



**Skilled  
Trades**  
Ontario

**Métiers  
spécialisés**  
Ontario

Apprenticeship  
Curriculum Standard

Residential (Low Rise)  
Sheet Metal Installer

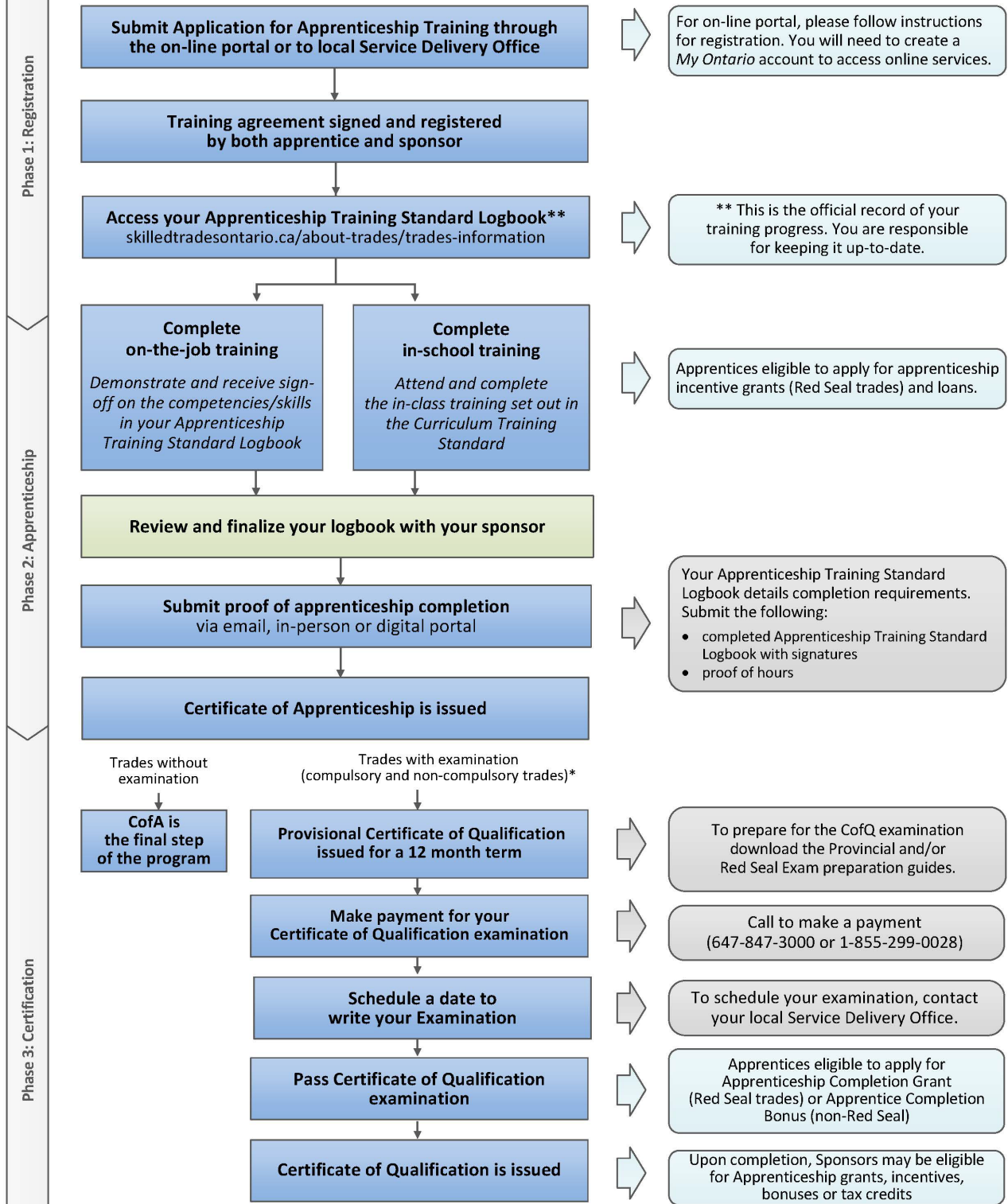
Levels 1 & 2

308R

2011



# Apprenticeship Pathway to a Certificate of Qualification



\* For a list of trades subject to a certification examination, visit: [skilledtradesontario.ca](http://skilledtradesontario.ca)

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## Residential (Low Rise) Sheet Metal Installer

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

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

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

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*Maintained with transfer to Skilled Trades Ontario 2011 (V100)*

### **Preface**

This curriculum standard for the Residential (Low Rise) Sheet Metal Installer trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 2 levels of training. The Reportable Subjects Summary chart (located on page 4) summarizes the training hours for each reportable subject.

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

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

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

Please refer to Skilled Trades Ontario website ([www.skilledtradesontario.ca](http://www.skilledtradesontario.ca)) for the most accurate and up-to-date information about Skilled Trades Ontario. For information on *Building Opportunities in the Skilled Trades Act, 2021 (BOSTA)* and its regulations, please visit [Building Opportunities in the Skilled Trades Act, 2021, S.O. 2021, c. 28 - Bill 288 \(ontario.ca\)](http://www.skilledtradesontario.ca/building-opportunities-in-the-skilled-trades-act-2021-s.o.-2021-c.-28-bill-288)

### **Pre-requisites**

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

### **Hours Disclaimer** (if applicable)

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

### **Suggested Equipment for Training Delivery Agencies**

The listing of tools on page 29 and page 54 does not list minimum quantities based on the understanding that the delivering TDA is in the best position to determine the need based on its delivery methodology.

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

## Introduction

This curriculum has been developed in keeping with the prescribed format of the Ministry of Labour, Immigration, Training and Skills Development. The curriculum will allow for easy adaptation to the current reporting structures for the respective program phase and for new alternative delivery modes.

For easy reference, a time allocation has been included for each unit, along with the Theory/Practical breakdown for the delivery of the units of learning outcomes.

The continual introduction of innovative techniques and more complex equipment is resulting in increasing demand for more highly skilled tradespersons. The curriculum has been developed to ensure that they will be prepared with this theoretical knowledge and to offer some practical applications to complement the on-the-job work competencies of the Residential (Low Rise) Sheet Metal Installer trade. These competencies are detailed in the Apprenticeship Training Standard for the trade of Residential (Low Rise) Sheet Metal Installer.

The Apprenticeship Training Standards are designed to be a guide to the apprentice as to the diversity of the trade, a “blueprint” for on-the-job training for the employer, and a record of hours and tasks that have been completed by the apprentice. The standard was produced and developed by the Ministry of Labour, Immigration, Training and Skills Development in consultation with industry through the Sheet Metal Worker Provincial Advisory Committee (PAC).

The objectives of the curriculum, therefore, are to provide a basis for:

- a. sound theoretical training to meet the challenges presented by increasingly more complex designs;
- b. the acquisition of fundamental skills of the trade through the exposure to practical applications;
- c. developing in the apprentices high standards of craftsmanship, problem-solving skills and personal pride in their trade;
- d. developing desirable work attitudes and a keen sense of responsibility, particularly in regard to co-workers and personal safety.

The curriculum has been presented in a chronological sequence in keeping with sound teaching methodologies. However, the actual application of the sequence may differ between training delivery agents because of scheduling, staff and facilities utilization.



The curriculum includes a large number of off-the-job “learning outcomes” linked to objectives identified in the Training Standards. However, employers should not assume complete coverage of all aspects of the learning outcomes. The in-school delivery focuses primarily on the knowledge required to master the respective learning outcome. Employers therefore are expected to complete the delivery of these learning outcomes by providing apprentices with opportunity to apply in-school knowledge to the practical learning experience in the workplace.

To ensure the successful students will be able to achieve the individual learning outcomes according to the performance criteria, specific times have been allocated. Time constraints will not permit engaging apprentices in tasks of limited benefit to learning or that are unrelated to the defined curriculum outcomes.

Regular evaluations of the apprentice’s learning achievements must be performed in both theory and application throughout the program to ensure consistency with learning outcome expectations. Testing of apprentice knowledge and skills will take place during the allotted delivery hours for each reportable subject. In addition to providing an evaluation of apprentice competency, the review of test questions is considered to be a valuable learning opportunity. The curriculum has also been designed to give the instructor every reasonable opportunity for flexibility and innovation without deviating to any significant degree from the course requirements.

In all practical activities, the apprentices will observe the *Occupational Health and Safety Act* and the applicable regulations, including use of personal protective equipment. Institutional regulations and policies may also apply.

## Program Summary of Reportable Subjects

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
<b>Level 1</b>				
S1081	Trade Skills and Practices	18	18	0
S1082	Hand Tools, Power Tools and Equipment	42	24	18
S1083	Reading and Interpretation of Drawings, Manuals and Orders	60	42	18
S1084	Duct Requirements and Installation Procedures	60	36	24
	<b>Level 1 Totals</b>	<b>180</b>	<b>120</b>	<b>60</b>
<b>Level 2</b>				
S1085	Worksite Organization and Practices	18	15	3
S1086	Installation of Residential Heating, Ventilation and Air Conditioning Equipment and Accessories	48	30	18
S1087	Advanced Planning, Preparation and Production of Drawings	54	36	18
S1088	Installation of Duct for Ventilation, Exhaust and Distribution	60	36	24
	<b>Level 2 Totals</b>	<b>180</b>	<b>117</b>	<b>63</b>
	<b>Totals</b>	<b>360</b>	<b>237</b>	<b>123</b>

# Level 1

**Program Summary of Reportable Subjects — Level 1**

<b>Number</b>	<b>Reportable Subjects</b>	<b>Hours Total</b>	<b>Hours Theory</b>	<b>Hours Practical</b>
S1081	Trade Skills and Practices	18	18	0
S1082	Hand Tools, Power Tools and Equipment	42	24	18
S1083	Reading and Interpretation of Drawings, Manuals and Orders	60	42	18
S1084	Duct Requirements and Installation Procedures	60	36	24
	<b>Level 1 Totals</b>	<b>180</b>	<b>120</b>	<b>60</b>

Number:	S1081		
<b>Title:</b>	<b>Trade Skills and Practices</b>		
Duration:	Total Hours: 18	Theory: 18	Practical: 0
Prerequisites:	None		
Content:	S1081.1 Identify materials in the trade. (3/0)		
	S1081.2 Identify types and application of seams and notches. (3/0)		
	S1081.3 Identify types and application of connectors and notches. (3/0)		
	S1081.4 Identify safe work practices. (4/0)		
	S1081.5 Describe environmental protection and practices. (5/0)		

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Periodic quizzes  
Final test at the end of the term

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration - practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation

Manuals

- Sheet Metal Trades Health & Safety Manual
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number:	S1081.0		
Title:	<b>Trade Skills and Practices</b>		
Duration:	Total Hours: 18	Theory: 18	Practical: 0
Cross Reference to Training Standard:	7211.01-7211.06, 7211.08, 7212.01-7212.04, 7214.02, 7216.01		

## General Learning Outcomes

Upon successful completion, the apprentice is able to identify materials used in the trade, types and applications of seams, notches, connector allowances and notching techniques, to identify safe work practices, and to describe environmental protection practices.

## Learning Outcomes and Content

### 1.1 Identify materials in the trade. (3/0)

Identify metal characteristics and properties including:

- brittleness
- corrosion
- ferrous
- non ferrous
- electrolysis
- galvanic

Identify the metals and coatings used for residential installations including:

- hot/cold rolled steel
- aluminium
- zinc
- galvalume
- satin coat
- tin plate
- stainless steel
- galvanized steel
- exotic material

Describe material thickness and gauges including:

- material gauging
- United States Standard Gauge
- American Wire Gauge
- Brown-Sharpe
- Birmingham Gauge

Describe material weights in metric and imperial.

1.2 Identify the types and application of seams and notches. (3/0)

Identify type and applications of seams including:

- Pittsburgh seam
  - Irish
  - Chicago
  - Hobo
- Button lock
- snap lock
- groove seam (ACME)
- riveted seam, (pop rivet)
- clinch
- related trade calculations

1.3 Identify types and application of connectors and notches. (3/0)

Identify types, allowances, formulas and applications for:

- “S” cleats (flat and standing)
- drive cleats
- fish lock or hammer lock
- coupling for round spirals
- connectors used for Hi-Velocity
- lap seam
- related trade calculations

Notch for modified duct including:

- “S” cleats (flat and standing)
- drive cleats
- fish lock or hammer lock
- coupling for round spirals
- connectors used for Hi-Velocity
- lap seam
- related trade calculations

1.4 Identify safe work practices. (4/0)

Identify applicable regulations as per the *Occupational Health and Safety Act* including:

- Joint Health and Safety Committee
- Enforcement of the Act
- Duties of Constructor, Employer, Supervisor and Worker
- Procedure to report unsafe work
- Right to Refuse
- Material Safety Data Sheets



Identify type and application of Personal Protective Equipment (PPE) including:

- safety boots
- safety glasses, goggles, face shields
- hearing protection
- respirators
- hand protection
- protective head gear
- safety harnesses

Identify safe working conditions including:

- first aid equipment
- work area clear of obstructions and debris
- tool and equipment storage and cleaning
- handling and storage of material
- containers for flammable materials

1.5 Describe environmental protection and practices. (5/0)

Identify hazardous materials in the work place including:

- duct sealers
- oils
- fuels
- metal debris

Describe procedures for storing, disposing and recycling of materials including:

- duct sealers
- oils
- fuels
- metal debris
- fittings
- duct work

Identify materials that can be reused in the work place to reduce on-site waste including:

- duct
- fittings
- pipe
- other installation components

Describe procedures for storing, and redistributing material including:

- duct
- fittings
- pipe
- other installation components

Identify fire safety procedures including:

- fire assessment
- fire suppression
- location of exits
- routes of escape

Identify common fire hazards including:

- open flame
- electrical
- explosion

List types of fires and classes including:

- class A, ordinary combustibles
- class B, flammable hydrocarbon fluids
- class C, electrical equipment
- class D, combustible metals

<b>Evaluation Structure</b>		
<b>Theory Testing</b>	<b>Practical Application Testing</b>	<b>Final Assessment</b>
40%	30%	30%

Number:	S1082		
Title:	<b>Hand Tools, Power Tools and Equipment</b>		
Duration:	Total Hours: 42	Theory: 24	Practical: 18
Prerequisites:	None		
Content:	S1082.1 Select and use hand tools. (9/8)		
	S1082.2 Select and use power tools. (9/6)		
	S1082.3 Select material handling equipment, ladders and scaffolding. (6/4)		

### **Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Final test at the end of the term  
Periodic quizzes

### **Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

### **Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

#### Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation

## Manuals

- Sheet Metal Trades Health & Safety Manual
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number:	S1082.0		
Title:	<b>Hand Tools, Power Tools and Equipment</b>		
Duration:	Total Hours: 42	Theory: 24	Practical: 18
Cross Reference to Training Standard:	7213.04-7213.06, 7211.09, 7211.10, 7213.09		

## General Learning Outcomes

Upon successful completion, the apprentice is able to select and use hand tools, power tools, material handling equipment, ladders and scaffolding effectively and safely to perform residential sheet metal installations.

## Learning Outcomes and Content

### 2.1 Select and use hand tools. (9/8)

Identify application of hand tools including:

- tape measure
- marking gauges
- squares
- level
- scratch awl
- wire/side cutters
- aviation snips
- snips pattern/straight/combination
- chisels
- drill bits
- hole saws
- hand seamers
- hand notcher and crimper
- bar folder
- wrench (adjustable, open/box)
- chalk line
- riveter
- hammers (setting, ball peen, claw)

Identify safety requirements for hand tools including:

- application of hand tools
- safe operation
- capacity
- limitations
- maintenance
- sharpening

Use hand tools to complete a practical assignment.

2.2 Select and use power tools. (9/6)

Identify required safety legislation and standards including:

- *Occupational Health & Safety Act*
- Infrastructure Health & Safety Association (IHSA)

Determine power tool capacity and manufacturer's operating safety procedures including:

- electric and cordless hand drills
  - variable
  - hammer
- power saws
  - chain
  - circular
  - reciprocating
  - cut-off
  - chop saw
- grinders
- nibblers
- uni-shears
- screw guns
- duct hammer
- pneumatic nailer

Identify methods and procedures for inspecting, testing, maintaining and storing of power tools including:

- electric and cordless hand drills
  - variable
  - hammer
- power saws
  - chain
  - circular
  - reciprocating
  - cut-off
  - chop saw

- grinders
- nibblers
- uni-shears
- screw guns
- duct hammer
- pneumatic nailer

Use power tools to complete a practical assignment.

2.3 Select material handling equipment, ladders and scaffolding. (6/4)

Identify procedures for operating material handling equipment.

Describe the application, functions, and capabilities of material handling equipment including:

- carts
- dollies
- ropes

Identify material handling equipment required for picking up and moving equipment and components.

Describe the application and capabilities of personnel lift equipment including:

- ladders
- scaffolds
- work platforms

<b>Evaluation Structure</b>		
<b>Theory Testing</b>	<b>Practical Application Testing</b>	<b>Final Assessment</b>
30%	30%	40%

Number:	S1083		
Title:	<b>Reading and Interpretation of Drawings, Manuals and Orders</b>		
Duration:	Total Hours: 60	Theory: 42	Practical: 18
Prerequisites:	None		
Content:	S1083.1 Read drawings and specifications to determine work to be performed. (10/4)		
	S1083.2 Produce freehand sketches and drawings. (18/10)		
	S1083.3 Read and interpret related codes, manuals and specifications. (8/4)		
	S1083.4 Identify symbols used in residential drawings. (6/0)		

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Periodic quizzes  
Final test at the end of the term

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation



Manuals

- Sheet Metal Trades Health & Safety Manual
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number:	S1083.0		
Title:	<b>Reading and Interpretation of Drawings, Manuals and Orders</b>		
Duration:	Total Hours: 60	Theory: 42	Practical: 18
Cross Reference to Training Standard:	7213.01, 7213.02, 7213.07, 7213.08, 7214.02		

## General Learning Outcomes

Upon successful completion, the apprentice is able to read and interpret drawings and specifications to determine work to be performed, produce free hand sketches and drawings, read and interpret related codes, manuals and specifications, and identify symbols used in residential drawings.

## Learning Outcomes and Content

3.1 Read and interpret drawings and specifications to determine work to be performed. (10/4)

Identify the different types and applications of residential plans including:

- architectural
- structural
- mechanical
- electrical
- plan and elevation
- interferences
- different lines and symbols
- drawing inter-relation by symbols
- scales metric, imperial
- convert decimals to fractions (and fractions to decimals)
- metric to imperial (and imperial to metric)
- trade-related calculations

Identify divisions and specifications of building and fire codes.

- *Ontario Building Code*
- *National Building Code*
- *Ontario Fire Code*

3.2 Produce freehand sketches and drawings. (18/10)

Determine measuring techniques.

Produce shop drawings using drafting equipment and templates including:

- sketch work
  - isometric
  - orthographic
  - perspective
- order sheet
  - free-hand
  - templates
  - drafting equipment
  - dimensioning techniques
- take-off from drawings and prints
  - develop job requisition

Sketch freehand for the ordering of items required for installations including:

- duct
- fittings
- accessories

Identify types and applications of CAD computer software. Use CAD computer software to produce drawings.

3.3 Read and interpret related codes, manuals and specifications. (8/4)

Identify areas of the building code relating to residential duct installation including:

- *Ontario Building Code*
- Local building codes
- International Residential Code (for Energy Star)

Identify specifications relating to residential duct installation including:

- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- Manufacturers' specifications
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

3.4 Identify symbols used in residential drawings. (6/0)

Identify symbols used in residential drawings including:

- air handling units
- exhaust fans
- kitchen hoods
- round and square ducting
- supply air (S/A) and return air (R/A) ducts
- inlets and outlets
- first and second floor risers
- cross sections
- registers and grills
- exhaust vents (flues)
- air cleaners
- indirect coils

<b>Evaluation Structure</b>		
<b>Theory Testing</b>	<b>Practical Application Testing</b>	<b>Final Assessment</b>
35%	35%	30%

Number:	S1084		
Title:	<b>Duct Requirements and Installation Procedures</b>		
Duration:	Total Hours: 60	Theory: 36	Practical: 24
Prerequisites:	None		
Content:	S1084.1 Develop a plan for duct installation. (8/2)		
	S1084.2 Identify duct sizing and load requirements. (8/3)		
	S1084.3 Describe methods for connecting, hanging, supporting and fastening duct. (8/3)		
	S1084.4 Install and assemble duct and fittings. (12/16)		

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Periodic quizzes  
Final test at the end of the term

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
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- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number:	S1084.0		
Title:	<b>Duct Requirements and Installation Procedures</b>		
Duration:	Total Hours: 60	Theory: 36	Practical: 24
Cross Reference to Training Standard:	7213.07, 7214.01, 7214.03, 7216.02-7216.06, 7216.08, 7216.09		

## General Learning Outcomes

Upon successful completion the apprentice is able to describe the requirement of a duct distribution system and the planning requirements for the installation; demonstrate the methods for connecting, hanging, and fastening; and, demonstrate the assembly and installation of duct work and fittings required in the low-rise residential installation.

## Learning Outcomes and Content

### 4.1 Develop a plan for duct installation. (8/2)

Identify materials required for a residential duct installation including:

- system components
- duct and fittings
- round pipe and elbows
- outlets/boots
- take off's
- joist lining
- transverse connections
- flexible duct

Produce a material list which includes:

- list of missing materials
- duct and sizes
- fitting and sizes
- round pipe
- boots, elbows and take off's
- joist lining
- hanging requirements
- connections
- flexible duct

Correlate job requirements and materials to:

- builder
- job lot number
- plan number
- equipment
- materials

4.2 Identify duct sizing and load requirements. (8/3)

Describe terminology and application for duct sizing including:

- velocity pressure
- static pressure
- total pressure
- cubic feet per minute (c.f.m.)
- feet per minute (f.p.m.)
- friction rate
- equivalent length
- effective length
- external static pressure
- equal friction

Describe terminology and applications for load requirements including:

- heat transfers
- term and definitions
- design temperatures
- “U” factors
- “R” factors
- cooling factors
- ventilation loads
- related formulas
- complete loads

4.3 Describe the methods for connecting, hanging, supporting and fastening duct. (8/3)

Identify materials and method for supporting and hanging duct and pipe including:

- drive cleat
- strapping
- threaded rod
- angle
- channel



Describe methods of connecting duct and pipe including:

- drive cleat
- S-Cleat
- fish lock
- snap lock
- Pittsburgh (Irish, Chicago, Hobo)
- button lock

Describe methods and required fasteners for duct and pipe including:

- screws
- tape
- nails
- pop rivets
- nuts and bolts
- lag bolts

4.4 Install and assemble duct and fittings. (12/16)

Organize and coordinate duct work for assembly including:

- duct sizes
- fittings
- block ends
- take off's
- boots
- round pipe
- flexible duct

Assemble duct work including:

- duct
- fittings
- round pipe

Install duct work (using required tools and equipment) including:

- duct
- fittings
- take off's
- round pipe
- flexible duct
- boots
- blank ends

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
25%	45%	30%

## **Summary of Equipment Required for Level 1**

Sheet metal hand tools

Power tools

Duct materials

Heating equipment

Exhaust equipment

Air exchange equipment

Air conditioning equipment (coils)

Filtration equipment

Residential installation simulator

Residential blueprints

# Level 2

**Program Summary of Reportable Subjects — Level 2**

<b>Number</b>	<b>Reportable Subjects</b>	<b>Hours Total</b>	<b>Hours Theory</b>	<b>Hours Practical</b>
S1085	Worksite Organization and Practices	18	15	3
S1086	Installation of Residential Heating, Ventilation and Air Conditioning Equipment and Accessories	48	30	18
S1087	Advanced Planning, Preparation and Production of Drawings	54	36	18
S1088	Installation of Duct for Ventilation, Exhaust and Distribution	60	36	24
	<b>Level 2 Totals</b>	<b>180</b>	<b>117</b>	<b>63</b>

Number:	S1085		
Title:	<b>Worksite Organization and Practices</b>		
Duration:	Total Hours: 18	Theory: 15	Practical: 3
Prerequisites:	Level 1		
Content:	S1085.1 Job site directives and work assignments. (6/0)		
	S1085.2 Communication with tradespersons, customers and others. (6/0)		
	S1085.3 Job site reports and injury reporting procedures. (3/3)		

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Periodic quizzes  
Final test at the end of the term

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation

Manuals

- Sheet Metal Trades Health & Safety Manual
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number: S1085.0  
Title: **Worksite Organization and Practices**  
Duration: Total Hours: 18 Theory: 18 Practical: 0  
Cross Reference to Training Standard: 7211.07, 7213.02, 7213.03, 7213.07, 7213.08, 7213.11, 7214.04, 7214.05

## General Learning Outcomes

Upon successful completion the apprentice is able to describe and apply directives in the completion of work assignments, communicate with tradespersons, customers and others, complete job site reports and describe injury reporting procedures.

## Learning Outcomes and Content

### 5.1 Job site directives and work assignments. (6/0)

Describe job site directives and methods for executing directives to complete work assignments, including:

- scheduling
- coordination
- deliveries
- time management
- fellow worker

Describe the application of jobsite directives to work assignments as relating to and including:

- Supervisors
- Fellow workers
- Subordinates
- Sub-contractors
- Customers
- Management

Describe basic work resolution skills, including:

- problem solving
- decision making
- procrastination
- confrontation



5.2 Communicate with tradespersons, customers and others. (6/0)

Describe the communication process:

- Definition of communication
- Barriers to good communication
- Improving communication
- Relationship between words and things
- Fallacies which interfere with clear thinking
- Listening styles
- Image and appearance

Identify barriers to communication:

- Poor and incorrectly interpreted written communication
- Verbal styles that can conflict with receiving verbal communication
- Non-verbal communication conflicting with verbal communication
- 'Noise' and 'interference'

Communicate with customers efficiently, including:

- Identifying customers'/clients' needs
- Communicating with customers/clients about matters such as estimates and complaints
- Communicating with customers/clients about the extent of services needed
- Explaining policies
- Describing to customers the services offered by a company

Determine good public relations with other tradespersons and the public, including:

- Cooperation with allied trades
- Coordination with other trade functions
- Recognition of problems in all phases
- Consideration of public needs

5.3 Complete job site reports and describe injury reporting procedures. (3/3)

Complete job site reports, including:

- equipment warranty
- site modifications
- time cards
- accident
- injury

Describe procedures for reporting injuries, including:

- situations where first aid may be required
- Workplace Safety & Insurance Board reporting requirements
- who receives required safety and injury reports
- completion of approved injury reports

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
40%	20%	40%

Number:	S1086		
Title:	<b>Installation of Residential Heating, Ventilation, Air-Conditioning Equipment and Accessories</b>		
Duration:	Total Hours: 48	Theory: 30	Practical: 18
Prerequisites:	Level 1		
Content:	S1086.1	Installation of residential heating equipment. (12/6)	
	S1086.2	Installation of residential ventilation equipment. (6/4)	
	S1086.3	Installation of residential of air side cooling components. (6/4)	
	S1086.4	Installation residential air system accessories. (6/4)	

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Final test at the end of the term  
Periodic quizzes

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation

Manuals

- Sheet Metal Trades Health & Safety Manual
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number: S1086.0  
Title: **Installation of Residential Heating, Ventilation, Air-Conditioning Equipment and Accessories**  
Duration: Total Hours: 48 Theory: 30 Practical: 18  
Cross Reference to Training Standard: 7213.04, 7213.05, 7215.03, 7215.04, 7216.02-7216.05, 7216.07, 7216.10-7216.12

### General Learning Outcomes

Upon successful completion the apprentice is able to install residential heating equipment, residential ventilation systems, residential air side cooling components, and residential air system accessories.

### Learning Outcomes and Content

#### 6.1 Installation of residential heating equipment. (12/6)

Identify type heating equipment used in a residential application including:

- High boy
- Low boy
- Horizontal
- Down draft
- Hi velocity
- Fireplace

Identify material and components use to connect venting and combustion air.  
Assemble venting and combustion air systems.

Install approved materials of plastic for venting and combustion air piping.

Assemble metal venting including A, B, BW & BH, C, D (direct vent), L, and other special venting systems.

Describe the method of connection to chimneys and liners.

6.2 Installation of residential ventilation. (6/4)

Identify mechanical ventilation components used for residential exhaust including:

- Bath exhaust
- Dryer exhaust
- Range hood
- Exterior mounted
- Heat Recovery Ventilators (HRV)
- Energy Recovery Ventilators (ERV)

Describe the method of installation of mechanical ventilation components used in residential exhaust systems.

Identify insulation and vapour barrier requirements in the installation of mechanical ventilation components used in residential exhaust systems.

Describe the procedure for the installation of sleeves, louvers and prefabricated flashings for duct penetrations.

6.3 Installation of residential air side cooling components. (6/4)

Identify types of evaporator coils used in residential cooling systems.

Describe methods of locating and installing residential cooling equipment and accessories.

Describe the procedure for installation of evaporator coils including

- slope
- access for line set
- access for drainage

Install an evaporator coil including:

- cutting in to plenum
- placement of support angles
- placement and securing of evaporator coil
- locating and cutting in refrigerant line access
- locating and cutting in drain access

6.4 Installation of residential air system accessories. (6/4)

Describe the types of air cleaners used to remove air borne particulates including:

- media
- static
- electronic precipitators
- aluminium mesh filter (grease)
- ultra-violet (UV) light
- charcoal

Identify components of air cleaners including:

- filter racks
- frames
- airflow sensors

Describe the operation and configuration of media filters used in a residential air distribution system.

Describe the operation and configuration of electronic precipitators for residential air distribution systems including:

- cabinet location and installation
- primary filter
- collector panels
- charcoal filter

Describe the types of humidification systems used in residential applications including:

- atomizing
- flow through
- drum type
- absorption

Identify components of a humidifier including:

- solenoid
- evaporation panel
- water valve
- drain line
- by-pass
- humidistat

Describe the operation and configuration of humidifiers for a residential air distribution system.

Install a residential humidifier including:

- location
- levelling
- by-pass
- water line
- humidistat
- drain

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
40%	30%	30%



Number:	S1087		
Title:	<b>Advanced Planning, Preparation and Production of Drawings</b>		
Duration:	Total Hours: 54	Theory: 36	Practical: 18
Prerequisites:	Level 1		
Content:	S1087.1	Describe principles of home construction. (6/0)	
	S1087.2	Identify load bearing and non-load bearing walls and supports. (8/0)	
	S1087.3	Read and interpret specifications, codes and manuals. (10/8)	
	S1087.4	Produce drawings and sketches for modifications (12/10)	

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Periodic quizzes  
Final test at the end of the term

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation

Manuals

- Sheet Metal Trades Health & Safety Manual
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number:	S1087.0		
Title:	<b>Advanced Planning, Preparation and Production of Drawings</b>		
Duration:	Total Hours: 54	Theory: 36	Practical: 18
Cross Reference to Training Standard:	7213.07, 7213.08, 7213.10, 7214.01, 7214.03, 7216.05, 7216.06		

## General Learning Outcomes

Upon successful completion the apprentice is able to describe principles of home construction, identify load bearing and non-load bearing walls and supports, read and interpret specifications, codes and manuals, and produce drawings and sketches for modifications.

## Learning Outcomes and Content

### 7.1 Describe principles of home construction. (6/0)

Identify the terminology and the function of components used in home construction including:

- foundation walls
- sill plate
- floor joists (TGI, open web, etc.)
- joist headers
- floor trusses and beams
- subfloor
- sole plate
- studs
- trimmer stud
- cripple stud
- top plate
- headers and sills
- fire blocks
- diagonal bracing
- ceiling joists
- roof rafters (common, hip, valley)
- roof trusses
- exterior finishes

- 7.2 Identify load bearing and non-load bearing walls and supports. (8/0)
- Describe requirements for cutting load bearing and non-load bearing walls or partitions for an air distribution system.
- Describe requirements for additional support prior to cutting.
- Describe the process for cutting access routes for ducting an air distribution system.
- Describe reinforcement requirements when cutting into non-load bearing walls.
- 7.3 Read and interpret specifications, codes and manuals. (10/8)
- Identify pertinent areas of building codes relating to home construction including:
- *National Building Code*
  - *Ontario Building Code*
  - Local building codes
- Interpret manufacturers' and SMACNA specifications for residential equipment and components including:
- coil installation procedure
  - filter installation procedure
  - humidifier installation procedure
  - heat recovery ventilators and energy recovery ventilators
  - installation procedure
  - types of ducted systems
  - demonstrating start-up and evaluation of systems
- Identify legislation relating to the installation of venting and combustion air systems.
- Interpret manufacturers' installation documentation for venting and combustion air systems to determine layout requirements.
- Describe venting and combustion air system design and installation:
- duct work orientation
  - grills
  - terminations
  - common venting
  - louvers

7.4 Produce drawings and sketches for modifications. (12/10)

Sketch freehand for job modifications, including:

- plenum transitions
- duct changes
- fittings

Describe the requirements for interference drawings, including:

- rerouting
- design conditions

Demonstrate job site as built drawings, including:

- retrofit installations
- site modification

<b>Evaluation Structure</b>		
Theory Testing	Practical Application Testing	Final Assessment
30%	30%	40

Number:	S1088		
Title:	<b>Installation of Duct for Ventilation, Exhaust and Distribution</b>		
Duration:	Total Hours: 60	Theory: 36	Practical: 24
Prerequisites:	Level 1		
Content:	S1088.1 Installation of supply air duct work. (12/12)		
	S1088.2 Installation of return air duct work. (10/12)		
	S1088.3 Installation of grills and registers (6/0)		
	S1088.4 Describe principles of air flow and properties of air. (8/0)		

**Evaluation & Testing:**

Assignments related to theory and application of skills  
Minimum of one mid-term test during the term  
Periodic quizzes  
Final test at the end of the term

**Instructional and Delivery Strategies:**

Lecture  
Video  
Paper based material  
Demonstration – practical lab assignments  
Internet on-line

**Reference Materials:**

*Occupational Health and Safety Act and Regulations for Construction Projects*  
Workplace Hazardous Materials Information System  
Software training materials (including for CAD software)

Legislation

- *Ontario Building Code*
- *National Building Code*
- Municipal building codes
- *Technical Standards and Safety Act (TSSA)*
- *Ontario Fire Code*
- *Environmental Protection Act* and other Ministry of the Environment legislation

Manuals

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- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) manuals
- Manufacturers' operating and safety manuals
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) manuals

Number: S1088.0  
Title: **Installation of Duct for Ventilation, Exhaust and Distribution**  
Duration: Total Hours: 60 Theory: 36 Practical: 24  
Cross Reference to Training Standard: 7213.03, 7216.01-7216.04, 7216.06, 7216.08, 7216.10-7216.12

### General Learning Outcomes

Upon successful completion the apprentice is able to install supply air duct work, return air duct work, and grills and registers, and describe principles and properties of air.

### Learning Outcomes and Content

#### 8.1 Installation of supply air duct work. (12/12)

Demonstrate the installation of a supply air distribution system including:

- plenum
- plenum take off (PTO)
- riser
- offset
- elbows (various degrees)
- duct
- round pipe
- flexible duct
- take off's
- outlets/boots

Describe the application of supply air duct in a residential air distribution system.

Determine requirements to reduce air restriction and maximize air flow of supply air duct in a residential air distribution system.

Describe methods and installation techniques for connecting a complete supply air system in a residential application using various components and fasteners.

Set up air distribution equipment and install supply air duct work.



8.2 Installation of return air duct work. (10/12)

Install a return air distribution system including:

- return air plenum (drop)
- collector box (main duct)
- jumper (duct/pipe)
- joist lining (panning)
- joist block end
- return air boot

Describe the application of wall cavity (stud space) and floor cavity (joist space) in a return air system.

Determine the area and air volume requirements when using wall cavity and floor cavity on the return air side of an air distribution system.

Describe methods and installation techniques for connecting a complete return air system in a residential application using various components and fasteners.

Set up air distribution equipment and install return air duct work.

8.3 Installation of grills and registers. (6/0)

Describe the terminology and techniques of an air distribution system including:

- throw
- spread
- drop and rise
- occupied zone
- stagnant air
- AK factor
- isothermal air
- register
- grille
- diffuser

Describe outlet placement and its effect on air distribution including:

- high wall
- low wall
- floor
- ceiling

Identify types of grills and registers used in a residential air distribution system including:

- floor register
- ceiling register
- fixed blade grille
- adjustable blade grille
- damper register/grille

8.4 Describe principles of air flow and properties of air. (8/0)

Interpret manufacturer's and SMACNA specifications for installation of a residential ducted system.

Describe fitting construction standards relating to:

- pressure classification
- gauging of duct/fittings
- joint connection
- intermittent duct reinforcement
- material selection
- ferrous and non ferrous
- hangers and accessories
- elbows
- transitions
- splitter vanes
- offsets
- "y" branch
- splitter dampers

Describe duct leakage:

- methods to test for duct leakage
- how to reduce duct leakage

Describe terminology applied to duct sizing and pressure:

- velocity pressure
- static pressure
- total pressure
- cubic feet per minute (c.f.m.)
- feet per minute (f.p.m.)
- friction rate
- equivalent length
- effective length
- external static pressure
- total system resistance
- equal friction

Identify duct system design methods and related formulas including:

- calculating fitting loss
- calculating cubic feet per minute
- calculating velocity
- calculating area
- ratio and proportion (aspect)

<b>Evaluation Structure</b>		
<b>Theory Testing</b>	<b>Practical Application Testing</b>	<b>Final Assessment</b>
30%	40%	30%

## **Summary of Equipment Required for Level 2**

Sheet metal hand tools

Power tools

Duct materials

Heat equipment

Exhaust equipment

Air exchange equipment

Air conditioning equipment (coils)

Filtration equipment

Residential installation simulator

Residential blue prints



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