



FIRE INSTRUCTOR I

Student Presentation Lesson Plan

23-Transfer of Heat

Outline of Instruction

Objective

Upon successful completion of this lesson, the student shall be able to:

- Describe the impact of thermal energy on heat, temperature, and heat transfer. [NFPA® 1001, 5.3.12]

Instructor Directions

1. Set up non-projectable training aids
 - a. Chart pad to include:
 - i. Title Page
 - ii. Acronym
 - iii. Summary
 - iv. 1 Application scenario
 - v. 2 Evaluation questions
2. Set up projectable training aids (LCD projector & computer)
3. Present lecture utilizing this outline of instruction, non-projectable and projectable audio visual aids.
 - a. Overall time 18 min. (set up, present topic, and take down of audio visuals)
 - b. Presentation time 8-12 min. (presentation time is part of the 18 min)
4. Breakdown of projectable training aids.

Reference Stowell, F.(2013). Essentials of Fire Fighting and Fire Department Operations (6th ed.). Upper Saddle River, N.J.: Brady Pub.; ISBN# 978-013-314080-4

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Preparation

Introduction

- Instructor introduction
- Objectives
- Preparation Step


Presentation

Understanding the concept of heat transfer can help in several ways.

Understand transfer from initial fuel package to others

Estimate size of fire before attacking – Evaluate effectiveness of attack

Transfer occurs from warmer to cooler – Same temperature cannot transfer

5-25 

Heat Transfer

Understanding concept helps firefighters

Understand the transfer of heat from initial fuel package to other fuels in, beyond the area of origin affects growth of any fire

Use knowledge of heat transfer to estimate size of fire before attacking, to evaluate effectiveness of attack

Know that transfer occurs from warmer to cooler objects – Objects at same temperature cannot transfer heat

Transfer rate

Related to temperature differential of bodies, thermal conductivity of solid material involved

Greater the temperature differences between bodies, greater transfer rate

Heat flux

Energy transfer over time per unit of surface area

Measured in kilowatts per meter squared (kW/m^2)

Conduction


Transfer of heat through and between solids

The concept of transfer rate is influenced by several factors.

Related to temperature differential – Thermal conductivity

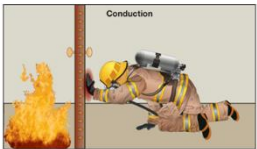
Greater temperature difference – Greater transfer rate


Heat flux

5-26 

Conduction is the transfer of heat through and between solids.

Conduction



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Occurs when material is heated as result of direct contact with heat source

Results from increased molecular motion; collisions between molecules of substance resulting in transfer of energy through substance

More tightly packed molecules are, more readily substance will conduct heat

Dependent on

Area being heated

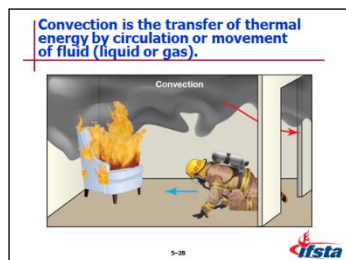
Temperature difference between heat source and material being heated

Thermal conductivity of heated material

Insulating materials slow conduction of heat

Disrupt point-to-point transfer of heat or thermal energy

Best used in building construction are made of fine particles, fibers with void spaces filled with gas – Gases do not conduct heat well



Convection

Transfer of thermal energy by circulation or movement of fluid (liquid or gas)

Usually through movement of hot smoke, fire gases in fire environment

May occur in any direction – Generally upward because smoke, fire gases are buoyant

Can move laterally

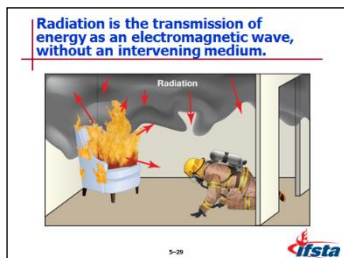
Result of differences in pressure

Move from areas of high pressure to low pressure

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Can be from fire area or openings on windward side (higher pressure) to leeward side

Will feel increase in temperature when working in flow path – Energy is transferred from gas to skin



Radiation

Transmission of energy as electromagnetic wave, without intervening medium

Can become dominant mode of heat transfer when fire grows in size; may affect objects located some distance from fire

Influenced by wide range of factors

Nature of exposed surfaces

Dark materials emit, absorb heat more effectively than lighter color materials

Smooth, highly polished surfaces reflect more radiant heat than rough surfaces

Distance between heat source and exposed surfaces – Increasing distance reduces effect of radiant heat

Temperature difference between heat source and exposed surfaces

Temperature difference has major effect on heat transfer through radiation

As temperature of heat source increases, radiant energy increases by factor to fourth power

Travels in straight line at speed of light

Common cause of exposure fires – Fires ignited remote from initial origin

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Travels through vacuums, air spaces where conduction, convection normally disrupted – Also disrupted by materials that reflect radiated energy

Radiant energy sources in fire

Flames have high temperature

Hot smoke in upper layer

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Chart Pad:

Title Page

- Name, Department, Title of Presentation

Acronym

- **L.I.P.** (Life Safety, Incident Stabilization, Property Conservation)
instructor relates these priorities to the lecture

Summary (2-4 key points)

- Instructor reviews 2-4 key points of the lesson plan to clarify uncertainties, prevent misconceptions, increase learning and improve retention

Application (1 scenario)

- The student is given a scenario where the student will apply all of the knowledge that was given in the lecture. *This is not a question*, it is merely the explanation of the scenario.

Evaluation (2 questions)

- Instructor should ask students 2 direct questions that were presented during the lesson. *Answer to the questions must be give after asking the question.*