PARTNERING
FOR A
SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify the purpose and interrelationship of the laws governing the installation of fuel oil equipment

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

16.01.01	Identify the purpose and interrelationship of the laws governing the installation of fuel oil equipment and the OBT-2's role compared to their previous OBT-3 role regarding those laws.	Structure of the laws governing fuel oil installations:
		• Technical Standards and Safety Act
		• Regulations
		  ○ Fuel Industry Certificates Regulation 213/01
		  ○ Fuel Oil Regulation 215/01
		  ○ Codes and standards adopted by reference Regulation 223/01
		  ○ Boilers and Pressure Vessels Regulation 220/01
		  ○ Liquid Fuels Regulation 217/01
		  ○ Certification of Petroleum Mechanics Regulation 216/01
		  ○ Oil and Gas Pipeline Systems Regulation 210/01
		• Technical Legal Requirements
		  ○ Codes
		  ▪ B139 Installation code for oil-burning equipment
		  ▪ B138 Portable oil-burning equipment — Packaged equipment requirements/ Installation requirements
		  ▪ TSSA Fuels Safety High Pressure Piping Code
		  ▪ B51 Boiler, pressure vessel, and pressure piping code
		  ▪ Ontario Electrical Safety Code
		  ▪ C282 Code for emergency electrical power supply for buildings
		  ▪ Ontario Building Code
		  ▪ Z240 RV Recreational vehicles code
		  ▪ Z241 Park model trailers code
		  ○ Standards
		  ▪ Standards listed in the B139 Code – especially B140 Series of standards and standards for tanks, vent types, valves, piping/tubing and fittings.
		  ○ Manufacturer's certified installation instructions – how to determine if manufacturer's instructions are certified and, therefore, legal requirements

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify, interpret, and apply specific sections of the TSS Act and Regulations

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
16.02.01	Identify, interpret, and apply specific sections of the TSS Act and Regulations and the OBT-2's role compared to their previous OBT-3 role regarding those laws.	• TSS ACT, 2000 as amended ○ Definitions of "authorization"; "authority having jurisdiction"; "person"; "seal" ○ Sections 6 to 13 regarding requirement for authorization and appeal process. ○ Sections 14 to 16 regarding safety and compliance orders ○ Sections 17 to 22 regarding powers of an inspector ○ Sections 23 to 32 regarding powers of a Director ○ Section 37 regarding offences and penalties ○ Section 41 regarding duties of employers, contractors • Fuel Industry Certificates Regulation O/Reg. 215/01 ○ Definitions of "direct supervision"; "general supervision"; "supervising certificate holder" ○ Section 4 on certificate renewal and reinstatement requirements ○ Sections 13 to 15 on requirements and qualifications for certification ○ Sections 39 to 50 on oil scope of certificates ▪ Detailed coverage of the OBT-3 scope with requirement for supervision with limited allowance for general supervision with sign-off document ▪ Detailed coverage of scopes for OBT-1, OBT-2, OP, OBAT and construction heater certificates ○ Section 55 on exemptions from certification • Fuel Oil Regulation O/Reg. 213/01 ○ Section 1 - all definitions ○ Section 2 regarding application of regulation ○ Section 3 regarding general requirement for compliance ○ Section 4 regarding certificates required for various activities ○ Sections 5 to 15 and 19 to 26 regarding responsibilities of distributors, contractors, certificate holders, and owners/users ○ Section 17, 27 and 28 regarding equipment approval requirements • Petroleum Industry Certificates Regulation 216/01 ○ Brief overview of the certificate requirements for aboveground tanks with a capacity over 5000L and all underground tanks

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify, interpret, and apply specific sections of the TSS Act and Regulations

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
16.03.01	Identify, interpret, and apply B139 Code requirements and the OBT-2's role compared to their previous OBT-3 role regarding those laws.	How the Fuel Oil Code Adoption Document amends the National B139 Code to create the Ontario B139 Code Scope of the B139 Code • installation of appliances, equipment, components, and accessories where oil is used for fuel purposes in applications that include: (a) space heating; (b) service water heating; (c) power generation; and (d) process application. • provides minimum requirements for installing or altering all stationary and portable oil-burning equipment. • provides minimum requirements for installing or altering ancillary equipment including piping and tubing systems; pumps, control devices, venting systems, accessories, heat distribution systems that affect the proper operation of the oil-burning equipment, central oil distribution systems and underground supply tanks, aboveground outdoor tanks, and aboveground tanks installed inside of buildings. • requirements for the maintenance of the most commonly used types of oil-burning equipment. Exclusions the scope of the B139 Code • marine or pipeline terminals • process equipment installed in refineries • appliances installed in park model trailers, recreational vehicles, and marine craft • portable devices such as lamps, blowtorches, melting pots, and weed burners • integral fuel tanks of 45 L (10 gal) capacity or less on internal combustion engines • portable oil-burning equipment within the scope of CAN/CSA-B138.1/ B138.2 Legal requirement to comply with code requirements • Legal requirement to comply with code requirements with a "shall" statement unless otherwise allowed by the authority having jurisdiction • Code requirements using the terms "may" and "should" are recommendations

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify, interpret, and apply B139 Code requirements

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
16.03.01	Identify, interpret, and apply B139 Code requirements and the OBT-2's role compared to their previous OBT-3 role regarding those laws. continued	Current B139 Installation Code for Oil-burning Equipment as amended • Scopes of each of the four parts of the B139 Code • Definitions, abbreviations, and reference publications • Fuel-containing devices, piping, tubing, valves, and fuel oil pumps • General requirements of oil supply tanks based on location (indoors, outdoors aboveground, underground) • Capacity and protection of oil supply tanks based on location (indoors or outdoors aboveground) • Underground piping • Tank connections • Air for combustion and venting • Venting products of combustion • Test and maintenance requirements • Annexes • General requirements for stationary engines. • General requirements for special installations such as used oil appliances, construction heaters and vehicle heaters • General requirements for installation of oil burning equipment for residential and small commercial buildings

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify, interpret, and apply the general requirements in Section 4 of the B139 Code

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
16.03.02	Identify, interpret, and apply the general requirements in Section 4 of the B139 Code and the OBT-2's role compared to their previous OBT-3 role regarding those laws.	General requirements • Acceptable equipment • Responsibilities of the installer • Initial activation • Before leaving a new installation • Posting of instructions • Conversion from a different energy source • Replacement of components • Quality of work • Suitability of equipment and chimney • Accessibility • Electrical features • Gas features • Supply of fuel oil • Hazardous atmosphere • Fuel oil filters and strainers • Preheating of fuel oils • Emergency shut-off devices • Appliance clearances to building construction • Servicing and maintenance clearances • Appliance installation — General requirements • Appliance installation in garages • Appliance installation outdoors • Spill or leak response • Maintenance

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify the designated testing agencies and determine whether equipment is approved.

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

16.04.01	Identify the designated testing agencies that are authorized to approve fuel oil equipment and how to determine whether equipment is approved.	Two governing bodies overseeing equipment standards and approvals
		• TSSA is the only organization authorized to field approve fuel-fired equipment
		• SCC – Standards Council of Canada - oversees the acceptance of safety standards and accredits testing and certification agencies.
		
		Three designated testing agencies that can develop equipment standards and test equipment for compliance with those standards
		• CSA - Canadian Standard Association
		  ○ This organization is also accredited to develop codes including the B139 Installation Code for Oil Burning Equipment.
		  ○ CSA owns the Canadian Gas Association (CGA) which is also accredited by the SCC to develop equipment standards and test fuel equipment
		• ULC - Underwriter's Laboratories of Canada
		• UL - Underwriter's Laboratories Inc.
		
		Four designated testing agencies that are only authorized to test equipment for compliance with standards accepted by TSSA and SCC
		• INTERTEK Testing Services – Parent company of ETL and WH
		  ○ ETL - Equipment Testing Laboratories Inc.
		  ○ WH - Warnock Hersey Professional Services Ltd.
		• LC – LabTest Certification Inc.
		• OTL - Omni-Test Laboratories Inc.
		• PSF Corporation (operating as PFS TECO)

16.04.02	Identify whether equipment is approved.	Methods for determining whether an appliance is approved • The label of a designated testing agency is on the rating plate of an appliance which extends to all the components original to that appliance • The label of a designated testing agency is on a component or its instructions • Conduct a web search of a testing agency or label at www.scc.org

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s):** None **Estimated theory hours:** 8

Task: Identify, interpret, and apply codes other than the current B139 Code.

Module 16	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
16.05.01.	Identify, interpret, and apply codes other than the current B139 Code that apply to OBT activities and fuel oil installations	Previous B139 Codes • Installations must comply with the code in effect at the time of installation unless the authority having jurisdiction specifies a retroactive requirement • OBTs should determine which edition of the B139 Code applies to an existing installation Occupation Health and Safety Act • WHMIS, workers' rights, asbestos Boiler and Pressure Vessels Act • Boilers, welded piping, containers, cylinders Ontario Building Code • Residential ventilation requirements • Chimney construction requirements • Clearances from factory-built chimneys/vents Transportation of Dangerous Goods • Restrictions/ requirements for transporting fuel oil and combustible gases Ontario Electrical Code • Accessibility clearances, vent termination clearances, separate circuits, wire sizing, switch requirements, permits and inspections Trades Qualification and Apprenticeship Act and Regulations • Job descriptions and qualifications for other trades working at fuel oil installations Environmental Protection Act • Spills reporting, response, and clean-up requirements Installation Requirements for Fuel Oil Appliances in Mobile Homes • Specific requirements for installation of appliances in mobile homes

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s)**: None **Estimated practical hours**: 6

Performance objective: Apply laws to common scenarios faced by technicians

Module 16	Practical		
	Scenario	**Procedure**	**Criteria**
16.06.01	The student will identify the fuel oil specific laws (Act, Regulation, Code, Standard, manufacturer's instructions etc.) that should be reviewed, interpreted, and applied to at least four different scenarios demonstrated or described by the instructor in order to answer a practical question posed by the instructor about legal requirements.	The instructor will show the students or describe in detail at least four installations, sets of activities, or scenarios that require the student to access, interpret, and apply the laws governing oil installations in order to answer a practical question about legal requirements. The student shall identify which legal document(s), the pertinent sections of those documents, and how those sections support their answer to the practical question posed by the instructor. Examples of installations/scenarios and questions: • Installing a new burner on an old appliance when the burner listed on the rating plate is no longer available. Question: Under what conditions can a burner that is not listed on an appliance rating plate be installed on that appliance? • An outdoor oil supply tank tips over spilling its entire capacity of 200 gal (900L) on the ground. Question: What action is required of an OBT-2 who finds this spill? • Compression fittings are found on oil supply lines to an appliance that was installed in the 1990s. Question: Is an OBT-2 required to replace the compression fittings at this existing installation? • An OBT-2 is instructed by his employer to supervise an uncertified worker who is installing oil lines while the OBT-2 is installing the appliance and venting. Question: Can an OBT-2 supervise an uncertified worker?	The student's response to each practical question asked by the instructor must comply with the laws governing the fuel oil industry and the list of legal documents and their sections and interpretations must be reasonably complete.

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced installation codes, Acts and Regulations **Prerequisite(s)**: None **Estimated practical hours**: 6

Performance objective: Apply laws to oil installations

Module 16	Practical		
	Scenario	**Procedure**	**Criteria**
16.07.01	The student will identify unacceptable conditions at an oil installation in the shop or other location or as presented in videos/photographs by the instructor and complete the required paperwork and state what notifications are required.	The instructor will show a non-compliant oil installation in the shop or other location or by means of videos/ photographs. The student shall identify the code infractions and complete infraction tags and notices as specified in the Fuel Oil Regulation. The infractions should include both immediate and non-immediate hazards. The instructor should make a list of all unacceptable conditions to compare with the list presented by the student.	The student must correctly identify all unacceptable conditions and correctly categorize each one as immediate or non-immediate. The student must complete and properly locate the tag to be left on the equipment. The student must correctly state that the owner/user, distributor, and TSSA will be given a copy of the notice. The installation must be left in a safe condition at the end of this exercise.

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Describe role of OBT-2s regarding fuel oil supply tanks and lines

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.01.01.	Identify the similarities and differences between an OBT-3's role and an OBT-2's role regarding the installation and servicing of fuel oil supply tanks and lines.	• With reference to the Fuel Industry Certificates Regulation ○ An OBT-2 can work without supervision to install or service tanks with a maximum capacity of 5000L and oil lines of any size. ▪ An OBT-3 is not authorized to install tanks of any size unless the work is conducted under the direct supervision of an OBT-2 or OBT-1 ▪ An OBT-3 must always be supervised and is restricted to working on oil lines no larger than 50 mm (2") supplying appliances with an input not greater than 2 GPH unless work is conducted under the direct supervision of an OBT-2 or OBT-1 ○ An OBT-2 can provide general supervision to an OBT-3 who is installing, activating, or bleeding oil lines less than 2.5 inches if the OBT-3 has demonstrated the essential skills required to perform such work and has had that experience documented and signed-off by the supervising OBT-2 in a form set out and published by the director ○ An OBT-2 can provide direct supervision to an OBT-3 for all activities permitted for an OBT-2 and, when doing so, is responsible for the work of the OBT-3 ▪ An OBT-3 cannot supervise any other certificate holder and is only responsible for the work they conducted under general supervision. • With reference to the students' OBT-3 work experience: ○ The instructor should assess each student's level of knowledge and work experience on each of the following topics and provide an overview of what improvements are required to gain OBT-2 certification and become a valued technician. ▪ Types of tanks they have knowledge of and experience with ▪ Threading pipe and flaring tubing ▪ Working on pumps, filters, valves, oil preheaters ▪ Leak testing tanks and oil lines ▪ Responding to leaks ○ See practical exercise 17.16.01

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank standards listed in the B139 and B138 Codes

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

17.02.01	Locate, recognize, interpret, and compare the tank standards identified in each of the four parts of the B139 Code.	• With reference to the current B139 Code
		  ○ Identify the tank standard number and title as well as the defining characteristics of tanks built to each standard (i.e. construction type, size range, unique features) for tanks listed in the:
		  ▪ B139.1.0 Code for both aboveground and underground tanks
		  ▪ B139.1.1 Code – although standards are not listed in this Code, identify requirement to comply with the B139.1.0 standards as well as the exceptions and additional requirements to that compliance (e.g. only metallic tanks for fire pumps)
		  ▪ B139.1.2 Code – same comment as for the B139.1.1 Code and explain applicability of tank requirements for central oil distribution systems
		  ▪ B139.2 Code – compare listed standards in the B139.1.0 Code to the standards in the B139.2 Code and explain how the scope of the B139.2 Code further restricts the standards that apply to residential and small commercial buildings
		  ○ Identify that the scope of the B139 Code does not apply to integral fuel tanks of 45L (10 gal) capacity or less on internal combustion engines but does require that such tanks be specifically suitable for the purpose

17.02.02	Locate, recognize, and interpret the tank standards identified in the B138.1 Code and compare these standards to the ones in the B139 Code.	• Review the scope and applicability of the B138.1 Code to OBT-2 activities
		• With reference to the current B138.1 Code
		  ○ Identify the tank standard number and title as well as the defining characteristics of tanks built to each standard (i.e. construction type, size range, unique features) for tanks with a capacity exceeding 450L (99 gal).
		  ○ Identify and interpret the conditions for use of uncertified tanks with a capacity of 450L (99 gal) or less
		• Compare and interpret the similarities and differences between tank standard requirements in the B139 Code and the B138 Code

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank capacity requirements given in the B139 and B138 Codes

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

17.03.01	Locate, recognize, interpret, and compare the tank capacity and protection requirements in each of the four parts of the B139 Code.	• With reference to the current B139 Code
		  ○ Identify the tank capacity and protection requirements listed in the:
		  ▪ B139.1.0 Code for
		  • Aboveground tanks, tanks in vaults, and underground tanks
		  • indoor tanks:
		  ○ not installed in a storage room
		  ○ installed in a storage room, protected storage room, or dedicated tank building
		  ○ installed below or above grade level (ground storey)
		  • outdoor tanks
		  ○ above or at ground level (ground storey)
		  ○ based on distance from buildings, property lines, and other fuel equipment
		  • auxiliary tanks supplying appliances other than engines
		  ▪ B139.1.1 Code for auxiliary supply tanks or supply tanks supplying engines
		  • Indoors in engine service rooms and protected service rooms
		  • Outdoors at grade level
		  • Outdoors above ground-level storey
		  ▪ B139.1.2 Code for
		  • Tanks used for the storage of used oil
		  ▪ B139.2 Code
		  • Review scope regarding limitations of capacity and location (i.e. aboveground only)
		  • Indoor tanks
		  • Outdoors tanks at or above ground level

17.03.02	Locate, recognize, and interpret the tank capacity and protection requirements in the B138.1 Code and compare these requirements to the ones in the B139 Code.	• Review the scope and applicability of the B138.2 Code to OBT-2 activities • With reference to the current B138.2 Code ○ Identify the tank capacity and protection requirements based on risk parameters • Compare and interpret the similarities and differences between tank capacity and protection requirements in the B139 Code and the B138.2 Code

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank capacity requirements given in the C282 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.03.03	Locate, recognize, and interpret the tank capacity and protection requirements in the C282 Code and compare these requirements to the ones in the B139 Code.	• Review the scope and applicability of the C282 Code to OBT-2 activities • With reference to the current C282 Code ○ Identify the minimum tank capacity based on hours of operation and L/horsepower • Compare and interpret the similarities and differences between tank capacity and protection requirements in the B139 Code and the B138.2 Code

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank location requirements given in the B139 and B138 Codes

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.04.01	Locate, recognize, interpret, and compare the tank location requirements other than those based on capacity and protection in each of the four parts of the B139 Code.	• Identify the tank location requirements given in the: ○ B139.1.0 Code for ▪ Shipping containers (drums) ▪ Tanks certified only to CGSB-43-146 Standard shall not be installed in a building ▪ Distance from an oil-burning appliance other than an engine ▪ Distance from electrical panel or apparatus ▪ Distance from any means of egress from a building ▪ Distance from walls, floors and other oil supply tanks ▪ Location allows for clearly visible rating plate and vacuum gauge ▪ Distance from other buildings on the same property and to property lines ▪ Distance from fuel dispensers / storage equipment or tanks with flammable liquids ▪ Underground tanks (only a brief overview of location requirements) ○ B139.1.1 Code for auxiliary supply tanks or supply tanks supplying engines ▪ Indoor tanks must be in engine service room and protected service room ○ B139.1.2 Code – no additional location requirements ○ B139.2 Code ▪ Distance from an oil-burning appliance other than an engine Integral tank ▪ Distance from electrical panel or apparatus ▪ Distance from any means of egress from a building ▪ Distance from walls, floors, and other oil supply tanks ▪ Location allows for clearly visible rating plate and vacuum gauge ▪ Distance from other buildings on the same property and to property lines ▪ Distance from fuel dispensers / storage equipment or tanks with flammable liquids ▪ Pressure-filled multiple top-connected tanks shall only be installed indoors
17.04.02	Locate, recognize, and interpret the tank location requirements other than those based on capacity and protection in the B138.2 Code and compare these requirements to the ones in the B139 Code.	• With reference to the current B138.2 Code ○ Distance from fuel dispensers / storage equipment or tanks with flammable liquids ○ Distance from building openings and buildings ○ Conditions for tanks located in partially enclosed spaces ○ Clearances to combustible materials ○ Separation from where the ground is subject to large, rapid amounts of erosion.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank temperature and pressure requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.05.01	Locate, recognize, interpret, and compare the aboveground tank temperature and pressure requirements in each of the four parts of the B139 Code.	• Identify the tank temperature and pressure requirements given in the: ○ B139.1.0 Code for ▪ Maximum operating pressures in the vapour space in 7 kPa (1 psi) ▪ Allowed pressure in an auxiliary tank located below the main supply tank ▪ Maximum temperature allowed in outdoor and indoor tanks ▪ Requirements for higher pressure ratings when the fill or vent pipes terminate more than 7m (23') above the bottom of the tank ▪ Maximum vacuum pressure exerted on elevated auxiliary tanks is 300 Pa ○ B139.1.1 Code for auxiliary supply tanks or supply tanks supplying engines ▪ Maximum temperature allowed in tanks is the same as in the B139.1.0 Code but direction is given on how to measure the oil temperature returning to the tank ▪ If the oil temperature in outdoor tanks can exceed 38˚C (100˚F), the tank must be located at least 3m (10') from buildings and property lines ○ B139.1.2 Code – no additional temperature and pressure requirements ○ B139.2 Code ▪ Same basic requirements as in the B139.1.0 code but less emphasis on higher vent and fill pipes exerting pressure on tank given the limited size of tanks in the B139.2

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank support requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.06.01	Locate, recognize, interpret, and compare the aboveground tank support, installation, foundations, and anchorage requirements in each of the four parts of the B139 Code.	• Identify tank support, installation, foundations, and anchorage requirements given in the: ○ B139.1.0 Code • Comply with manufacturer's instructions • Rigid, non-combustible supports with fire rating of at least 2 hours • Requirement for earthquake protection • Requirement for sloping of bottom outlet tanks up to 2500L • Requirement to seal unused openings • Outdoor tank foundation requirements: • Protection from uplifting in potential flood areas • Annex N in the B139-24 regarding tank securement ○ B139.1.1 Code for auxiliary supply tanks or supply tanks supplying engines ▪ Same requirements as B139.1.0 except for package fire pump assemblies ○ B139.1.2 Code – no additional requirements ○ B139.2 Code ▪ Same requirements as B139.1.0 with following additions for outdoor tank foundations: ○ Requirements for site preparations ○ Detailed options for construction of reinforced concrete slab, precast concrete pads, and pressure-treated wood sleepers with reference to Figure B.15 ○ Foundation shall be 25mm (1") above grade ○ Anchoring required for protection against wind effects ○ Allowance to use four concrete patio stones for horizontal tanks ○ Allowance to install a tank on an elevated stand under specific conditions

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare the tank gauging requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.07.01	Locate, recognize, interpret, and compare the aboveground tank gauging requirements in each of the four parts of the B139 Code.	• Identify tank gauging requirements given in the: ○ B139.1.0 Code for ▪ Requirement for tank gauging except for some auxiliary tanks ▪ Allowance to use visual observation or dipstick for outdoor tanks but not indoors ▪ Indoor tanks must have a gauge or fill alarm device that meets specific standards ▪ Requirement to locate gauge in a protected area ○ B139.1.1 Code – no additional requirements ○ B139.1.2 Code – no additional requirements ○ B139.2 Code ▪ Same requirements as in the B139.1.0 code
17.07.02	Describe characteristics, operation, and installation requirements for visual, signal and distant reading gauges.	• Visual gauge ○ certified to standards listed in B139 code ○ float on a swing arm or float on string ○ indicates fuel level but not reliable for filling ○ arrow points to long end of tank ○ installation instructions • Audible gauge/signal ○ certified to standards listed in B139 code ○ vent air goes through whistle as tank is filled and stops when oil at whistle inlet ○ allows for expansion of oil 4"/6" below top of tank ○ installation instructions • Remote gauge/signal certified to standards listed in B139 code ○ mostly used for underground tanks or large tank installations ○ must provide audible and visual indication when tank meets safe fill level ○ may provide level indication ○ operates electronically or pneumatically ○ installation instructions

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, interpret, and compare the tank testing requirements given in the B139 Code and manufacturer's instructions

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.08.01	Locate, recognize, interpret, and compare the aboveground tank testing requirements in each of the four parts of the B139 Code.	• Identify tank testing requirements for new or replacement tanks given in the: ○ B139.1.0 Code for ▪ Tanks with secondary containment or double wall construction shall be tested as per manufacturer's instructions ▪ Single wall tanks shall be tested by the installer: ○ Pneumatic test conditions and procedures ○ Hydrostatic test conditions and procedures ▪ Transfer of water or sludge from replaced tank to new tank is prohibited ○ B139.1.1 Code – no requirements ○ B139.1.2 Code – no requirements ○ B139.2 Code ▪ Same requirements as in the B139.1.0 code
17.08.02	Locate, interpret, and apply tank test requirements for tanks with secondary containment or double wall construction.	• Review various manufacturer's instructions for tanks with secondary containment or double wall construction ○ Identify test options and procedures

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare tank fill and vent pipes requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.09.01	Locate, recognize, interpret, and compare the aboveground tank fill and vent pipe requirements in each of the four parts of the B139 Code.	• Identify tank connections requirements given in the: ○ B139.1.0 Code for ▪ Fill pipes ○ Allowed materials ○ Maximum height of fill termination above bottom of the tank ○ Fill cap and spill containment requirements ○ Requirement for an overfill protection device ○ Slope requirements with exceptions for pressurized filling ○ Conditional allowance to install a valve in the fill line ○ Minimum size of fill pipe is 50 mm (2”) ○ Location requirements for fill pipe termination ○ Conditional allowance for a common fill pipe to multiple tanks ○ Requirements for fill pipes on auxiliary supply tanks (see 17.XX.XX) ▪ Vent pipes ○ Allowed materials ○ Maximum height of vent pipe termination above bottom of the tank ○ Minimum and required sizes of vent pipes ○ Slope requirements for vent pipes ○ Protection of vent outlet ○ Location requirements for vent pipe connection to tank ○ Location requirements for termination of normal vents, emergency vents and interstitial vents ○ Prohibition against cross-connecting vents with fill pipes or with fuel oil return lines ○ Maximum equivalent lengths of tank vents ○ Conditional allowance for a common venting of multiple tanks ○ Tank venting requirements for auxiliary supply tanks (see 17.10.01) ○ B139.1.1 Code – compliance with the B139.1.0 code is required • Emphasize that the fill pipe, normal vent, and emergency vent but not the interstitial vent must terminate outdoors even for engines in skin-tight enclosures ○ B139.1.2 Code – compliance with the B139.1.0 code is required • Conditional allowance to fill and vent used oil tanks inside a building ○ Continued

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare tank fill and vent pipes requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.09.01 Continued	Locate, recognize, interpret, and compare the aboveground tank fill and vent pipe requirements in each of the four parts of the B139 Code. Continued	• Identify tank connections requirements given in the: ○ B139.2 Code – similar to the B139.1.0 Code with the following exceptions ▪ Fill pipes ○ No requirement to have spill containment at fill pipe entry ○ Location requirements for fill pipe termination are the same except that the B139.2 code does not require the fill pipe entry to be 1.5m (5') from a building exit ○ No requirements related to remote fill pipes or recessed fill pipes ○ No reference to common fill pipe for multiple tanks with a capacity exceeding 2500L ○ B139.2 has significantly more requirements related to pressure-filled multiple top-connected supply tanks with a total capacity of 5000 L (1100 gal) or less ○ No requirements are given for fill pipes on auxiliary supply tanks ○ Requirements for an overfill protection device are significantly different in B139.2 ○ B139.1.0 requires an overfill protection device certified to ULC-S661 for all tanks unless the oil level can be visually determined at the point of filling ○ B139.2 sets separate requirements for indoor and outdoor tanks ○ Outdoor tanks must be equipped with a vent whistle plus a visible gauge or electronic fill-limiting device ○ Indoor tanks also require a vent whistle plus a visible gauge at the fill pipe location or electronic fill-limiting device or a release prevention barrier ○ Specifications for release prevention barriers are only given in the B139.2 ▪ Vent pipes ○ Requirements for vent greater than 4.15 m (13-1/2 ft) above the bottom of the tank as well as requirements for tanks with emergency vents are not repeated in the B139.2 Code but references are made to comply with the B139.1.0 Code ○ Requirements for common venting of multiple tanks is significantly different in the B139.2 Code ○ The B139,2 Code does not cover venting requirements for auxiliary supply tanks

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare auxiliary tank fill and vent pipe requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.10.01	Describe and apply the tank fill and vent pipe requirements for auxiliary tanks as given in the B139.1.0 and B139.1.1 Codes.	• Identify auxiliary tank connections requirements given in the: ○ B139.1.0 Code ▪ Fill pipes ○ Requirements for a liquid level control to have spill containment at fill pipe entry ○ Requirements when a supply line to an auxiliary supply tank is located below the highest liquid level in the main supply tank ○ Requirement for an anti-siphon device or method when a drop tube is used on the fuel supply line to the auxiliary tanks ▪ Vent pipes ○ Two options given for normal and emergency venting of auxiliary supply tanks ▪ Vent only through the overflow pipe back to the main supply tank ○ Minimum size of the overflow pipe ○ Maximum projection of the overflow pipe into the main supply tank ○ Minimum size must factor in the supply pump capability to over pressurize the auxiliary tank ○ Prohibitions against sags, traps, valves, or obstructions in overflow pipe ○ Requirement for a vacuum breaker for elevated auxiliary tanks ○ Allowance and conditions for having an additional emergency vent ▪ Vent directly to the outdoors ○ Ontario amendment requiring that design of the installation shall be submitted to TSSA ○ Requirements for a redundant level control ○ Requirements for vent size ○ Conditions for installation of a level detection device in the vent pipe ○ Allowance and conditions for also using an overflow pipe ○ B139.1.1 Code ▪ Options with conditions given for the return line from engine to terminate in the main supply tank rather than the auxiliary tank ▪ Requirements for a drop tube on the return line to an auxiliary when the temperature of the oil exceeds 38 °C (100 °F) ▪ Requirements for supply and return lines to enter the top of the auxiliary tank ▪ Electric level controls and valves shall be provided with continuous power.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare piping and tubing requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.11.01	Locate, recognize, interpret, and compare the aboveground piping and tubing requirements in each of the four parts of the B139 Code.	• Identify aboveground piping and tubing requirements given in the: ○ B139.1.0 Code ▪ Requirement and conditional exemptions for external parts of the body of a fuel-containing device to have a melting point not less than 538 °C (1000 °F) ▪ Amended requirements for piping to be in accordance with three ASME standards ▪ Amended requirement for piping or tubing to be submitted to TSSA for approval ▪ Piping and tubing material requirements with specific standards identified ▪ Allowed materials for fill and vent pipes ▪ Minimum allowed sizes of piping and tubing ▪ Allowance and conditions for use of flexible connectors ▪ Allowance and conditions for use of hose connectors ▪ General protection requirements ▪ Prohibition against damaging building structure when installing piping or tubing ▪ Piping support requirements ▪ Allowed methods for protecting piping and tubing that penetrates a wall ▪ Minimum unthreaded portion of piping showing through a wall/floor/ceiling penetration ▪ Allowed methods for installing piping and tubing in concrete floors ▪ Prohibition against using galvanized for conveying preheated fuel ▪ Allowed materials and methods for joining piping and tubing ▪ Requirements for concealed piping installations ▪ Requirements for rooftop piping installations (NOTE: Tubing not allowed on a roof) ○ B139.1.1 Code ▪ Identify the piping and tubing considered to be part of an engine and therefore exempt from the Code ▪ Requirement for a fusible-link valve when hose connectors are part of the engine ▪ Requirement that supply and return fuel line shall enter the top of the supply tank ▪ Conditional allowance for the supply line from the tank to the engine can be taken from the side of the supply tank ▪ Requirement to use a flexible connector to connect fuel piping to an engine. ▪ Conditions placed on the use of flexible connectors ▪ Termination requirements for return line from engine to auxiliary or supply tank ▪ Allowance to use stainless steel double-ferrule compression fittings ○ Continued

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare piping and tubing requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.11.01 Continued	Locate, recognize, interpret, and compare the aboveground piping and tubing requirements in each of the four parts of the B139 Code. Continued	• Identify aboveground piping and tubing requirements given in the: ○ B139.1.2 Code ▪ Termination requirements for supply and return lines in a used oil supply tank ○ B139.2 Code– similar to the B139.1.0 Code with the following exceptions ▪ Allowance with conditions to use a certified automatic oil de-aerator are only given in the B139.2 code ▪ B139.2 does not reference or require compliance with the ASME B.31 piping standards ▪ B139.2 code does not specify the standards for piping, tubing and fittings ▪ B139.2 code does not identify brass pipe as an allowed material ▪ B139.2 code specifies that copper tubing must have n outer plastic coating ▪ B139.2 code as amended recommends brazing of concealed piping joints whereas the B1239.1.0 code recommends welding. Similarly the B139.2 requires brazing to be performed by a qualified brazer whereas the B139.1.0 specifies a qualified welder ▪ B139.2 does not address the joining of brass pipe but the B139.1.0 code does ▪ B139.1.0 code prohibition against using unions with gaskets/packing or right and left couplings are not repeated in the B139.2 code amendments ▪ Requirements for rooftop piping and underground piping are not repeated in the B139.2 code but compliance with the B139.1.0 is required for these installations
17.11.02	Locate, recognize, interpret, and compare the underground piping and tubing requirements in the B139.1.0 Code.	NOTE: Given that an OBT-2 can only install or service underground piping if the OBT-2 is trained in the certified manufacturer's installation instructions, a general overview of underground piping requirements is all that is required. Highlight the following: ▪ Material requirements – standards and double-wall construction ▪ Overview of installation requirements ▪ Overview of sump requirements

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare valve requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.12.01	Locate, recognize, interpret, and compare the valve requirements in each of the four parts of the B139 Code.	• Identify valve requirements given in the: ○ B139.1.0 Code ▪ Option of using a fusible-link valve upstream of components that have a melting point below 538˚C ▪ Requirement that shut-off valves are certified to the ULC/ORD-C842 Standard ▪ Location and protection requirements for valves ▪ Requirements for installation and signage of valves on outdoor or underground tanks ▪ Requirement for a separate valve for emergency equipment ▪ Requirements for a pressure relief valve when a shut-off valve in used in the return line or when a heater is used in the fuel supply line ▪ Requirement for “a means to relieve pressure” between two automatic shut-off devices ▪ Requirement for automatic shut-off valves to meet one of three standards ▪ Requirement that solenoid valves and actuators for automatic valves be fail safe ▪ Conditional requirements for installing an automatic shutoff device in case of fire around the burner or in case of breakage of a supply line serving multiple burners ▪ Requirements for an anti-siphon valve and test method when the fuel line is located below the fuel level in the tank ▪ Requirements concerning constant level valves ▪ Requirements for a pressure relief valve when the allowed inlet pressure to a pump is exceeded ▪ Requirements for a pressure relief valve on a non-integral pump outlet ▪ Requirements for an anti-siphon valve when the supply line to an auxiliary tank is below the fuel level in the main supply tank ▪ ○ B139.1.1 Code ▪ Review the detailed anti-siphon protection requirements and flow chart given in this code ○ B139.1.2 Code ▪ Requirements for a manual or spring-loaded valve on an indoor fill line to a tank used for the storage of used oil ○ Continued

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare valve and filter requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.12.01 Continued	Locate, recognize, interpret, and compare the valve requirements in each of the four parts of the B139 Code. Continued	○ B139.2 Code– similar to the B139.1.0 Code with the following exceptions ▪ Requirement to install a fusible-link valve upstream a de-aerator ▪ B139.2 does not require signage of valves on outdoor or underground tanks ▪ B139.2 does not require a separate valve for emergency equipment ▪ B139.2 only requires automatic shut-off valves to meet one of the three standards listed in the B139.1.0 code ▪ B139.2 does not specify that solenoid valves or actuators for automatic valves be fail safe ▪ B139.2 does not require an anti-siphon valve and test method when the fuel line is located below the fuel level in the tank
17.13.01	Locate, recognize, interpret, and compare the filter requirements in each of the four parts of the B139 Code.	• Identify valve requirements given in the: ○ B139.1.0 Code ▪ An oil line-mounted device must have a melting point > 538˚C or be protected ▪ Location and protection requirements for filters ▪ Requirements for oil strainers to be certified to the ULC/ORD-C331 Standard ▪ Requirement for an oil strainer downstream of an oil preheater ○ B139.1.1 Code ▪ Identify the filters considered to be part of an engine and therefore exempt from the Code ▪ Requirement to locate a fuel oil filter or strainer assembly or a water separator inside the engine room or enclosure ○ B139.1.2 Code ▪ A 150 µm filter shall be installed in the supply line of all used-oil-burning appliances ○ B139.1.2 Code – similar to the B139.1.0 Code with the following exception ▪ Only the B139.2 has requirements for a filter to be installed over a containment device ▪ Only the B139.2 has a requirement for a filter to be installed upstream of a de-aerator

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s):** None **Estimated theory hours:** 24

Task: Locate, recognize, interpret, and compare pump and preheater requirements given in the B139 Code

Module 17	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
17.14.01	Locate, recognize, interpret, and compare the pump requirements in each of the four parts of the B139 Code.	• Identify pump requirements given in the: ○ B139.1.0 Code ▪ Maximum pressure at pump inlet is 35 kPa unless it is designed for higher pressures ▪ Maximum lift imposed on a pump is 4.9m (16') ▪ Requirements when the pump is located above the supply tank ▪ When a pump supplies an auxiliary tank, it shall be controlled by a level-control device ▪ Only a suitable positive displacement pump shall be used for elevated piping systems ▪ On elevated installations, a pressure-sensing device shall be provided at the oil pump location to shutdown the pump when oil pressure falls below normal operating pressure ▪ When the total capacity of the tanks connected to one supply line exceeds 2500 L (550 gal), transfer shall be by pump only ○ B139.1.1 Code ▪ Identify the pumps considered as part of an engine and therefore exempt from the Code ○ B139.1.2 Code – no specific pump requirements ○ B139.2 Code– no specific pump requirements since this code only covers integral pumps (not booster or transfer pumps)
17.15.01	Locate, recognize, interpret, and compare the preheater requirements in each of the four parts of the B139 Code.	• Identify preheater requirements given in the: ○ B139.1.0 Code ▪ General requirement to maintain oil at a suitable temperature for pumping and atomizing ▪ Requirement to not supply oil for combustion until it is at a suitable temperature ▪ Requirement to have a means of cold starting the appliance ▪ Prohibition against heating the oil above the tank's maximum temperature rating ▪ Requirements for use of a steam coil oil preheater, hot water coil oil preheater, or an electric oil preheater ○ B139.1.1 Code – no specific preheater requirements ○ B139.1.2 Code – no specific preheater requirements ○ B139.1.2 Code – similar to the B139.1.0 Code with the following exception ▪ No requirements for use of a steam coil oil preheater or hot water coil oil preheater

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Identify the current knowledge and skill level of each student

Module 17	Practical		
	Scenario	**Procedure**	**Criteria**
17.16.01	The intent of this exercise is to identify the student's level of knowledge and work experience related to fuel oil tanks, piping/ tubing and associated supply system components. It is recommended that a combination of self-assessment and practical assessment tools be employed. Equipment to display or provide photos/video of: • A variety of tank types • Various types of piping, tubing, fittings, valves, filters, pumps, etc. Work equipment: • Power threader/cutter/reamer • Cutting/flaring/reaming/bending tools for tubing • Steel pipe and fittings • Copper tubing and fittings • Hand tools	The instructor will ask each student (preferably in written form) to provide an overview of their level of knowledge and work experience related to the following topics. ▪ Types of tanks they have knowledge of and experience with ▪ Threading pipe and flaring tubing ▪ Working on pumps, filters, valves, oil preheaters ▪ Leak testing tanks and oil lines ▪ Responding to leaks In addition to this self-assessment, each student will be required to conduct one or both of the items #1 and #2 and one or both of items #3 and #4 to prove the accuracy of their self-assessment: 1. Identify a variety of tank types displayed in the shop or in photos/videos and explain key characteristics regarding construction and installation requirements 2. Various types of piping, tubing, fittings, valves, pumps displayed in the shop or in photos/videos and explain key characteristics regarding construction and installation requirements 3. Construct a simple piping project requiring the cutting, reaming, threading, and joining of pipe 4. Construct a simple tubing project requiring the cutting, reaming, flaring, and joining of tubing	The information gained from the student's self-assessment and from watching them complete one or more of the listed tasks should be used by the instructor to inform the student about what improvements are required in his/her knowledge and skill level to gain OBT-2 certification. If the practical exercises related to threading piping and flaring tubing are not skilfully conducted, the student should be required to complete exercise 05.10.01 from Module 5 of the OBT-3 curriculum. Failure to skilfully complete the simple piping project or tubing project in this exercise before the completion of the OBT-2 course should result in a failing practical mark.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Read and interpret tank manufacturer's installation instructions.

Module 17	Practical		
	Scenario	**Procedure**	**Criteria**
17.17.01	The student will read and interpret manufacturer's instructions for a double wall tank with a plastic inner tank in a galvanized steel outer tank (e.g. a Roth tank). Ideally, there will the same make and model of tank in the shop and additional exercises can be conducted on the tank.	The student will be given a manufacturer's installation instruction for a double wall tank with a plastic inner tank in a galvanized steel outer tank (e.g. a Roth tank) and a list of questions to answer that proves the student's ability to read and interpret manufacturer's instruction. Questions may include: ▪ Is the tank certified for use in Canada? ▪ What are the available models and sizes ▪ What fuels can be stored in the tank? ▪ Can the tank be installed outdoors? Conditions? ▪ What tank support is required? Options? ▪ What is the maximum number of tanks that can be joined together with common fill and vent pipes? ▪ What type of pipe tape, pipe dope or other sealants are recommended for threaded joints? ▪ What are the requirements for installation of the supply line and tank gauge? • What is the maximum fill pressure and ideal pumping rate required to fill multiple tanks? • Describe how the leak detector works. • Describe how to test the tank after installation. • What maintenance is required for the tank? • Can a damaged tank be repaired? If so, how? • If a 1000L tank has 20" of oil in it, how many hours could a generator operate at peak load if it is designed to burn 7 US gph at maximum load? If the same or similar tank is available in the shop or at another site or via video, have the student assess the installation for compliance with the manufacturer's instructions and the B139 Code.	The student must correctly answer 75% of the questions asked. If an assessment of an installation with a similar tank is possible, the student must correctly identify whether the installation complies with the manufacturer's instructions and the B139 Code.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Design and select components for a multiple bottom connected tank installation

Module 17	Practical		
	Scenario	**Procedure**	**Criteria**
17.18.01	The student will create a detailed drawing of an installation with two indoor 900L (200 gal) single wall steel or fibreglass tanks that are bottom connected to supply two boilers fired at 1 GPH each and located on the same level as the tanks. The student will also identify the make, model, and key features of the tanks and components such as valves, filters, flex connectors etc. required for the installation.	The student will be provided with access to manufacturer's literature for a wide variety of single wall tanks and piping system components (valves, filters, flex connectors, etc.). The drawing must show: • The position of the supply tanks in relation to each other, distance from walls, distance and elevation from outdoor fill and vent pipe terminations, etc. • Relative position of the tanks and boilers. • The material, size, configuration, and termination location of the fill and vent pipes for the tanks. • The material, size, and configuration of the supply line(s) and return line(s) (if applicable) between the tanks and the boilers. The student will also provide a component list with the make, model, and key features of the: ○ Supply tanks ○ Valves ○ Filters ○ Flex connectors (if applicable) ○ Description of the secondary containment system (if applicable) Ideally, the student will be required to supply copies of the manufacturer's literature for each selected component with highlighting showing why the component meets requirements.	The drawing will be assessed for: • Compliance with the instructions provided by the instructor • Use of proper piping diagram symbols • Neatness • Compliance with code requirements for this type of installation The component list will be assessed for: • Compliance with the instructions provided by the instructor • Neatness of the presentation • Whether the make, model, and key features of each component comply with code requirements for this type of installation. • Whether the requirements for secondary containment were identified and described

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Design three tank and piping installations with a main supply tank, auxiliary tank, and pump set (if applicable)

Module 17	Practical		
	Scenario	**Procedure**	**Criteria**
17.19.01	The student will create three detailed drawings of installations with a 5000L main supply tank and an auxiliary tank supplying an indoor 60 kW diesel generator located: 1. on the same level as the main supply tank 2. below the level of the main supply tank 3. 20 m (66') above the main supply tank The student will also identify the make, model, and key features of the main supply tank, auxiliary tank, pump set, and key components such as valves, filters, flex connectors, level controls, etc. required for the third drawing listed above.	The student will be provided with access to manufacturer's literature for a wide variety of main supply tanks, auxiliary tanks, pump sets, and piping system components (valves, flex connectors, etc.). Each of the three drawings must show: • The position of the main supply tank in relation to the building (indoors or outdoors, distance from walls, property lines (if applicable), etc. • Relative position of the main supply tank, auxiliary tank, generator, and pump set (if applicable). • The material, size, and termination location of the fill and vent pipes for the main supply tank. • The material, size, and configuration of the supply line and return line (if applicable) between the main tank, pump set (if applicable), and auxiliary tank. • The material, size, and configuration of the supply line and return line (if applicable) between the auxiliary tank and the generator. The component list required for the third installation must include make, model, and key features of the: ○ Main supply tank ○ Auxiliary tank ○ Pump set ○ Valves ○ Filters ○ Flex connectors ○ Level control device Ideally, the student will be required to supply copies of the manufacturer's literature for each selected component with highlighting showing why the component meets requirements.	The three drawings will be assessed for: • Compliance with the instructions provided by the instructor • Use of proper piping diagram symbols • Neatness • Compliance with code requirements for each type of installation The component list provided for the third installation will be assessed for: • Compliance with the instructions provided by the instructor • Neatness of the presentation • Whether the make, model, and key features of each component comply with code requirements for elevated installations.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced fuel oil supply systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Install a main supply tank, auxiliary tank, and pump set.

Module 17	Practical		
	Scenario	**Procedure**	**Criteria**
17.20.01	The instructor will demonstrate the proper components, connection methods and wiring methods for a duplex pump set fed by gravity from the main supply tank and feeding an elevated auxiliary tank. Each student will disassemble and reassemble the piping and wiring system for this installation	The instructor will demonstrate and describe the piping and control components necessary for an installation with a duplex pump fed by gravity from the main supply tank and feeding an elevated auxiliary tank. Each student will disassemble and reassemble the piping and wiring system for this installation as instructed. The instructor may choose to change the installation requirements – for example: • Duplex pump set is above the main supply tank • The auxiliary tank is vented to atmosphere rather than through the overflow return line (or vice versa)	Assessment criteria: • proper PPE selected and used properly • all work conducted safely • neatness • no oil leaks • proper tank fill and vent piping installation for both tanks • proper electrical wiring • proper components selected and installed • installation meets code requirements and manufacturer's instructions, • proper method used for checking operation of controls and sequence of operation

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Describe the principles of air flow and how to measure it as applicable to oil-fired appliances.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

18.01.01	Describe the principles of air flow and how to measure air flow direction and rate	• Air flow principles
		  ○ Air flows from high pressure to low pressure zones
		  ○ The greater the pressure difference, the greater the flow rate
		• Air flow measurement
		  ○ Reference point is local atmospheric pressure rather than gauge pressure
		  ○ Measurement instrument must be capable of being zero-adjusted to local atmospheric pressure
		  ○ Measurement instrument must be capable of measuring in thousandths of an inch of water column pressure or pascals
		  ○ After zeroing the instrument and inserting the sensing end in a vent, combustion chamber, or room:
		  ▪ a negative pressure reading indicates air flow direction out of the sensing area
		  ▪ a positive pressure reading indicates air flow direction into the sensing area
		  ▪ the greater the pressure difference, the greater the flow rate

18.01.02	Describe the air flow requirements for different types of oil-fired appliances	• Appliance input plus the following design factors determine air flow requirements
		  ○ Appliance type: direct-vent appliance or an appliance that consumes indoor air.
		  ○ Burner type: natural air supply burner or mechanical air supply burner
		  ○ Heat exchanger pressure: negative or positive pressure
		  ○ Venting type: vents with or without draft control devices

18.01.03	Describe how the characteristics and quality of combustion air supply affects oil-fired appliances	• Air temperature effects on combustion and venting
		  ○ Cold, dry air increases excess air %, flame length, and draft but lowers the temperature of the flame and heat exchanger.
		  ○ Hot, moist air decreases excess air %, flame length, and draft but increases the temperature of the flame and heat exchanger.
		• Air quality effects on combustion and venting
		  ○ Any chemicals or airborne particles entering the combustion chamber with the combustion air will change the combustion reaction.
		  ○ Chemical such as hydrogen chloride (bleach) can cause damage to the appliance

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Determine the minimum sizes for combustion air and ventilation air openings.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.02.01	Determine whether air supply openings are required for oil-fired appliances	• B139 Code requires installer to inspect the building to determine if it could create a negative pressure condition that would prevent the oil-fired appliance from operating properly. ○ If there is insufficient air for proper combustion or the temperature of the air available for combustion and venting could prevent safe operation of the appliance, corrective action must be taken or the appliance must not be installed. ○ B139 Code requires outside air supply openings for non-direct vented appliances in residential buildings constructed or significantly renovated after 1985 and for **all** commercial/industrial buildings.
18.02.02	Determine the minimum supply air opening sizes for non-direct vented oil-fired appliances	• B139.2 Code requirements for air supply openings at residential buildings. ○ For appliances installed in a large room or space, one opening is required and sized based on a calculation of 1 in^2 per 5000 Btuh input ○ For appliances installed in a limited room or space and combustion and ventilation air is taken from inside the building, two openings are required and sized based on a calculation of 1 in^2 per 1000 Btuh input ○ For appliances installed in a limited room or space and combustion air is taken from outside the building but ventilation air is taken from inside the building: ▪ The combustion air opening is sized based on a calculation of 1 in^2 per 5000 Btuh ▪ Two ventilation openings are required and sized based on a calculation of 1 in^2 per 1000 Btuh input ○ For appliances installed in a confined space and air is taken from outside the building, two openings are required and sized based on a calculation of: ▪ 1 in^2 per 4000 Btuh input if air is delivered through vertical ducts or direct access ▪ 1 in^2 per 2000 Btuh input if air is delivered through horizontal ducts • B139.1.0 Code requirements for air supply openings commercial or industrial buildings ○ For passive air supply systems, one combustion air opening is required and sized based on a calculation of 1 in^2 per 14,000 Btuh input ○ For mechanical air supply systems, detailed requirements are provided in the code for interlocking the proof of air flow to the burner control system

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Determine the minimum sizes for combustion air and ventilation air openings.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.02.03	Identify the required location and conditions for air openings or ducts.	• Calculated all air supply opening sizes are free air; blockage by louvres or grills must be factored into rough air opening sizes • Minimum duct size dimension is 3" (75mm) • Outdoor air supply opening must be at least 1 ft. above grade and at least 1 ft. above the anticipated snowfall for the area • If a damper is installed in used in the air supply duct, it must be interlocked to prove that it is fully open before the burner operates • Direct ducting of outdoor air to the burner is only permitted if the connection kit is *approved* specifically with the appliance and installed as per manufacturer's instructions. • Louvres and screens shall not be smaller than 6 mm (1/4") mesh and shall be readily accessible for cleaning. • Location of air supply openings in the appliance room must not cause freeze damage
18.02.04	Identify the special requirements related to air supply to stationary engines	• Examine Section 7 "Air for combustion and venting" in the B139.1.1 Code ○ Identify the conditions that require automatic air supply dampers to be interlocked to prevent the engine from starting before the combustion air damper is fully open. ○ Identify the conditional exemptions to the interlock requirement
18.02.05	Identify the purpose and limitations of air openings required by the code	• Air supply opening sizes required by the B139 Code are only designed to replace the air consumed for combustion and venting • Air supply openings calculations are based on the building pressure being neutral • Code compliant air supply openings do not guarantee proper combustion and venting • The installer should use the building-as-a-system approach to inspect the building to determine if it could create a negative pressure condition that would prevent the oil-fired appliance from operating properly.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain the key components of the building as a system and how they impact on heat, moisture, and air flow.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.03.01	Define key components	• Key components ○ building envelope - construction materials ○ occupants ○ mechanical / electrical systems ○ external environment - attitude, atmospheric conditions
18.03.02	Describe the impact of each key component of the building system on heat, moisture, and air flow.	• Building envelope - impacts: ○ thermal envelope ▪ skin such as wood, brick, concrete ▪ windows ▪ insulation ▪ vapour barrier ▪ moisture barrier, etc. all affect: ♦ heat loss/heat gain ♦ infiltration/exfiltration ♦ moisture content and relative humidity • Occupants - impacts: ○ a includes the people, pets, plants, furniture, floor coverings. and other non-mechanical/non-electrical components inside the building ○ occupants add heat, moisture, and pollutants to the indoor environment. ○ operation and maintenance of the mechanical and electrical equipment are controlled by the occupants ○ occupants add moisture by cooking, dishwashing, clothes washing/drying, bathing, breathing, and perspiring ○ occupants add contaminates by smoking, hobby activities, breathing (CO_2)

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain the key components of the building as a system and how they impact on heat, moisture, and air flow.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.03.02 Continued	Describe the impact of each key component of the building system on heat, moisture, and air flow. Continued	• Mechanical and electrical systems - impacts: ○ all equipment and appliances inside the building which add to the generation of heat or moisture or cause air movement such as: ▪ water heaters ▪ dryers ▪ motors ▪ fireplaces ▪ woodstoves ▪ air cleaners ▪ central vacuum cleaners ▪ refrigerators ▪ lighting ▪ natural draft appliances, etc. ▪ air changers (heat recovery ventilators) ▪ indoor air quality - ventilation required • External environment - impacts: ○ outdoor air temperature and humidity ○ wind ○ rain/snow and surface water ○ exposure to the radiant heat from the sun and heat absorbers like the earth ○ location and landscape features ○ radon gas ○ outdoor odours

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain the key components of the building as a system and how they impact on heat, moisture, and air flow.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.03.03	Describe the ways of minimizing the negative impact of key components on the building system	• Building envelope: ○ skin ▪ protects underlying materials ▪ helps maintain building integrity ▪ helps reduce heat loss/heat gain ○ vapour barrier ▪ reduces moisture transfer ▪ reduces air infiltration/exfiltration ▪ helps control relative humidity ▪ dry bulb/wet bulb temperatures ▪ reduced humidification/dehumidification costs ○ moisture barrier ▪ reduces water transfer ♦ less mould, mildew ♦ maintains the integrity of the structure ♦ helps control relative humidity ○ insulation (R value) in attic, walls, etc. ▪ reduces heat loss/heat gain ○ attic ventilation ▪ preserves building integrity ▪ reduces heat gain in summer by lowering temperature change (rooms to attic) ▪ increases comfort level

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain the key components of the building as a system and how they impact on heat, moisture, and air flow.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.03.03 Continued	Describe the ways of minimizing the negative impact of key components on the building system. Continued	• Occupants ○ select appliances appropriate to type and number of occupants and their activities ○ instruct occupants on the proper use and maintenance of oil-fired equipment • Mechanical systems ○ Install properly sized and located combustion and ventilation air openings to compensate for air consumed in combustion and venting processes ○ ventilation/Heat recovery ventilators - improve indoor air quality and comfort • External environment ○ location of building on lot ○ orientation of building on lot ○ landscaping ○ exposure

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Describe building science principles as they relate to heat, moisture, and air flows in a building

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

18.04.01	Explain the importance of air leakage control for energy efficiency, comfort, and the preservation of the building	• Control of air leakage results in:
		  ○ Reduced heat loss/heat gain
		  ▪ identify types of heat transfer: conduction, convection and radiation
		  ○ decreased operating costs
		  ○ increased comfort (drafts)
		  ○ control of relative humidity
		  ▪ reduced health problems such as sore throats, colds
		  ▪ reduced heating costs (dry indoor air requires higher indoor temperature)
		  ▪ reduced cooling costs (moist indoor air requires more air conditioner operation)
		  ▪ reduced damage to building (shrinking, cracking, growth of mould and mildew.

18.04.02	Identify sources of heat loss and heat gain.	• Sources include:
		  ○ basements - walls and floors and windows
		  ○ main building walls and windows
		  ○ attics
		  ○ general air leakage
		  ○ poor construction
		  ○ improper vapour barrier

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Describe building science principles as they relate to heat, moisture, and air flows in a building.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.04.03	Describe factors that create positive and negative building pressures	• Factors affecting building pressures ○ stack effect ▪ air exfiltrates from upper portions of the building and infiltrates into the lower portions ○ flue and ventilation effect ▪ air consumed by the combustion and venting of fuel-fired appliances creates a negative pressure and cause infiltration ▪ various exhaust systems create a negative pressure and cause infiltration ▪ unbalance supply air systems create a positive pressure and cause exfiltration ○ wind effect ▪ positive pressure on the windward side and a negative pressure on the leeward side cause infiltration and exfiltration ○ distribution effect ▪ unbalanced supply and return openings create positive or negative pressures in each zone ▪ duct leakage in both supply and return ductwork creates positive or negative pressures

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Describe building science principles as they relate to heat, moisture, and air flows in a building.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.04.04	Identify sources of moisture.	• Occupancy sources such as: ○ cooking - steam and products from gas range ○ breathing/perspiring ○ bathing/showering ○ plants • Building related sources such as: ○ new construction (new wood contains a tremendous amount of water - can take months to dry out ○ open sump pits ○ both raise the moisture content in the house and can raise relative humidity
18.04.05	Describe methods of controlling excess moisture which result in surface condensation.	• Control relative humidity in various ways such as: ○ dehumidifiers/air conditions - cooling season ○ heat air and lower relative humidity - heating season ○ increase amount of ventilation air and lower relative humidity ○ add moisture to increase relative humidity - heating season ○ install heat recover ventilators ○ exhaust warm, moist air and bring in cooler, drier air
18.04.06	Describe the purpose and describe methods of installing air, vapour, and moisture barriers to protect the integrity of the building.	• Air and vapour barriers ○ reduce movement of air through building envelope ○ reduce moisture flow in vapour form ○ vapour barrier - on warm side of insulation, air barrier on either side • Moisture barriers ○ keep foundation walls, insulation, and wood framing dry ○ exterior sealed ○ interior barrier at least 6 mil polyethylene

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain ways of incorporating energy conservation measures into building construction and renovation.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

18.05.01	Identify three main building construction types	• Balloon frame
		  ○ continuous wall cavity from ground floor to attic
		  ○ high flue effect
		  ○ can easily add blown insulation
		• Double brick or insulated concrete forms (ICF)
		  ○ double layer of brick employed on older buildings may have rigid insulating board or vermiculite insulation between brick and inside wall finish
		  ○ ICF on some newer buildings has rigid insulation on outside and inside of concrete
		• Platform framing
		  ○ most common type
		  ○ each floor built as a separate platform
		  ○ air leakage possible at headers

18.05.02	Describe historical levels of insulation in Ontario housing	• Overall insulation requirements have continued to increase
		  ○ pre-1920, stone or solid brick, little insulation, leaky construction
		  ○ 1920-1945, solid brick, little insulation, leaky construction
		  ▪ insulation - paper, sawdust
		  ○ 1945-1970, brick veneer, little attic insulation, leaky construction
		  ▪ insulation - paper, sawdust, woodchips, mineral wool
		  ○ 1970-1985, insulation increasing gradually, tighter construction, increased moisture problems
		  ▪ insulation - mineral wool, asbestos, fibreglass, foam
		  ○ 1985-1990, awareness of R2000 concepts and problems with inadequate ventilation
		  ▪ insulation - fibreglass
		  ○ 1990-present, increased insulation, tight construction, mechanical ventilation
		  ▪ insulation - most often fibreglass batts or foam cellular insulation

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain ways of incorporating energy conservation measures into building construction and renovation.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.05.03	Prioritize energy conservation measure such as air sealing, insulation and upgrading of mechanical systems for cost effectiveness.	• Less heat loss - lower fuel consumption can be achieved by: ○ air sealing reduces consumption by 30% to 40% on average ○ increase insulation ○ upgrade to higher efficiency furnaces ○ install heat recovery ventilators to minimize infiltration ○ complete heat loss list by priority of payback
18.05.04	Identify locations for installing air sealing products.	• Major locations include: ○ windows, doors, baseplates and headers, foundations, etcetera ○ electrical outlets, and ceiling lights
18.05.06	Identify and describe basic air sealing techniques.	• Sealing techniques include: ○ caulking ○ expandable foam insulation ○ door sweeps etcetera
18.05.07	Describe methods of insulating attics, basements, and walls, and upgrading windows and doors.	• Methods as per manufacturer's instructions for various locations include: ○ vapour barrier and blown or friction fit fibreglass insulation ○ basements - vapour and moisture barrier and Styrofoam or friction fit fibreglass ○ walls - vapour barrier and foam, blown, or friction fit insulation ○ doors and windows - caulking and double or triple glazing ○ determine the Energy Rating (ER) for doors and windows

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain how mechanical systems affect the heat, moisture, and air flows of a building.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.06.01	Describe the types of residential combustion and exhaust appliances.	• Combustion appliances contribute to negative pressure in a building: ○ standard efficiency and mid efficiency forced air furnace ○ wood-burning fireplace ○ domestic hot water heater ○ gas fireplace • Exhaust appliances contribute to negative pressure in a building: ○ clothes dryers ○ bathroom fans ○ range hood exhaust fans and countertop ranges ○ central vacuum cleaner ○ shop/hobby exhaust fans
18.06.02.	Identify methods of resolving competing air problems.	• Air problems can be resolved by: ○ upgrading to direct vent or sealed combustion appliances ○ installation of a heat recovery ventilator ○ providing combustion and mechanical ventilation air ○ sealing ductwork to reduce leakage ○ installing better air cleaner system

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain the requirement for ventilation and filtration in a building and the issues and control of indoor air quality.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.07.01	Identify potential building pollution sources.	• Pollution sources such as: ○ biologicals ○ chemicals – i.e. Furnishings “gassing” ○ moisture ○ dust
18.07.02	Describe methods of controlling pollutants.	Methods such as: ○ source control ○ source containment ○ source removal ○ point of usage removal ○ substitution to prevent pollution ○ furnishings and decorative components can be selected to reduce chemical pollutants in the home ○ kitchen cabinets can be sealed ○ “bake-out” procedure can be employed during manufacturing process to reduce chemical emissions in the home
18.07.03	Prioritize methods of controlling pollutants.	• HVAC balancing • Local exhaust • Upgrading the air cleaner

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Explain the requirement for ventilation and filtration in a building and the issues and control of indoor air quality.

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.07.04	Define ventilation and filtration.	• Ventilation ○ the introduction of outside air to replace exhausted air or to dilute indoor air • Filtration ○ the removal of dirt and dust particles from an air stream
18.07.05	Identify the ventilation requirements for a building.	• Ventilation requirements ○ Rough calculation based on building dimensions and providing an air exchange rate of 0.3 air changes per hour ○ Detailed room by room requirements as per Ontario and National Building Codes and HRAI standard for residential applications.
18.07.06	Describe the features and benefits of mechanical ventilation systems.	• Systems to include: ○ exhaust only system ○ supply only system ○ balanced system

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Apply the building-as-a-system approach to assessing and testing building effects on oil-fired appliances

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.08.01	Describe procedures for visually assessing an installation for air supply and venting problems	• Visually assess the exterior of the building ○ Apply knowledge of building-as-a-system to assess environmental conditions, landscape features, building's orientation, exposure to the sun and prevailing winds ○ Assess condition and age of building envelope – especially visible vents/chimneys • Visually assess the interior of the building ○ Apply knowledge of building-as-a-system to assess prevalence of air leakage, excessive moisture, noxious odours, mould growth, etc. ○ Assess the condition of the ductwork, ventilation system, number and type of appliances ○ Check appliances and vents for signs of spillage, blockage, or damage and for proper air supply openings • Listen to and ask questions to the occupants regarding any problems, complaints, and take note of the number of occupants, pets, plants, water usage, etc. ○ Apply knowledge of building-as-a-system to assess the effects that the occupants may have on the use and operation of oil-fired appliances
18.08.02	Describe procedures for a basic venting test for natural draft appliances	• The purpose of the test is to check for spillage of flue gases due to negative pressures caused by the operation of exhaust devices and the lack of make-up air. ○ Close all exterior openings and turn on all exhaust fans. ○ Turn on fuel-fired appliances other than the oil-fired natural draft appliance(s) ○ Starting with the smallest oil appliance, activate each natural draft appliance and check for spillage from the draft regulator or ignition/combustion problems if there is no draft regulator. ○ Overfire and breech draft readings should also be taken and compared to the manufacturer's recommended readings

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s):** None **Estimated theory hours:** 16

Task: Apply the building-as-a-system approach to assessing and testing building effects on oil-fired appliances

Module 18	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
18.08.03	Describe procedures for conducting a passive depressurization test.	• A passive depressurization test measures the actual depressurization level of the house with all exhaust devices activated ○ Same preparation steps as conducted for the basic venting test ○ Use an incline manometer or electronic monitor to measure the differential pressure between the furnace room and a point 8m – 23m (25' – 75') from the building ○ Compare pressure readings to recommended building depressurization limits for various appliance and vent types.
18.08.04	Interpret readings from a mechanical depressurization test	• A mechanical depressurization test measures the combined size of air leakage openings in a building by using an exhaust fan to depressurize a building to a standardized level and measuring the amount of time it takes for the building pressure to re-balance. A calculation is conducted to determine the size of opening that would allow for this re-balancing time. ○ This test is conducted by ventilation technicians rather than OBTs ○ The report generated will identify the airtightness of a building ○ If the test indicates an equivalent leakage area of 78 in^2 (0.05 m^2) or less at a differential pressure of 0.00145 psig (10 Pa) as determined by a recognized Canadian fan depressurization test procedure, the building in classified as "tight". ○ Spillage-susceptible appliances may not operate properly in tight buildings. ○ Air supply openings required by the B139 Code must be installed in tight buildings
18.08.05	Identify remedial actions for installations that fail the basic venting test, passive depressurization test, or mechanical depressurization test.	• Remedial action includes: ○ Treat the failure as an unacceptable condition and take the appropriate action required in the Fuel Oil Regulation for immediate or non-immediate hazards ○ Recommend that direct-vent appliances be installed or used for a replacement

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Air Supply and Building as a System **Prerequisite(s)**: None **Estimated practical hours**: 4

Performance objective: Apply a building-as-a-system approach to assessing a building and air opening requirements

Module 18	Practical		
	Scenario	**Procedure**	**Criteria**
18.09.01	The student will apply the theory knowledge gained in this Module to the assessment of a building and generate a report detailing his/her findings and recommendations regarding the installation of oil-fired appliances. Ideally, the selected building would be a residential or small commercial building rather than the shop. However, the shop can be employed if there are no alternates.	The instructor will outline the conditions and expectations for this exercise: • Student can select any building • Student is responsible for gaining permission to inspect the building • No tests or alterations are to be conducted at the installation – just a visual assessment • Student will provide a written report detailing: ○ The type and size of building ○ Important aspects of the environment outside the building that could affect the flow of air, heat, moisture or affect the choice or operation of oil-fired equipment ○ Important aspects of the building skin that could affect the flow of air, heat, moisture or affect the choice or operation of oil equipment ○ Important issues related to the occupants that could affect the flow of air, heat, moisture or affect the choice or operation of oil equipment ○ Important aspects of the mechanical/ electrical system that could affect the flow of air, heat, moisture or affect the choice or operation of oil-fired equipment ○ Important aspects of the fuel-fired appliance(s) (type, input, vent type etc.). If selected building does not have a fuel-fired appliance, assume that a natural draft vented oil-fired forced air furnace installation is planned and estimate the input based on providing 50 Btuh/ ft^2 of living area ○ Identify and state whether the existing air supply openings are code compliant and, if they are not or for new installations, identify the size and location of required air supply openings. ○ Explain why a natural draft oil-fired appliance should or shouldn't be installed in the selected building	Student's report will be evaluated for: • Completeness in providing the details identified in the procedure column • Accuracy of identifying the air supply opening requirements. • Thoughtfulness of the explanation regarding whether a natural draft appliance should be installed at the site. • Neatness of report

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24

Task: Describe the different types of venting systems

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

19.01.01.	Describe the different types of venting systems in terms of their defining operating principles, types of material employed, and general installation requirements.	• Natural draft venting system
		  ○ Operating principles
		  ▪ temperature difference between inside the vent and outside building
		  ▪ hot flue gases rising in the vent causes a suction effect and negative pressure in the appliance and vent
		  ○ Vent material used
		  ▪ clay-tile or transit lined chimneys
		  ▪ usually galvanized single wall vent connectors
		  ▪ usually requires draft control device which consumes more indoor air
		  ▪ vent connector must transition to an approved vent material including clay-tile or transit lined chimney, Types A or L factory-built metal vents.
		  ▪ vent materials are not designed for positive pressure
		  ○ General installation requirements
		  ▪ Material selection, sizing, configuration, and installation methods are primarily based on B139 code requirements with minimal input from the appliance manufacturer
		• Mechanical draft venting systems – special venting systems
		  ○ Operating principles
		  ▪ a mechanical device moves air and flue gases through the appliance and vent
		  ▪ induced mechanical draft systems create a negative pressure at the appliance and upstream of the induced draft fan and a positive pressure downstream of the induced draft fan
		  ▪ forced draft systems employ a mechanical device upstream of the combustion chamber to create positive pressure in the appliance and vent
		  ○ Vent material used
		  ▪ Use of clay-tile or transit lined chimneys not permitted for positive pressure
		  ▪ Induced draft systems may employ single-wall galvanized vent material and a draft regulator upstream of the inducer or a flexible metal vent. Downstream of the inducer requires sealed vent material since it is under positive pressure.
		  ▪ Forced draft systems require a sealed vent material since it is under positive pressure. Material is usually metal but may be plastic in some cases.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24
Task: Describe the different types of venting systems

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

19.01.01
 	
continued
	Describe the different types of venting systems in terms of their defining operating principles, types of material employed, and general installation requirements.
	
	continued
		• Mechanical draft venting systems – special venting systems… Continued
		  ○ General installation requirements
		  ▪ material selection, sizing, configuration, and installation methods are primarily based on appliance manufacturer's instructions with minimal input from the B139 Code except for side-wall vent termination requirements
		• Fan-assisted venting systems
		  ○ Operating principles
		  ▪ combination of natural draft (primarily) with induced mechanical draft assistance
		  ○ Vent material used
		  ▪ same as identified above for natural draft systems plus a fan located in-line in the vent connector or at the termination of the vertical vent
		  ○ General installation requirements
		  ▪ Material selection, sizing, configuration, and installation methods are primarily based on B139 code requirements with minimal input from the manufacturer of the appliance or fan-assist device
		• Direct venting systems
		  ○ Operating principles
		  ▪ appliance is constructed and installed so that all the air for combustion and draft control is taken directly from the outside atmosphere and all the combustion products are discharged directly to the outside atmosphere
		  ▪ mechanical direct systems may be induced or forced but must have sealed air intake pipe to the burner and sealed vents from the appliance to the outdoors
		  ▪ some modern vaporizing pot burner space heaters employ balanced draft whereby air flows naturally to the combustion chamber and out the sealed vent to the outdoors
		  ○ Vent material used
		  ▪ use of clay-tile or transit lined chimneys not permitted for direct venting
		  ▪ air intake and vent materials must be gas-tight
		  ▪ usually metal construction but may be plastic in some cases.
		  ○ General installation requirements
		  ▪ Material selection, sizing, configuration, and installation methods for both the air intake and vent pipes are primarily based on appliance manufacturer's instructions with minimal input from the B139 Code except for side-wall vent termination requirements.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24

Task: Identify different types of vent materials and their allowed use.

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
19.02.01	Identify different types of vent materials and their allowed use.	• masonry chimneys o must be clay-tile or transit-lined o chimney construction /condition must meet Building Code requirements o chimney vent size and base temperature shall comply with B139 Code requirements o usually lined with a stainless-steel flexible or rigid chimney liner o usually requires the use of a draft control device • factory-built vents o Type A: double-wall stainless steel with insulation between walls ▪ only Class II and III are approved for use with oil-fired appliances ▪ only Class III is approved for use with wood/oil-fired appliances ▪ vent size and base temperature shall comply with B139 Code requirements ▪ may be installed inside or outside the building envelope ▪ clearance to combustibles varies from 1” to 3” o Type B: double-walled with aluminium inner wall and galvanized outer wall. ▪ not approved for use with oil-fired appliances o Type L: double-walled with stainless-steel inner wall and galvanized outer wall. ▪ approved for use with some oil-fired appliances as shown on the rating plate ▪ approved only for installation inside the building except above the roof line ▪ usually requires the use of a draft control device ▪ clearance to combustibles is usually 3” o Type C: single wall galvanized or black steel pipe only approved for use as a vent connector on some natural draft or induced draft vented appliances ▪ vent connector size and gauge thickness shall comply with the B139 Code ▪ usually galvanized but black stove pipe required for wood/oil appliances ▪ joints connected with three metal screws ▪ clearance to combustibles is usually 9” but may be 18” in some cases o Type BH: special venting system approved for use with the appliance. ▪ usually metal but may be plastic ▪ vent material, size, configuration, joint connections, and clearance to combustibles specified by appliance and vent manufacturer

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24

Task: Identify natural draft venting system components and terms

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
19.03.01	Identify natural draft venting system components and terms	Venting system components: • vent connector • flue collar • draft control devices • base tee fittings for factory-built vents and chimney liners • chimney sleeve and cleanout for masonry clay-tile lined chimneys • vent termination kit for side-wall vented appliance (special venting systems) Venting terminology • lateral • horizontal • rise • height • vent connector • common vent connector • common chimney/vent • exterior chimney/vent • interior chimney/vent • base chimney temperature • thermal resistance values as employed in Tables B.1 and B.2 of the B139 Code • spillage susceptible

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24
Task: Size natural draft venting systems

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

19.03.02	Size natural draft venting systems	• For appliances with an individual or combined input up to 5 USGPH, use Tables B.1 and B.2 in the B139 Code
		  ○ Selection of which Table to use depends on reading, interpreting, and applying the R value or RSI value designations given in the notes to the table.
		  ○ Size selection within the allowed range depends on reading, interpreting, and applying the design principle given in the notes to the table regarding the % of excess air.
		  ○ The vent connector size for an individually vented oil appliance shall be the same size as determined for the vertical vent.
		  ○ The vent connector size for an oil appliance common vented with other oil appliances shall be determined using the Tables for each appliance as if individually vented
		  ○ Proof of compliance with the Tables requires performing a base chimney temperature test as specified in the B139 code and ensuring that the minimum base chimney temperature meets or exceeds that listed in the tables. Adjustments to excess air % may be required to meet minimum base chimney temperature
		• For appliances with an individual or combined input exceeding 5 USGPH, use the appliance and vent manufacturer's instructions or employ good engineering practices.
		  ○ Proof of compliance with B139 vent sizing requirements may be achieved by taking draft and flue gas analysis readings that prove that flue gases are safely being vented
		• For the unusual cases where an oil-fired appliance is common vented with a gas appliance as allowed in the B139 Code, the vent size shall be determined by using both the tables in the B149.1 Gas Code and the B139 Oil Code. If a conflict exists, the stricter requirement shall prevail.
		  ○ Proof of compliance with B139 vent sizing requirements may be achieved by taking draft and flue gas analysis readings that prove that flue gases from all commonly vented appliances are safely being vented to the outdoors
		• For the unusual cases where an oil-fired appliance is common vented with a solid-fuel appliance as allowed in the B139 Code, the vent size shall be determined by using both the tables in the B139 Oil Code and the B365 code requirements for venting. If a conflict exists, the stricter requirement shall prevail.
		  ○ Proof of compliance with B139 vent sizing requirements may be achieved by taking draft and flue gas analysis readings that prove that flue gases from all commonly vented appliances are safely being vented to the outdoors.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24

Task: Identify B139 code requirements related to material selection for natural draft venting systems.

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

19.03.03	Identify, interpret, and apply B139 code requirements related to material selection for chimneys/vents, vent connectors and draft regulators on natural draft venting systems.	• Vent connector material
		  ○ must be non-combustible – usually galvanized sheet metal
		  ○ galvanized sheet metal only permitted if fuel gas temperature is less than 400 °C (750 °F)
		  ○ minimum thickness of material depends on diameter and expected flue gas temperature
		  ○ must be insulated with 25 mm (1 in) or more of insulation or be double wall constructed for lengths exceeding 6m (20 ft)
		  ○ if no dilution air is used, vent connector sections shall be of double-wall construction or of single-wall construction with sealed connections and insulated
		  ○ manually operated dampers are prohibited in vent connectors of residential oil-burning appliances
		  ○ manually operated dampers in vent connectors of non-residential oil-burning appliances shall be interlocked to prevent burner operation until the damper is proven fully open
		  ○ automatically operated dampers in vent connectors shall be interlocked to prevent burner operation until the damper is proven to be at least 80% open
		• Draft regulator material
		  ○ must be certified to the ULC/ORD-C378 *Guide for the Investigation of Draft Equipment*
		• Masonry chimney material
		  ○ must be clay-tile or transit lined and meet Building Code requirements
		• Chimney liner material
		  ○ must be stainless-steel.
		  ○ only permitted for use in clay-tile or transit lined chimneys that meet Building Code
		• Factory-built metal vent material
		  ○ Vents located outside the building must be certified to ULC-S629 *Standard for 650 °C Factory-Built Chimneys* or ULC-S604 *Standard for Factory-Built Type A Chimneys*
		  ○ Vents located inside the building must be certified to ULC-S609 *Standard for Low Temperature Vents Type L* or ULC-S629 or ULC-S604
		  ○ Uncertified metal vents are prohibited at residential and small commercial buildings but may be permitted with large installations and construction heaters as specified in the 139 Code

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24
Task: Identify B139 code installation requirements for natural draft venting systems.

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
19.03.03 Continued	Identify, interpret, and apply B139 code installation requirements related to chimneys/vents, vent connectors and draft regulators on natural draft venting systems. Continued	• Vent connector installation requirements ○ if the vent connector size does not match the appliance flue outlet size, a gradual transition shall be used and tested for proper draft operation ○ must be as short as possible with a minimum of restrictions ○ pitch or rise from the appliance must be at least 2% of horizontal length ○ must extend through chimney wall and be flush with inner wall of chimney ○ clearance to combustibles must not be less than specified in the B139 code ○ joints shall be mechanically secured with at least three equally spaced screws ○ shall not pass through a floor or ceiling ○ shall not pass through a combustible wall if the fuel gas temperature is > 400 °C (750 °F) • Draft regulator installation requirements ○ must be installed in the same room as the appliance ○ must be located so it does not interfere with the combustion air to the burner ○ hinge must be level horizontally and gate must be perpendicular to the ground ○ must be located and installed as per manufacturer's instructions • Masonry chimney installation requirements ○ installer must examine chimney to determine whether it meets code requirements ○ chimney height must extend at least 1 m (3 ft) above the roof and not less than 0.6 m (2 ft) above the highest roof surface or structure within 3 m (10 ft) • Chimney liner installation requirements ○ must provide a continuous lining from the base inside the space where the appliance is located to the top of the masonry chimney flue ○ must include a capped access opening at the bottom or base of the flue ○ installed in accordance with CAN/ULC-S635 *Standard for Lining Systems for Existing Masonry or Factory-Built Chimneys and Vents* and the manufacturer's instructions. ○ vented appliances are safely being vented to the outdoors. • Factory-built metal vent installation requirements ○ must not be altered by cutting ○ must be installed as per manufacturer's instructions ○ must be supported separately from the appliance as per manufacturer's instructions ○ height must extend at least 1 m (3 ft) above the roof and not less than 0.6 m (2 ft) above the highest roof surface or structure within 3 m (10 ft)

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24

Task: Identify B139 code requirements related to sizing, material selection, and installation for special venting systems.

Module 19	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

19.04.01	Identify, interpret, and apply B139 code requirements related to sizing, material selection, and installation for special venting systems.	• Sizing and material selection for special vent systems
		  ○ requirements are only given in the appliance manufacturer's installation instructions
		• Installation requirements for special vent systems
		  ○ requirements for configuration, joining method, support, and clearance to combustibles are given in the installation instructions provided by the appliance manufacturer and the vent manufacturer. If there are conflicting instructions, the appliance manufacturer's instructions prevail.
		  ○ through-the-wall vent installation and termination requirements are given in the B139 code and in the appliance or sidewall kit manufacturer's instructions. If there are conflicting instructions, the stricter requirement prevails.

19.05.01	Identify, interpret, and apply B139.1.1 code requirements related to venting stationary engines.	• Examine Sections 8, 9 and 10 in the B139.1.1 Code
		  ○ Identify the materials that can be used for venting stationary engines
		  ○ Requirement for a flexible connector between the exhaust pipe and engine manifold
		  ○ Requirement to size exhaust pipe to ensure that the back pressure on the engine does not exceed the level recommended by the engine manufacturer
		  ○ Identify exhaust termination methods (flapper or an ASHRAE stack-head)
		  ○ Requirements related to condensate drains
		  ○ Requirements for insulating exhaust pipes with exemption for skin-tight enclosure
		  ○ Requirements for pressure testing uncertified metal exhaust stacks inside a building
		  ○ Conditional requirement to install protective guard on vent pipes outside buildings
		  ○ Compare the through-the-wall vent installation and termination requirements given in the B139.1.1 code to the similar requirements in the B139.1.0 and B139.2 Codes
		  ○ Discuss the practical considerations

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s):** Module 18 **Estimated theory hours:** 24

Task: Recognize signs of venting problems.

19.06.01	Recognise signs of venting problems	Signs include: • heat, moisture, or soot stains at vent joints or combustion chamber inspection door • incomplete combustion • noisy or faulty ignition • flue gas or oil odours in building • high flue gas temperatures • signs of elevated levels of CO in building (e.g. CO alarm, health problems, etc.)
19.06.02	Identify the source(s) of vent corrosion	• Corrosive vapours ○ household products containing chlorine or fluorine ○ paint thinners, stripers, ○ dry cleaning chemicals • Condensing flue gases

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Identify vent material types and install a draft regulator

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.07.01	The student will identify different types of venting materials as displayed or shown by the instructor.	The instructor will display various types of venting materials and ask the student to identify each type, where/when it is used (i.e. with what type of draft system, indoors and/or outdoors, and where in the system), along with the required clearance to combustibles. Displayed vent materials should include: • Type A vent (Classes I, II, and III) • Type B-vent • Type L-vent vent • L-vent to C-vent adapter • Section of clay-tile and metal liner (photographs may be used) • Type BH-vent (metal and plastic) • C-vent • Draft regulator • Sidewall power vent kit	The student must correctly identify • the type of vent material • whether it can be used on oil-fired appliances (Type A Class I and B-vent not allowed) • the type of draft system the vent material can employed with • whether it can be installed outdoors • where in the system it is employed • the minimum clearance to combustible allowed for each vent type
19.08.01	The student will install a draft regulator on a short section of C-vent and then attach the C-vent to a natural draft appliance. Materials • draft regulator • sheet metal • fasteners and tape • hand and power tools • functional natural draft appliance	The student will be shown how to locate and install a draft regulator and will then repeat the process. Once the draft regulator has been installed on a short section of C-vent, the student will attach the section to a natural draft appliance in the shop.	All work must be performed safely and in a timely fashion while under supervision of the instructor. The draft regulator must be installed • to manufacturer's specifications • hinge level horizontally • gate perpendicular to the floor • properly secured to the rest of the vent connector and appliance • in a minimum of time • with a minimum of wastage.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Size a chimney natural draft venting system and create a material list of components for the installation

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.09.01	The student will size a natural draft venting system using a masonry chimney based on information provided by the instructor and create a material list for the installation.	The instructor will provide the following information: • Make, model, input rating of an appliance along with its manufacturer's instructions • A diagram of the installation site with the size, height, and construction details for the masonry chimney along with the distance from the appliance to the chimney • Access to component manufacturer's literature for draft regulators and chimney lining systems. Student will: ○ determine the size of the vent connector ○ determine whether the masonry chimney can be employed for this installation ○ if the chimney is found to be inappropriate, determine the size of the chimney liner ○ identify the minimum base temperature required for this installation ○ select the type, gauge thickness, and approximate lengths of vent connector sections and any associated fittings ○ select the make, model, and size of draft regulator ○ identify where the draft regulator will be installed in relation to the flue outlet ○ select the make, size, and length of chimney liner along with required liner components (sleeve, cap), if required	The student must correctly identify • the size of vent connector • whether the masonry chimney can be employed for this installation • the size of the chimney liner, if required • the minimum base temperature required for this installation • the type, gauge thickness, and approximate lengths of vent connector sections and any associated fittings • the make, model, size, and location of the draft regulator • the make, size, and length of chimney liner along with required liner components (sleeve, cap), if required

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Size a metal vent natural draft venting system and create a material list of components for the installation

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.10.01	The student will size a natural draft venting system using metal vent material based on information provided by the instructor and create a material list for the installation.	The instructor will provide the following information: • Make, model, input rating of two appliances along with their manufacturer's instructions • A diagram of the installation site with the location of the appliances in relation to each other, outside walls and/or potential chase ways for interior vertical vent installations • Access to component manufacturer's literature for draft regulators and a variety of factory-built vents. Student will: ○ determine the size of the vent connectors for each appliance ○ determine the size of the common vent employed for this installation ○ identify the minimum base temperature required for this installation ○ select the type, gauge thickness, and approximate lengths of vent connector sections and any associated fittings ○ select the make, model, and size of draft regulator ○ identify where the draft regulator will be installed in relation to the flue outlet ○ select the type, make, model, size, and length of factory-built vent along with required components (adapters, supports, cap, fire stops, etc.) ○ select the appropriate location for the common vent	The student must correctly identify • the size of each vent connector • the size of the common vent • the minimum base temperature required for this installation • the type, gauge thickness, and approximate lengths of vent connector sections and any associated fittings • the make, model, size, and location of the draft regulators • the type, make, size, and length of factory-built vent along with required components (adapters, supports, cap, fire stops, etc.) • the appropriate location for the common vent

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Size a sidewall power venting system and create a material list of components for the installation

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.11.01	The student will size a sidewall power vented system based on information provided by the instructor and create a material list for the installation.	The instructor will provide the following information: • Make, model, input rating of an appliance along with their manufacturer's instructions • A diagram of the installation site with the location of the appliances in relation to outside walls and building openings • Access to component manufacturer's literature for draft regulators and a variety of sidewall power venters. Student will: ○ determine whether a power venter can be used for this installation ○ select the make, model, and size of power venter along with required components (adapters, supports, fire stops, electrical wiring etc.) ○ determine the size of the vent connector ○ select the type, gauge thickness, and approximate lengths of vent connector sections and any associated fittings ○ select the make, model, and size of draft regulator, if required ○ identify where the draft regulator will be installed in relation to the flue outlet ○ identify the vent termination requirements including minimum height above grade, minimum distance to building openings, property lines, inside corners, etc.	The student must correctly identify • whether a power venter can be used for this installation and how this decision was determined • the appropriate make, model, and size of power venter along with required components (adapters, supports, fire stops, electrical wiring etc.) • the size of each vent connector • the type, gauge thickness, and approximate lengths of vent connector sections and any associated fittings • the make, model, size, and location of the draft regulators • the type, make, size, and length of factory-built vent along with required components (adapters, supports, cap, fire stops, etc.) • the vent termination requirements including minimum height above grade, minimum distance to building openings, property lines, inside corners, etc. • the electrical wiring requirements for powering the power venter and interlocking its operation with the appliance

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Size a special venting system for a condensing direct-vent furnace and create a material list of components

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.12.01	The student will size a special venting system based on information provided by the instructor and create a material list for the installation.	The instructor will provide the following information: • Make, model, input rating of a condensing direct-vent furnace approved for plastic vent material along with the manufacturer's instructions • A diagram of the installation site with the location of the appliances in relation to outside walls and building openings • Access to component manufacturer's literature for draft regulators and a variety of plastic vents. Student will: ○ determine the type and size of plastic pipes along with the type and number of fittings to be used for the air intake and vent pipes ○ select the make, model, and approximate lengths of plastic pipes along with required components (adapters, supports, fire stops, fittings, glue, etc.) ○ identify the vent termination requirements including termination fitting type(s), minimum height above grade, minimum distance to building openings, property lines, inside corners, etc.	The student must correctly identify • the type and size of plastic pipes along with the type and number of fittings to be used for the air intake and vent pipes • the appropriate make, model, and approximate lengths of plastic pipes along with required components (adapters, supports, fire stops, fittings, glue, etc.) • the vent termination requirements including termination fitting type(s), minimum height above grade, minimum distance to building openings, property lines, inside corners, etc.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Join sections of vent materials

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.13.01	The instructor will demonstrate or show photos/videos of joining methods and support requirements for a variety of vent systems. The student will join metal vent materials together as considered appropriate by the instructor. NOTE: joining C-vent sections together is performed by the student in 19.06.01 and joining plastic vent sections together is performed in 19.11.02	The instructor will demonstrate or show photos/videos of joining methods for: • two sections of A-vent • two sections of L-vent • two sections of C-vent • C-vent to L-vent using an adapter • C-vent to chimney liner • C-vent or chimney liner connection into a masonry chimney with a properly cemented/sealed sleeve The instructor will demonstrate or show photos/videos of vent support materials and methods for various types of vents. Reference should be made to vent manufacturer's instructions for supporting A-vent and L-vent	The student must properly join metal vent materials together as considered appropriate by the instructor.
19.13.02	The instructor will demonstrate or show photos/videos of cutting and joining materials/methods for a variety of plastic vent systems. The student will select materials for and join plastic vent materials together as considered appropriate by the instructor.	The instructor will demonstrate or show: • A variety of approved plastic vent pipes and fittings (PVC, CPVC, PP) • Proper glue or other joining system for each type of plastic vent system • How to cut and glue or otherwise join each type of plastic piping and fittings The instructor will provide short sections and fittings (couplings, elbows, etc.) glues, and cutting tools for a variety of plastic types. The student will select a section of pipe, fitting and glue that can be used together. The student will cut the pipe and glue it to the fitting.	All work must be performed safely and in a timely fashion while under supervision of the instructor. The student must • select the appropriate pipe, fitting, and glue • properly cut the pipe and prepare the cut end for joining to the fitting • apply the glue properly to the pipe and fitting and join them together After the appropriate drying time, the join shall be cut in half diagonally and the joint assessed for proper insertion depth and glue coverage.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Venting Systems **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Identify venting problems and solutions

Module 19	Practical		
	Scenario	**Procedure**	**Criteria**
19.14.01	In this scenario, the student will identify venting problems as displayed or shown by the instructor. Displayed or shown venting problems should include: • Improper chimney construction • Corroded vents • Heat damaged vents • Separated vent sections • Damaged chimney liners • Obstructed vents • Improperly installed draft regulator • Improperly sloped vent connectors • Improperly supported vents • Soot stains around burner mounting plate or inspection door or vent joints • Improper vent clearance to combustibles • Engine exhaust pipe problems	The instructor will display or show in photographs/videos venting problems at various installations and ask the student to identify the problem and provide probable causes and appropriate action to take.	Student must correctly identify the problem and provide reasonable and thoughtful probable causes and appropriate action to take.

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Identify electrical hazards, safe working techniques and procedures.

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

20.01.01	Recognize the need for safe working techniques and tool limitations and use requirements as well as the importance of grounding equipment.	• Six factors effecting severity of electrical shock
		  ○ Amount of current
		  ○ Path of travel through the body
		  ○ Condition of the skin
		  ○ Type of voltage – AC or DC
		  ○ Amount of voltage
		  ○ Time duration of shock
		• Identify common electrical safety hazards at OBT worksites and how to avoid them
		• Requirements for and types of personal protective clothing and equipment
		• How to respond to electrical fires
		• How to respond to electrical emergencies

20.01.02	Describe the requirements for lock-out and tagging procedures for electrical equipment.	• proper lock-out and tagging procedures for electrical equipment • reason for proper lock-out and tagging procedures • construction and industry lock-out and tagging procedures

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Recognize common features of power supply

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.02.01	Explain electrical terms and their relationship.	• Electrical terms: Electromotive force, current, resistance • Electrical measurement scales: voltage, amperage, ohms • Ohm's Law to calculate amps, volts, and ohms • Watt's Law to calculate power
20.02.02	Describe the components of a simple electrical circuit.	Types and fundamentals of operation of each component • sources of potential difference (voltage) • conductors • switches • overload protectors (fuse, cartridge, plug, breaker, time-delay) • loads (resistance) Terms: ○ closed circuit ○ open circuit ○ short circuit ○ dead circuit - physically disconnected at panel ○ complete circuit ○ live circuit
20.02.03	Identify the four types of electrical circuits and their similarities, differences and uses in oil installations.	Four types of electrical circuits • simple circuit (one load) • series circuit • parallel circuit • series-parallel • Similarities, differences, and uses of each type of circuit in oil installations.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Recognize common features of power supply

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

20.03.01	Describe amperage service to a building	• electrical supply to a building is described in "amps"
		  ○ the maximum current draw of all appliances in the building
		  ○ minimum requirement in most new residential construction is 100 amperes
		  ▪ many 60 ampere services in older homes
		  ▪ homes with electric heat have a minimum of 200 ampere service
		• the main fuses or breakers are sized for the maximum capacity of the panel
		• individual branch circuits are sized according to the wire size of the circuit
		• as more circuits are added, the total current increases
		• main panel size may have to be increased to accommodate additional loads
		• electrical utility may have to increase wire size to a home, and a new, larger capacity panel may have to be installed

20.03.02	Describe the purpose of ground fault circuit interrupters (GFCI) and arc fault circuit interrupters (AFCI)	• GFCI:
		  ○ a device (either a special circuit breaker or a special receptacle} designed to interrupt within a given time, the electrical circuit to the load when a current to ground exceeds some predetermined value which is less than that required to operate the overcurrent protective device of the supply circuit
		  ○ used where receptacles are near sinks, swimming pools, hot tubs, etc.
		  ○ the conductor is still protected at the breaker rating (15 amperes for example) but the circuit will be opened if the current to ground is above the ground fault circuit interrupter rating
		• AFCI
		  ○ sense tiny sparks, or arcs, in the wiring, and serve to protect against fire
		  ○ recently required by the Ontario Electrical Code for all new installations or additions to 15-amp and 20-amp 120/125-volt circuits
		  ○ may be either special circuit breakers or special outlet receptacles

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Recognize common features of power supply

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.04.01	Explain 240 and 120 volt single phase, and 208 and 575 volt three phase supply	• Single phase ○ in residential applications, the supply to the building is 240 volts, single phase ○ smaller units and appliances with low current requirements generally utilize 120 volts ○ heavier appliances (stoves, central air conditioners and electric furnaces) generally utilize 240 volts • Three phase ○ commercial/industrial applications usually have 208/230 volt or 575 volt three phase ○ three live wires come into the panel plus a ground wire (and a neutral wire at times) ○ the sine waves of the lines are out of phase ○ higher starting torque and lower amperage than single phase ○ reversing any two wires on a 3 phase motor will reverse the direction of rotation ○ phase imbalance may cause problems with operation of supplied equipment ○ two types of 3 phase supply from the supply transformer: Delta and Wye windings ○ Delta type 3 phase supply may not have a ground reference
20.04.02	Describe how to obtain 240 volts, 120 volts, and 24 volts from an electrical panel or by using a transformer	• The service to a residential electrical panel has two hot lines (fused), one neutral wire (not fused or switched) and one ground wire ○ branch circuits are either: ▪ 240 volts - two fused lines, one from each hot line coming onto the panel, plus a ground ▪ 120 volts - one fused line from one hot line coming into the panel, and one neutral line from the neutral bar in the panel, plus a ground ○ all line voltage circuits must have a continuous ground from the main panel to each junction box and receptacle or appliance ○ control voltage for appliances is generally 24 VAC • a stepdown transformer either 240/24 volt or 120/24 volt is required

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Recognize common features of power supply

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.05.01	List types and gauges of fuses/breakers	• All fuses and breakers are sized to protect the circuit conductors, not the appliances • Fuses are "one time only" devices and must be replaced when they blow • Time delay fuses or "slow blow" fuses should be used where intermittent momentarily high loads will be encountered e.g. motor circuits and air conditioner circuits • circuit breakers can be reset if they trip • to rest a circuit breaker, switch the breaker to the "off' position then to the "on" position • overload protection devices must not be oversized
20.05.02	List types and gauges of wires	• Conductors are sized to carry different maximum currents depending on length, diameter, and material (copper, aluminum, silver, etc.) ○ 14 AWG copper or 12 AWG aluminum - 15 amps maximum fuse size ○ 12 AWG copper or 10 AWG aluminum - 20 amps maximum fuse size ○ 10 AWG copper or 8 AWG aluminum - 30 amps maximum fuse size • If a circuit is fused higher than allowed, the conductor can overheat and start a fire • Conductors may be solid or stranded ○ Solid conductors are cheaper but are less flexible. ○ where a conductor must flex, flexible wire must be used • the application determines the type of insulation required on a conductor ○ NMD (non-metallic dry) must be used in locations where it will not be exposed to moisture ○ NMW (non-metallic - wet) can be used in damp locations ○ unshealhed conductors run outdoors must be run in liquid-tight conduit ○ armoured cable (BX) must be run in steel stud or steel joist applications ○ watertight BX is TEK ○ conductors used in high temperature applications must be appropriately insulated against these high temperatures ○ the resistance of the conductor increases with temperature and therefore the voltage drop in the conductor will increase ○ the insulation may start to burn if it is not appropriate • Identify proper wire colours: green or bare for ground, white or natural grey for neutral, any other colour for hot

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe 240 volt, 110 volt and 24 volt circuits and hardware

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.05.03	Determine characteristics of solid and stranded wire	• As the diameter of a wire increases, the gauge number decreases ○ #10 AWG copper wire is relatively large in diameter and can carry up to 30 amps ○ #18 AWG copper wire is relatively small in diameter and can carry up to 2.5 amps at 24 volts • As wire diameter decreases, the voltage drop in the wire increases because the total resistance increases • As the length of the wire required increases, it may be necessary to increase the wire diameter • The type of wire material (copper, aluminum, silver, etc.) determines the maximum voltage which can be applied to that wire • The type of insulation also determines the maximum voltage which can be applied to that wire
20.05.04	Describe electrical hardware	• Connectors and terminals ○ solderless and solder type • Cables and wires • Switches, relays, and contactors • Switch and junction boxes • Insulators • Sockets and plugs • Fasteners, clamps, cleats, sleeves, straps, grommets etc.
20.05.05	Describe proper wire installation procedures	• Proper methods of cutting and stripping solid, stranded, and amoured wires • Proper methods of supporting wires (every 1.5 m/ 5’ and within 0.3m / 1’ of junction box • Proper methods of joining solid and stranded wires and terminal connections • Proper methods and equipment for joining aluminum wires together and joining aluminum to copper and approved devices using anti-oxidizing chemicals • Proper wire connections in junction boxes – 150mm / 6” of wire in box, all ground wires connected and box grounded, proper clamp connectors, use of anti-short devices on amoured cable

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Read, interpret and draw simple wiring diagrams, schematics, and symbols

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.06.01	Identify internationally accepted electrical symbols	• Electrical symbols for: ○ fuses, circuit breakers ○ switches ○ temperature controls ○ pressure controls ○ flow controls ○ level controls ○ motors ○ transformers ○ crossing and connecting wires ○ ground ○ lights ○ factory wiring versus field wiring ○ line voltage versus low voltage wiring ○ solenoid valves ○ relays, contactors ○ normally open / normally closed contacts ○ overload heaters ○ capacitors ○ humidistats ○ timers ○ limits ○ alarms
20.06.02	Recognize different types of wiring diagrams	• pictorial diagrams show where the wires or components are physically located • schematic (ladder) diagrams show how the circuit works, and what the components do • connection diagrams are similar to pictorial but not as complete
20.06.03	Determine the sequence of operation from a wiring diagram	• sequence of operation can only be determined from a schematic diagram. • contacts have the very same designation as the coils that control them
20.06.04	Understand that wiring diagrams denote "at rest" conditions	• All diagrams are shown with the main disconnect device open, and no call for heating or cooling. ○ no devices are energized, and nothing is operational (operating control is open) ○ fuse(s) and their size are shown after the main disconnect for each power supply ○ all switches and devices are in their "normal" positions ○ all switches are drawn to the left of the loads (never on the neutral side) ○ only one load per line but there can be numerous switches per line ○ power source line (L1) on the left and neutral line (N) on the right ○ order of operation should be indicated from top to bottom ○ coils and the contacts they control must have the same designation ○ the power supply - voltage, frequency, and phasing are shown at the top of the drawing ahead of the (fused) disconnect ○ show both the primary and secondary voltages on transformers ○ reduction in wire size after a stepdown transformer requires a new fuse

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Read, interpret and draw simple wiring diagrams, schematics, and symbols

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

20.06.05	Employ and interpret electrical terms for switches and controls	• Controls and switches are described ("called up") based on:
		  ○ Position
		  ▪ normally open or normally closed
		  ○ Type
		  ▪ What causes it to change position: manual, temperature, pressure, flow, etc
		  ○ Action
		  ▪ What change in the sensed condition causes the switch to change position: rise or fall, direct or reverse acting
		• The symbol, and the way it is drawn will indicate all the information required to determine its role in the sequence of operation

20.06.06	Convert a pictorial diagram to a schematic diagram	• Manufacturers often provide only pictorial diagrams for equipment ○ cannot determine the sequence of operations from a pictorial • Use the information provided in 20.06.01 to 20.06.05 to convert a pictorial diagram to schematic diagram for troubleshooting purposes

20.06.07	Read schematic diagram to determine sequence of operation and for troubleshooting purposes	• Review various manufacturer's diagrams for oil-fired appliances and apply the principles provided in 20.06.01 to 20.06.05 to determine:
		  ○ Sequence of operation
		  ○ Fault symptoms when various controls fail
		  ○ Where to test circuits to determine cause of fault

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Select and utilize electrical measuring and test instrument

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.07.01	Select and explain the use of different electrical measuring and test instruments to test electrical circuits	Describe the types and applications of electrical measuring instruments ○ voltmeter ○ millivolt meter ○ ammeter (in-line and clamp-on) ○ microamp meter ○ ohmmeter / continuity ○ capacitance ○ multimeter (primarily digital but also a brief description of analog meters) • instructions and symbols (~, V, Ω, OL, ∞ etc.) associated with each instrument/function • measuring instruments and accessories based on application and measured value • safe limitation and setting for electrical measuring and test instruments • CSA approved meters should be used – explain CAT I to IV protection levels • resistance reading that creates continuity beep varies with each meter • care, maintenance and storage of electrical measuring and testing instruments
20.07.02	Determine how to connect electrical measurement instruments to the circuit	• Voltmeters - in parallel with the load or device • In-line ammeters - in series with the load • Clamp-on ammeters – one wire in the closed clamp • Ohmmeters - across the de-energized and isolated device or circuit • Test leads inserted into the proper outlets for the function, scale, and range being tested
20.07.03	Explain how to determine if a device is energized or de-energized, open or closed	• Proper use of a voltmeter to determine if a single and a three phase disconnect switch is de-energized ○ select and use proper PPE for the electrical work being conducted ○ select correct function and range on the multimeter ▪ if meter is not auto-ranging and voltage is unknown, set meter to highest scale and once value has been determined, set range to the proper scale for greater accuracy ○ conduct a pre-test and post-test at a known voltage outlet to ensure meter is functioning ○ for single phase devices, test across the device and from each terminal to ground ○ for a three phase disconnect switch, test L1 to ground, L2 to ground, L3 to ground, L1 to L2, L1 to L3, and L2 to L3 ○ Interpreting expected and unexpected readings

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe 240 volt, 110 volt and 24 volt circuits and hardware

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.07.04	Explain how to determine polarity	• Explain polarity and reasons for testing for polarity • Proper use of a voltmeter to test for hot (L1) wire versus neutral wire (don't depend on wire colour) • Proper use of a voltmeter to test for correct polarity for the output voltage from stepdown control transformers
20.07.05	Explain how to measure current	• Explain direct and alternating current and units of measurement (A, mA, µA) • Explain how an in-line ammeter measures current versus the clamp-on method • Proper use of an inline ammeter in series with the load and set to the appropriate function and scale • Proper use of a clamp-on ammeter in series set to the appropriate function and scale and clamped around only one wire for higher current values or multiple loops of a wire to measure for lower current values • Measured values compared to rated maximum value on component rating plate
20.07.06	Explain how to measure resistance and continuity	• Explain differences/similarities of ohmmeter versus continuity functions • Ohmmeter and continuity meter connected across de-energized and isolated device/ circuit • Expected readings across open and closed switches, motor terminals, motor terminal and casing, transformer windings, electronic ignition transformer, capacitor • Interpreting unexpected readings e.g. resistance reading across a closed switch means corroded contacts or OL (∞) across motor windings means break in winding, etc. • Danger of connecting an ohmmeter or continuity meter to a live circuit
20.07.07	Explain how to measure capacitance	• Explain how and why a capacitor functions and the microfarad scale • Proper method of bleeding a capacitor • Proper method of testing a capacitor • Interpreting test readings

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe the basic fundamentals of controls

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.08.01	Identify operating principles, function and normal location of control types employed on oil-fired appliances	Control types include: • Temperature controls ○ Metallic ○ Bi-metallic ○ Bulb and bellows ○ Resistance (resistance temperature detectors / PTC and thermistor / NTC) ○ Used as thermostats, aquastats, high limits, circulating air fan operating controls, outdoor temperature sensors, blocked vent switches, motor thermal overload, stack relay sensor, fuses, circuit breakers, fusible links, safety switch heater resets • Liquid level controls ○ Float ○ Conductivity (Probe type) ○ Used on boilers to prove safe level of water and in constant level valves to control oil level and feed rate • Liquid flow controls ○ Mechanical paddle types are most common but ultrasonic, heat dissiption, and orifice type are sometimes used ○ Used on boilers to prove sufficient water flow • Air proving controls ○ Diaphragm types ▪ Designed/employed to sense negative or positive pressure or both (differential) ○ Used to prove that a mechanical air moving device is moving sufficient air • Pressure controls ○ Balance gate e.g. draft regulator ○ Spring-operated relief valves ○ Pressure regulators ○ Used as relief valves on boilers / water heaters, to set safe cut-in and cut-out oil pressures to the nozzle, maintain proper oil pressure to the nozzle

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe the basic fundamentals of controls

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.09.01	Identify operating principles, function and normal location of control types employed on oil-fired appliances continued	Control types continued: • Position monitoring controls ○ Mechanical ○ Magnetic ○ mercury ○ Used to prove that air filter door is closed, hinged burner mounting plate is closed, vent or air supply dampers are open, upright position of construction heaters • Motion sensing controls ○ centrifugal switches - used in some motors to de-energize the start windings ○ Hall-effect switches – used on some motors to prove operation and/or rpm • Flame/ignition proving control ○ Light sensors: cadmium sulphide visible light detectors, infrared light detectors, and ultraviolet light detectors ○ Bi-metallic heat sensors / stack relays ○ Used to prove that a flame is established and maintained throughout the run cycle • Primary control / Flame safeguard control ○ Electromechanical relays (stack relay controls) ○ Electronic, solid-state relays (cad cell relay controls) ○ Used to control burner operation within safety limits

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe the basic sequence of operation and identify the role of controls

Module 10	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

20.10.01	Explain the role of controls in the sequence of operation applicable to a wide variety of oil-fired appliances equipped with pressure atomizing burners.	Normal sequence of operation for a wide variety of oil-fired appliances
		• Call for heat
		  ○ Electrical contacts close on a temperature-sensing operating control (thermostat, aquastat etc.) to activate a motor. The motor may be a:
		  ▪ pump on a hot water boiler or on an air handler on a combo water/space heater
		  ▪ venter motor for a mechanical draft venting system
		  ▪ burner motor if all safety limit controls are proven safe
		• Safety limits are proven
		  ○ Before oil is permitted to flow to the nozzle, all safety control devices must be proven to be in their safe condition. Safety limits include:
		  ▪ Liquid flow proving switches close to prove boiler pumps are operating
		  ▪ Air flow proving devices close to prove that venter motors are operating
		  ▪ High temperature limit controls, filter door position switches, blocked vent controls, and control reset switches are all in their normally closed positions
		  ▪ Flame/ignition sensing device is open proving no flame is present
		• Purge blower and/or timer are activated
		  ○ Mechanically vented appliances may have a timed prepurge cycle to remove combustible gases from the combustion chamber before ignition occurs
		• Combustion blower and fuel unit are activated
		• Oil pressure is delivered to the nozzle
		  ○ Pressure regulating control opens allowing oil to exit the pump at cut-in setting
		  ○ Delay action solenoid valve opens
		• Ignition transformer is energized
		  ○ Happens simultaneously with oil delivery to nozzle
		• Trial for ignition period
		  ○ Primary control incorporates a method of stopping oil flow to the nozzle if a flame or heat in the vent outlet is not sensed within a fixed time period
		  ○ Ignition transformer is de-energized when flame/ignition is proven or after a fixed time period

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe the basic sequence of operation and identify the role of controls

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

20.10.01	Explain the role of controls in the sequence of operation applicable to a wide variety of oil-fired appliances equipped with pressure atomizing burners.
	
	continued
		Normal sequence of operation continued
		• Run cycle
		  ○ Pressure regulating control in fuel unit maintains delivery pressure to nozzle
		  ○ Forced air furnaces employ a temperature sensor outside the heat exchanger that activates the air circulating blower or a timer relay contact closes to energize the air circulating blower
		• Satisfied call for heat
		  ○ Electrical contacts open on a temperature-sensing operating control (thermostat, aquastat etc.) to stop oil flow to the nozzle.
		  ▪ Usually the burner motor is de-energized which stops the combustion blower and fuel unit from operating
		  ▪ In some cases, a solenoid valve on the outlet of the fuel unit closes stopping oil flow to nozzle but allowing the combustion blower to continue to operate for the post-purge
		  ▪ pressure regulating control closes stopping oil flow from pump at cut-out setting
		• Post-purge cycle
		  ○ Venter motor continues to operate for a fixed time to remove flue gases from combustion chamber and vent
		  ○ In cases where the combustion blower is used for purging, the blower continues to operate for a fixed time without oil flowing to nozzle
		• Heat distribution system is de-energized
		  ○ For forced air heating systems, a temperature sensing switch opens to de-energize the circulating air blower when the temperature falls below a set temperature, or a timer relay contact opens to de-energize the air circulating blower
		  ○ For boilers and combo water/space heaters. a timer relay contact opens to de-energize the circulating pump after a fixed time period

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe operation of primary controls

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.11.01	Describe general operation of older and newer primary controls	Older primary controls • Call for heat energizes the burner motor, ignition transformer and a safety switch heater ○ if a flame is established, the flame proving device (cad cell relay or stack relay / optical or thermal device} causes the safety switch heater to be bypassed (de-energized) and allows the burner to stay on. The ignition transformer may stay on if wired for intermittent operation or de-energized if wired for interrupted operation ○ if flame is not established, the heat from the safety switch heater causes a bimetallic switch to trip (open), and de-energize the burner and ignition transformer within the approved trial for ignition time (15 to 30 seconds) resulting in a lockout condition ○ a failed trial for ignition results in a soft lock-out requiring manual reset ○ some controls will go to a hard lockout after a fixed number of soft lockout resets requiring additional action to allow for another trial for ignition • Flame failure during the run cycle ○ Some older controls respond to flame failure by re-energizing the safety switch heater which causes the bimetallic safety switch to trip causing a lockout condition ○ Some older controls respond to flame failure by triggering a solid-state timing device that shuts down the burner in a fixed time period (5 to 15 seconds). These controls may allow an unlimited or fixed number of flame failures as long as the trial for ignition is successful Newer primary controls • Call for heat energizes the burner motor, ignition transformer and starts a trial for ignition timer ○ if flame is established, the flame proving device (optical device} causes the trial for ignition timer contacts to be bypassed (de-energized) allowing the burner to stay on but de-energizes the ignition transformer ○ if flame is not established, the trial for ignition timer contacts open which, de-energizes the burner and ignition transformer within the approved trial for ignition time (5 to 15 seconds) resulting in a lockout condition requiring manual reset ○ a failed trial for ignition results in a soft lock-out requiring manual reset ○ some controls will go to a hard lockout after a fixed number of soft lockout resets requiring additional action to allow for another trial for ignition • Flame failure during the run cycle ○ Newer controls respond to flame failure by energizing the flame failure timer which will deenergize the burner and transformer if a flame signal is not reestablished with a fixed time ○ An unlimited or fixed number of flame failures maybe allowed if trial for ignition is successful

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe operation of flame sensors

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.12.01	Describe operation and testing of thermos-mechanical flame sensors	Thermo-mechanical sensors • Stack relays employ a bi-metal heat-sensing element inserted in the vent connector at the appliance flue outlet for flame detection • This flame sensing method may still be employed on older appliances. • As the bimetallic device expands with heat, the hot contacts close and the cold contacts open. This action causes the safety switch heater to be by-passed and allows the burner to continue operating. The ignition transformer may stay on if wired for intermittent operation or de-energized if wired for interrupted operation. • As the bimetallic device fails to be heated or cools on a flame failure, the hot contacts open and the cold contacts close. This action causes the heat from the safety switch heater to open the safety switch contacts shutting down the burner and ignition transformer. A manual reset is required. • Maintenance as per manufacturer's instructions ○ Remove from vent connector ○ Inspect condition of wires, contacts, terminals, bi-metallic heat sensor ○ Clean if required and reinstall ensuring that device is properly located and positioned • Test as per manufacturer's instructions ○ Test trial for ignition function by providing a normal call for heat to activate the burner while preventing oil delivery to the nozzle and ensure that burner shuts off within the time specified by the appliance manufacturer ○ Test the flame failure response function by cutting off the fuel delivery to the nozzle during the burner run period and ensure that the burner shuts down within the time specified by the appliance manufacturer • Reset as per manufacturer's instructions ○ Before resetting a primary control, take reasonable actions to determine the cause of the lockout and whether oil has accumulated in the combustion chamber ○ After heat has dissipated from the vent and/or safety switch heater, move the reset lever or button to the operating position

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Describe operation of flame sensors

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.13.01	Describe operation of optical flame sensors	• Three useful light wave lengths: visible, infrared, ultraviolet o cadmium sulfide (cad) cells detect visible light ▪ resistance changes when subjected to light ▪ > 100,000 ohms in darkness thus preventing current flow through the cell ▪ below 1,600 ohms when exposed to light thus allowing current flow through the cell ▪ fast response but primary control safety heater or electronic timer determines the response timing to the burner operation ▪ this is the most common type of flame sensor in oil appliances o lead sulfide flame detectors respond only to infrared (IR) light ▪ like cad cells in that resistance decreases and current increases when exposed to infrared light ▪ hot refractory emits enough infrared light to fool older infrared sensors which may result in a delayed response to flame failures. However, most modern IR detectors and controls sense the flicker rate of a flame and will not be fooled by the steady IR from the refractory ▪ IR detectors may be used in higher input oil appliances or dual-fuel oil/gas appliances o ultraviolet (UV) flame detector only responds to ultraviolet light ▪ two electrodes (cathode and anode) are sealed in a quartz glass tube filled with a special gas that becomes conductive when exposed to UV light. An AC voltage is applied to the electrodes but current only flows when the special gas is conductive. When current flows, the gas loses it conductivity which stops current flow until UV light makes the gas conductive again, This “firing” and “quenching” creates a pulsating DC current which is the flame signal to the primary control ▪ UV detectors are commonly used on higher input gas appliances or oil/gas but seldom with oil only appliances. ▪ Two major problems with UV detectors are that they respond to the ignition spark and can fail in the flame-proving condition.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Maintain, test, reset, and wire a primary control

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.14.01	Identify basic maintenance, test, and reset procedures for optical flame sensor primary controls	• Maintenance as per manufacturer's instructions ○ Inspect condition of wires and terminals ○ Clean the optical sensor • Test as per manufacturer's instructions ○ Test trial for ignition function by providing a normal call for heat to activate the burner while preventing oil delivery to the nozzle and ensure that burner shuts off within the time specified by the appliance manufacturer ○ Test the flame failure response function by cutting off the fuel delivery to the nozzle during the burner run period and ensure that the burner shuts down within the time specified by the appliance manufacturer ○ A hot refractory hold-in test and a hot refractory saturation test should be conducted on IR flame sensors ○ A spark response test should be conducted on ultraviolet flame sensors • Reset as per manufacturer's instructions ○ Before resetting a primary control, take reasonable actions to determine the cause of the lockout and whether oil has accumulated in the combustion chamber ○ After heat has dissipated from the safety switch heater, push the reset button ○ Some modern primary controls will have a limited number of soft lockouts on trial for ignition failures or flame failure failures before going into a hard lock out which requires an addition reset procedure as specified by the manufacturer
20.14.02	Wire cad cell primary controls	• Follow manufacturer's wiring instructions ○ Relay based, solid state controls are relatively simple to wire ▪ Two external terminals for 24 V thermostat connection ▪ Two external terminals for cad cell connection ▪ 120V hot wire connected through the high limit to the black wire of cad cell control ▪ Line neutral and neutrals from burner and transformer are connected together ▪ Orange wire of the cad cell control connected to burner motor black wire and to transformer if wired for intermittent ignition ▪ Blue wire of the cad cell control connected to ignition transformer for interrupted ignition

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Wire a primary control

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.14.02	Wire cad cell primary controls continued	• Follow manufacturer's wiring instructions ○ Newer microprocessor controls have more wiring options ▪ Two external terminals for 24 V thermostat connection ▪ Two external or internal terminals for cad cell connection ▪ 120V hot wire connected through the high limit to power the cad cell control ▪ Line neutral and neutrals from burner and transformer are connected together ▪ Separate terminals or wire leads for burner motor, transformer, oil valve, burner off delay (post-purge), alarm ○ Some microprocessor controls have added features such as LED diagnostic display, programming options for prepurge and post-purge timing, fault history and communication ports for remote display of operation and faults ○ Some controls (like Riello cad cell controls and Honeywell RM7800 series control) have the wires connected to a wiring base which the control attaches to.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s):** None **Estimated theory hours**: 24

Task: Identify the regulatory and code requirements governing electrical work at oil installations.

Module 20	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
20.15.01	Explain the training and certification requirements to conduct electrical work at oil installations	Requirements in the Fuel Industry Certifications Regulation 215/01 • An OBT-2 is authorized to maintain, service or replace mechanical or electrical component that forms part of an appliance with an input not exceeding 7 GPH and to install, repair, service and maintain electrical wiring from a disconnect switch to such appliances in order to service, repair or install an approved appliance and carry out the replacement of electrical wiring necessary to complete the reconnection or installation of controls, control systems, components and accessories that are essential to the operation of the appliance • Only a qualified electrician (i.e, no level of OBT certificate) is authorized to conduct work on building wiring that is subject to the requirements of the Electrical Codes • An OBT-2 can provide general supervision to an OBT-3 if all the requirements for general supervision are met • An OBT-2 can provide direct supervision for an OBT-3 but is responsible for the actions of the OBT-3 under direct supervision

20.15.02	Recognize the Federal, Provincial, Municipal and general codes and standards affecting electrical work at oil installations.	• Ontario Hydro Inspection
		• Ontario Electrical Safety Code Book verses the Canadian Electrical Safety Code Book
		• the authority for rules governing the installation of electrical equipment
		• legal requirements affecting the connection and disconnection of any electrical equipment
		• requirements for notification of inspecting authority
		• requirements for reconnection of electrical equipment (i.e. permits required)
		• requirements for renovation of existing installation
		• electrical inspection permit
		• Canadian Electrical Code Section 2:
		  ○ Authority for Rules
		  ○ Special Requirements
		  ○ Permits
		  ○ Application for Inspection
		  ○ Fees
		  ○ Posting of Permit
		  ○ Notification for Inspection
		  ○ Use of Approved Equipment·

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Recognize common types of conductors

Module 20	Practical		
	Scenario	**Procedure**	**Criteria**
20.16.01	This test will determine the student's ability to correctly identify different types of conductors. The student will be provided with different types of conductors of different materials, construction, gauge, and insulation.	The student will be asked to identify different types and gauges of wire such as NMW, NMD, LV, and AC (armoured cable – BX) and correctly identify locations where each type of wire can or must be used. The student will be asked to identify copper and aluminium #18-, 14-, 12-, and 10-gauge wire and specify the maximum fuse rating for the latter three gauge sizes.	The evaluation tool will be a "yes - no" checklist (see attached sample). The student must correctly identify the: •type of wire (material and category (NMD, BX, etc.) •correct gauge of wire •maximum ampacity •permitted and/or compulsory installation locations

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

MODULE 20
SAMPLE PRACTICAL EVALUATION CHECK LIST
20.16.01

Performance objective: Recognize common types of conductors

	YES	NO
1. Correctly identify wirematerial (copper or aluminium)...	❑	❑
2. Correctly identify #18-gauge wire	❑	❑
3.Correctly identify #14-gauge wire	❑	❑
4.Correctly identify #12-gauge wire	❑	❑
5.Correctly identify #10-gauge wire	❑	❑
6.Correctly state maximum ampacity of #14 copper wire.	❑	❑
7. Correctly state maximum ampacity of #14 aluminium wire	❑	❑
8.Correctly state maximum ampacity of #12 copper wire.	❑	❑
9. Correctly state maximum ampacity of #12 aluminium wire	❑	❑
10.Correctly state maximum ampacity of #10 copper wire	❑	❑
11. Correctly state maximum ampacity of #10 aluminium wire	❑	❑
12.Correctly state location restrictions for NMD wire	❑	❑
13.Correctly state allowable installation locations for NMW wire...	❑	❑
13.Correctly state allowable installation locations for amoured cable (BX) wire	❑	❑

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SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Read, interpret and draw simple wiring diagrams, schematics, and symbols

Module 20	Practical		
	Scenario	**Procedure**	**Criteria**
20.17.01	This exercise is designed to test the student's ability to convert a manufacturer's pictorial diagram to a schematic diagram suitable for troubleshooting purposes. The student will be given a complete pictorial diagram for a particular appliance, access to the appliance, and an ohmmeter.	The student will produce an accurate schematic diagram which will incorporate conventional electrical symbols with all switches and relay contacts shown in their normal positions. Proper wiring diagram conventions must be followed. The student will be permitted to examine the appliance and use an ohmmeter to determine the normal position of switches and contacts.	The schematic diagram will be neat and accurate. Conventional symbols must be used and a legend must be incorporated into the drawing. Switches will be lined up over each other, as will loads, as much as possible. All switches will be drawn in their normal position. Relay contacts must have the same designation as the coils which control them. The sequence of the schematic and the pictorial drawings must be identical. If the schematic as drawn would blow a fuse or create a dangerous situation or not work, the drawing must not receive a passing grade.

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Select and utilize electrical measuring and test instruments

Module 20	Practical		
	Scenario	**Procedure**	**Criteria**
20.18.01	This test will determine the student 's ability to correctly select, connect, measure, and interpret electrical test instruments and their readings. The student will be provided with an analog or digital clamp-on meter and an analog multi-range and multi-scale multimeter, a test appliance or test board, and a check list to complete.	The student will be asked to complete an electrical check sheet provided by the instructor. The student must choose the correct meter for each task, choose the correct ranges and scales, connect the meter correctly and correctly read the values on the meter. The tasks will include tests on appliances and controls including: • 240V, 120V, 24V power supplies • Step-up and stepdown transformers • Manual switches • Fuses (good and blown) • Thermostats/aquastats • High temperature limit controls • Cad cells • Oil solenoid valves • Burner motor • Air circulating blower motor or circulating pump • Venter motor and air proving switch • Capacitors • Measuring, reading, and recording voltage, current, and resistance as appropriate to the component being tested When finished with the individual meter(s) the student will store the instrument safely.	Proper PPE must be selected and properly employed. The evaluation tool will be a "yes - no" checklist. (see attached sample). The student must correctly perform each of the following tasks as applicable: • choose the correct meter • choose the correct range • choose the correct scale • connect the meter correctly • correctly read the value • correctly record the values read, using the correct units of measurement • store meter safely and properly If at any point during testing the student is about to cause a potentially unsafe situation either bodily or to the equipment, the test must be stopped, and the student will receive a failing grade.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

MODULE 11
SAMPLE EVALUATION CHECKLIST
20.18.01

The following check list may be used for each type of meter reading required. i.e. voltage, current, and resistance in all ranges.

Performance objective: Select and utilize electrical measuring and test instruments **YES** **NO**

1. Proper PPE selected and used ❑ ❑
2. Select correct meter for purpose ❑ ❑
3. Correct range selected ❑ ❑
4. Correct scale selected ❑ ❑
5. Meter connected to circuit properly ❑ ❑
6. Correct interpretation of reading ❑ ❑
7. Reading recorded correctly with the correct unit of measurement ❑ ❑
8. Student able to identify a closed and open switch using a voltmeter ❑ ❑
9. Student able to identify a closed and open switch using an ohmmeter ❑ ❑
10. Student able to identify a good and a blown fuse using an ohmmeter ❑ ❑
11. Student able to identify a good and a faulty cad cell using an ohmmeter ❑ ❑
11. Student able to test a capacitor and interpret if it is properly rated for the motor ❑ ❑
12. Student able to determine the polarity of wires on the primary and secondary sides of a 120V / 24V stepdown transformer ❑ ❑
13. Student able to interpret current readings taken on a motor ❑ ❑
14. Meter stored properly ❑ ❑

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Repair 240-volt, 120-volt and 24-volt oil-fired appliance control wiring circuits, loads, and switches

Module 20	Practical		
	Scenario	**Procedure**	**Criteria**
20.19.01	This test will determine the student's ability to apply troubleshooting techniques to determine circuit and control characteristics. The student will be given a test board or an appliance to work on, and a multimeter to perform the procedure.	The test board or appliance will have a predetermined fault or faults in the control circuit. The student will use the multimeter and, using a logical progression, attempt to determine the fault(s).	Proper PPE must be selected and properly employed. Student must: • First check source of power • Use logical test sequence based on appliance sequence of operation • Ensure proper range is selected before applying to circuit • Confirm proper ground connections • Uses ohmmeter to determine continuity • Disconnect wiring from the device before applying ohmmeter • Use capacitor tester (not ohmmeter) to determine capacitance of a capacitor • Use correct range switch settings to check for open or shorted circuits • Identify when a neutral wire is broken

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

Performance objective: Repair 240-volt, 120-volt and 24-volt oil-fired appliance control wiring circuits, loads and switches

Module 20	Practical		
	Scenario	**Procedure**	**Criteria**

20.20.01	This test will determine the student 's ability to detect and repair physical electrical faults in appliance and system wiring.	The student will be expected to detect and correctly analyse various problems such as flash overs, arcing, burning, increased resistance, open and short circuits.
		These faults will be repaired by replacing the required sections of wire using correct splices and joints.
			Proper PPE must be selected and properly employed.
			The student will be evaluated during all stages of the process.
			• visual inspection
			  ○ detect burns, arcs, discoloured wiring and terminal connections.
			• after visual inspection
			  ○ correct use of ohmmeter to determine increased resistance due to overheating and corroded connections
			  ○ correct use of ohmmeter to detect open and shorted circuits, components and conductors
			• after detection and correct analysis
			  ○ correct repair or replacement
			• proper and safe use of tools and materials:
			  ○ cutting
			  ○ stripping
			  ○ joining
			  ○ splicing

20.20.02	The student will be provided with all the tools and materials required including hand tools, electrical test instruments, and wire cutters and strippers. Electrical faults will be established by the instructor on a test appliance or a test board.	The student will be instruction as to the correct method of repairing these types of faults and selecting the correct type of wire to complete the repairs. Instruction will be given as to cutting, splicing, and joining different types of conductors. • plastic and armour covered wires • stripping and splicing solid and stranded conductors • joining solid to solid, solid to stranded, stranded to stranded • splicing various gauges together	

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Electricity and Controls **Prerequisite(s)**: None **Estimated practical hours**: 24

Task: Service flame detection devices

Module 20	Practical		
	Scenario	**Procedure**	**Criteria**
20.21.01	This exercise will demonstrate the tests conducted on infrared (IR) and ultraviolet (UV) flame detection and the student will apply knowledge of interaction of mechanical and electrical to determine system problems.	Instructor will demonstrate the following tests on IR and UV detector systems: • IR tests: ○ Safe start check ○ Flame signal test ○ Trial for ignition and flame failure tests ○ Spark interference/response tests ○ Hot refractory hold-in test ○ Hot refractory saturation test • UV tests: ○ Safe start check ○ Flame signal test ○ Trial for ignition and flame failure tests ○ Spark response tests	• Student must demonstrate an understanding of the purpose and interpretation of each test as assessed by the instructor.
20.21.02	The student will conduct a trial for ignition (TFI) test and flame failure response (FFR) test along with soft and hard lockout resets of a cad cell primary control on a functioning appliance. Maintenance of the cad cell primary control will be conducted during this exercise. Materials: • Fully functional operating appliance • Appliance and primary control manufacturer's instructions	The instructor will demonstrate how to conduct a safe start check, TFI test, FFR test, and cad cell resistance tests along with soft and hard lockout resets of a primary control on a functioning appliance. The potential dangers of resetting a primary control too many times must be clearly identified (i.e. oil flooded combustion chamber). The student will repeat the safe start check, TFI test, FFR test, and cad cell resistance tests along with soft and hard lockout resets of a cad cell primary control on a functioning appliance.	Guidelines for evaluation is as follows: All work must be performed safely and in a timely fashion. Proper PPE must be selected and properly employed. Tools must be used properly and all tests must be performed properly. The student must determine if the safe start check, TFI timing, FFR timing, and cad cell resistance readings meet manufacturer's specifications.

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Install air cleaners

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.01.01	Identify basic types, applications, characteristics and operating features of oil burners	NOTE: Conduct Module 21 Practical exercise #21.09.01 to assess the level of knowledge and work experience that each student brings to the topics of burners and combustion. • Vaporizing type (Pot burners) ○ usually approved for kerosene or No.1 fuel oil but may be approved for No. 2 ○ input normally limited to less than 2 USGPH ○ primarily used for space heating ○ oil fed into pot through a metering device (constant level valve) calibrated in c.c./s ○ vaporization occurs and is maintained on the surface of the oil in the pot if oil temperature is above the fire point ○ combustion air and excess air is normally introduced passively by convection as heat rises but may be fan assisted in some limited cases ○ electrically or manually ignited with no automatic flame monitoring • Atomizing types ○ two major types – mechanical atomization and pressure atomization ○ mechanical atomization - rarely (if ever) encountered and no longer available for sale ○ two sub-types of pressure atomizing burners ▪ low pressure – under 100 psi and usually 1 to 10 psi. - not commonly encountered ▪ high pressure 100 psi or greater ○ usually approved to fire on No.1 and No.2 fuel oil but may be approved for B5 biofuel ○ input ranges from 0.4 USGPH to well over 7 USGPH ○ motor drives combustion fan and fuel unit (integral fuel pump) ○ oil is forced at high pressure through the nozzle which creates a thin film of oil spray into the combustion chamber ○ air from the combustion fan is directed through the combustion head at the oil spray to break the oil into droplets ○ electrodes from a step-up transformer ignite the fuel vapours from the atomized droplets ○ oil is burned in suspension ○ flame safety is monitored and controlled by a temperature or light sensor

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of fuel handling components on atomizing burners

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.02.01	Describe the types, features, and function(s) of fuel handling components on pressure atomizing oil burners	Fuel oil pump (fuel unit); ▪ burner motor drives pump by means of a pump coupling designed to break if pump seizes ▪ draws oil from supply tank to burner and, if by-pass plug is installed, returns oil to tank ▪ filters the oil - screen and/or rotary filter ▪ develops and regulates suitable burner nozzle pressure and provides clean cut-in and cut-out flow to the nozzle at 80% of delivery pressure ▪ usual pressure at pump outlet is 100 psi but commonly higher on newer appliances ▪ ports available for supply line, return line, inlet vacuum gauge, outlet pressure gauge, and bleeding air from the supply line and pump ▪ may have one or two gear sets ○ Single stage pump lifts up to 8 feet ○ Two stage pump lifts up to 15 feet Solenoid oil valve types ▪ Delayed action oil valve ○ Delays delivery of oil to the nozzle to ensure maximum oil pressure and air flow to nozzle before opening thus improving initial combustion ○ Fixed time delay ○ closes when de-energized simultaneously with burner motor to prevent after drip ○ usually located at pump outlet ▪ Instantaneous oil valve ○ Provides instantaneous shutoff when de-energized to prevent after drip ○ Normally closed; opens when energized simultaneously with burner motor ○ usually located at pump outlet Delivery tube, nozzle adapter, and optional in-line preheater ▪ draw assembly delivers oil to the nozzle for combustion ▪ centering supports on tube position nozzle in center of combustion head • nozzle adapter allows for easy connection of replaceable nozzle • in-line oil preheater may be installed to reduce viscosity of oil just before nozzle

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of fuel handling components on atomizing burners

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.02.01 continued	Describe the types, features, and function(s) of fuel handling components on pressure atomizing oil burners continued	Nozzle; ▪ Functions of a nozzle ○ meter the fuel ▪ size of opening and pump pressure determines flow rate - standardized at 100 psi ○ filter the fuel – screen or cinder filter at nozzle inlet ○ Atomize the oil - reduces the pressure and increases the velocity of the oil to break the flow into a thin stream that assists with the atomization of the oil into droplets ▪ determines spray pattern - hollow cone; solid cone; semi-solid cone ○ determines spray angle : 30˚ to 90˚ ○ may be equipped with a check valve that provides clean cut-in and cut-out flow ○ Some staged-firing burners have 2 or 3 nozzles each controlled by a solenoid valve ○ Modulating input burners may use a recirculating nozzle with flow from a return line from the nozzle controlled through a modulating input control valve • Criteria for selecting nozzle flow rate, spray angle and pattern: ○ Determined by appliance manufacturer's rating plate/instructions ○ Shape and size of combustion chamber ○ Combustion head design ○ Combustion chamber type • Effect of changes in fuel oil pressure on nozzle performance ○ Increase in pressure increases atomization and firing rate ○ Decrease in pressure increases droplet size, decreases firing rate, and adversely effects combustion (increased smoke/soot) • Effect of changes in oil viscosity due to oil type or temperature changes ○ Higher viscosity increases droplet size and firing rate and adversely effects combustion (increased smoke/soot) • Remedies to nozzle performance problems ○ Preheat oil ○ Adjust pump pressure to appliance manufacturer's recommendation ○ Replace nozzle – do not attempt to clean nozzle

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of air handling components on atomizing burners

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

21.03.01	Describe the types, features, and function(s) of air handling components on pressure atomizing oil burners	• Burner motor
		  ○ Types: split-phase, permanent split-phase; capacitor start or start/run
		  ○ Higher input burner motors may be three phase or variable speed
		  ○ 1725 or 3400 rpm
		• Air gate
		  ○ provides method for metering combustion air
		  ○ inner and outer bands
		  ○ may be equipped with an automatic shutter that closes when burner motor is de-energized and opens to a selected setting when burner motor is energized
		  ○ may be connected to ducting from outdoors if approved
		• Squirrel cage fan
		  ○ cleanliness and clearance from housing are critical for proper operation
		• Air scroll or burner housing design
		  ○ design determines the air flow pattern and static capability to the combustion head
		  ○ may require installation or removal of a low-fire plate to match airflow to firing rate
		• Static disc (tubulator)
		  ○ starts twirling action of airflow in the blast tube
		• Blast tube
		  ○ delivers combustion air from the burner housing to the combustion head
		  ○ must be sized and positioned so end is ¼" recessed from combustion chamber wall
		  ○ may be equipped with an insulating cone to prevent heat damage
		• Combustion head
		  ○ patterns the air to improve oil / air mixing and atomization
		  ○ two types: conventional head (pre-1970s) and flame retention head (exclusively used since early1970s. Briefly describe why retention heads are better.
		  ○ two types of retention heads – fixed and adjustable
		  ▪ both have primary, secondary, and excess air slots or openings
		  ▪ Both tightly shape the flame and
		  ▪ fixed heads require nozzle to be positioned a set distance from head and selected based on firing rate as per manufacturer's instructions
		• adjustable heads allow for adjustment of excess air opening between combustion head and end cone to match firing rate as per manufacturer's instructions

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of ignition components on atomizing burners

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.04.01	Describe the types, features, and function(s) of ignition components on pressure atomizing oil burners	• Ignition transformer ○ Confirm understanding of transformer construction and operation ○ minimum allowed secondary voltage output is 10,000 at 20 mA ○ Two construction types – iron-core and electronic ○ Two operation types • Interrupted – starts on a call for heat and ceases after a short trial for ignition time or when the flame is proven. Employed on most burners. • Continuous – starts on a call for heat and stays on through firing cycle. May be encountered on older burners but rarely employed. • Ignition leads or bus bars ○ leads are flexible, heavily insulated wires connecting transformer to electrodes ○ bus bars are solid metal plates on the electrodes which springs on the transformer terminals contact when the transformer is secured in place • Ignition electrodes ○ Two solid metal rods with porcelain insulators at positioning clamps ○ Sharpened and angled ends must be positioned with the gap and orientation to the nozzle as per manufacturer's instructions. • Burner primary control ○ Electromechanical relays (stack relay controls) ○ Confirm understanding of construction, operation, maintenance, testing ○ Electronic relays (cad cell relay controls) ○ Confirm understanding of construction, operation, maintenance, testing ○ Discuss the various types and advanced features of newer controls ○ Used to control burner operation within safety limits

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of combustion

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.05.01	Identify types of combustion and the products of combustion	• Types of combustion ○ perfect combustion – theoretical concept used to compare with actual combustion readings ○ complete combustion – chemical reaction of carbon atoms and oxygen to create CO_2 and hydrogen atoms with oxygen to create H_2O with no (or minimal) CO, C, or unburned fuel ○ incomplete combustion - chemical reaction not completed resulting in unacceptable levels of CO, soot, and/or unburned fuel. • Products of combustion of No. 1 and No. 2 fuel oil ○ CO_2 ○ H_2O ○ heat ○ light ○ O_2 / N^2 ○ sulphur ○ carbon (soot/smoke) ○ CO ○ NOx } Emphasize these last four • Products of combustion when fuel oil also contains Biofuel ○ Identify the expected differences in flue gas readings due to higher O_2 level in fuel • Combustion problems ○ Discuss how fuel type, quality, and characteristics (temperature, viscosity, etc) affect flue gas readings ○ Discuss how air quality and characteristics (temperature, contaminates, etc) affect flue gas readings ○ Discuss how heat transfer problems can be identified by flue gas analysis (high stack temperatures may indicate a dirty heat exchanger) ○ Discuss how flue gas readings can be used to identify a cracked heat exchanger

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of combustion testing equipment

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

21.06.01	Identify and select specialty testing instruments.	Select test instruments and describe their applications
		• CO_2 / O_2 / CO analysers
		  ○ electronic devices
		  ○ orsat (fyrite) devices
		• smoke tester - mechanical and electronic
		• draft gauges - mechanical and electronic
		• temperature gauges - mechanical and electronic
		• pressure gauges - - mechanical and electronic

21.06.02	List procedures for proper care, use, handling, storage, and calibration of testing instruments.	• check hose condition • check filters on analyser and smoke tester • select proper fuel for electronic analyzers ○ discuss how this applies to Biofuels • check battery level for electronic devices • zero calibration of instruments in fresh air • manufacturer's requirements for calibration • manufacturer's requirements for operating temperature • manufacturer's requirements for storage
21.06.03	Describe combustion efficiency	• measure the effectiveness of the combustion process • effectiveness in transferring heat energy of burner to the heated medium • steady state thermal efficiency based on formula using CO_2 or O_2 reading and net stack temperature • flue gas analysis determines efficiency of combustion process

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Review and extend understanding of combustion analysis procedures

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.07.01	Describe the procedure to perform combustion efficiency tests	Tools/equipment, CO_2 / O_2 / CO analyser, stack temperature thermometer, draft gauge, smoke tester, efficiency calculator/software, pressure gauges Procedure • ensure all instruments are zero adjusted and in good, reliable condition • activate appliance and assess ignition characteristics • assess flame condition and adjust air as required • run appliance for 5 minutes or until stack temperature stabilizes • determine if sampling ports are properly located • check pump pressure or flow rate to meet manufacturer's specifications • take overfire draft reading, if possible, and adjust draft regulator to meet manufacturer's specifications • take breech draft reading to either compare with the overfire draft or, if no overfire draft reading/adjustments were made, to adjust draft regulator to meet manufacturer's specifications • take smoke test reading and adjust air as required • take flue gas sample with CO_2 / O_2 / CO analyser and adjust air as required • take flue gas temperature and calculate net stack temperature • calculate efficiency (automatically with electronic devices or manual efficiency calculator) • shutdown and reactivate appliance to ensure proper ignition • leave appliance in safe operating condition and in compliance with code requirements and manufacturer's specifications
21.07.02	Identify, interpret, and apply requirements in the B139 Code and manufacturer's instructions regarding flue gas analysis	• When and where to take flue gas tests • Maximum smoke readings allowed by code • Maximum flue gas temperature allowed by code • Requirement to meet manufacturer's instructions for draft, CO_2 / O_2 / CO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated theory hours:** 10

Task: Extend understanding of combustion analysis procedures to more complex burners

Module 21	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
21.08.01	Describe the procedure to perform combustion efficiency tests for staged firing and modulated firing rate burners	▪ Identify the similarities and differences between conducting a flue gas analysis and combustion set up on a single firing rate burner compared to a multi-stage firing rate burner ○ Review one or more manufacturer's instructions for a more complex burner ○ Discuss how air to gas ratio adjustments are made at the various firing rates ○ Discuss how to set the safe light-off firing rate, minimum firing rate, and maximum firing rate ○ Discuss potential combustion problems and solutions for more complex burners

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated practical hours**: 12

Performance objective: Identify the current knowledge and skill level of each student

Module 21	Practical		
	Scenario	**Procedure**	**Criteria**
21.09.01	The intent of this exercise is to identify the student's level of knowledge and work experience related to burners and combustion analysis. It is recommended that a combination of self-assessment and practical assessment tools be employed. Equipment to display or provide photos/video of: • A variety of burner types (vaporizing, atomizing, various makes/models) • One or more higher input (3 to 7gph) appliances with staged-firing or modulated firing burners Work equipment: • Burners • Combustion analyzers • Smoke testers • Draft gauges	The instructor will ask each student (preferably in written form) to provide an overview of their level of knowledge and work experience related to the following topics. ▪ Types of burners they have knowledge of and experience with ▪ Combustion analysis and set-up on appliances In addition to this self-assessment, each student will be required to conduct either Task #1 or #2 and Task #3 to prove the accuracy of their self-assessment: 1. Identify a variety of burner types displayed in the shop or in photos/videos and explain key characteristics regarding component parts and set-up requirements 2. Disassemble an atomizing burner on a bench and identify the component parts before re-assembling the burner. 3. Conduct a combustion set-up on a functioning appliance with an atomizing burner in the shop: ○ Safely and properly activating the appliance ○ Adjusting oil pressure to manufacturer's specs ○ Take a smoke test and adjust air ○ Conduct a flue gas analysis and explain the initial readings to the instructor with recommended improvements ○ Make adjustment to flue gases to meet manufacturer' specification ○ Leave the appliance in safe working order	The information gained from the student's self-assessment and from watching them complete the listed tasks should be used by the instructor to inform the student about what improvements are required in his/her knowledge and skill level to gain OBT-2 certification.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated practical hours**: 12

Performance objective: Review manufacturer's literature for a complex firing rate burner

Module 21	Practical		
	Scenario	**Procedure**	**Criteria**
21.10.01	The student will review the manufacturer's installation and service instructions for a higher input (3 to 7gph) burner with staged-firing or modulated firing. Ideally, a burner with staged-firing or modulated firing will be available for viewing purposes in the shop. All available manufacturer's literature for one make/model of burner with staged-firing or modulated firing will be provided the student.	Student will read the available manufacturer's literature for a burner with staged firing or modulating firing and answer questions (preferably in writing) regarding the burner components and set-up information. Questions may include: • What are the electrical supply requirements? • What type of nozzle(s) are required? • What is the designed oil pressure to the nozzle? • What is the designed furnace pressure? • What size of motor is required? • Is the combustion head fixed or variable? • What is the required gap for the electrodes? • What is the output voltage of the igniter? • For staged firing burners, how is the staged firing achieved and what is the designed flow rate at each stage of firing? • For modulated firing burners, how if the modulation achieved and what is the designed flow rate at low and high fire? • What are the designed trial for ignition and flame failure response times? • Does the control relay recycle or lock-out on a failed trial for ignition? • What are the similarities and differences between this burner and burners the student has worked on previously? If the burner covered by the manufacturer's literature is available in the shop, the student should be asked to identify components on the burner itself.	The student must prove his/her ability to read and interpret manufacturer's instructions by correctly answering at least 75% of the questions asked.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Advanced Burners and Combustion **Prerequisite(s):** Modules 17, 19, 20 **Estimated practical hours**: 12

Performance objective: Troubleshooting combustion problems and correct them

Module 21	Practical		
	Scenario	**Procedure**	**Criteria**
21.11.01	The student will assess the combustion in an appliance that has a safe but improper combustion set-up and correct the problem. Equipment: • Functioning appliance with an atomizing burner with all required manufacturer's instructions • Flue gas analysis equipment • Oil pressure gauges • Handtools Note: An initial activation exercise requiring combustion tests and set-up with a vaporizing pot burner is conducted in Module 26.	The instructor will create a safe combustion problem in a functioning appliance in the shop. The student will assess the combustion set-up of the appliance and tell the instructor what he/she thinks that the problem is and how it should be corrected. With the permission of the instructor, the student will make adjustments to the appliance to achieve the flue gas readings recommended by the appliance manufacturer and required by the B139 Code. Examples of combustion problem faults include: • Improper oil pressure • Damaged or improper nozzle • Improperly adjusted draft regulator • Improper combustion head or adjustment • Restricted fuel supply • Improperly adjusted air shutter • Restricted vent The instructor must ensure that the initial fault and any adjustments made by the student does not create an unsafe condition. More than one of these exercises may be conducted with different combustion problems.	Assessment criteria: • proper PPE selected and used properly • all work conducted safely • Student reads and refers to the manufacturer's instructions • Student uses the correct tools to test and adjust equipment • The procedure to identify the initial problem is logical and reasonable • The student's recommendations for correcting the initial problem are logical and reasonable • All adjustments made to the appliance show an understanding of combustion • The combustion problem is corrected, and the appliance is left in a safe working condition with flue gas readings as recommended by the appliance manufacturer and required by the B139 Code.

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16
Task: Identify types of potable water heaters and associated components

Module 22	**Learning Objectives: Upon successful completion, the student will be able to:**	**Theory**
		Content

22.01.01	Identify the types and components of potable hot water heaters	• Types of potable hot water heaters
		  ○ storage tank
		  ▪ residential models usually employ a center flue with a top or back breach
		  ▪ larger commercial models often have multiple flues
		Components
		• glass lined storage tank/ heat exchanger with flue baffle
		• high oil pressure atomizing burner firing into a cerafelt combustion chamber in the bottom center of the storage tank
		• dip tube
		• anodes (passive or active) for tank corrosion protection
		• temperature and pressure relief valve
		• operating and limit controls are usually the bulb and bellows type
		• venting system is usually natural draft but some heaters approved for sidewall power venting and direct venting
		• mixing valve

22.01.02	Identify safety and regulatory issues related to hot water heaters	Safety issues: • scalding • bacteria growth • sediment buildup • expansion of heated water • change of state from water to steam • leaking tanks and relief valves • clearance to combustibles • creation of hydrogen sulphide due to high heat during long periods of disuse Regulatory issues • requirements to comply with the Plumbing Code • OBT certificate limitations for working on water piping that is essential to the operation of the appliance • requirement to comply with rating plate approval for purpose and fuel type

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Identify types of heat transfer equipment and associated components used in combo systems

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
22.02.01	Identify and describe types and components of a combo system and accessories.	• Types of combination potable hot water and space heating appliances ○ All combo systems must employ a water heater approved on the rating plate and in the manufacturer's instructions for potable hot water heating AND space heating. A water heater cannot be used only for space heating but can be used for potable hot water heating only. ○ Add-on space heating systems include: ▪ Air-handlers connected to air distribution ductwork • hot water pumped through finned copper tubes with an integral air circulating blower forcing air (drawn through return ductwork and an air filter) across the coil into supply air distribution ductwork. This is the most common combo system – especially since air conditioning coils can be incorporated for cooling. ▪ Air handlers employed as unit heaters • same heating process as above but not designed to be connected to ductwork. Employs an axial fan without an air filter. Used in shops, garages, industries. ▪ Radiant in-floor tubing: hot water is pumped through tubes embedded in concrete floors or strapped above or below wooden floors and finished with a covering ▪ Radiator heating: hot water is pumped through baseboard heaters, radiant wall-mounted panels, or free-standing radiators. • Components vary with type of heating system: ○ All piping and heat transfer equipment must be new, never previously used for other than potable water, and approved for use with potable water. ○ Package air handlers (with and without ductwork) have integral pump, air circulating fan, balancing valves, check valve, air bleed valve, and fan-operating controls ○ Radiant in-floor and radiator systems require installer to select pump, balancing valves, check valve, air bleed valve ○ All combo stems require the installer to select and install thermostat(s) and wiring, backflow valve, expansion tank, water piping between water heater and heat transfer equipment

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Size water heaters and combo systems.

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

22.03.01	Sizing water heaters and combo heating systems.	• Two calculations required for sizing:
		  ○ Heat loss calculation (review heat loss calculation information from module 19)
		  ○ Domestic hot water use calculation
		• tank capacity sizing factors include:
		  ○ Family size and lifestyle - i.e. teenagers, hobbies, water use activities
		  ○ Number of bathrooms
		  ○ Laundry room requirements
		  ○ Non-bathroom or laundry uses such as dishwasher, Jacuzzi tubs, heavy uses
		  ○ Cubic feet per minute (CFM) rating of the air handler
		  ○ Gallons per minute (GPM) flow rate recommended for in-floor or radiator heating systems
		• Input of water heater based on:
		  ○ Water heater efficiency and recovery ratings
		  ○ Space heating requirement
		  ○ Type of space heating equipment
		• Manufacturer's instructions regarding sizing
		  ○ The manufacturer of the water heater and the manufacturer of space heat transfer equipment usually provide direction on sizing tank capacity and input
		  ○ Formulas are often provided

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Plan a combo system piping layout

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
22.04.01	Identify water piping and component drawing symbols and piping diagram principles applicable to combo heating systems	• Piping symbols include ○ Line designation or labelling for type and size of piping/ tubing and direction of flow ○ Water heater ○ Heat exchanger/ radiator ○ Circulating pump ○ Expansion tank ○ Various valve types: manual, solenoid, motorized, air bleed, mixing, check, balancing, backflow preventer, pressure regulating, relief ○ Fittings and joints: elbows, tees, unions, end caps, soldered joints, threaded joints • Diagram principles ○ How to show elevation on a two-dimensional drawing ○ Crossing versus connecting lines ○ Legend
22.05.01	Read and interpret manufacturer's instructions and diagrams related to water piping layout for combo systems.	With reference to various manufacturers' instructions for different types of combo heating systems, identify: • Location requirements for water heater in relation to heat transfer equipment • Minimum pipe size requirements • Maximum piping resistance (length, height, fittings) if applicable • Location of circulating pump(s) • Location and types of valves • Location of inlet and outlet ports for water heater and heat transfer equipment • Flow direction • Flow rate requirements • Differentiating between requirements and recommendations

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Size circulator pump and install water heater and piping system

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
22.06.01	Size circulator pump for combo systems that do not include an integral pump	• Heat transfer equipment manufacturers will specify pump requirements for proper operation of their equipment – flow rate and velocity • Installer must factor in pressure drop of the piping system to and from the heat transfer unit(s) caused by: ○ pipe size and length ○ head pressure ○ fittings • Selected pump (make and model) must be approved for use with potable water • Pump manufacturer's sizing charts interpreted based on heat transfer equipment specifications and calculated pressure drop through piping systems
22.07.01	Select location for combo system water heater and piping system	• Select water heater location based on code requirements ○ water heater location must provide for effective venting and air supply ○ clearance to combustibles requirements must be met • Heat transfer equipment location depends on type of combo system ○ air handler with return and supply ductwork should be centrally located ○ floor radiant and radiator systems should be located to minimize piping length between water heater and heat transfer equipment ○ heating loops for floor heating systems connected to a header should be approximately the same length with closer spacing near outside walls ○ radiators should be located on outside walls ○ water piping location must not be exposed to freezing temperatures

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Locate and install water piping and electrical wiring for combo systems.

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
22.08.01	Locating and installing water piping and components	• Review OBT scope of certificate limitation for working on water piping essential to the operation of the appliance as it applies to each type of combo system • Follow manufacturer's instructions for heat transfer equipment regarding location of: ○ Heat transfer equipment ○ Circulator pump ○ Expansion tank ○ Valves: manual, solenoid, motorized, air bleed, mixing, check, balancing, backflow preventer, pressure regulating, relief ○ Air filters (if applicable) • Follow Plumbing and Building Code requirements regarding potable water systems ○ Backflow preventer requirements ○ All piping/tubing, components, and joining systems must be approved for use with potable water
22.09.01	Wiring electrical components and controls for water heater and combo system	• Review OBT scope of certificate limitation for working on electrical wiring essential to the operation of the appliance as it applies to each type of combo system • Follow manufacturer's instructions and Electrical Code for electrical equipment and control wiring for: ○ Overload protection for water heater and heat transfer equipment ○ Wiring type and size for powering water heater and heat transfer equipment ○ Disconnect switch requirements (location, identification, etc.) ○ Thermostat type, location, wiring ○ Circulator pump(s) ○ Electrically operated valves ○ Air circulating blower (if applicable) ○ Electronic air filters (if applicable)

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Initial activation and set up of combo systems.

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
22.10.01	Initially activate and set-up combo systems	• Initial activation, set-up, and servicing of water heaters are covered in Module 26, so this Module focuses on the interaction between the water heater and heat transfer equipment. • Follow heat transfer equipment manufacturer's instructions regarding: ○ Filling water piping and inspecting for leaks ○ Bleeding air from the system ○ Activation of circulator pump (some water-cooled pumps require initial manual activation) ○ Temperature setting and differential setting for water heater ○ Temperature requirements for inlet and outlet of heat transfer equipment ○ Use of balancing valves / mixing valves to control inlet and outlet temperatures ○ Measuring and adjusting temperature rise across heat transfer equipment ○ Select settings for fan-operation and safety limits as applicable ○ Test safety and operating controls • Meet regulatory requirements: ○ Complete and apply installation label as required by Fuel Oil Regulation ○ Post manufacturer's instructions as required in B139 Code ○ Instruct owners/users in the proper operation of the equipment as per B139 ○ Record necessary information to prove that equipment complies with the B139 Code and that the equipment is ready for safe use

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated theory hours:** 16

Task: Service and maintain combo systems.

Module 22	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
22.11.01	Service and maintain combo systems.	• Service and maintenance applicable to burners and controls are covered in Modules 20 and 21, so this Module focuses on the special service and maintenance requirements for water heaters and heat transfer equipment. • Water heater service and maintenance beyond annual maintenance procedures: ○ Test operating and safety controls ▪ Procedure for replacing water heater operating and safety controls ○ Test T & P relief valve as per manufacturer's instructions ▪ Procedure for replacing T & P relief valve ○ Check dip tube performance by testing temperatures ▪ Procedure for replacing dip tube ○ Mixing valve adjustment/calibration using a temperature test ▪ Procedure for replacing mixing valve ○ Check condition of anodes as per manufacturer's instruction ▪ Procedure for replacing anodes ○ Flush/clean sediment from tanks as per manufacturer's instructions ▪ Procedure for de-liming a water heater tank • Follow heat transfer equipment manufacturer's instructions regarding: ○ Confirming proper temperature settings for water heater, potable water system, and heat transfer equipment ○ Testing, servicing, repairing, replacing circulator pump ○ Testing operating control for circulator pump ○ Testing operating control for air circulating blower (if applicable) ○ Cleaning heat exchanger surfaces on heat transfer equipment ○ Cleaning air circulating blower and cleaning/replacing air filter (if applicable)

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated practical hours:** 16

Performance objective: Select and locate water heater and air handler for a combo central heating system and accessories

Module 22	Practical		
	Scenario	**Procedure**	**Criteria**

22.12.01	Student will select the size and location of a water heater and central heating air handler unit based on information provided by the instructor and found in manufacturer's literature.	Instructor will provide:
		• Information necessary to determine the domestic hot water needs of a residential bldg.
		  ○ Number and ages of occupants
		  ○ Number of bathrooms
		  ○ Laundry uses
		  ○ Specialty water uses
		• Information necessary to size space heating equipment
		  ○ Heat loss calculation
		  ○ Floor and elevation plans for all floors with locations of potable water use equipment
		• Manufacturer's instructions for a variety of water heaters, central heating combo system air handlers, and associated components (e.g. thermostats, circulator pumps, power venters, valves, etc.)
		Student will select:
		• Make/model, tank size, and input of water heater
		• Venting material and vent size required for selected water heater
		• Make/model/size and required accessories for the air handler unit
		• Location for the following equipment and show it on the floor diagrams:
		  ○ Oil supply tank and lines
		  ○ Water heater and air handler
		  ○ Venting system (vertical chase way or sidewall vent termination)
		  ○ Air supply opening sizes and location
			Student will properly select and provide reasons for the selection of:
			• Water heater make/model/size/input
			• Vent type/material, size, and accessories
			• Air opening size
			• Air handler make/model/size
			• Accessories for combo system associated components (e.g. thermostats, circulator pumps, power venters, valves, etc.)
			
			Student will correctly show on the floor drawing the location of:
			• Oil supply tank and supply lines
			• Water heater and air handler
			• Venting system (vertical chase way or sidewall vent termination)
			• Air supply opening(s)

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated practical hours:** 16

Performance objective: Select and locate water heater and floor heating combo system accessories

Module 22	Practical		
	Scenario	**Procedure**	**Criteria**

22.12.02	Student will select the size and location of a water heater to be used with a simple floor heating combo system and create a water piping diagram for the system based on information provided by the instructor and found in manufacturer's literature.	Instructor will provide:
		• Information necessary to determine the domestic hot water needs of a residential bldg.
		  ○ Number and ages of occupants
		  ○ Number of bathrooms
		  ○ Laundry uses
		  ○ Specialty water uses
		• Information necessary to size space heating equipment
		  ○ Heat loss calculation
		  ○ Floor plan for a single floor shop/garage with locations of water supply and use equipment
		• Manufacturer's instructions for a variety of water heaters, floor heating tubing/manifolds and associated components (e.g. thermostats, circulator pumps, power venters, valves, etc.)
		
		Student will select:
		• Make/model, tank size, input of water heater
		• Venting material and vent size required for selected water heater
		• Make/model/size of circulator pump and required accessories for floor heating
		• Location for the following equipment and show it on the floor diagrams:
		  ○ Oil supply tank and lines
		  ○ Water heater and manifold for floor heating
		  ○ Venting system (path and termination)
		  ○ Air supply opening sizes and location
		
		Student will provide a water piping diagram showing all components between water heater and floor heating manifold as well as basic layout of floor heating looks.
			Student will properly select and provide reasons for the selection of:
			• Water heater make/model/size/input
			• Vent type/material, size, and accessories
			• Air opening size
			• Circulator pump make/model/size
			• Type of floor heating tubing and manifold
			• Accessories for combo system associated components (e.g. thermostats, power venters, valves, etc.)
			
			Student will correctly show on the floor drawing the location of:
			• Oil supply tank and supply lines
			• Water heater and floor heating manifold
			• Venting system (path and termination)
			• Air supply opening(s)
			
			Student will correctly show on the water piping diagram the size and location of:
			• Potable water inlet and outlet locations and associated manual valves on the water heater
			• Floor heating inlet and outlet connections to water heater / water system
			• Manual valves and bleed valve
			• Mixing valve
			• Electric valves
			• Backflow prevention valve
			• Expansion tank
			• Circulator pump
			• Basic design of floor heating loops

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated practical hours:** 16

Performance objective: Provide electrical wiring drawings for a combo system

Module 22	Practical		
	Scenario	**Procedure**	**Criteria**
22.13.01	Student will identify the electrical wiring requirements for the combo system selected in exercises 21.12.01 or 21.12.02	Based on the combo system and components selected by the student in completing exercises 22.12.01 or 22.12.02, the student will provide pictorial and schematic (ladder) diagrams showing external electrical wiring and components to the water heater and heating system. Diagrams must use proper symbols and layout requirements and show: ○ Overload protection for water heater and heat transfer equipment ○ Wiring type and size for powering water heater and heat transfer equipment ○ Disconnect switch(es) ○ Thermostat ○ Circulator pump(s) if not integral to air handler ○ Electrically operated valves ○ Air circulating blower (if applicable) ○ Connection to heating system control wiring ○ Connection to power venter (if applicable) NOTE: Appliance wiring/controls packaged with the water heater or air handler do not have to be show on the drawings.	Each student's drawings will be assessed for proper: • Format and symbols employed • Neatness and completeness • Overload protection type/size • Electrical wiring type/size • Disconnect switch(es) • Thermostat wiring • Wiring of electric valves • Wiring of air circulating blower as applicable • Connection to heating system control wiring • Connection to power venter (if applicable)

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated practical hours:** 16

Performance objective: Conduct set-up/maintenance tests/procedures on a water heater / central heating air handler combo system

Module 22	Practical		
	Scenario	**Procedure**	**Criteria**

22.14.01	Student will watch the instructor demonstrate how to conduct set-up and maintenance tests/procedures on a water heater and central heating air handler combo system and repeat the procedures as specified by the instructor	Instructor will demonstrate the following set-up and maintenance tests/procedures applicable to central air heating combo systems and ask the student questions and to repeat some or all these tests as considered appropriate by the instructor:
		• Water heater tests/procedures:
		  ○ Filling water piping and bleeding air from the system
		  ○ Test potable hot water outlet temperature and adjust to meet system requirements and to determine the condition of dip tube
		  ○ Flush test T & P relief valve
		  ○ Flush and clean water tank
		  ○ Test operating and safety controls
		  ○ Replace dip tube and anode
		• Air handler tests/procedures
		  ○ Test inlet, outlet, and differential temperature of air handler and adjust to meet requirements
		  ○ Test temperature rise across air handler heat exchanger and make corrections to meet requirements
		  ○ Test operating and safety controls
		  ○ Replace circulator pump
		Instructor must ask each student to repeat one or more of the demonstrated tests/procedures and ask each student one or more challenging questions related to the tests/procedures and/or operation of combo systems.
			Each student will be assessed for proper:
			• Completion of set-up/maintenance tests or procedures as assigned by the instructor
			• Response to questions asked by instructor regarding set-up/maintenance tests or procedures and/or operation of combo systems.

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Water Heaters and Combo Systems **Prerequisite(s)**: Modules 18 to 21 **Estimated practical hours:** 16

Performance objective: Troubleshoot and service a water heater / central heating air handler combo system

Module 22	Practical		
	Scenario	**Procedure**	**Criteria**
22.15.01	The student will troubleshoot and correct problems created or described by the instructor on a water heater / central heating air handler combo system. Appropriate equipment and manufacturer's instruction will be available to complete this exercise.	Instructor will create or describe problems related to the operation of a water heater and central air heating combo system and provide access to the appropriate equipment and manufacturer's instruction to complete this exercise. The student will use or describe equipment needed and test procedures to determine the cause of the problem and take or describe actions required to correct the problem. Suggested problems or symptoms: • Noisy water heater (gurgling tank) • Leaking T & P valve • Cold potable water heater supply temperature • Insufficient hot water temperature to potable water system and/or air handler • Cold supply air from air handler • Air handler not operating • Noisy operation of circulator pump • Scalding temperatures at sinks/showers	Each student will be assessed for using or describing proper: • Equipment required to troubleshoot and correct the problem • Steps and tests to take to identify the cause of the problem • Actions required to correct the problem

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated theory hours:** 16

Task: Hydronic distribution systems

Module 23	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
23.01.01	Differentiate and describe boiler types and terminology.	• Heat exchange types: ○ Cast iron sectional ○ Steel tube (fire tube and water tube) ○ Copper fin tube ○ Tankless coil • Boiler rating ○ Hot water or steam ○ Low or high pressure (B139 boiler definition) ○ Design pressure versus operating pressure ○ Heating capacity – input or output in Btuh, GPH, kW, etc. ○ Horsepower – definition and conversion factors to Btus and GPH ○ Efficiency – condensing or non-condensing ○ High-mass or low-mass • Boiler design: ○ Combustion chamber refractory/insulation ○ Wet or dry base ○ Wet or dry back ○ Flue passage for combustion gases including baffles/turbulators ○ Water connections
23.02.01	Describe controls commonly used on boilers.	• Common boiler controls such as: ○ Aquastat ○ Temperature//pressure relief valve ○ Low water cut-off ○ Flow switch ○ Limits

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated theory hours:** 16

Task: Hydronic distribution systems

Module 23	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
23.03.01	Describe and compare convection distribution systems	• Gravity circulation (natural convection) systems • Forced circulation (forced convection) systems
23.04.01	Differentiate and describe hydronic distribution systems.	• Distribution system types ○ Series ○ One pipe ○ Two pipe ○ Manifold system ○ Direct return and reverse return ○ Tankless coils and secondary heat exchangers in tanks for domestic hot water ○ Open and closed systems ○ Conversion of open systems to closed systems
23.04.02	Describe the operation, purpose, and proper location of distribution system devices	• Distribution system devices: ○ circulating pumps ○ flow switches ○ low water cut-off devices ○ pressure reducing valves ○ feedwater valves ○ backflow preventers ○ by-pass valves ○ expansion tanks ○ air separators / eliminators ○ balancing valves ○ check valves ○ isolation valves ○ temperature actuated valves ○ thermostatic radiator valves ○ hot water temperature controls ○ indoor/outdoor reset control ○ zone flow control valves ○ low-loss header

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated theory hours:** 16
Task: Hydronic distribution systems

Module 23	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

23.04.03	Describe the operation, purpose, and proper location of distribution heat emitters	• Heat emitter types:
		  ○ in-floor (or in-wall) radiant heating systems
		  ○ cast iron radiators
		  ○ baseboard heaters
		  ○ panel heaters
		  ○ unit heaters
		  ○ kick plate heaters
		  ○ tankless coils and secondary heat exchangers in storage tanks for domestic hot water

23.05.01	Describe the function, operation and installation of circulating pumps and pump components.	• Circulating pump topics
		  ○ purpose
		  ○ construction (bronze, iron)
		  ○ configuration
		  ○ flow rates
		  ○ pump head
		• Pump components
		  ○ Impeller
		  ○ casing and volute
		  ○ pump coupling
		  ○ seal bearing
		  ○ pump motor

23.05.02	Determine pump sizes for system applications.	• Calculating flow rates, pump head, impeller size RPM, motor HP • Pump curves and their use • Pump location and installation criteria (vertical mounting, discharge reduction and inlet pipe configuration) • The effects on the pump due to a change in system characteristics such as: resistance, flow rate, impeller size, motor RPM, HP • Heat output and temperature difference

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated theory hours:** 16

Task: Install and activate a hydronic heating system

Module 23	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
23.06.01	Describe how to fill boiler and distribution system and bleed air from system.	• Describe: ○ procedure for filling and leak testing each section of the distribution system ○ air bleed types and location for air bleeds ○ expansion tank sizing, location, and charging ○ dangers of over pressurizing and over filling steam boilers
23.06.02	Describe water quality requirements, treatment, and potential problems	• Review various manufacturer's instructions regarding water quality and treatment ○ pH, total hardness, conductivity, etc. ○ corrosion due to oxygen and carbon dioxide ○ corrosion due to chemicals (chlorine, bromine) ○ proper use of glycol ○ materials to be used for system (plastics, copper, etc.) ○ how to test water quality ○ continuous water treatment for open systems ○ handling and storage of water treatment chemicals
23.07.01	Describe the location, operation, function, and interaction of system devices	• The role of system devices in the sequence of operation: ○ mechanical ○ electrical ○ electromechanical
23.07.02	Compare appliance wiring diagrams with appliance field wiring and sequence of operation to troubleshoot system.	• Use proper tools and measuring instruments to: ○ determine electrical and mechanical malfunctions of pumps and components ○ apply mechanical troubleshooting techniques to determine the integrity and operation of system mechanical components ○ apply electrical troubleshooting techniques to determine the integrity and operation of system electrical controls and components ○ repair defective components or determine and install suitable replacement

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated theory hours:** 16

Task: Maintain a hydronic heating system

Module 23	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
23.08.01	Follow manufacturer's instruction for correctly install a hydronic heating system.	• Given a floor or building plan determine: ○ appropriate boiler location ○ a distribution system design (instructor's discretion) ○ size of boiler, piping, circulating pump(s), and expansion tank ○ the fittings/devices required for proper operation of the system
23.08.02	Activate a new hydronic heating system or a retrofit boiler including the proper procedures and sequence of events.	• Describe ○ cleaning the system ○ activating the boiler ○ bleeding and filling the system ○ checking controls and sequence of operation
23.08.03	Recognize and correct common boiler problems	• Common boiler problems: ○ improper sequencing of boiler operation ○ water leaks at fittings or devices ○ improper air supply, draft, and/or venting ○ carboning, condensation, corrosion, and liming (emphasize limited water change) ○ insufficient heat through out: the building, one zone, one or more rooms ○ noisy system or noisy components

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated theory hours:** 16

Task: Maintain a hydronic heating system

Module 23	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
23.09.01	Locate, interpret, and apply regulatory and code requirements related to boilers	• Fuel Industry Certificates Regulation ○ OBT certificate limitations for working on water piping that is essential to the operation of the appliance • Fuel Oil Regulation ○ requirements to comply with the Plumbing Code • B139 Code requirements ○ requirement to comply with manufacturer's certified instructions ○ requirement to comply with rating plate approval for purpose and fuel type ○ large room or space definition for boilers ○ boiler specific section of Annex L entitled *Maintenance – Residential Installations* • B51 - *Boiler, pressure vessel, and pressure piping code* ○ requirements for low-water cut-off devices and flow controls ○ requirements for pressure relief valves, (installation, maintenance, testing) • B214 - *Installation code for hydronic heating systems* ○ general overview ○ material requirements for hot water heating distribution systems ○ control requirements for hydronic systems

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

Performance objective: Install a hydronic system

Module 23	Practical		
	Scenario	**Procedure**	**Criteria**
23.10.01	Replace/install and activate a hydronic heating system as specified by the instructor. Instructor will designate the boiler make and model and the type of hydronic system. The student will be required to: • prepare the site • use appropriate codes and follow manufacturer's instructions to correctly replace and or install a hydronic boiler • connect the boiler to an existing oil and water system • make proper venting connection • activate the system	The student will: • select correct boiler type • organize removal and or installation • correctly lift, lower, and position boiler • connect fuel piping/tubing • select and install components for distribution system • connect water piping/tubing • connect electrical supply and controls • select and connect venting system • demonstrate the proper sequence of events and methods for activating a hydronic heating system including: ▪ cleaning the system ▪ bleeding and filling the system ▪ activating the boiler ▪ checking operation of controls and sequence of operation	Assessment criteria (see attached sample checklist): • proper PPE selected and used properly • all work conducted safely • neatness • uncluttered work site • no oil leaks • no water leaks • appliance and equipment are level • proper venting system selected and installed • proper electrical wiring • proper controls selected and installed • appliance and venting system installed as per code and manufacturer's instructions, • proper sequence of events used for activating system • proper method used for checking operation of controls and sequence of operation

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

MODULE 23
23.10.01 SAMPLE PRACTICAL CHECKLIST
INSTALL AND ACTIVATE

In this scenario, the instructor must observe all actions and question the student thoroughly during the process. Following is a sampling of a few things to look for.

Performance objective: Install a hydronic system

	YES	NO
1. Proper PPE selected and used	❑	❑
2. All work conducted safely	❑	❑
3. Correct vent material selected and installed	❑	❑
4. Correct distribution system components selected and installed	❑	❑
5. Demonstrated correct cleaning procedures	❑	❑
6. Consulted and followed manufacturer's instructions	❑	❑
7. Demonstrated correct method of bleeding system	❑	❑
8. Demonstrated correct method of filling system	❑	❑
9. Correct oil leak detection method followed	❑	❑
10. Checked for water leaks (cold and hot)	❑	❑
11. Correct activation sequence	❑	❑
12. Correct controls selected and installed	❑	❑
13. All control settings checked	❑	❑
14. All control operations verified and confirmed	❑	❑

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

Performance objective: Perform maintenance on circulating pump

Module 23	Practical		
	Scenario	**Procedure**	**Criteria**
23.11.01	Perform maintenance on circulating pump.	The student will: • obtain manufacturer's instructions or manual • visually inspect pump/motor assembly for physical damage • use and ohmmeter and check for open, grounded, or shorted motor windings • inspect motor and pump bearing for leakage of lubricant • inspect coupling for damage and possible misalignment • mark positioning of coupling and bearing housings • disconnect pump and motor housings • remove pump housing bolts, separating pump volute • inspect housing gaskets/seals for damage • inspect impeller for damage or foreign material around impeller • measure impeller diameter and record • inspect bearings for foreign matter and for adequate lubrication • reassemble pump and motor components and assemblies • torque all bolts down to manufacturer's specifications • determine type of lubricant to be used and lubricate all bearings as required	Assessment criteria: • proper PPE selected and used • proper selection and use of tools • proper measurement of electrical characteristics • accuracy of observations • correct disassembly procedure • accuracy of observations • diagnosis of faulty components • proper lubrication application • correct reassembly procedure • clean up

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

Performance objective: Perform maintenance on circulating pump

Module 23	Practical		
	Scenario	**Procedure**	**Criteria**
23.11.02	Apply troubleshooting techniques to determine electrical and mechanical pump malfunctions.	Student will: • obtain pump curves from manufacturer • start-up hydronic system with pump • allow system to reach normal operating conditions • using a voltmeter measure supplied voltage and record value • using an ammeter measure current draw and record value • determine heating unit output capacity - nameplate or manufacturer's data • use thermometer to measure temperature across heating unit • measure pressure difference across pump • calculate flow rate of the pump • determine pump head • determine motor HP requirements • increase system resistance (add an extra loop to system or partially close pump discharge valve)	Assessment criteria: • proper PPE selected and used • proper selection and use of tools • proper measurement of electrical characteristics • selection of correct scale • correct sequence of operation • accuracy of readings • diagnosis of problem • diagnosis of faulty component • clean up

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

Performance objective: Inspect, check operation and condition of an installed boiler

Module 23	Practical		
	Scenario	**Procedure**	**Criteria**
23.12.01	Inspect, check operation and condition of an installed boiler and associated components (controls, connections, relief valves)	Student will: • obtain manufacturer's specification sheets • perform visual inspection of following components - burner assembly, vent condition, combustion chamber, heat exchanger, flue passages, controls, pumps, pipe connections, refractory, expansion tank, air bleed device, pumps and pipe connections • assess and determine state of boiler and components to determine the presence of carboning, corrosion, condensation, water leakage, corrosion damage • bleed and refill system • set operating and limit controls • start up boiler • ensure that pump is operating (if applicable) • bleed hydronic system • ensure proper level in expansion tank / diaphragm • adjust fuel oil pressure using appropriate tools • perform flue gas analysis • make adjustments to draft and air shutter as required • measure temperature rise across heat exchanger and adjust to meet manufacturer's specifications·	Assessment criteria (see attached sample checklist): An evaluation checklist of components should be prepared. The student should make an accurate assessment of the condition of each major component, and indicate whether it is positioned correctly etc. • proper PPE selected and used • proper selection and use of tools • neatness • accuracy • proper procedures • diagnosis of conditions • report of conditions • recommendations

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

MODULE 23
SAMPLE EVALUATION CHECK LIST
23.12.01

Performance objective: Inspect, check operation and condition of an installed boiler

	YES	NO
1. Proper PPE selected and used	❑	❑
2. All work performed safely	❑	❑
2.All piping preparation and assembly procedures correct	❑	❑
3.System components installed as per manufacturer's instructions	❑	❑
4.System activated according to manufacturer's instructions	❑	❑
5.All operating controls verified	❑	❑
6.All safety controls verified	❑	❑
7.All control settings confirmed	❑	❑
8.Leak test performed (oil side)	❑	❑
9.Leak test performed (water side)	❑	❑
10.Oil pressure checked and set	❑	❑
11.Bypass valve set for optimum temperature rise with no condensation	❑	❑
12.Measured pressure difference across pump	❑	❑
13.Measured current draw of pump motor	❑	❑
14.Calculated flow rate of pump.	❑	❑
15.Performed flue gas analysis and set-up properly	❑	❑
16. Measured and adjusted temperature rise across heat exchanger properly	❑	❑

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

Performance Objective: Service mechanical components of a Hydronic Heating Boiler.

Module 23	Practical		
	Scenario	**Procedure**	**Criteria**

23.13.01	The student will dismantle inline circulating pump, identify the defective component(s), drain and recharge a diaphragm expansion tank.
	
	Student must recognize that there is a faulty circulating pump or component in the system.
		The student will:
		• Correctly remove an inline circulating pump.
		• Perform the proper procedure for one of the following:
		  ○ oiling / replacing seal bearings
		  ○ oiling / replacing motor
		  ○ checking / replacing / cleaning the impeller
		• Correctly re-install inline pump.
		• Drain and re-charge diaphragm expansion tank
			Assessment criteria (see attached sample checklist):
			
			Student must be able to identify and describe the function and operation of circulating pump components such as:
			• pump motor
			• pump coupling
			• seal bearing
			• impeller
			
			Student must be able to describe the differences between circulating pumps used for potable water and heating systems.
			
			Student must demonstrate the proper procedure for draining and recharging a diaphragm tank.

Module Title: Hydronic Heating Systems **Prerequisite(s):** Modules 17 to 22 **Estimated practical hours**: 24

MODULE 23
23.13.01 SAMPLE EVALUATION CHECK LIST

During the evaluation of this practical module, the instructor must observe all actions and question the learner thoroughly during the process. Following is a sampling of a few things to look for.

Performance Objective: Service mechanical components of a Hydronic Heating Boiler.

	YES	NO
DEMONSTRATION		
1.Correct method of draining a replacement of expansion tank	❑	❑
2.Describe correct method of lubricating pumps and motors	❑	❑
3.Correct use of electrical test meter to check for shorted motors	❑	❑
4.Correct use of electrical test meter to check for grounded motors	❑	❑
5.Correct use of electrical test meter to check for open motors	❑	❑
RECOGNITION		
Correctly identifies:		
1.Pump motor	❑	❑
2.Pump coupling	❑	❑
3.Seal bearing	❑	❑
4.Pump impeller	❑	❑
5.Flow control switch	❑	❑
6.High limit switch	❑	❑
7.Operating thermostats	❑	❑
8.Low water cut-off device (if applicable)	❑	❑
9.Flow switch (if applicable)	❑	❑
10.By-pass valve (if applicable)	❑	❑
11.Balancing valve (if applicable)	❑	❑
12.Back flow preventer	❑	❑
13.Water makeup device	❑	❑
14.Type of boiler construction / design (i.e.. sectional, copper fin coil, etc.)	❑	❑

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24
Task: Identify the types and components of forced warm air heating systems

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.01.01	Identify the types and components of forced warm air heating systems	Types categorized by the position of the air circulating blower or position / use of the unit
		• Low-boy
		• High-boy
		• Horizontal
		• Downflow
		• Multi-position
		• Duct furnaces
		• Attic furnace
		• Rooftop heating units
		• Indirect-fired construction heater
		Components
		• burner make/model, pump pressure, nozzle type and firing rate must be as listed on approved rating plate
		  ○ smaller burners (< 3 gph) are usually a single firing rate
		  ○ larger burners (>3 gph) may have 2- or 3-stage fixed firing rates or full modulation
		• heat exchanger configurations: primary, secondary, condensing, and wood/oil
		• venting system options include natural draft, fan-assist, induced draft, forced draft, direct vent, special venting systems (including plastic vent materials)
		• operating control is separately provided by a properly located and installed thermostat
		• air circulating fan operation provided by:
		  ○ temperature activated sensor located between furnace case and heat exchanger
		  ○ fan relay / delay timer
		• safety controls include:
		  ○ primary control for burner operation, trial for ignition, flame failure response timing
		  ○ high temperature limit switch located between furnace casing and heat exchanger
		  ○ blocked vent temperature switch located at furnace flue outlet
		  ○ air proving switches on venter motors and mechanical air supply systems
		  ○ position switches on air supply dampers and air filter door
		• Air circulating blower is usually a centrifugal (squirrel cage) design for ductwork systems and axial design for unit heaters and indirect-fired construction heaters:
		  ○ forward curve, backward inclined, double inlet and single inlet
		  ○ AC or DC motor drive types - belt, direct and drive ratio adjustments to control speed
		  ○ Motor speed options - single speed, 2 speed, multi-speed, and variable speed
		  ○ Single phase for smaller units or 3-phase for large systems
		• Air filter (passive or electronic) required on all furnaces connected to ductwork

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Assess duct design and identify safety issues applicable to forced warm air heating systems

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
24.02.01	Identify duct system types and components.	Duct system types • radial system • extended plenum system • reducing plenum system • reducing trunk system • perimeter loop system Components of a duct system and the associated issues such as: location placement, pressure drop, restriction effects and air flow requirements: • plenum, plenum take-offs / transitions / flexible duct connectors • dampers – zone control and air conditioning coil by-pass dampers, • boot types, diffusers, grilles, block ends, joist liners, risers, offsets, drive cleat, “S” cleat etc. • Pressure ratings and materials used (sheet metal, fibreboard, vinyl /flexible etc.) • Acoustical liners, insulated ducts and neoprene (flex) connectors • Air filters - electronic, electrostatic, fibreglass, pleated and high efficiency • Humidifiers - types - bypass, non-bypass, and power types • Cooling coils - A-coil and slant coil • Heat recovery ventilators
24.03.01	Identify safety and performance issues related to forced warm air heating systems	Safety issues: • Flue gas spillage (CO exposure) • Clearance to combustibles • Damaged/cracked heat exchangers Performance issues • Odours during initial activation • Noisy operation (furnace and/or duct noises) • Insufficient heat • Heat stratification – especially with room that have cathedral ceilings • Cycling on high limit • Dirty air filters and/or restricted return air opening • Uneven heat distribution

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Describe the sequence of operation for forced warm air heating systems

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.04.01	Identify the sequence of operation applicable to forced warm air heating systems with reference made to various furnace manufacturer's instructions	Normal sequence of operation for forced warm air heating systems
		• Call for heat
		  ○ Electrical contacts close on a room temperature-sensing thermostat to activate a motor. The motor may be a:
		  ▪ venter motor for a mechanical draft venting system
		  ▪ burner motor if all safety limit controls are proven safe
		• Safety limits are proven
		  ○ Before oil is permitted to flow to the nozzle, all safety control devices must be proven to be in their safe condition. Safety limits include:
		  ▪ Air flow proving devices close to prove that venter motors are operating
		  ▪ High temperature limit controls, filter door position switches, blocked vent controls, and control reset switches are all in their normally closed positions
		  ▪ Flame/ignition sensing device is open proving no flame is present
		• Purge blower and/or timer are activated
		  ○ Mechanically vented appliances may have a timed prepurge cycle to remove combustible gases from the combustion chamber before ignition occurs
		• Burner motor energized activating combustion blower and fuel unit
		• Oil pressure is delivered to the nozzle
		  ○ Pressure regulating control opens allowing oil to exit the pump at cut-in setting
		  ○ Delay action solenoid valve opens
		• Ignition transformer is energized
		  ○ Happens simultaneously with oil delivery to nozzle
		• Trial for ignition period
		  ○ Primary control incorporates a method of stopping oil flow to the nozzle if a flame or heat in the vent outlet is not sensed within a fixed time period
		  ○ For newer controls with interrupted ignition, the ignition transformer is de-energized when flame/ignition is proven or after a fixed time
		  ○ Older controls with intermittent ignition may keep the transformer energized as long as the main burner is firing. A constant-duty transformer is required.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Describe the sequence of operation for forced warm air heating systems and potential safety issues

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.04.01
 	
Continued
	Identify the sequence of operation applicable to forced warm air heating systems with reference made to various furnace manufacturer's instructions.
	
	Continued
		• Run cycle
		  ○ Pressure regulating control in fuel unit maintains delivery pressure to nozzle
		• A temperature sensor activates the air circulating blower or a timer relay contact closes to energize the air circulating blower
		• Satisfied call for heat
		  ○ Electrical contacts open on a room temperature-sensing operating control
		  ▪ Usually the burner motor is de-energized which stops the combustion blower and fuel unit from operating
		  ▪ In some cases, a solenoid valve on the outlet of the fuel unit closes stopping oil flow to nozzle but allowing the combustion blower to operate for the post-purge
		  ▪ pressure regulating control closes stopping oil flow from pump at cut-out setting
		• Post-purge cycle
		  ○ Venter motor continues to operate for a fixed time to remove flue gases from combustion chamber and vent
		  ○ In cases where the combustion blower is used for purging, the blower continues to operate for a fixed time without oil flowing to nozzle
		• Heat distribution system is de-energized
		  ○ A temperature sensing switch opens to de-energize the circulating air blower when the temperature falls below a set temperature, or a timer relay contact opens to de-energize the air circulating blower

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Identify regulatory and code requirements for installation of forced warm air heating systems

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
24.05.01	Identify and interpret code requirements applicable to forced warm air heating systems	• Determine which part of the B139 Code applies to furnace installations depending on furnace input, combined appliance inputs, building type, and supply tank size/location • Identify standards listed in the B139 Code that are necessary for proper interpretation and application of code requirements related to forced warm air heating systems • Identify terms defined in the B139 Code that are necessary for proper interpretation and application of code requirements related to forced warm air heating systems • Identify and interpret “General requirements” in the B139.1.0 Code and the “Appliance Installation” section in the B139.2 Code related to forced warm air heating systems ○ Applicability ○ Acceptable equipment ○ Responsibilities of installer ○ Workmanship ○ Suitability of equipment and chimney ○ Accessibility ○ Electrical and gas features ○ Supply of fuel oil ○ Hazardous atmosphere ○ Appliance clearance to building construction ○ Service and maintenance clearances ○ Appliance installation general requirements ○ Appliance installation in garages ○ Appliance installation outdoors (rooftop furnaces) • Identify and interpret maintenance requirements in the B139 Code specifically related to forced warm air heating systems • Identify and interpret potential conflicts between manufacturer’s instructions and B139 Code by reviewing several manufacturers’ instructions ○ Venting system conflicts ○ Combustion air supply conflicts ○ Vent termination conflicts

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Select size and location of forced warm air furnaces and assess acceptability of ductwork

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.06.01	Select size and location of forced warm air heating systems	• Furnace size determined by referencing
		  ○ Heat loss calculation (review information in Module 19)
		  ○ CFM capacity of furnace matches ductwork design requirements
		  ○ Efficiency rating of the selected furnace
		• When replacing an electric furnace, do not use the output of the electric furnace to size the new furnace
		• Do not use the input of an old fuel-fired furnace to size the new furnace
		• Appliance location:
		  ○ must allow for effective venting and air supply as per code requirements
		  ○ must allow for safe, code compliant oil supply tank and line installation
		  ○ must meet appliance clearance to combustibles and accessibility requirements
		  ○ furnaces with return and supply ductwork should be centrally located
		  ○ furnaces in garages must meet code requirements regarding height above floor and sealed return air openings
		  ○ unit heaters without ductwork must be located where they can be properly suspended and protected

24.06.02	Assess ductwork design	• New installations of ductwork require Building Code permit and must pass inspection
		• Existing ductwork installations should be professionally assessed and repaired or replaced as warranted. An OBT should consider the following factors before connecting to an existing ductwork system:
		  ○ plenum size and means of connection must meet the appliance manufacturer's requirements including clearance to combustibles above the plenum
		  ○ each room should have balanced supply and return openings sized to the room heat loss calculation with supply outlet(s) near outside walls/windows and return air inlet(s) near inside walls
		  ○ duct joints must be tight, and ducts properly supported and clean (no drywall dust)
		  ○ ducts through unheated spaces must be insulated
		  ○ vents must not pass through ductwork
		  ○ if the furnace uses indoor air for combustion or venting, there must not be a return air inlet within 1.8m (6 ft.) of the furnace

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Select and install forced air furnaces

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.06.03	Select make and model of appliance based on factors other than size and location	• After selecting the proper size and location of the furnace, other factors to consider when selecting the make and model include:
		  ○ Whether an air conditioning coil is to be installed
		  ○ Whether other add-on devices such as electronic air filters or humidifiers are compatible
		  ○ Whether there is available space and access
		  ○ Price and availability of furnace and replacement parts
		  ○ Reliability of selected make/model

24.07.01	Identify the tasks required to complete the installation of a forced warm air heating system	• Before installing a furnace in a newly constructed building, ensure that a building permit has been applied for and appropriate inspections arranged • For new or replacement installations, ensure that an electrical permit has been applied for and appropriate inspections organized • Read the manufacturer's installation instructions • Protect the appliance from damage while moving it to the installation site • Remove all packaging – especially inside the appliance • Inspect the appliance and burner for damage • Select the appropriate return air inlet connection to the furnace and use appropriate tools to cut the return air opening in the furnace • Install the air filter assembly at the inlet to the furnace as per manufacturer's instructions and connect/secure the return air ductwork to the filter assembly • Connect and secure the plenum to the furnace supply air outlet opening • Connect and secure the plenum to the ductwork • Install the complete venting system and air supply openings as per manufacturer's instructions and code requirements • Install the burner with the appropriate nozzle as per manufacturer's instructions • Ensure that the dedicated electrical circuit to the appliance and accessories is de-energized before connecting electrical power through a properly located disconnect switch to the appliance as per manufacturer's instructions and electrical code requirements • If a power venter is employed, ensure proper electrical connection and interlocks • Select and install thermostat and thermostat wiring that is compatible with the new furnace and its add-on components. • Ensure that oil supply tanks and lines are properly installed and tested (for new installations) before connecting oil supply line to burner.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Install forced air furnaces

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
24.07.01 Continued	Identify the tasks required to complete the installation of a forced warm air heating system Continued	• Check wiring connections and ensure that the combustion blower, power venter, and air circulating blower squirrel cages move freely • Energize the electrical circuit to the furnace with the thermostat contacts open • Check for proper electrical voltage and polarity at the furnace • Activate the air circulating blower and check for its proper operation • Turn up the thermostat and check operation of venter motor if so equipped – ensure it turns on and operates for the time specified by the manufacturer before the burner starts • Bleed the air from the oil supply line • Set combustion air shutter at the recommended initial setting • Allow burner to fire and ensure proper activation and flame characteristics • Shut off oil supply at burner and ensure proper burner shut down on flame failure • Advise occupants that there may be odours for a short time from the ductwork as the heat exchanger oil burns off and open doors and windows if possible. • Check/adjust oil pressure to meet manufacturer's requirements • Conduct a smoke test and adjust air shutter to achieve the desired trace smoke • Take draft readings and adjust draft control (if so equipped) to achieve desired readings • Check/adjust performance of ductwork to ensure proper flow/velocity at supply air outlets • After building reaches normal temperature and steady state operation is achieved, complete flue gas analysis and adjustments to achieve manufacturer's requirements • For natural draft venting systems, conduct a base chimney temperature test to confirm compliance with the minimum temperature given in Tables B1 / B2 or make adjustments • Test all operating and safety controls at their designed set point • Test heat rise across heat exchanger and take corrective action if it is not as recommended by the manufacturer • Test ductwork static pressures and take corrective action if they are not as recommended by the manufacturer • Record all test results and observations that prove that the appliance is in safe operating condition and apply appliance installation label as required by the Fuel Oil Regulation • Leave manufacturer's instructions with the user and instruct the user in the safe and correct operation and maintenance requirements of the appliance

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Size, design and install plenums and return air ductwork

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
24.08.01	Size and design a plenum and return air duct with an air filter assembly to meet furnace manufacturer's specifications and installation conditions	• For new installations of ductwork, the following measurements and design features must be provided to the sheet metal worker installing the ductwork ○ Outlet opening size, position, and height of the supply air opening on the furnace ○ Inlet opening size, position, and height of the return air opening on the furnace ○ Inlet opening size and position of the air filter assembly ○ Whether an air conditioning coil and or humidifier will be employed • For existing ductwork installations, transition ductwork may be required to connect existing ductwork to the new supply and return opening size, position, and height for the new furnace • Read and interpret furnace manufacturer's instructions regarding ductwork configuration and design requirements/options. • Use tape measure, plumb line, set square, straight edge, and other associated measuring tools to determine size, shape and dimensions of fittings required to connect existing ducting system to replacement furnace, filter humidifier etc..
24.08.02	Select and use sheet metal components, tools, and procedures to join ductwork to the furnace	• Sheet metal tools include snips, folders, benders, "S" cleats, drive cleats, flexible connection material, hand tools • Describe proper selection and use of sheet metal tools to join plenums and return air ducts to various configurations of forced air furnaces.
24.08.03	Identify restriction points in a duct system and effects of restrictions.	• Restrictions include: ○ return air blockage, undersized ducting, dirty air filtration device, blocked cooling coil and improperly positioned dampers, dirty/clogged blower • Effects of the various restrictions ○ High temperature limit trip ○ Damage to heat exchanger ○ Reduced comfort levels and system efficiencies ○ Increased amp-draw on blower motor causing motor damage, increased electrical costs

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Understand heat loss/gain requirements as applicable to forced warm air heating system performance

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.09.01	Apply knowledge of heat transfer theory for heat gain/heat loss requirements.	• Types of heat transfer
		  ○ conduction, convection, radiation, evaporation, and condensation
		• Factors affecting heat transfer rates
		  ○ area, temperature difference, thermal conductivity, infiltration, ventilation,
		  ○ transmission loads, solar loads, interior loads (people, lights, and equipment)
		• U values and R values
		• latent heat and sensible heat (including formulas) for heat addition and removal
		• British Thermal Units (BTU) and tons
		• Temperature readings such as Fahrenheit, Celsius, and absolute

24.09.02	Describe air properties and characteristics.	• Enthalpy (heat content), specific volume, density, and standard air conditions • moisture content in air, saturation, dew point, relative humidity, grains, and pounds of water • air flow requirements (CFM) for heating and cooling applications • improper air flow affects - noise, comfort levels, duct sizing, temperature rise across heat exchangers and temperature difference across cooling coils • recommend existing approved courses for individuals who wish to perform heat loss - heat gain calculations. (HRAI or OEL)
24.10.01	Define manufacturer specifications for air handling devices (air circulating blower) and components.	• type of air handler (top discharge, bottom discharge, side discharge etc.) • type of blower assembly (direct drive, belt drive, draw through, blow through, single outlet and double inlet) • type of blower (forward curve, backward curve, air foil, propeller etc.) • maximum RPM or CFM ratings, horsepower, and static pressure relationship • lubrication requirements (intervals and type of lubricant) • belt tightness and replacement criteria (cracks, wear, type, matching set) • pulley and belt alignment

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Service air circulating blowers

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
24.10.02	Describe servicing procedures for air circulating blowers.	• removal and replacement of motor (belt drive and direct drive) • removal and replacement of blower assembly (shaft, blower, pulley, belt, motor alignment) • blower bearing removal and alignment • disconnect and reconnect electrical harness
24.10.03	Demonstrate electrical wiring techniques for air circulating blowers.	• motor speed change for direct drive motors and 2 speed belt drive motors • capacitor removal and connection • motor reversal connections • relay connection for speed control
24.10.04	Define manufacturer variable speed controls for air circulating blowers.	• electronically controlled (infinite control) • multi-tap control using relays (preset control)
24.10.05	Define drive ratios for air circulating blowers.	• fixed pulley combinations • variable pulley (sheave) combinations • affects due to motor/blower pulley diameter change • calculation of motor to blower diameter/speed ratios
24.10.06	Define motor requirements for air circulating blowers.	• shaft diameter and length • body diameter and mounting configuration • motor speed and rotation • current draw and horsepower requirements • affects due to add-on devices - cooling coil, air filtration devices and restrictions

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Test and adjust performance of air circulating blower and ductwork

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
24.11.01	Describe and identify the terms and measurement tools for testing air flow and ductwork performance.	• Air flow terms ○ CFM ○ Velocity ○ static pressure ○ total pressure ○ velocity pressure ○ external static pressure ○ pressure drop • Air measurement tools: ○ Velometers and anemometers ○ Thermometers ○ Manometers and Magnehelic Gauges
24.11.02	Describe testing methods for assessing air flow and ductwork performance and corrective action.	• Temperature rise test ○ Test port locations ○ Comparing test results to manufacturer's specifications and interpreting differences ○ Adjustments to achieve manufacturer's recommended • Total external static pressure test ○ Test port locations ○ Comparing test results to manufacturer's specifications and interpreting differences ○ Adjustments to achieve manufacturer's recommended • Pressure drop tests across air filter and across air conditioning coil ○ Test port locations ○ Comparing test results to manufacturer's specifications and interpreting differences ○ Adjustments to achieve manufacturer's recommended • Room temperature and air flow rate balancing tests ○ Test locations ○ Comparing test results to room heat loss calculation and interpreting differences ○ Adjustments to air flow for each room to match calculated heat loss

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced Warm Air Heating Systems **Prerequisite(s):** Module 17 to 23 **Estimated theory hours**: 24

Task: Clean, maintain, and troubleshoot problems with forced warm air heating systems

Module 24	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

24.12.01	Describe procedures for cleaning and maintaining forced warm air heating systems.	• Comply with furnace manufacturer's instructions regarding maintenance.
		  ○ Review the maintenance sections in two or more manufacturer's instructions to identify differences and similarities of recommended maintenance procedures
		• Comply with B139 Code requirements regarding maintenance.
		  ○ Review Annex L in the B139 Code entitled "Maintenance – Residential Installations". Note that the Annex is identified as "normative" (i.e. mandatory) and Section 12 of the B139.2 Code states: "*Oil-burning equipment shall be inspected and maintained in accordance with the manufacturers' recommendations and to at least the minimum requirements in accordance with Annex L of CSA B139.1.0."* As such, Annex L is mandatory for residential installations.

24.13.01	Apply procedures covered in Module 22 and in furnace manufacturer's instructions to troubleshoot problems in forced warm air heating systems	• Read and interpret furnace manufacturer's instructions regarding troubleshooting.
		  ○ Review the troubleshooting sections in two or more manufacturer's instructions to identify differences and similarities of recommended troubleshooting procedures
		  ○ Review the sequence of operation information provided in manufacturer's instruction and identify how it can be used for troubleshooting
		• Practical exercises for this Module will confirm the student's ability to apply troubleshooting procedures and tools to troubleshoot problems in forced warm air heating systems

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced warm air heating systems **Prerequisite(s):** Modules 17 to 23 **Estimated practical hours**: 24

Performance objective: Identify components on forced warm air heating systems

Module 24	Practical		
	Scenario	**Procedure**	**Criteria**
24.14.01	The student will identify the components on old and new forced warm air heating systems including their location, function, and operation. Equipment: • old and new forced warm air heating systems or test boards • hand tools necessary to access components.	The student will identify the location and state the function and operation of components on old and new forced warm air heating systems such as: • air circulating blower (type and features) • fan operating controls • high limit • blocked vent switch • operating control/thermostat (types and features) • air cleaner (type and features) • plenum and return air ductwork • vent (type and features) • power venter (type and features)	The student must reliably demonstrate the ability to recognize the location and function of various components on old and new forced warm air heating systems.
24.14.02	Examine heat exchangers for damage and state corrective action required. Tools & Equipment • Standard, mid-, and high-efficiency furnaces • Furnace with cracked heat exchanger • inspection mirrors • Hand tools	The student will examine heat exchangers on a variety of forced warm air heating systems and: • Identify heat exchanger sections (primary, secondary, tertiary) • show or describe how to identify defective heat exchangers e.g.: removal of fan assembly, access to top, removal of burners, use of mirrors, smoke generator as permitted by manufacturer, CO tester, CO_2 / O_2 tester • describe action to be taken if a cracked heat exchanger is found	Students to show knowledge of heat exchangers sections and how to check heat exchangers for damage. • correct procedure followed to determine if heat exchange is cracked • correctly describe what is required if crack is found in a heat exchanger

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced warm air heating systems **Prerequisite(s):** Modules 17 to 23 **Estimated practical hours**: 24

Performance objective: Complete electrical connections to forced air furnace and troubleshoot electrical faults

Module 24	Practical		
	Scenario	**Procedure**	**Criteria**
24.15.01	Student will wire a furnace as per manufacturer's instructions as directed by the instructor Tools & Equipment • forced air furnace with instructions • Multimeter • Electrical panel • Amoured cable and wire connectors • Disconnect switch	Student will: • Select the appropriate PPE and electrical meter functions for each task • Identify designated circuit for furnace (must have separate circuit) • Connect electrical wires through a disconnect switch to the burner, furnace, and any associated components such as thermostat, venter motors, electronic air cleaner, humidifier, condensate pump • Identify amperage draw from rating plates and identify appropriate overload protection • Activate the furnace and confirm proper operation of all electrical components	All work must be done neatly and safely. Proper PPE must be selected and properly employed. Ensure students have knowledge to safely hook up furnaces to electrical supply • correct wire and overload protection • furnace circuit identified on panel • phasing is correct • safe and proper procedure used to activate furnace and assess electrical components
24.15.02	Student will troubleshoot electrical problems on a forced warm air heating system or test boards using a wiring diagram and sequence of operation Tools & Equipment Have furnaces or test boards with fault switches wired in to simulate: • tripped overload protection • broken neutral wire • open thermostat • inoperable venter motor • faulty transformer (step-up & step-down) • open high limit • open blocked vent switch • faulty fan control • faulty air circulating blower • faulty primary control • faulty cad cell	Student will read the manufacturer's instruction for the furnace or test board to find the electrical drawing(s) and information on the sequence operation. The student will troubleshoot a minimum of 10 faults as assigned and either correct or identify the proper action to correct the problem	All work must be done neatly and safely. Proper PPE must be selected and properly employed. The instructor will watch the student troubleshoot each fault and evaluate the student's performance based on: • use of sequence of operation to focus troubleshooting approach • use of wiring diagram to focus troubleshooting approach • safe and proper use of electrical test instruments • correct and timely identification of each fault • complete or describe corrective action to be taken

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced warm air heating systems **Prerequisite(s):** Modules 17 to 23 **Estimated practical hours**: 24

Performance objective: Service mechanical components on forced air furnaces

Module 24	Practical		
	Scenario	**Procedure**	**Criteria**
24.16.01	Perform mechanical tests on an operational furnace Equipment: One or more operational furnaces Temperature measuring devices Pressure measuring devices mirrors, hand tools Flashlight or trouble light Heat exchanger leak test equipment (if available)	Instructor should demonstrate the following tests and then have each student repeat the tests on other furnaces Test: • temperature rise across the heat exchanger • total external static pressure test in the duct • check for cracked heat exchanger • safety checks, ○ high temperature limit ○ blocked vent switch ○ door switch (if applicable) ○ venter safety devices (pressure switches, interlock with burner, etc.) ○ air supply opening interlock (if applicable)	All work must be done neatly and safely. Proper PPE must be selected and properly employed. Students to demonstrate the ability to correctly check temperature rise, duct pressures, heat exchanger condition, safety controls, and show an understanding of the purpose of these tests and how to interpret the results.

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced warm air heating systems **Prerequisite(s):** Modules 17 to 23 **Estimated practical hours**: 24

Performance objective: Install and service a fan centre on forced air furnaces

Module 24	Practical		
	Scenario	**Procedure**	**Criteria**
24.17.01	This test will determine the student's ability to install, connect, and service fan centres to provide two speed operation for belted fan motors in appliances. The student will be provided with: • all tools and materials required, • a fan centre • a test board or appliance for installation of the fan centre.	The student will be given either a simulator or an actual appliance to modify. There will be a single speed belted fan motor installed. The student will be required to install a two-speed belted fan motor (may be simulated) and a fan centre (relay transformer). The motor will be wired to run continuously on low speed when the appliance power is turned on. The motor must go on to high speed either on a call for cooling (if equipped) or when the motor is energized on a call for heating.	All work must be done neatly and safely. Proper PPE must be selected and properly employed. The fan centre must be properly secured and all wiring to and from the centre must be properly sized and installed. The low speed of the fan motor must come on when the furnace switch is closed and must run continuously. On a call for cooling (if equipped), the fan motor must immediately switch to high speed. On a call for heating, the fan motor must switch to high speed either when the fan switch closes on temperature rise or as specified by the equipment manufacturer (i.e. time delay rather than temperature initiation).

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced warm air heating systems **Prerequisite(s):** Modules 17 to 23 **Estimated practical hours**: 24

Module 24	Practical		
	Scenario	**Procedure**	**Criteria**
24.18.01	The student will design and size a plenum and return air connection with an air filter assembly to meet furnace manufacturer's requirements and demonstrate proper sheet metal procedures for installing a plenum and return air duct to a furnace and ductwork Tools & Equipment Plenums, plenum take off's, filter rack, snips, folders, benders, "S" cleats, drive cleats, flex connector, hand tools, forced air furnace with manufacturer's instructions	Instructor will demonstrate how to size and design a plenum and return air duct with an air filter assembly to meet manufacturer's specifications and installation conditions and how to install the plenum and return air duct with an air filter assembly to the furnace. The student will repeat the sizing and design for an appliance in the shop or based on information provided by the instructor and provide a drawing of the plenum and return air duct design The student will repeat the installation procedure for an appliance in the shop.	Each student will be assessed based on: • The accuracy and completeness of the design drawings for the plenum and return air connection through an air filter • Safe and proper use of tools to prepare the plenum and return air duct with filter assembly for connection to the appliance. Proper PPE must be selected and properly employed. • The quality and completeness of the complete the plenum and return air connection through an air filter

Performance objective: Design and install a plenum and return air duct on a forced air furnace

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced warm air heating systems **Prerequisite(s):** Modules 17 to 23 **Estimated practical hours**: 24

Module 24	Practical		
	Scenario	**Procedure**	**Criteria**
24.19.01	The student will service direct drive and belt driven fan assemblies Tools & Equipment • Forced air furnace with a direct-drive fan assembly • Furnace with a belt-driven fan assembly • Multimeter • Tachometer • Hand tools	Student will remove each fan assembly from the furnace and: • identify fan assembly type (direct or indirect drive) • demonstrate an understanding of the purpose and potential service issues related to fan blades, belt, motor position, pulley, pulley positions, and belt tension • check belt tension, adjust pulley • take adjustable pulley apart • demonstrate an understanding of rpm and pulley sizing. i.e.: 1 turn of motor pulley in relation to fan pulley ○ if 1 to 3 motor speed $\frac{1750}{3}$ = 587 rpm for fan • explain effects of motor speed on unit ○ i.e.: increase or decrease temperature rise, efficiency of unit • demonstrate an understanding of the purpose and potential service issues related to rubber grommets on fan and tension hold down • identify motor type, horsepower, frame number, and rotation from nameplate to determine correct replacement • dismantle all components of blower: bearings, shaft, motor, pulleys, and belts. • clean and reassemble blower assembly • reinstall blower assembly in furnace • check for correct wiring, rotation, motor grounding, and amperage draw. • Test under load	All work must be done neatly and safely. Proper PPE must be selected and properly employed. Students to demonstrate: • an understanding of the purpose and service issues related to fan assembly components and how to interpret the results. • an understanding of rpm and pulley sizing • fan assembly is clean, oiled if necessary, belts and pulleys are aligned correctly. • belt tension is correct • proper selection and installation of a new filter, or clean permanent type filter

Performance objective: Service direct drive and belt driven fan assemblies

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Install air cleaners

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

25.01.01	Describe types, operation, and purpose of air cleaners or filters.	Types of air cleaners:
		• Electronic
		  ○ major components: pre-filter, ionizing section, collector section, power section, flow sensor
		  ○ ionizes particles to ensure they are removed from the air and deposited on collector plates.
		  ○ requires electrical hook-up
		  ○ produces low levels of ozone
		• Electrostatic
		  ○ layers of filtering material create a static charge as air flows through the filter
		  ○ electrical hook-up not required
		• Mechanical (Media filters)
		  ○ usually a disposable fibreglass medium in a cardboard frame or secured in hammock frame
		  ○ pleated disposable HEPA filters employ medium similar to blotting paper which is more effective but causes greater resistance
		Different cleaners remove different types and sizes of contaminants (mold spores, bacteria, viruses, pet dander and dust, harmful gasses, and odours like cigarette smoke).

25.02.01	Describe the installation location and procedures to install air cleaners	Type of air cleaner used is determined by the application • must filter the entire return air stream • must have minimum acceptable restriction to air flow. • sized for proper air flow • in return air duct upstream of cooling coil and upstream of humidifier wherever possible • installed as per manufacturer's specifications

25.03.01	Explain the impact of air cleaner on air flow.	• As filter loads up, air volume decreases
		  ○ system static pressure decreases
		  ○ high limit may trip on heating cycle
		  ○ freeze-up problems on cooling cycle

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Install air cleaners

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

25.04.01	Describe the sheet metal modifications necessary to install an air cleaner	• filter racks must be the correct size
		• must not interfere with air flow or insertion/removal of air filter
		• must determine:
		  ○ return air plenum size
		  ○ dimensions of electronic air cleaner
		  ○ distance between supply and return air plenums to facilitate fabrication of offset transition
		• transitions for electronic air cleaners must be as gradual as possible to ensure optimum air flow through cleaner

25.05.01	Explain the electrical procedures required for the installation of an air cleaner.	• air cleaner must be centred in air stream as much as possible • wired in parallel with the circulating fan motor • wired to high speed of belt-driven fan motor • ozone and effects

25.06.01	Explain how to position the air cleaner according to manufacturer's specifications	• air cleaner must not be installed immediately after an elbow unless turning vanes are incorporated in the elbow
		  ○ uneven air distribution through air cleaner
		  ○ reduced air cleaner efficiency

25.06.02	Confirm the operation of the air cleaner	• power indicator light operational • air proving switch operational • test component such as test button or efficiency light indicates unit is operational

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Maintain air cleaners

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
25.07.01	Instruct the customer on operation and cleaning procedures	• show customer power switch and test component (if equipped) • show customer installation and removal procedure for pre-filters and electronic cells • advise customer to clean filters and cells according to manufacturer's instructions
25.07.02	Describe cleaning agents that meet manufacturer's specifications	• Review cleaners as listed in various manufacturer's literature
25.07.03	Describe manufacturer's recommended cleaning/replacement procedures.	• Average cleaning frequency - weekly for first month then monthly o dishwasher o bath • Rinsing procedure o ensure electronic cells are thoroughly dry before re-establishing power to unit • Disposable filters must be replaced, not cleaned and reinstalled o mineral oil comes off with dirt o if filter is reinstalled, efficiency is negligible, and dirt passes through the filter. • Reusable filters must be thoroughly cleaned with detergents and, if applicable, re-oiled as per manufacturer's instructions before reinstalling. o if re-oiled in place, oil ends up on blower assembly and on heat exchange surfaces
25.07.04	Service different types of air cleaners	• Describe service procedures for: o mechanical (media filters) o electronic o electrostatic
25.07.05	Remove air cleaner components and reassemble air cleaners.	• As per manufacturer's specifications o electronic cells and ionizing wires are very delicate o must be handled with extreme caution o power door must be replaced accurately and securely
25.07.06	Ensure electronic cells are discharged before removing and servicing	• As per manufacturer's specifications

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Service electronic air cleaners

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
25.08.01	Describe the operation of electronic air cleaners.	• primary voltage • secondary voltage • ionizing process

25.08.02	Service the principle components of an electronic air cleaner.	• Procedures to service major components such as:
		  ○ high voltage transformer
		  ○ air proving switch
		  ○ system switch
		  ○ indicator light
		  ○ ionizing wires
		  ○ collector plates

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Identify purpose, types, and components of humidifier

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

25.09.01	Describe the principles and effects of indoor humidity	• indoor humidity levels change due to:
		  ○ outdoor temperature and moisture levels
		  ○ occupants, cooking, laundry, showers/baths, plants, pets, building materials, furnishings
		• dry indoor air causes occupant discomfort/health problems, damage to structure and furnishings, and increased heating costs

25.09.02	Measure and interpret relative humidity	• Define relative humidity, dew point, enthalpy, humidity ratio. desirable relative humidity levels • Use and interpretation of readings using a sling psychrometer or electronic psychrometers
25.10.01	Identify and describe different types of humidifiers and their components.	• Bypass humidifier • Non bypass humidifier • Wick type humidifier • Drum type humidifier • Flow through type humidifier • Atomizing (spray) type humidifiers • Steam humidifiers • Ultrasonic
25.10.02	Identify humidifier components and their function	• Humidistat • Water connection • Air connections • Electrical connections • Float mechanism • Drum motor • Water solenoid valve • Water saving control • Evaporator parts

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Install humidifier

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
25.11.01	Describe sheet metal modifications and procedures to install humidifiers	• Number and location of openings required • Size(s) of opening(s) • Review procedures listed in various manufacturer's instructions
25.11.02	Describe water connection installation procedures to install humidifiers	• Use of self-tapping saddle valve into copper lines • Use of tee connections with valve into copper or plastic lines • Tubing type, size and configuration • Review procedures listed in various manufacturer's instructions
25.11.03	Describe humidistat installation/ wiring procedures to install humidifiers	• Location of humidistat and outdoor temperature sensor (if applicable) • Transformer type, size, and connections • Wire type and size • Connection to furnace integrated control (if applicable) • Review wiring procedures listed in various manufacturer's instructions
25.11.04	Confirm proper operation of humidifier	• Operational inspections as per manufacturer's specifications : ○ water level correct ○ float valve assembly working and adjusted properly ○ humidistat working ○ drum turning ○ atomizing ○ steam generating

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Clean humidifier

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

25.12.01	Describe the manufacturer's recommended cleaning procedures.	• As per manufacturer's specifications
		  ○ chemicals in humidifier pan to prevent scaling
		  ○ humidifier pad must be kept clean to permit proper absorption and evaporation of water
		  ○ replace humidifier pads when necessary

25.12.02	Instruct customer on replacement and cleaning procedures	• As per manufacturer's recommendations

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated theory hours:** 12

Task: Maintain cooling coil

Module 25	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
25.13.01	Maintain an add-on indoor heating or cooling coil.	• Check coil for cleanliness ○ Reasons: ▪ reduced air flow to space ▪ increased temperature rise across furnace ▪ reduced efficiency, increased stack temperature ○ Check ▪ visually ▪ cut inspection port in plenum ▪ pressure drop across coil ▪ check static pressure drop across coil ▪ clean indoor coil ▪ check and clean condensate drain

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated practical hours**: 10

Performance objective: Install electronic air cleaner.

Module 25	Practical		
	Scenario	**Procedure**	**Criteria**
25.14.01	The student will measure the existing plenum, determine the dimensions of the air cleaner, and design and sketch the transition(s) required to install an electronic air cleaner on a forced air appliance. The student will be provided with a forced air furnace, tape measure, installation instructions for the air cleaner, the appliance manufacturer's electrical drawing for the forced air furnace, and the tools necessary to install the electronic air cleaner.	The student will measure the return air ductwork both horizontally and vertically, determine the overall dimensions of the accessory device to be installed, and determine the dimension between the supply and return plenum. With these dimensions the student will design the necessary transition piece(s) and produce a neat, dimensioned sketch of the material required. This sketch must be suitable for a third party to fabricate the required piece(s). The air cleaner must, as much as possible, be centred in the ductwork, as far from elbows as possible, and the transitions from ductwork to the air cleaner and back to the ductwork must be as gradual as possible to ensure correct and even air flow across the face of the air cleaner. The student will receive the transition pieces s/he designed and will use these to install the air cleaner on the appliance. The student will use the appliance manufacturer's electrical drawing to indicate where the line voltage connections would be made to tie in the air cleaner.	All work must be done neatly and safely. Proper PPE must be selected and properly employed. The student will be evaluated for both process and final product. A checklist should be used as an evaluation tool and will include the following items: • Were correct ductwork measurements taken? • Were correct air cleaner measurements taken? • Have transition angles been minimized? • Is sketch neat and accurately dimensioned? • Is the overall height of the transition acceptable? • Does transition fit furnace and air cleaner? • Does the installed air cleaner interfere with other equipment? • Is the installed air cleaner fully serviceable?

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated practical hours**: 10

Performance objective: Service electronic air cleaners

Module 25	Practical		
	Scenario	**Procedure**	**Criteria**
25.14.02	The student will assess whether an electronic air cleaner is operating properly. The student must show knowledge of the component parts, explain their purposes, and determine if the electronic air cleaner is producing the correct output voltage. The student will be given the following materials to perform the task: • electronic air cleaner • voltmeter with high voltage probe • ohmmeter	Student will check and confirm the operation of components such as: • high voltage transformer • air proving switch • system switch • indicator light • ionizing wires • collector cells	All work must be done neatly and safely. Proper PPE must be selected and properly employed. Student must ensure the primary and secondary voltages are within acceptable tolerances. The air proving switch must be checked to ensure it opens on insufficient air flow. Ionizing wires should be inspected visually for: • tightness • kinks • corrosion • breaks • short circuits Collector cells should be checked for: • spot burns • cracks or holes in insulators

PARTNERING FOR A SAFE ONTARIO

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Forced air add-on devices **Prerequisite(s):** Modules 18, 20, 24 **Estimated practical hours**: 10

Performance objective: Install and service a humidifier

Module 25	Practical		
	Scenario	**Procedure**	**Criteria**
25.15.01	The student will prepare to install a power bypass humidifier on a particular appliance. The student will be provided with the following materials to perform the task: • power bypass humidifier with installation instructions. • measuring tape • straight edge • manufacturer's electrical pictorial for the forced air furnace	The student will: • determine component locations and mark the opening locations on ductwork. • Explain the procedure to mount the components • Explain how to install the low voltage transformer, the humidistat, and make water connections. • Indicate on the electrical drawing where line voltage electrical connections are to be made.	• Openings must be of the correct size and in the proper locations. • The humidifier scribe lines must be level and square. • The explanation for the electrical connections must be complete and the procedure described must be safe. • The scribed humidistat location must be in the return air ductwork, ahead of the humidifier connections.
25.15.02	A power humidifier must be inspected and a report generated with regard to its overall condition. The student will be provided with the following materials to perform the task: • power humidifier • power supply for low voltage (24 volt) transformer.	Student will: • identify all components • determine the condition of the components • make recommendations regarding repairs required	The student will • correctly identify the major components. • accurately determine the condition of the components. • correctly describe the required procedure to repair the humidifier. • complete a written report which will detail the condition of the equipment and make recommendations for repairing the unit.

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OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe the responsibilities of an installer

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.01.01.	Identify, interpret, and apply the responsibilities of an OBT-2	**NOTE: As indicated by the prerequisites for this Module, this final Module in the OBT-2 course is designed to confirm and build upon the knowledge and skills developed during the course. Previous Modules have covered installation, troubleshooting and servicing for specific appliance types or components. This Module takes a more general approach with more attention paid to the burner, combustion set-up, and leaving the appliance in a safe operating condition.** • Review the responsibilities of an installer as identified in the B139 Code and discuss the challenges posed by these requirements and how the OBT-2 can prove compliance: ○ the installer shall ensure that the equipment is in safe working order by activating the appliance. ○ The installer shall ensure that the work they conduct complies with the Code and that the oil-burning equipment is ready for safe use ○ The installer shall instruct the user in the safe and correct operation of equipment ○ Requirements when converting from a different energy source to oil ○ Requirements when converting from oil to a different energy source (see 6.6 of B139.1.0 and 6.8 of B139.2 Code) ○ Responsibilities when replacing a part ○ Responsibilities regarding suitability of equipment and chimney ○ Requirement to comply with the CSA B214 Installation Code for Hydronic Heating Systems when installing or servicing a water heater that is part of a hydronic system ○ Responsibility to comply with the Electrical Code and Plumbing Code • Review the responsibilities of an OBT-2 given in the Fuel Oil Regulation and discuss the challenges posed by these requirements and how the OBT-2 can prove compliance: ○ Requirement to register as a contractor if the OBT meets the definition of a contractor ○ Responsibilities regarding equipment approval ○ Requirement to leave a record of identification after installing a tank or appliance ○ Requirement to notify TSSA regarding “dangerous occurrences” ○ Responsibilities regarding “unacceptable conditions”

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe the legal and practical requirements related to converting an appliance from another energy source to fuel oil

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content

26.02.01.	Identify, interpret, and apply the legal and practical requirements related to converting an appliance from another energy source to fuel oil	• Legal requirements concerning conversions:
		  ○ TSSA field approval is required if the appliance rating plate does not identify the make and model of oil burner selected for the conversion
		  ▪ Review amended Section 5 of the B139.1.2 Code
		  ○ For appliances approved for use with either gas or oil burners, use a burner (make, model, firing rate, oil pressure, nozzle features) listed on the appliance rating plate and follow manufacturer's instructions for installation and set-up of the new burner
		  ○ No matter whether the conversion is field approved or pre-approved for conversion to oil by the appliance rating plate, the entire appliance installation must meet code requirements in effect at the time of conversion – i.e. not the requirements when the appliance was installed
		  ○ Conversions in park model trailers and recreational vehicles must comply with the Z240 and Z241 codes
		• Practical considerations concerning conversions that meet the above legal requirements:
		  ○ Physical condition of the heat exchanger and combustion firing chamber
		  ○ Can the legal and practical requirements for installing an oil tank and oil lines be met at the site?
		  ○ Efficiency of converted appliance and its ability to meet the current heat loss requirements of the building or the domestic hot water needs of the occupants
		  ▪ Would it be more cost effective to install a new, higher efficiency oil-fired appliance?
		  ○ Is the heat distribution system (ductwork or hydronic system) satisfactory?
		  ○ What changes (if any) are required to the venting system?
		  ▪ Chimney/vent size and construction must meet the requirements of the B139 Code
		  ▪ A base tee is required for a chimney liner or L-vent – unlike for gas installations
		  ▪ B-vent and aluminum chimney liners cannot be employed for venting oil appliances
		  ▪ Draft regulators must be changed to single-acting (gas are double-acting)
		  ○ What changes (if any) are required for the supply of combustion and ventilation air?
		  ○ Clearances from combustibles are often larger for oil-fired appliances
		• Discuss how the above legal and practical considerations apply to the installation of a new oil-burner that is not listed on the rating plate of the oil appliance
		• Discuss how the above legal and practical considerations apply to an OBT-2 who is servicing an appliance that has been converted by someone else.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe the factors affecting the selection of appliances and replacement components

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.03.01	Identify the factors affecting the selection of oil burning appliances	• Factors that should be considered when selecting or recommending an appliance ○ The purpose of the appliance – e.g. room heat, multi-room heating, potable or non-potable water heating, generate electricity, industrial process applications. ○ Other functions or goals that the appliance is required to achieve e.g. air conditioning as well as heating, emergency heat during power outages, meet environmental emission requirements, fast operation ○ Other issues the owner identifies as important – e.g. humidity control, air filtration, quiet operation, fuel efficiency, ○ Where the appliance is installed – e.g. residential, commercial, or industrial building, indoors or outdoors, available space in building, can clearance to combustibles be met, can venting and air supply requirements be met ▪ For indoor appliances, apply the building-as-a-system approach to assessing the building - size and construction of the building (heat loss calculation), outside environment effects, building envelope effects, flue and ventilation effects, occupants' effects • Applying the above factors will narrow the selection options to the type, size, and location of the appliance and add-on equipment. The factors affecting the choice of make and model include: ○ Does it meet the factors identified above? ○ Reliability and availability of the appliance and its components ○ Price
26.03.02	Identify the factors affecting the selection of replacement components	• Replacement components should have the same make, model, features of the component that was originally approved with the appliance. Do not assume that the component requiring replacement is the originally approved component. • Check manufacturer's instructions and rating plate to determine if a different component from the one originally approved with the appliance can be used for replacement. ○ Note: *Many parts have been designated non-interchangeable because they affect the appliance's certification* • If the same make/model of component originally approved with the appliance is not available and if the component can be replaced without voiding the appliance approval, the replacement component must provide operational characteristics at least equivalent to the original part. ○ Must be certified for the purpose and tested to prove it is at least equivalent ○ Component manufacturer's instructions must be left with the appliance

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe the steps required for the initial activation of an appliance or component

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.04.01	Identify the steps required for the initial activation of an oil burning appliances	• The technician conducting the initial activation must ensure that the complete installation is ready for initial activation – whether they installed the equipment or not ○ Tank(s) and fill/vent lines are properly installed as per manufacturer's instructions and Code ▪ Inspect existing tanks to ensure they are in good condition and meet the code requirements at the time of their installation ▪ Leak test new tanks as per manufacturer's instructions and Code ○ Oil supply/return lines and associated components (valves, filters, de-aerators etc.) are properly installed as per code requirements ▪ Inspect existing oil lines to ensure they are in good condition, leak free, properly sized, and meet the code requirements at the time of their installation ▪ Leak test new oil lines pneumatically or wait to conduct vacuum test during activation ○ Appliance, venting system, associated accessories, air supply openings nozzle size/type, burner insertion/mounting are properly installed as per manufacturer's instructions and Code ○ Electrical supply and appliance wiring meet all requirements ○ Distribution system properly installed and ready for use ▪ Ductwork is clean and filter is in place for forced air heating systems ▪ Water tank, boiler, and associated piping are full of water and leak free ▪ A qualified electrician has confirmed that a generator is ready for activation ○ All tools and instruments (gauges, flue gas analysis equipment, mirrors, hand tools, etc.) are available and ready for use. ▪ Appropriate gauges must be installed properly on the fuel unit and it is recommended that a valve be installed between the pump and drawer assembly for the initial activation • After ensuring that the complete installation is ready for initial activation, the technician should ready themselves mentally for conducting the activation by taking the approach that: ○ An unsafe condition could occur at any time since the appliance has not been activated previously – the technician's focussed attention without distractions is required ○ Assumes that one or more problems exist and that it is their role to find and correct those problems so they can prove with recorded tests and observations that the appliance is in safe working order and ready for safe use. • The steps and the order they are taken in to initially activate an appliance will vary with the type of appliance and installation. For a furnace, boiler or water heater, the steps may include: ○ Read the manufacturer's start-up instructions ○ Supply power to the appliance without a call for heat

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe the steps required for the initial activation of an appliance or component

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.04.01 Continued	Identify the steps required for the initial activation of an oil burning appliances. Continued	Continued - steps and the order they are taken in to initially activate an appliance include: ○ Check voltage and polarity at the appropriate points ○ Close the recommended valve between the pump and nozzle to ensure no oil is delivered to the combustion chamber until required ○ Create a call for heat and ensure that the sequence of operation is proper before the burner motor is activated (i.e. venter motor, if so equipped, operates for the appropriate time; circulating pump, if so equipped, operates before the burner starts; and the delay oil valve, if so equipped, opens at the appropriate time) ○ Bleed air from the supply line and confirm that the trial for ignition time is correct. This may require a few cycles. Check outlet pressure after bleed valve is closed. ○ Close the tank supply valve and conduct a vacuum leak test of the oil line if a pneumatic test was not previously been conducted. Open tank valve after test. ○ If appliance is equipped with a venter motor, test the air proving device to ensure that the burner motor does not start if the air proving switch is open. Discuss the various ways to test the air proving device. Return device to normally operating condition after test. ○ If the installation includes a circulating pump with a flow switch, test the flow proving device to ensure that the burner motor does not start if the flow switch is open. Discuss the various ways to test the flow proving device. Return device to normally operating condition after test. ○ Open valve in line between pump and drawer assembly (if installed for test purposes) ○ Set air shutter on burner at recommended initial setting ○ Activate burner and pay close attention to how the burner fires. It is recommended that the technician stand away from the appliance during this initially firing of the burner. ○ Once the flame is lit, observe the flame characteristics and outlet oil pressure. ○ Adjust oil pressure to match rating plate requirements and adjust air shutter to achieve the appropriate flame characteristics. ○ If a sampling port has not been prepared at the flue outlet, prepare one now. Note: do not drill a hole in a positive pressure venting system; follow manufacturer's instructions regarding the flue gas analysis sampling method. ○ Take a smoke reading to confirm that the flame characteristics will allow for safe operation during the rest of the initial activation tests. Adjust air shutter setting to achieve a trace smoke ○ Take an overfire draft reading (if possible) and adjust draft regulator, if so equipped, to achieve the draft reading given on the rating plate. ○ Take a breech draft reading and compare it to the rating plate reading. If the draft regulator was not adjusted based on the overfire draft, adjust it now to achieve the required breech draft

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.04.01 Continued	Identify the steps required for the initial activation of an oil burning appliances. Continued	Continued - steps and the order they are taken in to initially activate an appliance include: ○ If the appliance is equipped with an air circulating blower, ensure that it comes on at the set temperature or time specified by the manufacturer. ○ End the burner operation by shutting off the valve between the pump and drawer assembly, if so equipped, or removing a cad cell wire to simulate a flame failure and ensure that the shutdown sequence is as specified by the manufacturer: ▪ flame failure response time is correct ▪ burner shuts down but circulating blower or pump continues until the set temperature or time specified by the manufacturer is achieved ▪ venter motor continues to operate for the specified post purge, ▪ primary control locks out or recycles as per manufacturer's specifications, etc. ○ Create a second call for heat and confirm that the startup sequence is correct and the flame characteristics are acceptable. ○ While waiting for the system to reach steady-state efficiency, ensure safety and limit controls will operate properly at the correct temperature or pressure, or both, and operating controls are in satisfactory condition ▪ Discuss appropriate methods of testing high temperature switches, blocked vent switches, low water cut-offs, air and/or water flow switches for sufficient flow, pressure relief devices, position switches, etc. ○ After system reaches steady state efficiency, conduct the following tests as applicable: ▪ For water heaters, test the outlet temperature at the point of human contact and adjust set temperature and or mixing valve to meet requirements. ▪ For forced air furnaces, test temperature rise across heat exchanger and duct pressures to achieve manufacturer's specifications ▪ For boilers, test temperature rise across heat exchanger to achieve manufacturer's specifications ▪ Conduct a flue gas analysis and set up to achieve manufacturer's specifications ▪ Conduct a base chimney temperature test to ensure that temperature meets requirements ○ Record the results of all tests and observations including any manufacturer's start-up checklist. ▪ Leave manufacturer's instructions and start-up checklist with the owner ▪ Leave a record identifying the information required by Clause 18 of the Fuel Oil Regulation ▪ Retain a copy of all tests and observations for company's and technician's file ○ Before leaving a new installation, the installer shall: ▪ ensure that the newly installed equipment complies with this Code and that the oil-burning equipment is in safe working order and ready for safe use ▪ instruct the user in the safe and correct operation and maintenance requirements

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe methods of troubleshooting problems at oil installations

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.05.01	Identify the purpose and principles of successful troubleshooting	• The goal of troubleshooting is to find and resolve the root cause of a problem (not just the symptom of a deeper problem) and to leave the installation in safe working order and ready for safe use. • Principles of successful troubleshooting methods include: ○ Identify the general type of problem during the initial call from the owner/user ▪ Is the problem a safety concern (e.g. CO) or nuisance issue (e.g. humidifier not working)? ▪ Is it a no heat call during cold weather? ▪ Is it a reoccurring problem (i.e. happens at a consistent point in the sequence of operation) or a random problem (i.e. only happens occasionally)? ▪ What is the type and age of the oil burning equipment ▪ When was the last maintenance conducted and have there been recent service calls? ○ Actions to take before entering building ▪ Gather information about previous service calls and maintenance records ▪ Observe outside environment and building skin using the building-as-a-system approach ▪ Check for outdoor tank and lines or fill/vent pipes to indoor tank and their condition ▪ Check outdoor location and condition of chimney/vent and termination(s) ○ Actions to take upon first entering building and meeting the owner/user ▪ Follow company's customer relations procedures (e.g. proper attire and tone) ▪ Take note of any unusual odours or conditions that may affect your safety or help you address the reported problem ▪ Listen to the owner/user's description of the problem as well as short- and long-term history of the installation and any recent, pertinent changes to the structure or occupant use ○ Actions to take during the initial assessment of the oil-burning equipment ▪ Visually assess the condition of the entire installation from the tank to the vent termination ▪ If the appliance is not operating, is the primary control in lockout? ▪ If the appliance is operating, assess the flame and venting conditions as well as any associated accessories (circulating blower or pump, air filter, air supply openings, etc.) ○ Actions to take if primary control is in lockout: ▪ Assume that the combustion chamber is flooded with oil until proven otherwise ○ Discuss methods of checking for a flooded chamber and how to clean and fire it ○ Select and employ the proper PPE when working on the equipment Continued …

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16
Task: Describe methods of troubleshooting problems at oil installations

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.05.01 Continued	Identify the purpose and principles of successful troubleshooting. Continued	Continued …Principles of successful troubleshooting methods include: ○ After it is determined that it is safe to activate the appliance, create a call for heat ▪ Observe the sequence of operation and compare it to the information gained from the owner/user and from the manufacturer's instructions ▪ If the appliance fails to start or shuts down before completing a proper sequence, make the appropriate tests as recommended in the manufacturer's troubleshooting instructions or based on your knowledge and experience regarding probable causes of this failure to start or failure to complete the sequence of operation (i.e. what are the requirements to start or to continue to the next step in the sequence) ▪ If the appliance starts and completes a sequence of operation, take note of unusual noises, odours, flame characteristics, venting action, or operation of associated accessories (circulating blower/pump, add-on devices, etc.) and make the appropriate tests as recommended in the manufacturer's troubleshooting instructions or based on your knowledge and experience regarding probable causes for the improper operation ▪ If the appliance starts and completes two or more normal sequences without any obvious problems, make the appropriate tests based on the information from the owner/user, For example: ○ Complaint about odours that are only detected occasionally - investigate cracked heat exchanger, other sources of reported odours such as drains, vehicles, occupant activities ○ Complaint about insufficient heat - investigate whether appliance is undersized, dirty heat exchanger, temperature rise across heat exchanger, heat distribution system, etc. ○ Complaint about excessive fuel usage - investigate recent unusual weather conditions or recent changes to occupant use, leaks from tanks or lines, appliance efficiency, possibility of theft, etc. ○ Complaint about random extensive periods when the appliance does not operate but then operates normally (with or without pressing the reset) – this may require a systematic investigation for loose or damaged wiring, faulty or worn components, etc. ○ Actions to take before replacing a part: ▪ Investigate whether another component or condition could have caused the part to fuel ○ Examples: blown fuse or tripped breaker may indicate an electrical fault; broken fuel pump coupling may indicate a seized pump; plugged nozzle may indicate fuel problems ○ Actions to take when selecting a replacement part ▪ Ensure that selected replacement is at least equivalent to the original and will not void the approval of the appliance Continued …

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated theory hours:** 16

Task: Describe troubleshooting methods

Module 26	Learning Objectives: Upon successful completion, the student will be able to:	Theory Content
26.05.01 Continued	Identify the purpose and principles of successful troubleshooting. Continued	Continued …Principles of successful troubleshooting methods include: ○ Actions to take after installing a replacement part ▪ Test installed replacement to ensure that it is in safe working order and ready for safe use ▪ Investigate whether the replacement resolved the problem or needed replacement because of a deeper problem or unrelated issue ▪ Continue the investigation to resolve the original complaint or any issues identified during previous tests and observations. ▪ If the service work involved the installation, alteration, or servicing of combustion-related components, conduct all applicable tests and observations required in Section 11 of the B139.2 Code or Section 13 of the B139.1.0 Code ○ Actions to take before leaving the installation: ▪ Inform the owner/user about your findings, actions, and recommendations ▪ If the problem has not been resolved and requires additional work, determine whether the installation constitutes an “unacceptable condition” and take the appropriate action ▪ ensure that the newly installed appliance, accessory, component, or equipment connected by the installer complies with the Code and that oil-burning equipment is ready for safe use ▪ if new components have been installed, instruct the user in the safe and correct operation and maintenance requirements of the components ▪ leave the manufacturer’s instructions for the newly installed component with the user. ○ Retain a copy of all tests and observations for company’s and technician’s file

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Service an older appliance that has been converted from coal to oil firing

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**
26.06.01	The student will identify the actions required when conducting a service call on an old appliance that has been converted from coal to oil.	The instructor will provide basic information that would reasonably allow the student to determine what action is required to service an old appliance that has been converted from coal to oil burning. Example of information: • Description or photos/videos of an old gravity feed residential furnace (“octopus” design) • Rating plate on the appliance indicates that it was coal fired • A shiny new flame retention head oil burner is installed in the furnace • Customer states: ○ They bought the burner on eBay since it was advertised as a conversion burner ○ They installed the burner but cannot get it to work properly – it comes on with a loud noise and will not shutdown automatically (customer uses the furnace disconnect switch to operate it). ○ They have limited financial resources for any work conducted at this installation which is a multi-family residential rental property Student will explain to the instructor (acting as the customer) the steps he/she would take to complete this service call and complete any paperwork required for this type of service call.	Assessment criteria: • Neatness and completeness of the presentation • Student states that he/she would identify this installation as an unacceptable condition and: ○ Not conduct service on the appliance ○ State that they would complete all actions and notification requirements identified in the Fuel Oil Regulation regarding unacceptable conditions that pose an immediate hazard, including: ▪ Shutting off the fuel supply to the furnace ▪ Immediately give oral notice to the owner/ user (instructor) and distributor of their findings and actions taken ▪ Provide the appropriate written notice to the owner/user ▪ Provide the appropriate appliance tag ▪ Provide the appropriate written notification that they indicate that they would send to the distributor and TSSA ○ Ideally, the student will research and provide the notification documents that the distributor and/or TSSA accept along with the means of sending the notifications (address, phone/fax number etc.). Hardcopies of the appliance tag and written notification to the distributor and TSSA are required.

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Select oil-fired appliances for a new residential building

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**

26.07.01	The student will select the type of fuel oil appliances suitable for a new house under construction as described by the instructor.
	
	The student will conduct independent research to identify the type, make, model, input, efficiency, add-on features, of the tank and appliances that they would recommend for installation and provide a drawing of the rough location of tanks, oil lines, vent system and termination and appliances.
		The instructor will provide basic information that would reasonably allow the student to select the type, make, model, input, efficiency, add-on features, and rough location of tanks, oil lines, and appliances for a new residence.
		
		Example of information:
		• Simple drawing of an 1100 ft^2 main floor bungalow with an unfinished basement
		• Heat loss calculated at 50,000 Btuh
		• Occupants will be a family of four with two young children, two dogs, and two cats
		• Customer wants a space heating appliance and domestic hot water heater
		• Additional features identified by the customer:
		  ○ Wants air conditioning capability
		  ○ High quality air filtration and humidification
		  ○ Are concerned about power outages which are common in their remote location
		  ○ Wants high quality, reliable appliances at a reasonable price.
		
		Student will select the type, make, model, input, efficiency, add-on devices that they would recommend for installation and draw the rough location of tanks, oil lines, vent system and termination and appliances on the drawing provided.
			Assessment criteria:
			• Neatness and completeness of the presentation
			• Tank type, make/model, size, location, and fill/vent pipe terminations are appropriate
			• Space heating type, make/model, input, efficiency rating, location, and vent system terminations are appropriate.
			  ○ Output of appliance must not be less than the calculated heat loss
			  ○ Air conditioning request is addressed
			  ○ Air filtration/humidification addressed
			• Domestic hot water type, make/model, input, capacity, location, and vent system terminations are appropriate.
			• The student can explain why he/she selected the above appliances and why they consider them to be high quality and reliable
			• Bonus marks awarded for:
			  ○ Explaining why the selected appliances are reasonably priced.
			  ○ Selecting the type, make/model, size, location of a diesel-fired stationary generator or a back-up vaporizing pot burner space heater that does not require electricity

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Select oil-fired appliances for a new commercial building

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**

26.08.01	The student will select the type of fuel oil appliances suitable for a new commercial building under construction as described by the instructor.
	
	The student will conduct independent research to identify the type, make, model, input, efficiency, add-on features of the tank and appliances that they would recommend for installation and provide a drawing of the rough location of tanks, oil lines, vent system and termination and appliances.
		The instructor will provide basic information that would reasonably allow the student to select the type, make, model, input, efficiency, add-on features, and rough location of tanks, oil lines, and appliances for a new commercial building.
		
		Example of information:
		• Simple drawing of an 800 ft^2 single floor commercial building used for a fast engine oil change business with 200 ft^2 used for office space with a washroom and 600 ft^2 used for oil changes with four large garage doors
		• Heat loss of office space calculated at 10,000 Btuh and continuous heat loss for the garage space as doors are opened and closed
		• Business hours occupants are two office staff and four technicians doing oil changes
		• Customer wants an oil-fired space heating appliance and some type of small hot water heater that are high quality, reliable, and reasonably priced.
		
		Student will select the type, make, model, input, efficiency, add-on features of the tank and appliances that they would recommend for installation and draw the rough location of tanks, oil lines, vent system and termination and appliances on the drawing provided.
			Assessment criteria:
			• Neatness and completeness of the presentation
			• Tank type, make/model, size, location, and fill/vent pipe terminations are appropriate
			• Space heating type, make/model, input, efficiency rating, location, and vent system terminations are appropriate.
			  ○ Output of appliance serving the office space must not be less than the calculated heat loss
			  ○ Heating system for the garage space must address the issue of continuous heat loss during cold weather.
			• Domestic hot water type, make/model, input, capacity, location, and vent system terminations are appropriate.
			  ○ If the student reasonably recommends using an electric water heater, they do not have to identify the make or model
			• The student can explain why he/she selected the above appliances and why they consider them to be high quality and reliable
			• Bonus marks awarded for:
			  ○ Explaining why the selected appliances are reasonably priced.

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Install and initially activate a vaporizing pot burner appliance

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**
26.09.01	The student will prove his/her ability to install or plan the installation of a vaporizing pot burner appliance and initially activate the appliance.	Two options for conducting this exercise: 1. Ideally, a modern pot burner appliance (such as a Monitor or Toyo space heater or an oil-fired fireplace/space heater) is available with space available for installing the appliance with its venting system in the shop. With this option, the student will install and initially activate the appliance under the supervision of the instructor and provide proof of compliance with the manufacturer's instructions and the code. 2. The instructor can provide access to manufacturer's instructions for a modern pot burner appliance and the student must create a material list of components required to complete the installation and a drawing showing the layout of the installation (e.g. distance from combustibles, vent configuration, tank location, and oil lines). With this option, the student will activate a vaporizing pot burner appliance that is installed in the shop and provide proof of compliance with the manufacturer's instructions and the code.	Assessment criteria: • proper PPE selected and used properly • all work conducted safely • installation or material list and drawing meets code requirements and manufacturer's instructions, • proper method used for initial activation including: ○ leak testing of tank and lines ○ proper activation of appliance ○ proper flue gas analysis and adjustments conducted, and final results recorded ○ flow rates of constant level valve confirmed ○ proper operation of operating and safety controls confirmed ○ proper operation of safety float in constant level valve confirmed • a tag identifying the information required by Clause 18 of the Fuel Oil Regulation is provided • the student instructs the user (instructor) in the safe and correct operation and maintenance requirements of the appliance • the appliance is left in safe working order and ready for safe use

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Install and initially activate an appliance with an atomizing oil burner

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**

26.10.01	The student will initially activate a tank, lines, and appliance with an atomizing oil burner.	A functioning appliance in the shop will be used for this exercise. The student will be instructed to treat the installation as a new tank and appliance that the owner of the new single-family detached dwelling has installed but has not activated previously. The owner has arranged with a local distributor to fill the tank when the student (acting as the OBT-2) is on site.
		
		The instructor, acting as the owner/installer, will answer any reasonable questions asked by the student that the owner/installer should be able to answer.
		
		The student will conduct any tests and observations that they consider necessary to complete the initial activation. A record of the tests and observations that would be acceptable to the distributor as proof that they can continue to supply oil will be completed by the student. If the appliance manufacturer has a start-up form, also complete that form.
		
		If any part of the oil installation is found to be in non-compliance with the code or applicable manufacturer's instructions but safe to operate, the student will identify these problems and required corrective action on a separate report form and then assume that the corrective action has been immediately carried out so the rest of the initial activation can be completed.
			• Proper PPE selected and used properly
			• All work conducted safely
			• A complete and proper visually inspection of the tank, lines, wiring, appliance (including its venting system) and air supply openings is conducted before the student authorizes the distributor to (theoretically) supply oil to the tank for the first time.
			  ○ Any problems and required corrective action are identified on a separate report form. Then assume that the corrective action has been immediately carried out
			• Properly complete a hydrostatic leak test of the tank following code and manufacturer's instructions.
			• Student reads/refers to the manufacturer's instructions
			• Check whether appliance wiring is proper
			• Bleed air from the supply line and conduct a vacuum test of the line
			• Confirms that nozzle is proper
			• Set the air gate at the recommended setting and activate the appliance.
			• Conduct required tests and observations and record final results
			  ○ All controls properly tested
			  ○ Proper flue gas analysis and adjustments conducted, and final results recorded
			  ○ Proper operation of the heat distribution system and add-on components confirmed
			• A tag identifying the information required by Clause 18 of the Fuel Oil Regulation is provided
			• The student instructs the user (instructor) in the safe and correct operation and maintenance requirements
			• The appliance is left in safe working order. ready for safe use

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Install and initially activate an appliance with an atomizing oil burner

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**
26.11.01	The student will conduct at least six troubleshooting exercises on a test board or appliance in the shop. The student will be given a test board or an appliance to work on along with the necessary manufacturer's instructions, and a multimeter to perform the procedure.	A functioning appliance in the shop or a test board will be used for this exercise. The test board or appliance will have a predetermined fault or faults in the control circuit. The student will use the multimeter and, using a logical progression, attempt to determine the fault(s). Examples of faults include: • Blown fuse • Bad cad cell • Faulty transformer • Improper electrode gap • Plugged nozzle • Faulty burner motor • Broken neutral • Faulty delay action valve • Faulty primary control • Fuel supply shutoff • Open safety control • Faulty operating control • Faulty air circulating blower or water pump	Proper PPE must be selected and properly employed. All work must be conducted safely Student must: • Read and refer to the manufacturer's instructions • Check source of power for correct voltage and polarity • Use a logical test sequence based on appliance sequence of operation • Ensure proper function and range on the multimeter are selected before applying to circuit • Confirm proper ground connections • Use ohmmeter properly to determine continuity ○ Disconnect wiring from the device before applying ohmmeter • Use voltmeter properly to determine voltage • Use correct range settings to check for open or closed switches and shorted circuits • Identify when a neutral wire is broken • The appliance or test board is left in safe working order and ready for safe use •

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Assess the installation of a stand-alone stationary generator

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**
26.12.01	The student will assess the installation of a stationary package diesel-fired generator in a skin-tight enclosure with an integral base generator tank and provide a report identifying whether the installation is acceptable to be supplied with oil.	Two options for conducting this exercise: 1. Ideally, a stationary package diesel-fired generator in a skin-tight enclosure that is fired at 7 gph or less is available at the training site or another accessible site. The manufacturer's instructions for the generator will also be available. With this option, the student will make the observations and tests necessary to provide a report to the distributor confirming that the installation meets code requirements and manufacturer's instructions and is safe to supply oil to. 2. The instructor can provide access to manufacturer's instructions for a stationary package diesel-fired generator in a skin-tight enclosure that is fired at 7 gph or less and drawings and/or photos/videos showing the layout of the installation (e.g. distance from buildings, building openings, property lines, location of the fill and vent terminations, etc.). With this option, the student will assess the drawing and photos/videos supplied by the instructor and with reference to the manufacturer's instructions provide a report to the distributor confirming that the installation meets code requirements and manufacturer's instructions and is safe to supply oil to.	Assessment criteria: • Ideally, the student will research and use the type of report that local oil distributors accept as proof that an installation meet requirements that allow them to supply oil to the installation. • If the student creates his/her own report/ checklist (or if the distributor approved checklist is lacking), the report should include: ○ Pertinent information from the generator rating plate ○ Pertinent information from the tank rating plate and whether it meets requirements ○ Whether the tank is equipped with the required vent whistle, level controls, and interstitial monitoring ○ Unused ports on the tank are plugged ○ Whether the generator is properly located in relation to buildings, openings, property lines, etc. ○ Whether the fill and vent pipes meet requirements: ▪ Fill, normal vent, and emergency vent terminate outdoors ▪ Proper termination caps or protective covers are on the fill and vent pipes ▪ Proper height and separation between fill and vent pipes ○ Whether a fusible-link valve is installed on the supply line ○ Whether the tank has been leak tested as per manufacturer's instructions ○ Any code infractions and actions taken to correct them must be clearly identified.

OIL BURNER TECHNICIAN 2 CURRICULUM

Module Title: Installation, troubleshooting, and servicing **Prerequisite(s):** Modules 16 to 25 **Estimated practical hours**: 32

Performance objective: Assess the installation of a portable generator

Module 26	Practical		
	Scenario	**Procedure**	**Criteria**

26.13.01	The student will assess a portable package diesel-fired generator in a skin-tight enclosure with an integral base generator tank that was built in 2024 and provide a report itemizing and describing how the fuel features of the equipment are compliant with all applicable clauses of B138.1-17.
	
	Access to the manufacturer's instructions for the generator and the B138.1-17 code is required.
		Two options for conducting this exercise:
		
		1. Ideally, a portable package diesel-fired generator in a skin-tight enclosure that is fired at 7 gph or less is accessible the inspection at a local rental company. Manufacturer's instructions must also be available.
		
		With this option, the student will make the observations and tests necessary to provide a report to that meets the amended B139.1.1 code requirements regarding portable generators.
		
		2. The instructor can provide access to manufacturer's instructions for a portable package diesel-fired generator in a skin-tight enclosure that is fired at 7 gph or less and drawings and/or photos/videos showing the equipment (e.g. rating plates, oil lines, tank connections, location of the fill and vent terminations, etc.).
		
		With this option, the student will assess the drawing and photos/videos supplied by the instructor and with reference to the manufacturer's instructions and the B138.1-17 code provide a report that meets the amended B139.1.1 code requirements regarding portable generators.
			• Ideally, the student will research and use the type of report that the industry and TSSA accept as proof that a portable generator meets the amended B139.1.1 code requirements.
			• If the student creates his/her own report/ checklist (or if the approved checklist is lacking), the report should include:
			  ○ Whether the B137.1-17 applies to the generator – is it covered under the scope?
			  ○ Pertinent information from the generator rating plate
			  ○ Pertinent information from the tank rating plate and whether it meets requirements
			  ○ Whether the tank is equipped with the required vent whistle, level controls, and interstitial monitoring and unused ports are plugged
			  ○ Whether every part is secure against displacement
			  ○ Whether the fill and vent pipes meet requirements:
			  ▪ Fill, normal vent, and emergency vent terminate outdoors
			  ▪ Proper termination caps or protective covers are on the fill and vent pipes
			  ▪ Proper height and separation between fill and vent pipes
			  ○ Whether a fusible-link valve is installed on the supply line
			  ○ Other pertinent B138.1 requirements
			  ○ Any code infractions and actions taken to correct them must be clearly identified.