Retrofit Installer-Mechanical

Lesson Plan Section 1: Gas FurnaceFundamentals

Learning Objectives

By attending this session, participants will:

- Know the components of a gas furnace
- Understand the basic principles of combustion
- Understand the principles of venting atmospheric and induced draft furnaces
- Know how condensing furnaces operate
- Understand furnace blower and airflow properties
- Understand operating and safety control systems

Key Terminology

Backdraft
Chimney
Combustion air
Combustion Appliance Zone (CAZ)
Condensing furnace
Direct vent
Draft hood
Draft induced
Heat exchanger
Natural Draft
Open return
Operating control
Safety control
Temperature rise
Vent connector
Vent pipe
Supplemental Materials

Handouts & Resources

PowerPoint presentation
Gas characteristics handout

Classroom Props

Various types of furnaces
Various types of heat exchangers
Furnace components
Vent system components

Hands on Demonstration and Activities:

Blower Static Pressure Demonstration: Demonstrate with furnace blowers on workbench how blower operating characteristics change as applied static pressure changes. The demonstration will measure amperage with ammeter and rpm with tachometer as static pressure is increased.

Temperature rise demonstration: Demonstrate the proper probe placement and measure supply and return air temperature to calculate furnace temperature rise.

Tools:

- Hand tools (nut drivers, wrenches, pliers)
- Tachometer
- Multi-meter
- Ammeter
- Dual probe temperature analyzer

Class Content Summary

Review gas furnace components with heating technicians. Break-up the presentation by showing various furnaces and components. Ensure technicians understand the principles of combustion, venting and airflow.

Retrofit Installer-Mechanical

Lesson Plan Section 2: Gas Appliance Inspection Procedure

Learning Objectives

By attending this session, participants will:

- Understand the responsibilities of the gas appliance inspection form
- Know how to leak test and inspect a gas piping system
- Know how to check a gas furnace for electrical safety
- Understand weatherization and code requirements for gas appliances and vent systems
- Know the indicators of and how to check for a cracked or corroded heat exchanger
- Know the proper process for a furnace *clean and tune*
- Demonstrate the ability to test and set-up a gas furnace for proper operation
- Demonstrate the ability to test carbon monoxide levels in combustion gas and ambient air
- Understand the action levels for carbon monoxide in ambient air and all gas appliances

Key Terminology

Carbon monoxide (CO)
Cycle rate
External static pressure (ESP)
Fan off
Flame interference
Flame roll out
Grounding and bonding
Heat anticipator
Limit test
Parts per million (ppm)
Polarity

Handouts & Resources

Indiana Weatherization Gas Appliance Inspection Form

Gas Meter Clocking Procedure Instruction Form

Gas Piping Inspection Handout

Classroom Props

- Various live gas furnaces for testing
- Gas ranges
- Gas water heater
- Gas piping system
- Vent system
- Masonry chimney liner prop

Hands on Demonstrations and Activities

Gas Input Rating Demonstration: Looking at a gas meter connected to lab furnace, use a calibration card or table and a timer, have the students determine the gas consumption of the furnace.

Adjust Gas pressure Demonstration: Using a monometer, have students adjust gas pressure to rate in furnace.

***Measure and Adjust Fan-off Temperature Demonstration*:**

***Leak Test Gas Piping Demonstration*:**

***Test Limit Switch Demonstration*:**

Class Content Summary

- Introduce the heating technicians to the Indiana Weatherization Gas Appliance Inspection Form and the procedure.

- Ensure the heating technicians understand the Indiana Weatherization requirements and have the ability to perform the related tasks.

Retrofit Installer- Mechanical

Lesson Plan Section 3: Carbon Monoxide Mitigation

Learning Objectives

By attending this session, participants will:

- Recognize indicators of carbon monoxide production
- Understand what causes carbon monoxide production
- Know testing locations and standards

Key Terminology

Air to fuel ratio	**Soot**
Carbon	**Steady state**
Impingement	**Ignition**
Parts per million (ppm)	**Combustion**

Supplemental Materials

Handouts & Resources

Testing Locations and Standards handout

Classroom Props

- Carbon monoxide analyzer
- Carbon monoxide alarms
- Carbon monoxide monitors

Hands on Props and Activities

Gas furnace testing: The students will operate various gas furnace a test carbon monoxide levels in the flue gas. Changes in operation will be made demonstrate how carbon monoxide is produced.

Gas range and water heater testing:

Students will operate gas ranges and water heaters to demonstrate where to test for carbon monoxide in the flue gas**.**

Class Content Summary

- **Introduce the dangers of carbon monoxide poisoning and associated symptoms that may occur.**
- **Recognize the conditions or characteristics that may indicate carbon monoxide production**
- **Demonstrate the ability to test for and solve carbon monoxide production issues.**

Retrofit Installer-Mechanical

Lesson Plan Section 4: Worst Case Draft Testing

Learning Objectives

By attending this session, participants will:

- Understand chimney effect and vent pressure
- Know the definition of Combustion Appliance Zone (CAZ)
- Know how to identify the CAZ boundaries in a house or building
- Understand how air ducts and exhaust fans affect pressure balances within the home
- Understand the process of determining *worst case*
- Have the ability to test appliances for proper operation
- Identify and solve pressure imbalance problems

Key Terminology

Chimney Effect

Combustion Appliance Zone (CAZ)

Draft Pressure

Establishing flow

Pascal

Spillage

Windy Day Kit

With Reference To (WRT)

Supplemental Materials

Handouts & Resources

PowerPoint presentation

Draft Pressure Requirements Handout

What do the numbers mean? Handout

Classroom Props

- Digital manometer
- Smoke puffer
- Draft gauge

- Windy day kit
- Carbon monoxide analyzer

Hands on Demonstrations and Activities

Title of activity here: The students will measure CAZ pressure in lab and determine *worst case* using exhaust appliances.

Title of activity here: After re-creating *worst case* conditions the students will test appliances for drafting and carbon monoxide in flue gas

Class Content Summary

- **Introduce the concepts of building science that effect the pressure balance in buildings and how it effects combustion appliance operation**
- **Ensure students have the ability to determine *worst case* conditions and test appliances under *worst case* conditions**
- **Demonstrate the ability to recognize and solve conditions that do not allow appliance to operate safely**

Retrofit Installer-Mechanical Assessment Methodology

Overview

Due to the technical and changing nature of the Weatherization (Wx) Assistance Program, a high priority has been placed on the training (and assessment) aspects of the program. Working in conjunction with DOE's Weatherization Job Tasks Analysis, IHCDA, in cooperation with INCAA, has developed Indiana Wx Competency Standards. This Competency is a requirement to be able to work in the Indiana Wx Program. Becoming Indiana Wx Competent will require passing a written exam and a skills verification event. The skills verification event will be in addition to testing at the classroom level. There is an assessment process for each of the five Wx job classifications: Energy Auditor, Retrofit Installer-Shell, Retrofit Installer-Mechanical, Crew Leader and Final Inspector.

Components

Retrofit Installer-Mechanical Classroom

In Class

- Lab participation
- Written test

Assessment Event

- Hand's on proficiency
    - Candidate will be required to perform all the tasks involved with completing the Indiana Wx gas appliance inspection form in the field
    - Candidate will be required to competently perform "Worst Case" pressure diagnostic procedure

Scoring Requirements

- Scoring is pass/fail – there will be no provisional results
- 70% passing score on written test
- 70% passing score on field portion
- Must be able to competently perform "Worst Case" pressure diagnostics procedure regardless of overall score

Maintenance

- Competency designation will apply for three years
- An Annual Competency Maintenance training will be required
- 24 hours of continuing education in your job designation will be required

Prerequisites

- Must be a heating system installer, service technician or have attended Basic Heating Systems training course or equivalent

Other Indiana Wx mandatory training requirements

- OSHA 10 or 30 Hour Training Course (not an INCAA training course)
- Lead Safe Weatherization

		Duties and Tasks	Final
A		**Maintain Safety**	
		Professionalism Skills	
	1	Follow work rule of jurisdiction having authority	
	2	Handle materials/equipment according to manufacturer specifications	
	3	Handle tools according to manufacturer specifications	
B		**Prepare for the job (before arriving to job site)**	
	1	Gather materials and supplies	
	2	Gather tools	
C		**Prepare and maintain tools and materials on-site**	
	1	Set up tools	
	2	Set up materials	
D		**Prepare and maintain job site**	
	1	Implement safety protocol (rigging, ventilation, blocking)	
	2	Use protective barriers (drop cloths)	
	3	Report preexisting conditions (that are not in scope)	
	4	Protect exterior environment	
E		**Implement work scope**	
	1	Locate specific work areas	
	2	Verify access to work areas	
	3a	Perform health and safety repairs on gas piping system	
	3b	Perform inspection and repair of flue gas vent systems	
	3c	Equipment electrical system safety requirements	
	3d	Gas furnace inspection and cleaning	
	3e	Gas furnace set-up and adjustments	
	3f	Gas furnace installation	
	3g	Water heater inspection and repair	
	3h	Gas range testing and repair	
	3i	Flue gas vent pressure testing	
F		**Wrap up**	
	1	Pick up tools and materials	
	2	Clean up and close out	
	3	Participate in client debriefing (thermostat operation, filter instructions, etc.)	
			100%