

## International Training Institute for the Sheet Metal and Air Conditioning Industry

The International Training Institute for the Sheet Metal and Air Conditioning Industry (ITI), formerly known as the National Training Fund, is a joint labor-management trust fund created in 1971 between the Sheet Metal Workers' International Association (SMWIA) and Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). ITI's mission is to develop training curriculum, educational support, and instructor training for the sheet metal and air conditioning industry. Students are enrolled in local apprenticeship programs sponsored by the local labor-management Joint Apprenticeship Training Committee.

Instructors are journeyperson sheet metal workers who participate in a five-year instructor training program administered by the ITI and Ohio State University. This program ensures the highest quality training and education for those in the apprenticeship program. ITI's materials and programs are available only to local Joint Apprenticeship Training Committees in the United States and Canada.

Web Address: [www.sheetmetal-iti.org](http://www.sheetmetal-iti.org)

**URL:** <http://www.sheetmetal-iti.org>

### Architectural Sheet Metal Curriculum

**ACE Number:** SMAC-0017

**Credit Type:** Course

#### Version 1

**Course Title:** Architectural Sheet Metal Curriculum

**Former Course Title:** Architectural

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 400 hours of classroom instruction and 4,000 hours of supervised practical experience over two years.

**Version Dates:** 08/01/2007 - Present

**Objective:** To provide hands-on knowledge and skills required of sheet metal journeypersons in the architectural sheet metal industry.

**Learning Outcome:** Upon completion of this course, the student will be able to safely design, fabricate, and install architectural sheet metal products including roof, wall and drainage systems, ventilation, substrate and supports, and various ornamental and specialty products.

**Instruction:** Major topics covered in the course are roof, wall, and drainage systems, louvers and ventilators, supports and substrates, restoration and finishing, layout and fabrication techniques, field installation techniques, and safety procedures. Methods of instruction include lecture, demonstrations, quizzes, projects, examinations and supervised field experience.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category, 3 semester hours in Construction Safety, 1 semester hour in Introduction to Architectural Design, 8 semester hours in Design of Architectural Sheet Metal Products, 8 semester hours in Fabrication of Architectural Sheet Metal Products, 8 semester hours in Installation of Architectural Sheet Metal Products, 3 semester hours in Applied Math, 3 semester hours in Construction Materials, and 1 semester hour in Project Management for a total of 35 semester hours (3/10).

### Building Information Modeling (BIM) Curriculum

**ACE Number:** SMAC-0013

**Credit Type:** Course

#### Version 1

**Course Title:** Building Information Modeling (BIM) Curriculum

**Former Course Title:** Building Information Modeling/Detailing

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 400 hours of classroom instruction and 4,000 hours of supervised practical experience over two years.

**Version Dates:** 08/01/2007 - Present

- Objective:** To provide hands-on knowledge and skills required of sheet metal journeypersons in the building information modeling or detailing industry.
- Learning Outcome:** Upon successful completion of this course, the student will be able to set up and maintain computers; use Microsoft programs; communicate through written construction documents; understand project organization and construction documents; interpret plans and specifications; record accurate field measurements for shop drawings; perform HVAC quantity take-offs; organize and coordinate project communication systems; use AutoCAD; and integrate third party software.
- Instruction:** Major topics covered in the course are basic computer set-up and Microsoft applications, written communication skills, construction project documents, plans and specifications, field measurement techniques, HVAC quantity take-offs, AutoCAD applications, and third party software integration. Methods of instruction include lecture, demonstrations, quizzes, projects, examinations and supervised field experience.
- Credit Recommendation:** In the lower division baccalaureate/associate degree category, 3 semester hours in Computer Applications, 3 semester hours in Written and Oral Communications, 3 semester hours in Construction Documents, 3 semester hours in Plans and Specifications, 2 semester hours in HVAC Field Measurements, 3 semester hours in HVAC Quantity Take-offs, 3 semester hours in AutoCAD, 3 semester hours in Advanced AutoCAD, and 6 semester hours in BIM Software Applications for a total of 29 semester hours (3/10).

## HVACR Residential Installer for Sheet Metal Mechanics

**ACE Number:** SMAC-0016

**Credit Type:** Course

### Version 1

- Course Title:** HVACR Residential Installer for Sheet Metal Mechanics
- Former Course Title:** Residential
- Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry
- Length:** 149 hours of classroom instruction and 4,000 hours of supervised practical experience over two years.
- Version Dates:** 08/01/2007 - Present
- Objective:** To provide hands-on knowledge and skills required of sheet metal journeypersons in the residential sheet metal industry to effectively install and service residential HVAC units.
- Learning Outcome:** Upon completion of this course, the student will be able to safely design, fabricate, and install different types of signs; apply job-specific knowledge that is common to HVAC new construction installers; discuss the safety training requirements, standards and guidelines; describe typical components and configurations of residential HVAC systems and the basic operation of these systems; explain and demonstrate the proper procedures for installing the following materials: ductwork constructed of sheet metal, flexible duct and duct board, dryer, kitchen and bath vents, combustion flues and venting, thermostat wiring, laundry chutes, and manufactured fireplaces; describe and understand the differences among furnaces, air conditioners, heat pumps and various add-on accessories; test an HVAC system to determine that it has been properly installed; describe the personal protective equipment, safety guidelines, and code requirements that a HVAC technician should use and follow to avoid injuries; list and explain customer requirements and site preparation, HVAC evaluation, and tasks for removing equipment and material that a HVAC Technician typically performs on a retrofit site; explain and demonstrate the proper procedures for installing ductwork and various add-on accessories; explain how to master the psychology of customer relations; list the guidelines for safety and code; describe the general strategy to effectively troubleshoot an HVAC system problem; and demonstrate the tasks for inspecting and servicing an HVAC system.
- Instruction:** Major topics covered in the course are residential new construction installer basics, safety, HVAC systems and theory, professionalism, installing new construction, finish installer basics, types of furnaces, split system, package unit, heat pump, accessories, retrofit technician basics, customer relations, safety and codes, retrofitting tasks; installing new HVAC systems, theory, preventive maintenance and troubleshooting. Methods of instruction include lecture, demonstrations, quizzes, projects, examinations and supervised field experience.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category, 2 semester hours in Comfort Cooling Systems, 2 semester hours in Heating Systems, 2 semester hours in Air Duct Construction, and 2 semester hours in Industrial Health and Safety for a total of 8 semester hours (3/10).

## Heating, Ventilation, and Air Conditioning (HVAC) Curriculum

**ACE Number:** SMAC-0003

**Credit Type:** Course

### Version 2

**Course Title:** Heating, Ventilation, and Air Conditioning (HVAC) Curriculum

**Former Course Title:** International Training Institute for the Sheet Metal and Air Conditioning Industry Sheet Metal Apprenticeship: HVAC Curriculum

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 458 hours of classroom instruction and 3,142 hours of supervised practical experience over two years.

**Version Dates:** 03/01/2010 - Present

**Objective:** This course will train technicians to install, maintain and repair HVAC equipment and supervise installation, maintenance, and repair of HVAC systems.

**Learning Outcome:** Upon successful completion of this course, the student will be able to select the system best matched to the heating and cooling needs of a building; construct the optimal duct system to deliver that conditioning; properly perform installation techniques and conduct business on site; quality check an installation to ensure that it meets the design specifications; apply basic electrical principles and measurement techniques; recognize different types of heating systems; understand principles of refrigerants; service air conditioners and heat pumps; protect the environment from harmful effects of CFC release; understand ladder diagrams and control loops, pneumatic controls, and the phase-in of digital control systems; perform basic TAB and system optimization; appreciate the role of the project management; read plans and specifications; and solve HVAC installation problems.

**Instruction:** Major topics covered in the course are introduction to HVAC; systems and components; heating; refrigeration; field installation; basic electricity; HVAC automatic controls; basic TAB; commissioning; load calculation and duct design; plans and specifications; industrial health and safety, and project management. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, projects, examinations and field experience.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category, 3 semester hours in HVAC Systems and Components; 4 semester hours in Heating; 3 semester hours in Refrigeration; 3 semester hours in Basic Electricity; 3 semester hours in HVAC Automatic Controls; 4 semester hours in HVAC Installation; 3 semester hours in Plans and Specifications; 4 semester hours in HVAC Load Calculation and Duct Design; 5 semester hours in Basic Testing, Adjusting, and Balancing; 1 semester hour in Project Management; and 3 semester hours in Industrial Health and Safety for a total of 36 semester hours (3/10).

### Version 1

**Course Title:** Heating, Ventilation, and Air Conditioning (HVAC) Curriculum

**Former Course Title:** International Training Institute for the Sheet Metal and Air Conditioning Industry Sheet Metal Apprenticeship: HVAC Curriculum

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 458 hours of classroom instruction and 3,142 hours of supervised practical experience over two years.

**Version Dates:** 09/01/2005 - 02/28/2010

**Objective:** This course will train technicians to install, maintain and repair HVAC equipment and supervise installation, maintenance, and repair of HVAC systems.

**Learning Outcome:** Upon successful completion of this course, the student will be able to select the system best matched to the heating and cooling needs of a building; construct the optimal duct system to deliver that conditioning; properly perform installation techniques and conduct business on site; quality check an installation to ensure that it meets the design specifications; apply basic electrical principles and measurement techniques; recognize different types of heating systems; understand principles of refrigerants; service air conditioners and heat pumps; protect the environment from harmful effects of CFC release; understand ladder diagrams and control loops, pneumatic controls, and the phase-in of digital control systems; perform basic TAB and system optimization; appreciate the role of the project management; read plans and specifications; and solve HVAC installation problems.

**Instruction:** Major topics covered in the course are introduction to HVAC; systems and components; heating; refrigeration; field installation; basic electricity; HVAC automatic controls; basic TAB; commissioning; load calculation and duct design; plans and specifications; and project management. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, projects or examinations and field experience.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category: 3 semester hours in HVAC Systems and Components; 4 semester hours in Heating; 3 semester hours in Refrigeration; 2 semester hours in Basic Electricity; 2 semester hours in HVAC Automatic Controls; 4 semester hours in HVAC Installation; 3 semester hours in Plans and Specifications; 4 semester hours in HVAC Load Calculation and Duct Design; 4 semester hours in Basic Testing, Adjusting, and Balancing; 1 semester hour in Project Management; and 6 semester hours in Field Experience for a total of 36 semester hours (12/05).

## Industrial Welding Curriculum

**ACE Number:** SMAC-0015

**Credit Type:** Course

### Version 2

**Course Title:** Industrial Welding Curriculum

**Former Course Title:** Industrial Welding

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 160 hours of classroom instruction and 7,040 hours of supervised practical experience over four years.

**Version Dates:** 03/01/2010 - Present

**Objective:** To provide hands-on knowledge and skills in welding required of sheet metal journey persons.

**Learning Outcome:** Upon successful completion of this course, the student will be able to safely weld utilizing different types of welding and cutting technologies: Gas Metal Arc Welding (GMAW); Gas Metal Arc Welding Pulse (GMAW-P); Gas Metal Arc Welding Surface Tension Transfer (GMAW-STT); Oxygen Fuel Cutting (OFC); Shield Metal Arc Welding (SMAW); Gas Tungsten Arc Welding (GTAW); Gas Tungsten Arc Welding Pulse (GTAW-P); Flux Cored Arc Welding (FCAW); Plasma Arc Cutting (PAC). Version 2: 160 hours of classroom instruction and 7,040 hours of supervised practical experience over four years. Student will be able to safely weld utilizing different types of welding and cutting technologies including Gas Metal Arc Welding (GMAW) including carbon steel plate in various positions 1F, 2F, 3F, 4F with material size ¼" and 1G, 2G, 3G, 4G, 3/8" carbon steel plate to include carbon steel pipe in 1G, 2G, 3G, 5G, 6G open root up and down Hill positions; Gas Metal Arc Welding Pulse (GMAW-P); Gas Metal Arc Welding Surface Tension Transfer (GMAW-STT); Oxygen Fuel Cutting (OFC); Shield Metal Arc Welding (SMAW) weld a pad of stringer bead 1F, 2F, 3F, and 4F positions, lap joint, corner joint, and edge joint in all positions with E6010 and E7018 electrodes; Gas Tungsten Arc Welding (GTAW) to include 1/8" plate 2F, 3F, 4F, and 1G, 2G, 3G, and 4G carbon steel plate; Gas Tungsten Arc Welding Pulse (GTAW-P); Flux Cored Arc Welding (FCAW) 1F, 2F, 3F and 4F positions carbon steel, 1G, 2G, 3G, 5G, and 6G pipe carbon steel; and Plasma Arc Cutting (PAC).

**Instruction:** Major topics covered in the course are communication skills; welding safety; Gas Metal Arc Welding (GMAW); Gas Metal Arc Welding Pulse (GMAW-P); Gas Metal Arc Welding Surface Tension Transfer (GMAW-STT); Oxygen Fuel Cutting (OFC); Shield Metal Arc Welding (SMAW); Gas Tungsten Arc Welding (GTAW); Gas Tungsten Arc Welding Pulse (GTAW-P); Flux Cored Arc Welding (FCAW); Plasma Arc Cutting (PAC). Methods of instruction include general instruction, demonstrations, quizzes, projects, examinations and supervised field experience.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category, 2 semester hour in Industrial Safety, 4 semester hours in Gas Tungsten Arc Welding, 4 semester hours in Gas Metallic Arc Welding, 4 semester hours in Shielded Metal Arc Welding, and 4 semester hours in Flux Core Arc Welding for a total of 18 semester hours (3/10).

### Version 1

**Course Title:** Industrial Welding Curriculum  
**Former Course Title:** Industrial Welding  
**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry  
**Version Dates:** - 02/28/2010

### **Roofing Curriculum**

**ACE Number:** SMAC-0018  
**Credit Type:** Course

### Version 1

**Course Title:** Roofing Curriculum  
**Former Course Title:** Roofing  
**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry  
**Length:** 280 hours of classroom instruction and 4,000 hours of supervised practical experience over two years.  
**Version Dates:** - Present  
**Objective:** To provide hands-on knowledge and skills required of sheet metal journeypersons in the architectural sheet metal industry.  
**Learning Outcome:** Upon completion of this course, the student will be able to safely install low-slope roofs; demonstrate a full understanding of the various roof and drainage systems; the techniques and materials needed to apply and install built-up and single-ply roofing; safety protocols; and how to avoid and troubleshoot hazards on the job.  
**Instruction:** Major topics covered in the course are built-up and modified bitumen membrane flashing, built-up roofing, common topics, decks, insulation, and drainage, hazards in commercial roofing, modified bitumen roof membranes, preparing the deck, repair, maintenance, and re-roofing, single-ply membrane flashing, and tools and equipment. Methods of instruction include general instruction, demonstrations, quizzes, projects or examinations and supervised field experience.  
**Credit Recommendation:** No Credit

### **Servicing Environmental Systems Curriculum**

**ACE Number:** SMAC-0006  
**Credit Type:** Course

### Version 2

**Course Title:** Servicing Environmental Systems Curriculum  
**Former Course Title:** International Training Institute for the Sheet Metal and Air Conditioning Industry Sheet Metal Apprenticeship: Servicing Environmental Systems  
**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry  
**Length:** 400 hours of classroom instruction and 3200 hours of supervised practical experience over two years.  
**Version Dates:** 03/01/2010 - Present  
**Objective:** To provide knowledge and skills required of sheet metal journeypersons to service, repair, and maintain commercial refrigeration, air conditioning, and industrial systems, as well as domestic refrigeration systems.

- Learning Outcome:** Upon successful completion of this course, the student will have the skills and knowledge to lay out, braze and solder piping systems; leak test piping and equipment; evacuate and charge systems with refrigerant; apply proper techniques of recovering and recycling refrigerant; safely service and test electrical components; connect pressure testing equipment; measure system performance; and diagnose and repair system malfunctions.
- Instruction:** Major topics covered in the course are: refrigeration principles and components; air conditioning; diagnostics; electricity; motors; HVAC systems and ventilation; heating systems; heat pumps; commercial systems; pneumatic systems; electronic systems; and energy management. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, and projects or examinations and supervised field experience.
- Credit Recommendation:** In the lower division baccalaureate/associate degree category, 2 semester hours in HVAC Tools and Equipment, 3 semester hours in Refrigeration Principles and Components, 4 semester hours in Refrigeration Systems Maintenance, 3 semester hours in Air Conditioning Systems, 4 semester hours in Air Conditioning Systems Maintenance, 4 semester hours in Electrical Controls, 3 semester hours in Electric Motors and Controllers, 3 semester hours in HVAC Systems, 3 semester hours in Heat Pump Principles and Controls, and 3 semester hours in Commercial Systems for a total of semester 32 hours (3/10).

### **Version 1**

- Course Title:** Servicing Environmental Systems Curriculum
- Former Course Title:** International Training Institute for the Sheet Metal and Air Conditioning Industry Sheet Metal Apprenticeship: Servicing Environmental Systems
- Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry
- Length:** 400 hours of classroom instruction and 3200 hours of supervised practical experience over two years.
- Version Dates:** 08/01/1996 - 02/28/2010
- Objective:** To provide knowledge and skills required of sheet metal journeypersons to service, repair, and maintain commercial refrigeration, air conditioning, and industrial systems, as well as domestic refrigeration systems.
- Learning Outcome:** Upon successful completion of this course, the student will have the skills and knowledge to lay out, braze and solder piping systems; leak test piping and equipment; evacuate and charge systems with refrigerant; apply proper techniques of recovering and recycling refrigerant; safely service and test electrical components; connect pressure testing equipment; measure system performance; and diagnose system malfunctions.
- Instruction:** Major topics covered in the course are: refrigeration principles and components; air conditioning; diagnostics; electricity; motors; HVAC systems and ventilation; heating systems; heat pumps; commercial systems; pneumatic systems; electronic systems; and energy management. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, and projects or examinations and supervised field experience.
- Credit Recommendation:** In the lower division baccalaureate/associate degree category: 1 semester hour in HVAC Tools and Equipment; 3 semester hours in Refrigeration Principles and Components; 3 semester hours in Air Conditioning Systems; 4 semester hours in Air Conditioning Systems Maintenance; 7 semester hours in Electrical Controls; 3 semester hours in HVAC Systems; 2 semester hours in Heat Pump Principles and Controls; 3 semester hours in Commercial Systems; and 6 semester hours in Field Experience for a total of 32 semester hours (12/05).

### **Sheet Metal Apprentice Core Curriculum**

- ACE Number:** SMAC-0002
- Credit Type:** Course

### **Version 2**

- Course Title:** Sheet Metal Apprentice Core Curriculum
- Former Course Title:** National Training Fund Sheet Metal and Air Conditioning Apprentice Curriculum: Sheet Metal Apprentice Curriculum
- Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry
- Length:** 400 hours of classroom instruction and 3,200 hours of supervised practical experience over two years.
- Version Dates:** 03/01/2010 - Present

<b>Objective:</b>	To provide fundamental knowledge and skills required of sheet metal journeypersons in fabricating, installing, and servicing sheet metal formed products.
<b>Learning Outcome:</b>	Upon successful completion of this course, student will be able to calculate and use related mathematical applications; calculate air movement and capacities; calculate heating and air conditioning loads; design, layout patterns, and assemble sheet metal components; define characteristics of different sheet metals and fibrous ductwork and their uses; install and test ductwork and architectural sheet metal; use sheet metal tools and power equipment in an efficient and safe manner; explain principles of electric motors and controls; explain basic principles of air conditioning; test and balance circulation systems; explain and demonstrate safe use of the various welding methods; and read and interpret electrical and mechanical drawings.
<b>Instruction:</b>	Major topics covered in the course are an overview of the trade and its history; communication skills; materials and fabrication; drafting; blueprint reading; layout; safety; plans, specifications and costing; field installation; HVAC fundamentals and control systems; and applied math and measurements. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, projects, examinations and supervised field experience.
<b>Credit Recommendation:</b>	In the lower division baccalaureate/associate degree category, 2 semester hours in Human Relations; 2 semester hours in Environmental Health and Safety; 3 semester hours in Industrial Materials and Fabrication; 2 semester hours in Design and Drafting; 4 semester hours Sheet Metal Layout; 4 semester hours in Installation Estimating and Planning; 3 semester hours in Applied Math; 2 semester hours in Electricity; and 2 semester hours in HVAC Fundamentals, and 2 semester hours in Control Systems for a total of 26 semester hours (3/10).

### Version 1

<b>Course Title:</b>	Sheet Metal Apprentice Core Curriculum
<b>Former Course Title:</b>	National Training Fund Sheet Metal and Air Conditioning Apprentice Curriculum: Sheet Metal Apprentice Curriculum
<b>Location:</b>	International Training Institute for the Sheet Metal and Air Conditioning Industry
<b>Length:</b>	400 hours of classroom instruction and 3,200 hours of supervised practical experience over two years.
<b>Version Dates:</b>	09/01/2003 - 02/28/2010
<b>Objective:</b>	To provide fundamental knowledge and skills required of sheet metal journeypersons in fabricating, installing, and servicing sheet metal formed products.
<b>Learning Outcome:</b>	Upon successful completion of this course, the student will be able to demonstrate proper safety techniques; draft and design, layout patterns, and assemble sheet metal components; generate plans, specifications and costing of sheet metal products; use sheet metal tools and associated power equipment properly; define characteristics of different sheet metal materials; perform field installation of sheet metal products; calculate and use related mathematical applications.
<b>Instruction:</b>	Major topics covered in the course are an overview of the trade and its history; communication skills; survival skills; trade materials; fabrication; drafting; blueprint reading; layout; safety; plans, specifications and costing; field installation; and trade math and measurement. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, projects or examinations and supervised field experience.
<b>Credit Recommendation:</b>	In the lower division baccalaureate/associate degree category: 2 semester hours in Human Relations; 2 semester hours in Environmental Health and Safety; 2 semester hours in Industrial Materials and Fabrication; 2 semester hours in Design and Drafting; 4 semester hours Sheet Metal Layout; 4 semester hours in Installation Estimating and Planning; 2 semester hours in Applied Math; and 6 semester hours in Field Experience for a total of 24 semester hours (12/05).

## Sheet Metal Apprentice Curriculum

<b>ACE Number:</b>	SMAC-0001
<b>Credit Type:</b>	Course

### Version 2

<b>Course Title:</b>	Sheet Metal Apprentice Curriculum
<b>Former Course Title:</b>	International Training Institute Sheet Metal and Air Conditioning Apprentice Curriculum (Formerly National Training Fund Sheet Metal and Air Conditioning Apprentice Curriculum)

<b>Location:</b>	International Training Institute for the Sheet Metal and Air Conditioning Industry
<b>Length:</b>	720 hours (4-5 year) plus supervised practical experience.
<b>Version Dates:</b>	03/01/1995 - 03/31/2010
<b>Objective:</b>	To provide knowledge and skills required of sheet metal journeypersons in fabricating and installing sheet metal products in heating and air conditioning systems and architectural applications.
<b>Learning Outcome:</b>	Upon successful completion of this course, the student will be able to calculate and use related mathematical applications; calculate air movement and capacities; calculate heating and air conditioning loads; design, layout patterns, and assemble sheet metal components; define characteristics of different sheet metals and fibrous ductwork and their uses; install and test ductwork and architectural sheet metal; use sheet metal tools and power equipment in an efficient and safe manner; explain principles of electric motors and controls; explain basic principles of air conditioning; test and balance circulation systems; and explain and demonstrate safe use of the various welding methods.
<b>Instruction:</b>	Major topics covered in the course are communication skills; personal relations within the industry; air movements and duct capacities; use of computers in sheet metal work; system design and layout; pattern development; various duct shapes; electric motors, circuits, and controls; applied mathematics; heating and air conditioning loads; use of fibrous materials and sheet metals; installation, testing, and balance of circulation systems; joining and fastening materials; safe use of sheet metal tools, machines, and power equipment; environmental and hazmat safety; principles of air conditioning; emergency procedures; modern techniques of gas and electric welding; and basic metallurgy. Methods of instruction include lecture, discussion, audiovisual materials, quizzes, projects or examinations and supervised field experience.
<b>Credit Recommendation:</b>	In the lower division baccalaureate/associate degree category: 2 semester hours in Applied Mathematics; 2 semester hours in Human Relations; 3 semester hours in Environmental Health and Safety; 1 semester hour in Basic Electricity; 6 semester hours in Blue Print Reading and Building Codes; 4 semester hours in HVAC Installation Techniques; 4 semester hours in HVAC Fundamentals; 4 semester hours in Heat Loads and Psychrometrics; 2 semester hours in HVAC Tools and Equipment; 6 semester hours in Sheet Metal Layout; 8 semester hours in Sheet Metal Fabrication; 6 semester hours in Technical Drawing; and 8 semester hours in Field Experience for a total of 56 semester hours (8/01) (12/05).

### Version 1

<b>Course Title:</b>	Sheet Metal Apprentice Curriculum
<b>Former Course Title:</b>	International Training Institute Sheet Metal and Air Conditioning Apprentice Curriculum (Formerly National Training Fund Sheet Metal and Air Conditioning Apprentice Curriculum)
<b>Location:</b>	International Training Institute for the Sheet Metal and Air Conditioning Industry
<b>Length:</b>	720 hours (4-5 years) plus supervised practical experience.
<b>Version Dates:</b>	09/01/1985 - 02/28/1995
<b>Objective:</b>	To provide knowledge and skills required of sheet metal journeypersons in fabricating and installing sheet metal products in heating and air conditioning systems and architectural applications.
<b>Learning Outcome:</b>	Upon successful completion of this course, the student will be able to calculate related mathematic applications; calculate air movement and capacities; calculate heating and air conditioning loads; design, layout patterns, and assemble sheet metal components; define characteristics of different sheet metals and fibrous ductwork and their uses; install and test ductwork and architectural sheet metal; use sheet metal tools and power equipment in an efficient and safe manner; explain principles of electric motors and controls; explain basic principles of air conditioning; test and balance circulation systems; explain and demonstrate safe use of the various welding methods.
<b>Instruction:</b>	Major topics covered in the course are communication skills; applied mathematics; personal relations within the industry; air movements and duct capacities; use of computers in sheet metal work; system design and layout; pattern development; various duct shapes; electric motors, circuits, and controls; heating and air conditioning loads; use of fibrous materials and sheet metals; installation, testing, and balance of circulation systems; joining and fastening materials; safe use of sheet metal tools, machines, and power equipment; environmental and hazmat safety; principles of air conditioning; emergency procedures; and modern techniques of gas and electric welding, and basic metallurgy. Methods of instruction include lecture, discussion, audio visual materials, unit quizzes, and yearly final examinations. Methods of instruction include lecture, discussion, practical exercises, computer-based activities, projects, written reports, performance tests, and a yearly final examination.



**Credit Recommendation:** In the vocational certificate or lower division baccalaureate/associate degree category, 2 semester hours in Applied Mathematics; 1 semester hour in Basic Electricity; 5 semester hours in Building Components; 3 semester hours in Environmental Health and Safety; 2 semester hours in Human Relations in the Workplace; 12 semester hours in HVAC Installation and Service; 1 semester hour in HVAC Tools and Equipment; 6 semester hours in Sheet Metal Layout and Fabrication; 16 semester hours in Technical Drawing and Blueprint Reading; and 8 semester hours in Field Experience for a total of 56 semester hours (2/95).

## Sheet Metal Business 101 Curriculum

**ACE Number:** SMAC-0019

**Credit Type:** Course

### Version 1

**Course Title:** Sheet Metal Business 101 Curriculum

**Former Course Title:** Business 101

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 16 hours (2 days).

**Version Dates:** 08/01/2009 - Present

**Objective:** To provide hands-on knowledge and skills required of sheet metal business owners.

**Learning Outcome:** Upon successful completion of this course, the student will be able to prepare a business plan.

**Instruction:** Major topics covered in the course are developing a business plan that includes costs, profits, bidding and cash flow. Methods of instruction include lecture, demonstrations, and projects.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category, 1 semester hour in Business (3/10).

## Sheet Metal Lean Construction Curriculum

**ACE Number:** SMAC-0020

**Credit Type:** Course

### Version 1

**Course Title:** Sheet Metal Lean Construction Curriculum

**Former Course Title:** Lean Construction

**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry

**Length:** 30 hours (4 days).

**Version Dates:** 08/01/2009 - Present

**Objective:** To train technicians to organize and coordinate work flow and operations using lean principles and techniques.

**Learning Outcome:** Upon successful completion of this course, the student will be able to conform to and fully support the SMWIA Code of Excellence program; understand workflow processes; and apply lean principles and tools.

**Instruction:** Major topics covered in the course are lean principles, workflow/batch processes, continuous improvement, lean techniques and tools, and the Last Planner System of the Lean Construction Institute. Methods of instruction include lecture, discussion, AV materials, quizzes, and projects.

**Credit Recommendation:** In the lower division baccalaureate/associate degree category, 2 semester hours in Fundamentals of Operations Management (3/10).

## Sign Industry Curriculum

**ACE Number:** SMAC-0012

**Credit Type:** Course

**Version 1**

<b>Course Title:</b>	Sign Industry Curriculum
<b>Former Course Title:</b>	Sign Industry
<b>Location:</b>	International Training Institute for the Sheet Metal and Air Conditioning Industry
<b>Length:</b>	300 hours of classroom instruction and 4,000 hours of supervised practical experience over two years.
<b>Version Dates:</b>	08/01/2007 - Present
<b>Objective:</b>	To provide hands-on knowledge and skills required of sheet metal journeypersons in the sign industry.
<b>Learning Outcome:</b>	Upon successful completion of this course, the student will be able to safely design, fabricate, and install different types of signs. Students will be able to identify types of signs and lighting; discuss and use safety techniques when working on signs; identify and use sheet metal tools and equipment; discuss the advantages of various signage materials; utilize various drafting methods to create signs; use computer-based design technology; discuss and use various layout methodologies; create letters for signs; use basic soldering and welding techniques; and safely install and move signs using hoisting and rigging techniques.
<b>Instruction:</b>	Major topics covered in the course are basics, signs, safety, tools and equipment, materials, drafting, computers, layout, letters, soldering and welding, and installation. Methods of instruction include lecture, demonstrations, quizzes, projects, examinations and supervised field experience.
<b>Credit Recommendation:</b>	In the lower division baccalaureate/associate degree category, 3 semester hours in Construction Materials, 3 semester hours in Industrial Health and Safety, 3 semester hours in Drafting, and 3 semesters hours in Design and Layout of Signs for a total of 12 semester hours (3/10).

**Testing, Adjusting and Balancing (TAB) Curriculum**

<b>ACE Number:</b>	SMAC-0014
<b>Credit Type:</b>	Course

**Version 2**

<b>Course Title:</b>	Testing, Adjusting and Balancing (TAB) Curriculum
<b>Former Course Title:</b>	Testing, Adjusting and Balancing
<b>Location:</b>	International Training Institute for the Sheet Metal and Air Conditioning Industry
<b>Length:</b>	80 hours of classroom instruction and 1720 hours of supervised practical experience over one year.
<b>Version Dates:</b>	03/01/2010 - Present
<b>Objective:</b>	To provide knowledge and skills required of sheet metal journeypersons to balance heating, ventilating, and air-conditioning (HVAC) systems.
<b>Learning Outcome:</b>	Upon successful completion of this course, the student will be able to calculate and verify electrical measurements; balance HVAC systems; adjust the total system to meet design specifications; measure and establish the fluid quantities of the system as required to meet design specifications; verify the performance of all equipment and automatic controls; calculate and apply related mathematical applications; measure sound and vibration; document results of testing.
<b>Instruction:</b>	Major topics covered in the course are instrument care; basics of heating, ventilating, and air-conditioning systems; airflow; psychometrics; heat and heat transfer; fundamentals of electricity; electrical measurements; motors and starters; rotational speed measurements; temperature measurements; air-pressure and airflow measurements; methods of airflow measurements; duct systems; automatic controls; fans; fan laws and v-belt drives; preparation for balancing and TAB forms; methods of balancing; hydronic systems; hydronic pressure and flow measurements; pumps and pump laws; principles of the cooling tower; hydronic balancing; and TAB-related disciplines. Methods of instruction include lecture, discussion, audiovisual materials, unit quizzes, and projects or examinations and supervised field experience.
<b>Credit Recommendation:</b>	In the lower division baccalaureate/associate degree category, 2 semester hours in Applied Mathematics, 1 semester hour in Basic Electricity; 2 semester hour in HVAC Fundamentals; 3 semester hours in HVAC Systems Testing, Adjusting, and Balancing for a total of 8 semester hours (3/10).

**Version 1**

**Course Title:** Testing, Adjusting and Balancing (TAB) Curriculum  
**Former Course Title:** Testing, Adjusting and Balancing  
**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry  
**Version Dates:** - 02/28/2010

**Testing, Adjusting, and Balancing (TAB) Curriculum**

**ACE Number:** SMAC-0004  
**Credit Type:** Course

**Version 1**

**Course Title:** Testing, Adjusting, and Balancing (TAB) Curriculum  
**Former Course Title:** International Training Institute for the Sheet Metal and Air Conditioning Industry Sheet Metal Apprenticeship: TAB Curriculum (Testing, Adjusting, and Balancing)  
**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry  
**Length:** 80 hours of classroom instruction and 1720 hours of supervised practical experience over one year.  
**Version Dates:** 09/01/2003 - Present  
**Objective:** To provide knowledge and skills required of sheet metal journeypersons to balance heating, ventilating, and air-conditioning (HVAC) systems.  
**Learning Outcome:** Upon successful completion of this course, the student will be able to calculate and verify electrical measurements; balance HVAC systems; adjust the total system to meet design specifications; measure and establish the fluid quantities of the system as required to meet design specifications; verify the performance of all equipment and automatic controls; calculate and apply related mathematical applications; measure sound and vibration; document results of testing.  
**Instruction:** Major topics covered in the course are instrument care; basics of heating, ventilating, and air-conditioning systems; airflow; psychometrics; heat and heat transfer; fundamentals of electricity; electrical measurements; motors and starters; rotational speed measurements; temperature measurements; air-pressure and airflow measurements; methods of airflow measurements; duct systems; automatic controls; fans; fan laws and v-belt drives; preparation for balancing and TAB forms; methods of balancing; hydronic systems; hydronic pressure and flow measurements; pumps and pump laws; principles of the cooling tower; hydronic balancing; and TAB-related disciplines. Methods of instruction include lecture, discussion, audiovisual materials, unit quizzes, and projects or examinations and supervised field experience.  
**Credit Recommendation:** In the lower division baccalaureate/associate degree category: 1 semester hour in Basic Electricity; 1 semester hour in HVAC Fundamentals; 2 semester hours in HVAC Systems Testing, Adjusting, and Balancing; and 4 semester hours in Field Experience for a total of 8 semester hours (12/05).

**Welding Curriculum**

**ACE Number:** SMAC-0005  
**Credit Type:** Course

**Version 1**

**Course Title:** Welding Curriculum  
**Former Course Title:** International Training Institute for the Sheet Metal and Air Conditioning Industry Sheet Metal Apprenticeship: Welding Curriculum  
**Location:** International Training Institute for the Sheet Metal and Air Conditioning Industry  
**Length:** 160 hours of classroom instruction and 7,040 hours of supervised practical experience over four years.  
**Version Dates:** 01/01/2004 - Present  
**Objective:** To provide hands-on knowledge and skills in welding required of sheet metal journeypersons.

- Learning Outcome:** Upon successful completion of this course, the student will be able to safely weld utilizing different types of welding and cutting technologies: Gas Metal Arc Welding (GMAW); Gas Metal Arc Welding Pulse (GMAW-P); Gas Metal Arc Welding Surface Tension Transfer (GMAW-STT); Oxygen Fuel Cutting (OFC); Shield Metal Arc Welding (SMAW); Gas Tungsten Arc Welding (GTAW); Gas Tungsten Arc Welding Pulse (GTAW-P); Flux Cored Arc Welding (FCAW); Plasma Arc Cutting (PAC).
- Instruction:** Major topics covered in the course are communication skills; welding safety; Gas Metal Arc Welding (GMAW); Gas Metal Arc Welding Pulse (GMAW-P); Gas Metal Arc Welding Surface Tension Transfer (GMAW-STT); Oxygen Fuel Cutting (OFC); Shield Metal Arc Welding (SMAW); Gas Tungsten Arc Welding (GTAW); Gas Tungsten Arc Welding Pulse (GTAW-P); Flux Cored Arc Welding (FCAW); Plasma Arc Cutting (PAC). Methods of instruction include general instruction, demonstrations, quizzes, projects or examinations and supervised field experience.
- Credit Recommendation:** In the lower division baccalaureate/associate degree category: 1 semester hour in Welding Safety; 2 semester hours in Oxy-Fuel Gas Cutting/Plasma Arc Cutting; 1 semester hour in Shielded Metal Arc Welding; 2 semester hours in Gas Metal Arc Welding; 1 semester hour in Flux Core Arc Welding; 1 semester hour in Gas Tungsten Arc Welding; 1 semester hour in Carbon Arc Welding/Oxy-Acetylene Welding; and 8 semester hours in Field Experience for a total of 17 semester hours.

