion.

7. Describe conversion burner selection criteria.

8. Describe the procedures for selecting and sizing an orifice for conversion.

9. Describe the procedures used to prepare burners for conversion.
   i) atmospheric
   ii) fan assisted
   iii) forced draft

10. Describe the procedures used to convert an appliance from one fuel type to another fuel type.

GFA-240 Dual and Alternate Fuels

Learning Outcomes:

- Demonstrate knowledge of duel and alternative fuels, their properties and characteristics.
- Demonstrate knowledge of the principles of combustion and their application to dual and alternative fuel appliances.

2014 National Occupational Analysis Reference:

13.03 Connects gas supply to equipment.

Objectives and Content:

1. Define terminology associated with dual and alternative fuels.

2. Identify hazards and describe safe work practices pertaining to dual and alternative fuels.
   - i) corrosive elements
     - bio-gas/methane
   - ii) erosive elements

3. Identify codes and regulations pertaining to dual and alternative fuels.

4. Identify tools and equipment associated with dual and alternative fuels.

5. Describe dual and alternative fuels systems.
   - i) storage facilities
   - ii) pipeline and supply storage
   - iii) fuel supply systems

6. Describe the maintenance of dual and alternative fuels equipment and storage facilities.
   - i) fuel pumps
   - ii) atomizing air compressors

7. Describe final connections of dual and alternative fuels installation.

GFA-245 Testing ICI Appliances and Equipment

Learning Outcomes:

- Demonstrate advanced knowledge of testing instruments, their applications, maintenance and procedures for use.
- Demonstrate advanced knowledge of techniques to test appliances and equipment, maintenance and procedures for use.

2014 National Occupational Analysis Reference:

16.01 Tests gas piping systems.
16.02 Performs start-up procedures.
17.01 Performs testing, adjusting and balancing procedures.

Objectives and Content:

1. Define terminology associated with testing appliances and equipment.

2. Identify hazards and describe safe work practices pertaining to testing appliances and equipment.

3. Identify codes and regulations pertaining to testing appliances and equipment.

4. Identify tools and equipment used to assist in testing appliances and equipment.

5. Describe the tests and inspections for appliances and equipment.
   i) pressure testing
   ii) meter dial test
   iii) hydrostatic/air test
   iv) bubble test

6. Describe the testing of appliances and equipment for safety, reliability and efficiency.
   i) verify safeties and interlocks
   ii) confirm operating parameters
      - flame signal
      - temperature rise
      - manifold pressure
      - communications

- systems integration according to manufacturers' specifications
- systems operation according to intended design

iii) combustion analysis

7. Explain the liabilities and responsibilities for the testing of appliances and equipment.
   i) manufacturer
   ii) Gasfitter - Class A
   iii) AHJ
   iv) building owner/representative

8. Identify manufacturers' required frequency for testing and maintenance of appliances and equipment.

9. Identify requirements for testing systems that have been altered or repaired.

GFA-250 ICI Commissioning and Decommissioning

Learning Outcomes:

- Demonstrate knowledge of the procedures to commission and decommission ICI appliances and equipment.

2014 National Occupational Analysis Reference:

17.02 Completes commissioning report and handover.
20.01 Disconnects appliances and accessories.
20.02 Removes gas-fired systems and components.

Objectives and Content:

1. Define terminology associated with commissioning and decommissioning appliances and equipment.

2. Identify hazards and describe safe work practices pertaining to commissioning and decommissioning appliances and equipment.
   i) confined spaces
   ii) asbestos containing materials
   iii) lead-based paint
   iv) energy isolation
   v) environment consideration
   vi) mercury

3. Identify codes and regulations pertaining to commissioning and decommissioning appliances and equipment.

4. Identify tools and equipment used to assist in commissioning and decommissioning appliances and equipment.

5. Interpret information pertaining to the commissioning and decommissioning appliances and equipment.

6. Describe the procedures used to decommission appliances and equipment.
   i) disconnect appliance from services and systems
   ii) boiler lay up (wet/dry)
   iii) seal appliance openings

iv) prepare for transportation
v) drain condensing appliances

7. Describe the procedures used to disconnect energy sources and components.
   i) water
   ii) fresh air
   iii) gas line
   iv) electrical
   v) gas venting
   vi) sprinkler
   vii) duct work