Glossary

AFUE (Annualized Fuel Utilization Efficiency): A measure of the efficiency of the heating unit (burner and boiler/furnace) including standby losses during the off-cycles, given on an annual basis. See also “Steady State Efficiency.”

Air: A mixture of nitrogen, oxygen and slight traces of other gases. For purposes of combustion analysis, we say air is 79% Nitrogen and 21% Oxygen.

Air Change: The number of times in an hour the air in a room is changed either by mechanical means or by the infiltration of outside air leaking into the room through cracks around doors and windows, etc.

Air Cleaner: A device designed for the purpose of removing airborne impurities such as dust, fumes and smoke.

Air Conditioning: This is the process of simultaneously controlling temperature, humidity, cleanliness and distribution of air to meet various requirements of the conditioned space.

Air Infiltration: The leakage of air into a house through cracks and crevices, doors, windows, and other openings, caused by wind, pressure, and/or temperature difference.

Alternating Current: In the case of alternating current, electrons are made to move first in one direction and then in the other. The direction of current flow reverses periodically in cycles.

Ammeter: An instrument for measuring the amount of electron flow in amperes.

Ampere: A measure of current flowing through a conductor having a resistance of 1 ohm and a difference of potential of 1 volt.

Aquastat: A term applied to a control which may be inserted in, or attached to, a vessel for the purpose of controlling the temperature of water within the vessel.

Atmospheric Pressure: The pressure of the atmosphere at a given elevation, the atmospheric pressure at sea level is 14.7 pounds per square inch, allowing water to boil at 212°F.

Atomization: The reduction of a substance to minute particles. In oil burning, atomization produces a fine mist of fuel.

Available Heat: The quantity of useful heat per unit of fuel available from complete combustion, after deducting dry flue gas and water vapor losses.

Biofuel: A renewable, biodegradable combustible liquid fuel. Manufactured by processing vegetable oils such as soy and rapeseed (canola). Also made from waste cooking oil and trap grease, tallow, and animal fats such as fish oil.

Bioheat Fuel®: A blend of 95% or more #2 oil and 5% or less B100 biofuel.

Boiler: A closed vessel in which steam is generated or in which water is heated by fire.

Boiler Efficiency: The ratio of heat absorbed per pound of fuel fired, to the heat of complete combustion of one pound of fuel.

Boiler Heating Surface: The area of the heat transmitting surfaces in contact with the water (or steam) in the boiler on one side, and the fire or hot gases on the other.

Boiler Rating: The guaranteed output of a boiler in Btus per hour, or in square feet of radiation, as determined in a test laboratory such as the Institute of Boiler and Radiator Manufacturers (IBR) or the American Society of Mechanical Engineers (ASME).

British Thermal Unit (BTU): The quantity of heat required to raise the temperature of 1 lb. of water 1°F. This is somewhat approximate but sufficiently accurate for any work discussed in this manual. Here is how the Btus of the various fuels compare:

- No. 2 Heating Oil = 138,690 Btus per gallon
- Natural Gas: Averages 1,027 Btus per cubic foot, about 135 cubic feet equals one gallon of oil.
- Kerosene: 131,890 Btus per gallon, 1.05 gallons of kerosene equals the heat content of one gallon of 2 oil.
- Propane: 91,330 Btus per gallon, 1.53 gallons of propane equals one gallon of 2 oil.
- Electricity: 3,412 Btus per kilowatt hour (kwh), 40.6 kwh equals one gallon of No. 2 oil.
- Wood: One full cord of wood has the heat value of between 95 and 140 gallons of oil.
- Anthracite Coal: Has 12,000 Btus per pound. About 12 pounds of coal equals the heat content of one gallon of No. 2 oil.

Cad Cell Relay: See “Primary Control.”

Carbon Dioxide (CO₂): A gas which, in heating practice, indicates the complete combustion of carbon in the fuel and is found through analysis of the flue gas.
Carbon Monoxide (CO): A gas which, in heating practice, indicates incomplete combustion of the carbon in the fuel and is found through analysis of the flue gas.

Centigrade: See “Celsius.”

Celsius: A thermometer scale at which the freezing point of water is 0° and its boiling point is 100°. In the United States it is only used in scientific and laboratory work.

Chimney Effect: The tendency of heated air or gas in a vertical passage to rise due to lower density compared to that of the surrounding air or gas. In buildings, the tendency of the cold, denser outside air to replace the heated air results in the “chimney effect.”

Circuit (Electrical): The complete path of an electric current from the source through a switch to a load and back to the source.

Circuit Breaker: A thermal device which opens a circuit when the current in the circuit exceeds a predetermined amount.

Cloud Point: The temperature at which wax crystals begin to form in fuel, typically 10 to 20 degrees above pour point.

Combustion: Defined as the rapid reaction of combustible material with oxygen, with the resultant generation of heat. For combustion to take place, the fuel must be heated to its ignition temperature and brought into contact with oxygen.

Combustion Chamber: The refractory or metal lined area within a boiler or furnace in which the combustion of fuel takes place. When no chamber is present (as in wet base boilers) the area is often referred to as “combustion space.”

Comfort Zone (Average): The range of effective temperatures over which the majority of adults feel comfortable.

Condensate: Liquid formed by the condensation of a vapor; in steam heating, water condensed from steam.

Conduction: The process of diffusion or flow of heat energy through a mass, or body of matter, by particle of molecular contact from the warmer to the colder parts.

Conductor (Thermal): A material capable of readily transmitting heat by means of conduction.

Conductor (Electrical): Any material suitable for carrying electric current.

Convector: A concealed radiator. An enclosed heating unit located (with enclosure) either within, adjacent to, or exterior to, the room or space to be heated, but transferring heat to the room or space mainly by the process of convection.

Converter: A piece of equipment for heating water with steam without mixing the two. It may be used for supplying hot water for domestic purposes or for a hot water heating system.

Cycle (Electrical): One complete positive and one complete negative alternation of a current or voltage.

Degree-Day (Standard): A unit which is the difference between 65°F and the daily average temperature, when the latter is below 65°F. The degree days in any one day is equal to the number of degrees F that the average temperature for that day is below 65°F.

Dew Point: The temperature below which water vapor contained in flue gases turns to a liquid. This change is referred to as condensation. To prevent condensation, stack temperature should range from 270°F to 370°F above ambient air temperature.

Dielectric: An insulator. The insulating material between the plates of a capacitor. The insulating porcelain of an ignition electrode.

Direct Current: An electric current that flows in one direction only.

Direct Return System (Hot water): A two-pipe hot water system in which the water, after it has passed through a heating unit, is returned to the boiler along a direct path, so that the total distance traveled by the water, from each radiator, is the shortest feasible.

Direct Venting: The mechanical exhausting of the flue gases of a heating unit in a structure that does not have a suitable chimney.

Down Feed System: A heating system in which the supply mains are above the level of the heating units which they serve.

Draft: In heating systems, draft refers to the pressure difference which causes a current of air or gases to flow through a combustion chamber, flue, chimney or space.

Efficiency: In a heating unit, it is that percentage of the heat energy input which is useful energy output. The ratio of output power to input power is generally expressed as a percentage.

Electromagnet: A magnet made by passing an electrical current through a wire wound on a soft iron core.

Electromotive Force (emf): The force that produces an electric current in an electric circuit.
Electron: A negatively charged particle of matter.

Energy: The ability or capacity to do work.

Fahrenheit: A thermometer scale at which the freezing point of water is 32°F and its boiling point is 212°F above zero. It generally used in the United States for expressing temperature.

Flame Velocity (Rate of Flame Propagation): is the speed with which a flame travels through a given fuel-air mixture. It varies with the fuel, fuel-air mixture ratio and temperature of the mixture.

Flash Point: Maximum temperature at which fuel oil can be safely stored and handled without serious fire hazard. ASTM minimum for No.1 and No.2 is 100°F).

Flue Gas: Includes all gases which leave the furnace combustion chamber by way of a flue. Flue gas consists of nitrogen, gaseous products of combustion, water vapor and oxygen.

Frequency: The number of complete cycles per second existing in any form of wave motion; such as the number of cycles per second of an alternating current.

Fuel: May be defined as any substance, solid, liquid or gaseous, which may be relatively easily ignited and burned to produce heat. Practically all fuels consist of carbon and hydrogen.

Furnace: That part of a boiler or warm air heating plant in which combustion takes place. Sometimes it is also the complete heating unit of a warm air heating system.

Gauge Pressure: The pressure above that of the atmosphere. It is the pressure indicated on an ordinary pressure gauge. It is expressed as a unit pressure such as pounds per square inch (PSI) gauge.

Generator: A machine that converts mechanical energy into electrical energy.

Grille: A perforated covering for an air inlet or outlet usually made of wire screen, cast iron or other material.

Gross Heating Value: Is the total amount of heat produced by the complete combustion of the fuel at atmospheric conditions.

Ground: A metallic connection with the earth to establish ground potential. Also a common return to a point of zero potential.

Heat: That form of energy into which all other forms may be changed. Heat always flows from a body of higher temperature to a body of lower temperature.

Heat of Combustion: The heat evolved when the substance combines rapidly with oxygen.

Heat Exchanger: Any device which is used for transferring energy from one fluid or gas to another.

Heat Unit: In the foot-pound-second system: the British Thermal Unit (BTU); in the centimetergram-second system: the calorie (cal).

Heating Medium: A substance such as water, steam, or air used to convey heat from the boiler, furnace, or other source of heat to the heating units from which the heat is dissipated.

Hot Water Heating System: A heating system in which water is used as the medium by which heat is carried through pipes from the boiler to the heating units.

Humidistat: An instrument which controls the relative humidity of the air in a room.

Humidity: The amount of water vapor within a given space, generally measured in pounds-per-cubic foot.

Hydronics: The science of heating and cooling with water.

Ignition: The act of starting combustion.

Ignition Point: Lowest temperature at which rapid combustion of a fuel will take place in air. For No.2 oil, the ignition point is over 500°F.

Insulation: A material which is used to minimize the heat losses from a given space.

Kilowatt Hour: It is 1000 Watts per hour of electrical energy and is equivalent to 3,412 BTU.

Latent Heat: The energy involved to change the physical state of a substance, (from a liquid to a gas) without changing its temperature.

Magnetic Field: The space in which a magnetic force exists.

Master Control: See “primary control.”

Milliammeter: An ammeter that measures current in thousands of an ampere.

Nitrogen (N2): Is present in air in a large quantity and does not serve any purpose in the process of combustion.

Ohm: The unit of electrical resistance.

Ohmmeter: An instrument for directly measuring resistance in ohms.
One-Pipe System (Hot Water): A hot water heating system in which one pipe serves both as a supply main and also as a return main. The heating units have separate supply and return connections to the same main.

One-Pipe System (Steam): A steam heating system consisting of a main circuit in which the steam and condensate flow in the same pipe. There is but one connection to each heating unit, which must serve as both the supply and return.

Over Head System: A heating system in which the supply main is above the heating units.

Oxidizing Flame: A flame produced by the burning of a fuel with more than the amount of oxygen required for burning under stoichiometric conditions.

Oxygen (O2): The lesser quantity of air that is necessary in the combustion of any fuel. When found in large quantity in flue gases, it is an indication of excess air being introduced to the unit.

Panel Heating: A method of heating involving the installation of the heating units (pipe coils) within the wall, floor or ceiling of a room.

Plenum Chamber: An air compartment maintained under pressure and connected to one or more distributing ducts.

Pour Point: Lowest temperature at which fuel will flow. The ASTM standard for untreated No. 2 oil is 17°F.

Primary Control: In an oil burner circuit, it is the control responsible for the proper sequencing and safety of the operation of the burner. It is often referred to as the cad cell relay, protectorelay, stack switch or master control.

Pressure: The force-per-unit-area measured in pounds-per-square-inch, inches of water or millimeters of mercury.

Pressure Reducing Valve: A piece of equipment for changing the pressure of a gas or liquid from a higher pressure to a lower one.

Pressuretrol: A pressure controller often used to identify the control used to limit the pressure in a steam system.

Proportioning: Can be applied to the maintenance of the ratio between fuel and air supply throughout the operating range of the burner.

Protectorelay: See “primary control.”

Radiant Heating: A heating system in which the heating is by radiation only. Sometimes applied to a panel heating system.

Radiation, Equivalent Direct: The amount of heating surface expressed in square feet which will deliver 240 Btu/HR for steam, and 150 BTU/HR for hot water systems operating at design conditions.

Radiator: Heated and exposed to view, radiator transfers heat by radiation to objects “it can see” and by conduction to the surrounding air, which in turn is circulated by natural convection.

Recirculation: A strong, swirling air pattern that recirculates combustion products for more complete mixing of fuel and air.

Register: In heating and air conditioning, it refers to a grille for the distribution of air which most often contains a built-in damper or shutter.

Relative Humidity: The amount of moisture in a given quantity of air compared with the maximum amount of moisture the same quantity of air could hold at the same temperature. It is expressed as a percentage.

Relay: An electromechanical switching device that can be used as a remote control.

Return Mains: The pipes which return the heating medium from the heating units to the source of heat supply.

Reverse Return System: (Hot Water) A two-pipe hot water heating system in which the water from the several heating units is returned along paths, arranged so that all radiator circuits of the system are practically of equal length.

Sensible Heat: Heat which only increases the temperature of objects as opposed to latent heat.

Series Loop System: A hot water heating system in which a single pipe connects from the heating unit to the first distributing unit then on to the next distributing unit, continuing this way until it returns to the heating unit. All distributing units would then be connected in series.

Solenoid: An electromagnetic coil that contains a movable plunger.

Square Foot of Heating Surface: See “Radiation, equivalent direct.”

Stack Switch: See “Primary control.”

Stack Temperature: The stack (flue gas) temperature is the temperature of combustion gases leaving the appliance, and reflects the energy that did not transfer from the fuel to the heat exchanger.

Static Pressure: The pressure necessary to overcome the frictional resistance to flow. In an oil burner, it will refer to...
the pressure within the burner tube as developed by the fan. In an air distribution system, it refers to the pressure necessary to overcome the total resistance created by the duct work.

**Steady State Efficiency**: A measure of the carbon dioxide in the flue gases, expressed as a percentage, to determine the level of completion of the chemical reaction during combustion taken at “steady state” conditions, meaning there is no further change in the reaction process.

**Steam**: Water vapor found when water has been heated to a boiling point, corresponding to the pressure it is under.

**Stoichiometric**: Describes a condition in which the reactants of a chemical reaction are present in the exact quantities, as predetermined for the chemical equation of the reaction. It describes perfect combustion when the reactants are fuel and oxygen.

**Sulfur Dioxide (SO₂)**: It is present in small quantities in fuel oil. It is the product of the combustion of sulfur.

**Supply Mains**: The pipes through which the heating medium flows from the boiler, or source of supply, to the run-outs and risers leading to the heating units.

**Therm**: A quantity of heat equal to 100,000 Btus.

**Thermistor**: A resistor that is used to compensate for temperature variations in a circuit.

**Thermocouple**: A junction of two dissimilar metals that produces a voltage when heated.

**Thermostat**: An instrument which responds to changes in temperature and which directly or indirectly controls the room temperature.

**Transformer**: A device composed of two or more coils, linked by magnetic lines of force. In transferring energy from one source to another, it can increase or decrease voltage.

**Two-Pipe System (Steam or Water)**: A heating system in which one pipe is used for the supply main and another for the return main. The essential feature of a two-pipe system is that each heating unit receives a direct supply of the heating medium which cannot have served a preceding heating unit.

**Up-Feed System (Hot Water or Steam)**: A heating system in which the supply mains are below the level of the heating units which they serve.

**Vacuum Heating System (Steam)**: A two-pipe heating system equipped with the necessary accessory apparatus to permit the pressure in the system to go below atmospheric pressure.

**Vapor Heating System (Steam)**: A two-pipe heating system which operates at pressures at or near atmospheric and which returns the condensate to the boiler or receiver by gravity.

**Ventilation**: Air circulated through a room for ventilating purposes. It may be mechanically circulated with a blower system or it may be natural circulation through an open window, etc.

**Vent Valve (Steam)**: A device for permitting air to be forced out of a heating unit or pipe and which closes against steam.

**Vent Valve (Water)**: A device permitting air to be forced out of a pipe or heating unit, but which closes against water.

**Viscosity**: The measure of a liquid’s resistance to flow, generally measured in terms of Saybolt Universal or Saybolt Furol Seconds.

**Volt**: The unit of electrical potential.

**Voltmeter**: An instrument designed to measure a difference in electrical potential, in volts.

**Warm Air Heating System**: A warm air heating plant consists of a heating unit (fuel burning furnace) enclosed in a casing, from which the heated air is distributed to the various rooms of building through ducts. If the motive heat producing flow depends on the difference in weight between the heated air leaving the casing and the cooler air entering the bottom of the casing, it is termed a gravity system. If a fan is used to produce circulation and the system is designed especially for fan circulation, it is termed a forced warm air system.

**Watt**: The unit of electrical power.

**Wattmeter**: An instrument for measuring electrical power in watts.

**Wet Return (Steam)**: That part of a return main of a steam heating system which is completely filled with water or condensation.