Sheet Metal Worker
Guide to Course Content

1-877-363-0536
apprenticeship@gov.sk.ca
saskapprenticeship.ca

Saskatchewan Apprenticeship and Trade Certification Commission

Online: www.saskapprenticeship.ca

Recognition:
To promote transparency and consistency, portions of this document has been adapted from the 2018 Sheet Metal Worker Red Seal Occupational Standard (Employment and Social Development Canada).

A complete version of the Occupational Standard can be found at www.red-seal.ca

STRUCTURE OF THE GUIDE TO COURSE CONTENT

To facilitate understanding of the occupation, this guide to course content contains the following sections:

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard detailing the essential skills and the level of training where the content is covered. The Task Matrix is broken down into the following:

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities.

Task: distinct actions that describe the activities within a major work activity.

Sub-task: distinct actions that describe the activities within a task.

Training Profile Chart: a chart which outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training.

Technical Training Course Content for the Sheet Metal Worker Trade: a chart which outlines the model for SATCC technical training sequencing. For the harmonized level of training, a cross reference to the Harmonized apprenticeship technical training sequencing, at the learning outcome level, is provided.

TRAINING REQUIREMENTS FOR THE SHEET METAL WORKER TRADE

To graduate from each level of the apprenticeship program, an apprentice must successfully complete the required technical training and compile enough on-the-job experience to total at least 1800 hours each year. Total trade time required is 7200 hours and at least 4 years in the trade.

There are four levels of technical training delivered by Saskatchewan Polytechnic in Saskatoon.

Level One: 8 weeks
Level Two: 8 weeks
Level Three: 8 weeks
Level Four: 8 weeks

***Any person who is not a journeyperson Sheet Metal Worker must become registered as an apprentice to work in this trade.**

The information contained in this guide to course content details the technical training delivered for each level of apprenticeship. An apprentice spends approximately 15% of their apprenticeship term in a technical training institute learning the technical and theoretical aspects of the trade. The hours and percentages of technical and practical training may vary according to class needs and progress.

The content of the technical training components is subject to change without notice.

Entrance Requirements for Apprenticeship Training

Your grade twelve transcripts (with no modified classes) or GED 12 is your guarantee that you meet the educational entrance requirements for apprenticeship in Saskatchewan. In fact, employers prefer and recommend apprentices who have completed high school. This ensures the individual has all of the necessary skills required to successfully complete the apprenticeship program, and receive journeyperson certification.

Individuals with “modified” or “general” classes in math or science do not meet our entry requirements. These individuals are required to take an entrance assessment prescribed by the SATCC.

English is the language of instruction in all apprenticeship programs and is the common language for business in Saskatchewan. Before admission, all apprentices and/or “upgraders” must be able to understand and communicate in the English language.

Designated Trade Name	**Math Credit** at the Indicated Grade Level❶	**Science Credit** at Grade Level
Sheet Metal Worker	Grade 11	Grade 10

❶ - (One of the following) WA – Workplace and Apprenticeship; or F – Foundations; or P – Pre-calculus, or a Math at the indicated grade level (Modified and General Math credits are not acceptable.).

*Applicants who have graduated in advance of 2015-2016, or who do not have access to the revised Science curricula will require a Science at the minimum grade level indicated by trade.

For information about high school curriculum, including Math and Science course names, please see: http://www.curriculum.gov.sk.ca/#

Individuals not meeting the entrance requirements will be subject to an assessment and any required training

SHEET METAL WORKER TASK MATRIX CHART

This chart outlines the major work activities, tasks, and sub-tasks from the 2018 Sheet Metal Worker Red Seal Occupational Standard. Each sub-task details the corresponding essential skill and level of training where the content is covered. *

* Sub-tasks with numbers in the boxes identify where the content will be delivered in training.

A - Performs Common Occupational Skills — 20%

A-1 Performs safety-related functions	**1.01 Uses personal protective equipment (PPE) and safety equipment** 1, In Context in 2, 3, 4	**1.02 Maintains safe work environment** 1, In Context in 2, 3, 4	**1.03 Performs lock-out and tag-out procedures** 1, In Context in 2, 3, 4		
A-2 Uses and maintains tools and equipment	**2.01 Uses hand and portable power tools** 1	**2.02 Uses shop tools and equipment** 1, 2, 3	**2.03 Uses gas metal arc welding (GMAW) equipment** 1, 2, 3, 4	**2.04 Uses resistant spot welding equipment** 1	**2.05 Uses gas tungsten arc welding (GTAW) equipment** 2,3
	2.06 Uses shielded metal arc welding (SMAW) equipment 3	**2.07 Uses oxy-fuel and plasma arc cutting equipment** 1	**2.08 Uses soldering and brazing equipment** 1, 2	**2.09 Uses measuring and layout equipment** 1	**2.10 Uses testing and inspection devices** 2, 3, 4
	2.11 Uses stationary and mobile work platforms 1	**2.12 Uses hoisting, rigging and positioning equipment** 1			
A-3 Organizes work	**3.01 Uses trade-related documentation** 1, 2 In Context in 3, 4	**3.02 Interprets drawings** 1, 2 In Context in 3, 4	**3.03 Organizes materials and equipment for project** 1, In Context in 3, 4	**3.04 Performs basic design and field modifications** 1, 2 In Context in 3, 4	

A-4 Uses communication and mentoring techniques	4.01 Uses communication techniques 1, In Context in 2, 3, 4	4.02 Uses mentoring techniques 4, In Context in 2, 3

B – Performs Fabrication 31%

B-5 Performs pattern development	5.01 Develops patterns using simple and straight line layout 1	5.02 Develops patterns using parallel line method 2, 3	5.03 Develops patterns using radial line method 2, 3	5.04 Develops patterns using triangulation method 2, 3	5.05 Uses computer technology for pattern development 4
B-6 Fabricates sheet metal components for air and material handling systems	6.01 Cuts ductwork, fittings and components 1	6.02 Forms ductwork, fittings and components 1, 2, 3, 4	6.03 Insulates ductwork, fittings and components 1	6.04 Assembles ductwork, fittings and components 1, 2, 3, 4	6.05 Fabricates dampers 4
	6.06 Fabricates hanger systems, supports and bases 1				
B-7 Fabricates flashing, roofing, sheeting and cladding	7.01 Cuts metal for flashing, roofing, sheeting and cladding 1, 2	7.02 Forms flashing, roofing, sheeting and cladding 1, 2			
B-8 Fabricates specialty products	8.01 Cuts material for specialty products 3, In Context in 4	8.02 Forms specialty products 3, In Context in 4	8.03 Assembles specialty products 3, In Context in 4	8.04 Finishes specialty products 3, In Context in 4	

C – Installs Air and Material Handling Systems

35%

C-9 Prepares installation site	9.01 Performs on-site measurements 2, In Context in 3, 4	9.02 Performs demolitions for renovations 2, In Context in 3, 4	9.03 Installs penetrations and sleeves 2, In Context in 3, 4	9.04 Installs supports and bases 2, In Context in 3, 4	9.05 Installs hangers, cables, braces and brackets 2, In Context in 3, 4
C-10 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment	10.01 Installs chimney 2	10.02 Connects appliances or mechanical equipment to chimney and breeching 2	10.03 Installs high efficiency appliances and mechanical equipment 2		
C-11 Installs air handling system components	11.01 Installs air handling equipment 1, 2, 3, 4	11.02 Installs sheet metal ducts and fittings 1	11.03 Installs dampers 1	11.04 Installs fire and fire/smoke dampers 2	11.05 Installs registers, grilles, diffusers and louvers 1
	11.06 Installs terminal boxes 3	11.07 Installs coils 3	11.08 Installs system component accessories 2, 3, 4	11.09 Installs plenums 1, 3	
C-12 Installs material handling system components	12.01 Installs pneumatic and gravity material handling system components 4	12.02 Installs mechanized material handling system components 4			
C-13 Applies thermal insulation, lagging, cladding and flashing	13.01 Applies thermal insulation to components 4	13.02 Applies lagging and cladding to components 4	13.03 Applies flashing to components 4		
C-14 Performs leak testing, air balancing and commissioning	14.01 Performs leak tests 4	14.02 Performs testing, adjusting and balancing (TAB) 4	14.03 Participates in the commissioning of air and material handling systems 4		

D – Installs Roofing and Specialty Products 8%

D-15 Installs metal roofing and cladding/siding systems	15.01 Lays out roof and walls 2	15.02 Installs insulation, isolation material and building envelope components 2	15.03 Installs roofing and cladding/siding system components 2	15.04 Seals exposed joints 2	15.05 Installs decking 2
D-16 Installs exterior components	16.01 Prepares surface 2	16.02 Fastens exterior components 2			
D-17 Installs specialty products	17.01 Installs stainless steel specialty products 3	17.02 Installs non-stainless steel specialty products 3	17.03 Installs marine products (Not Common Core) 3		

E – Performs Maintenance and Repair 6%

E-18 Performs scheduled maintenance	18.01 Performs maintenance inspections 3, In Context in 4	18.02 Services components 3, In Context in 4
E-19 Repairs faulty systems and components	19.01 Diagnoses system faults 3, In Context in 4	19.02 Repairs worn or faulty components 3, In Context in 4

TRAINING PROFILE CHART

This Training Profile Chart represents Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training at the topic level.

Level One	Transcript Code	Hours
Bench and Shop Work	BESK 102 – Theory	14
	BESK 103 – Practical	80
Pattern Drafting	DRFT 100 – Theory	10
	DRFT 101 – Practical	47
Trade Theory	SHME 100	77
Welding and Cutting	WELD 139	12
		240

Level Two	Transcript Code	Hours
Bench and Shop Work	BESK 200 – Theory	8
	BESK 201 – Practical	80
Pattern Drafting	DRFT 203 – Theory	8
	DRFT 204 – Practical	44
Print Reading	PRNT 204	14
Scheduled Maintenance & Repair*	MAIN 204	24
Trade Theory	SHME 200	54
Welding	WELD 208	8
		240

SATCC Level Three	Transcript Code	Hours
Bench and Shop Work	BESK 300 – Theory	10
	BESK 301 – Practical	68
Pattern Drafting	DRFT 300 – Theory	8
	DRFT 301 – Practical	40
Print Reading	PRNT 303	18
Scheduled Maintenance & Repair	MAIN 300	14
Trade Theory	SHME 381	70
Welding	WELD 303	12
		240

SATCC Level Four	Transcript Code	Hours
Bench and Shop Work	BESK 400 – Theory	8
	BESK 401 – Practical	80
Pattern Drafting	DRFT 400 – Theory	8
	DRFT 401 – Practical	30
Print Reading	PRNT 401	18
Scheduled Maintenance & Repair*	MAIN 400	18
Trade Theory	SHME 481	78
		240

TECHNICAL TRAINING COURSE CONTENT

This chart outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training sequencing. For the harmonized level of training, a cross reference to the Red Seal Occupational Standard (RSOS) apprenticeship technical training sequencing, at the learning outcome level, is provided.

Sub-tasks listed are the minimum to be covered in a topic. Related sub-tasks not listed may be used as a reference and taught "in context" in other topics.

Level One — 8 weeks — 240 hours

Bench and Shop Work – Theory — **14 hours**

- discuss the appropriate sheet metal hand tools and machines for specific shop applications
- identify powered metal forming equipment for a specific metal forming function
- discuss Gas Metal Arc Welding GMAW operations
- discuss hot process metal cutting using plasma and oxy-fuel equipment

Bench and Shop Work – Practical — **80 hours**

- explain fabrication procedures for various sheet metal seams, locks, and edges
- fabricate basic sheet metal items using simple layout procedures
- use a spot welder to seam sheet metal objects
- assemble a simple duct complete with takeoffs using standard sheet metal tools and equipment
- layout degree and ninety-degree rectangular elbows using basic layout methods
- fabricate regular and "ogee" offsets using basic layout methods
- explain safety related functions within a work environment
- fabricate sheet metal products using soldering and brazing
- use hoisting, rigging and positioning equipment
- fabricate insulated ducts and fittings
- fabricate hangers, supports, and bases
- install air handling equipment
- install dampers
- install outlets and louvers
- install plenums

RSOS topics covered in this section of training:

A-1 Tools & Equipment
A-2.03 Uses gas metal arc welding (GMAW) equipment
A-2.07 Uses oxy-fuel and plasma arc cutting equipment
A-2.08 Uses soldering and brazing equipment
A-2.12 Uses hoisting, rigging and positioning equipment

B-6 Fabricates sheet metal components for air and material handling systems
B-6.01 Cuts ductwork, fittings and components
B-6.02 Forms ductwork, fittings and flexible connectors
B-6.03 Insulates ductwork and fittings
B-6.04 Assembles ductwork, fittings and flexible connectors
B-6.06 Fabricates hanger systems, supports and bases

C-11 Installs air handling system components
C-11.01 Installs air handling equipment
C-11.02 Installs sheet metal ducts and fittings
C-11.03 Installs dampers
C-11.05 Installs registers, grilles, diffusers and louvers
C-11.09 Installs plenums

Pattern Drafting – Theory **10 hours**

- discuss the various drafting tools used to make drawings for the sheet metal industry
- recognize the types of lines, angles, and lettering used for drawings in the sheet metal industry
- recognize pictorial drawings and orthographic projections
- define terminology associated with drafting
- explain characteristics and measurements of various transverse connections
- identify complex layout methods

Pattern Drafting – Practical **47 hours**

- discuss geometric principles to construct lines, angles, and common shapes used in layout work
- illustrate orthographic drawings from pictorial drawings
- lay out patterns for sheet metal fittings using basic layout
- lay out patterns for rectangular elbows
- lay out patterns for regular and transitional cheek ogee offsets
- describe three main methods of pattern development
- use scales on drawings

RSOS topics covered in this section of training:

B-5 Pattern Development
B-5.01 Develops patterns using simple and straight-line layout

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Trade Theory **77 hours**

- demonstrate proper use of safety equipment and safe work practices
- identify common sheet metal hand tools and equipment
- describe the characteristics of shop tools and equipment
- recognize sheet metal seams, locks, and edges
- recognize appropriate fasteners for various sheet metal applications
- describe fabrication procedures used in typical sheet metal shops
- discuss the techniques and materials used to solder various metals
- describe factors affecting building ventilation
- demonstrate the knowledge and procedures required to rig and hoist materials safely
- discuss techniques and equipment for brazing
- discuss measurement and layout of equipment
- discuss organizing materials and equipment
- use effective communication techniques
- discuss installation of air handling equipment
- discuss installation of duct and duct accessories
- discuss installation of plenums.
- use basic mathematics and algebra
- perform calculations involving trade applications
- apply basic trigonometry to solve trade problems

RSOS topics covered in this section of training:

A-1 Safety-Related Functions
A-1.01 Uses personal protective equipment (PPE) and safety equipment
A-1.02 Maintains safe work environment
A-1.03 Performs lock-out and tag-out procedures

A-3 Organizes Work
A-3.01 Uses trade-related documentation
A-3.02 Interprets drawings
A-3.03 Organizes materials and equipment for project

A-4 Communication Techniques
A-4.01 Uses communication techniques

Welding and Cutting — 12 hours

- use Gas Metal Arc Welding (GMAW) equipment
- use welding and cutting protective equipment
- operate oxy-acetylene cutting equipment
- operate plasma arc cutting equipment

RSOS topics covered in this section of training:

A-2 Tools and Equipment
A-2.01 Uses hand and portable power tools
A-2.02 Uses shop tools and equipment
A-2.03 Uses gas metal arc welding (GMAW) equipment
A-2.04 Uses resistance spot welding equipment
A-2.07 Uses oxy-fuel and plasma arc cutting equipment
A-2.08 Uses soldering and brazing equipment
A-2.09 Uses measuring and layout equipment
A-2.11 Uses stationary and mobile work platforms
A-2.12 Uses hoisting, rigging and positioning equipment

Level Two — 8 weeks — 240 hours

Bench and Shop Work – Theory — **8 hours**

- demonstrate safe operation of powered shop equipment
- set up powered machinery to perform basic operations
- examine gas tungsten arc welding (GTAW) operations

Bench and Shop Work – Practical — **80 hours**

- operate a power press brake to form various types of metal to specific shapes
- operate the notching and punching stations on an iron worker
- tap holes in metal components for the specified machine screw
- use a power rolls machine to roll heavy gage sheet metal to various diameters
- fabricate components from pictorial drawing using the appropriate powered equipment
- assembles ductwork fittings and flexible connectors
- fabricate ducts, duct accessories, and fittings using basic layout
- fabricate fittings using parallel line layout
- fabricate fittings using radial line layout
- Fabricate fittings using triangulation layout
- use soldering and brazing equipment
- assembles ductwork, fittings, and flexible connectors
- fabricate exterior architectural sheet metal components
- demonstrate on-site measuring
- install appliances and venting
- install decking, hangers, and supporting components
- install air handling equipment
- install duct accessories
- demonstrate the process for sealing exposed joints and seams on ductwork

RSOS topics covered in this section of training:

B-6 Fabricates sheet metal components for air and material handling systems
B-6.02 Forms ductwork, fittings, and flexible connectors
B-6.04 Assembles ductwork, fittings, and flexible connectors

B-7 Flashing, roofing, sheeting, and cladding (fabricates)
B-7.01 Cuts metal for flashing, roofing, sheeting, and cladding
B-7.02 Forms flashing, roofing, sheeting, and cladding

D-15 Metal Roofing and Cladding Systems
D-15.01 Lays out roof and walls
D-15.02 Installs insulation, isolation material and building envelope components
D-15.03 Installs roofing and cladding system components
D-15.04 Seals exposed joints
D-15.05 Installs decking

Pattern Drafting – Theory — **8 hours**

- identify characteristics of basic layout of sheet metal fittings
- identify characteristics of parallel line layout of sheet metal fittings
- identify characteristics of radial line layout of sheet metal fittings
- identify characteristics of triangulation layout of sheet metal fittings
- identify isometric, oblique, and perspective drawings

Pattern Drafting – Practical **44 hours**

- develop patterns using basic layout methods
- develop patterns using parallel line layout methods
- develop patterns using radial line layout methods
- identify characteristics of triangulation layout methods
- prepare scaled and freehand isometric and oblique drawings

RSOS topics covered in this section of training:

B-5 Performs pattern development
B-5.02 Develops patterns using parallel line method
B-5.03 Develops patterns using radial line method
B-5.04 Develops patterns using triangulation method

Print Reading **14 hours**

- use trade-related documentation
- interpret drawings
- perform basic design and field modifications

RSOS topics covered in this section of training:

A-3 Organizes work
A-3.01 Uses trade-related documentation
A-3.02 Interprets drawings
A-3.04 Performs basic design and field modifications

Scheduled Maintenance and Repair **24 hours**

- define terminology associated with the servicing of system components
- use tools and equipment associated with the servicing of system components
- identify hazards and safe work practices pertaining to service work
- perform calculations of system performances
- use tools and equipment associated with airflow in ductwork
- describe the conditions that create airflow in ductwork

RSOS topics covered in this section of training:

E-18 Performs scheduled maintenance
E-18.01 Performs maintenance inspections
E-18.02 Services components

E-19 Repairs faulty systems and components
E-19.01 Diagnoses system faults
E-19.02 Repairs worn or faulty components

Trade Theory **54 hours**

- describe HVAC system categories and components including package units, built-up systems, and terminal units
- describe the components and subsystems within a material handling system
- identify the tools, equipment, and manpower to install HVAC and architectural systems and components
- explain how to prepare for ductwork installations
- describe the characteristics of anchors and hangers used to install ductwork
- discuss the characteristics of fire and smoke dampers

- interpret the SMACNA duct fabrication standards to determine gauge, transverse joint spacing and reinforcement for a given section of ductwork
- interpret information related to chimneys and vents
- explain the process of demolition for renovations
- explain field measuring fundamentals
- discuss installation of insulation and cladding
- discuss different forms of matter
- describe heat energy and heat transfer
- solve problems involving simple machines

RSOS topics covered in this section of training:

C-9 Installation Site (prepares)
C-9.01 Performs on-site measurements
C-9.02 Performs demolitions for renovations
C-9.03 Installs penetrations and sleeves
C-9.04 Installs supports and bases
C-9.05 Installs hangers, cables, braces and brackets

C-10 Chimney, Breeching, Venting (installs, connects)
C-10.01 Installs chimney
C-10.02 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment
C-10.03 Installs high efficiency appliances and mechanical equipment

C-11 Installs air handling system components
C-11.01 Installs air handling equipment
C-11.04 Installs fire and fire/smoke dampers
C-11.08 Installs system component accessories

D-16 Installs Exterior Components
D-16.01 Prepares surface
D-16.02 Fastens exterior components

Welding **8 hours**

- recognize hazards related to welding and cutting processes
- select personal protective equipment
- use gas tungsten arc welding (GTAW) equipment

RSOS topics covered in this section of training:

A-2 Tools and Equipment
A-2.02 Uses shop tools and equipment
A-2.03 Uses gas metal arc welding (GMAW) equipment
A-2.05 Uses gas tungsten arc welding (GTAW) equipment
A-2.06 Uses shielded metal arc welding (SMAW) equipment
A-2.08 Uses soldering and brazing equipment
A-2.10 Uses testing and inspection devices

The Level Two topics from the RSOS that are taught in context are:

- ***Safety Related Functions, and***
- ***Communication***

For details regarding the In Context Topics, see page 25

Level Three — 8 weeks — 240 hours

Bench and Shop Work – Theory — **10 hours**

- recognize hazards related to the use of powered fabrication equipment
- discuss the operational characteristics of powered fabrication equipment
- examine the operational characteristics of a power press brake
- examine Gas Tungsten Arc Welding (GTAW) operation
- examine Shielded Metal Arc Welding (SMAW) operation

Bench and Shop Work – Practical — **68 hours**

- demonstrate safe operation of powered shop equipment
- fabricate metal parts using heavy gage fabrication equipment
- fabricate ducts, duct accessories, and fittings using basic layout
- fabricate fittings using parallel line layout
- fabricate fittings using radial line layout
- fabricate fittings using triangulation line layout
- fabricate fittings using combined layout methods
- fabricate specialty sheet metal products
- fabricate specialty sheet metal products using stainless steel
- install air handling system equipment and accessories
- install air handling plenums
- install coils and terminal boxes

RSOS topics covered in this section of training:

B-6 Fabricates sheet metal components for air and material handling systems
B-6.02 Forms ductwork, fittings, and components
B-6.04 Assembles ductwork, fittings and flexible connectors

B-8 Fabricates specialty products
B-8.01 Cuts material for specialty products
B-8.02 Forms specialty products
B-8.03 Assembles specialty products
B-8.04 Finishes specialty products

D-17 Installs roofing and specialty products
D-17.01 Installs stainless steel specialty products
D-17.02 Installs non-stainless steel specialty products
D-17.03 Installs marine products (Not Common Core)

Pattern Drafting – Theory — **8 hours**

- identify characteristics of basic layout of sheet metal fittings
- identify characteristics of parallel line layout of sheet metal fittings
- identify characteristics of radial line layout of sheet metal fittings
- identify characteristics of triangulation layout of sheet metal fittings
- identify characteristics of a combined layout method for sheet metal fittings

Pattern Drafting – Practical — **40 hours**

- develop patterns using basic layout methods
- develop patterns using parallel line layout method
- develop patterns using radial line layout method
- develop patterns using triangulation layout method
- develop patterns using combined layout methods

RSOS topics covered in this section of training:

B-5 Performs pattern development
B-5.02 Develops patterns using parallel line method
B-5.03 Develops patterns using radial line method
B-5.04 Develops patterns using triangulation method

Print Reading — 18 hours

- interpret information from plans and specifications
- interpret information from shop drawings
- examine plans and specifications
- develop shop drawings for given specifications
- perform a take-off from a shop drawing

RSOS topics covered in this section of training:

B-5 Performs pattern development
B-5.02 Develops patterns using parallel line method
B-5.03 Develops patterns using radial line method
B-5.04 Develops patterns using triangulation method

Scheduled Maintenance and Repair — 14 hours

- performs maintenance inspections
- service components
- diagnoses system faults
- repairs worn or faulty system components
- use testing and inspection tools and equipment

RSOS topics covered in this section of training:

E-18 Performs scheduled maintenance
E-18.01 Performs maintenance inspections
E-18.02 Services components

E-19 Repairs faulty systems and components
E-19.01 Diagnoses system faults
E-19.02 Repairs worn or faulty components

Trade Theory — 70 hours

- compare HVAC systems and components
- examine the properties of air
- examine ventilation
- analyze air flow in ductwork
- categorize fans used in HVAC systems
- analyze HVAC duct systems
- examine the characteristics of heat
- examine the characteristics of cooling systems
- examine duct design characteristics
- compare duct sizing methods
- describe field measuring principles
- analyze hoisting and rigging operations
- examine HVAC equipment and installations
- discuss automatic control systems

- discuss sign work
- solve problems involving simple machines
- examine specialty sheet metal products
- discuss properties of various materials
- use basic mathematics and algebra
- perform calculations involving trade applications
- apply basic trigonometry to solve trade problems

RSOS topics covered in this section of training:

D-17 Installs roofing and specialty products
D-17.01 Installs stainless steel specialty products
D-17.02 Installs non-stainless steel specialty products
D-17.03 Installs marine products (Not Common Core)

Welding **12 hours**

- select protective equipment
- recognize hazards related to welding and cutting processes
- use gas tungsten arc welding (GTAW) operations
- use Shielded Metal Arc Welding (SMAW) procedures

RSOS topics covered in this section of training:

A-2 Uses and maintains tools and equipment
A-2.02 Uses shop tools and equipment
A-2.03 Uses gas metal arc welding (GMAW) equipment
A-2.05 Uses gas tungsten arc welding (GTAW) equipment
A-2.06 Uses shielded metal arc welding (SMAW) equipment
A-2.10 Uses testing and inspection devices

The Level Three topics from the RSOS that are taught in context are:

A-1 Safety Related Functions
A-4 Uses Communication and mentoring techniques
A-3 Organizes work
C-9 Prepares Installation Site
C-10 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment

For details regarding the In Context Topics, see page 25

Level Four — 8 weeks — 240 hours

Bench and Shop Work – Theory — **8 hours**

- discuss shop safety
- calculate bend allowance using empirical formula
- discuss the operational characteristics of powered fabrication equipment

Bench and Shop Work – Practical — **80 hours**

- fabricate complex fittings using the triangulation method
- fabricate complex fittings using the parallel line method
- fabricate complex fittings using the radial line method
- use a combination of drafting methods to fabricate various fittings
- calculate bend allowance using the empirical method and form the part
- fabricate dampers and louvers
- install insulation, lagging, cladding, and flashing
- install material handling components and equipment
- install air handling components and equipment

RSOS topics covered in this section of training:

B-6 Air/Material handling components (fabricates)
B-6.02 Forms ductwork, fittings and flexible connectors
B-6.04 Assembles ductwork, fittings and flexible connectors
B-6.05 Fabricates dampers

C-11 Air Handling System Components (installs)
C-11.01 Installs air handling equipment
C-11.08 Installs system component accessories

C-12 Installs pneumatic and gravity material handling system components
C-12.01 Installs pneumatic and gravity material handling system components
C-12.02 Installs mechanized material handling system components

C-13 Applies thermal insulation, lagging, cladding and flashing
C-13.01 Applies thermal insulation to components
C-13.02 Applies lagging and cladding to components
C-13.03 Applies flashing to components

C-14 Performs leak testing, air balancing and commissioning
C-14.01 Performs leak tests
C-14.02 Performs testing, adjusting and balancing (TAB)
C-14.03 Participates in the commissioning of air and material handling systems

Pattern Drafting – Theory — **8 hours**

- identify characteristics of sheet metal fitting layout
- examine computer technology for pattern development

Pattern Drafting – Practical — **30 hours**

- draft complex fittings using the triangulation method
- draft complex fittings using the parallel line method
- draft complex fittings using the radial line method
- use a combination of layout methods to fabricate various fittings
- use computer technology for pattern development

RSOS topics covered in this section of training:

B-5 Uses computer technology for pattern development
B-5.05 Uses computer technology for pattern development

Print Reading — 18 hours

- describe the importance of prints and specifications in the construction industry
- interpret information found in prints and specifications
- produce a shop print for a given blow pipe system
- perform a take-off from a shop print

RSOS topics covered in this section of training:

B-5 Uses computer technology for pattern development
B-5.05 Uses computer technology for pattern development

Scheduled Maintenance and Repair — 18 hours

- review the operation of a standing pilot appliance
- identify electrical components used in modern appliances
- describe the sequence of operation for various appliances
- perform leak tests of a duct system
- perform testing adjusting and balancing of a duct system
- perform commissioning of air and material handling systems
- measure voltage, current, and resistance to confirm the operation of electrical controls found in an appliance

RSOS topics covered in this section of training:

E-18 Performs scheduled maintenance
E-18.01 Performs maintenance inspections
E-18.02 Services components

E-19 Repairs faulty systems and components
E-19.01 Diagnoses system faults
E-19.02 Repairs worn or faulty components

Trade Theory — 78 hours

- analyze industrial sheet metal
- compare industrial material handling systems
- examine blowpipe systems
- examine industrial specialties related to sheet metal work
- describe duct leakage testing
- examine testing, adjusting, and balancing work
- describe the process of commissioning a building
- examine indoor air quality
- compare filtration and air cleaning equipment
- discuss special ventilation needs
- examine commercial refrigeration systems
- describe how automatic controls function in HVAC systems
- describe fabrication and installation procedures related to boiler breeching
- apply job-related interpersonal and oral communications
- discuss the principles of customer service
- prepare workplace documents

- use mentoring techniques
- use basic mathematics and algebra
- perform calculations involving trade applications
- apply basic trigonometry to solve trade problems

RSOS topics covered in this section of training:

A-4 Uses communication and mentoring techniques
A-4.02 Uses mentoring techniques

C-11 Air Handling System Components (installs)
C-11.01 Installs air handling equipment
C-11.08 Installs system component accessories

C-12 Installs pneumatic and gravity material handling system components
C-12.01 Installs pneumatic and gravity material handling system components
C-12.02 Installs mechanized material handling system components

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The Level Four topics from the RSOS that are taught in context are:

A-1 Performs safety related functions
A-3 Organizes work
A-4 Uses Communication and mentoring techniques
B-8 Fabricates specialty products
C-9 Prepares installation site
C-10 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment
D-15 Installs metal roofing and cladding/siding systems

For details regarding the In Context Topics, see page 25

In Context Topics

In context means learning that has already taken place and is being applied to the applicable task. Learning outcomes for in context topics are accomplished in other topics in that level.

A-1 Performs Safety Related Functions
A-1.01 Uses personal protective equipment (PPE) and safety equipment
A-1.02 Maintains safe work environment
A-1.03 Performs lock-out and tag-out procedures

A-3 Organizes Work
A-3.01 Uses trade-related documentation
A-3.02 Interprets drawings
A-3.03 Organizes materials and equipment for project
A-3.04 Performs basic design and field modifications

A-4 Uses communication and mentoring techniques
A-4.01 Uses communication techniques
A-4.02 Uses mentoring techniques

B-8 Fabricates specialty products
B-8.01 Cuts material for specialty products
B-8.02 Forms specialty products
B-8.03 Assembles specialty products
B-8.04 Finishes specialty products

C-9 Installation Site (prepares)
C-9.01 Performs on-site measurements
C-9.02 Performs demolitions for renovations
C-9.03 Installs penetrations and sleeves
C-9.04 Installs supports and bases
C-9.05 Installs hangers, cables, braces and brackets

C-10 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment
C-10.01 Installs chimney
C-10.02 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical
C-10.03 Installs high efficiency appliances and mechanical equipment