



Fire Protection Training

Procedures Handbook 4300

FIRE PHYSICS & CHEMISTRY

TOPIC: Types of Heat Measurement

TIME FRAME: 30 Minutes

LEVEL OF INSTRUCTION:

BEHAVIORAL OBJECTIVE:

Condition: A written quiz

Behavior: The student will identify different types of heat measurement

Standard: With a minimum of 70% accuracy

MATERIALS NEEDED:

- Blackboard
- Appropriate visual aids

REFERENCES:

- NFPA, Fire Protection Handbook, 17th Edition
- Principals of Fire Protection Chemistry, NFPA

PREPARATION: The temperature of a material is the condition which determines whether it will transfer heat to or from other materials. It is important that we understand heat measurement so we can prevent fires, protect property, and utilize heat resistive material for our protection.



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TYPES OF HEAT MEASUREMENT

| PRESENTATION | APPLICATION |
|--|---|
| <p>I. HEAT MEASUREMENT</p> <p>A. Specific heat is the amount of heat a material absorbs as its temperature increases</p> <p>B. Latent heat is the amount of heat absorbed by a substance, as it is converted from a solid to a liquid or from a liquid to a gas</p> <p>II. TEMPERATURE MEASUREMENT SCALES</p> <p>A. Celsius</p> <p>A celsius (centigrade) degree ($^{\circ}\text{C}$) is 1/100 the difference between the temperature of melting ice and boiling water (at one atmosphere pressure)</p> <ol style="list-style-type: none">1. 0°C is the melting point of ice2. 100°C is the boiling point of water <p>B. Kelvin</p> <p>A kelvin degree is the same size as the celsius degree, however:</p> <ol style="list-style-type: none">1. Zero on the kelvin scale is minus 459.67°F2. Absolute lowest achievable temperature | <p>Can anyone tell me what the two types of heat measurement are?</p> <p>What are the four types of temperature units?</p> <p>Temperature is a measurement of heat intensity.</p> |

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|---|---|
| <p>C. Fahrenheit</p> <p>A fahrenheit degree (oF) is 1/180 the difference between the temperature of melting ice and boiling water (at one atmosphere pressure)</p> <ol style="list-style-type: none">1. 32oF is the melting point of ice2. 212oF is the boiling point of water <p>D. Rankine</p> <p>A rankine degree (oR) is the same size as the fahrenheit degree</p> <ol style="list-style-type: none">1. On the rankine scale, zero is -459.67oF, so the rankine also provides an absolute lowest achievable temperature | <p>Heat measurement involves the amount of heat produced, not the intensity of heat produced.</p> |
| <p>III. HEAT MEASUREMENT</p> <p>A. Joule</p> <p>The amount of heat energy provided by one watt flowing for one second</p> <p>B. Calorie</p> <p>The amount of heat required to raise the temperature of one gram of water one degree celsius</p> <ol style="list-style-type: none">1. One Calorie = 4.183 Joules <p>C. British Thermal Unit</p> | |

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|---|--|
| <p>The amount of heat required to raise the temperature of one pound of water one degree fahrenheit</p> <p>1. One BTU = 252 Calories or 1,054 Joules</p> <p>IV. TEMPERATURE MEASUREMENT DEVICES</p> <p>A. Devices Depend Upon Physical Change</p> <ol style="list-style-type: none">1. Expansion of a solid, liquid, or gas2. Change of state (solid to liquid)3. Energy change (changes in electrical potential energy, i.e., voltage)4. Changes in thermal radiant emission and/or spectral distribution <p>B. Thermometers</p> <ol style="list-style-type: none">1. Liquid Expansion Thermometer: Consists of a tube (partially filled with a liquid) which measures expansion and contraction of the liquid with changes in temperature2. Bimetallic Thermometer<ol style="list-style-type: none">a. Contains strips of two metals (that are laminated) with different coefficient of expansion | <p>What is the most common temperature measurement device?</p> <p>What other type of thermometer can we use?</p> |



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| <p>b. As the temperature changes, the two metals expand or contract to different extents, causing the strip to deflect</p> <p>C. Thermocouple</p> <ol style="list-style-type: none">1. One end has a pair of wires of different metals connected to each other (the sensing end)2. The other end is connected to a voltmeter3. When the sensing ends are at a different temperature from the voltmeter end, a voltage is created4. The voltage magnitude depends upon the temperature difference between the two ends <p>D. Pyrometer</p> <ol style="list-style-type: none">1. Measures the intensity of radiation from a hot object | <p>What is a pyrometer?</p> |

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SUMMARY:

Essentially, ignition is a matter of increasing temperature by adding heat; whereas physical fire extinguishment usually is accomplished through reduction of temperatures by removal of heat.

By understanding temperature and the measurement of heat we will be better able to combat fire with the proper heat removing substance.

EVALUATION:

A written quiz.

ASSIGNMENT:

To be determined by instructor(s).