

# INSTRUCTOR GUIDE

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## RINGS OF FIRE

Tire Fire Prevention and Suppression

### Lesson Plan 09 FIRE BEHAVIOR

<b><u>TOPIC:</u></b>	The Effects of Fire Behavior on Firefighting
<b><u>LEVEL:</u></b>	I
<b><u>TIME:</u></b>	30 Minutes
<b><u>BEHAVIORIAL OBJECTIVE:</u></b>	
<b>Condition:</b>	Complete evaluation with 70% accuracy
<b>Behavior:</b>	The student will . . . <ol style="list-style-type: none"><li>1. Identify the stages of a tire fire</li><li>2. Identify the burn characteristics of whole and altered tire material</li><li>3. Encourage site operators to take an active role in fire prevention and protection</li></ol>
<b>Standard:</b>	According to the referenced text
<b><u>REFERENCES:</u></b>	Slaughter, Rodney "RINGS OF FIRE: Tire Fire Prevention and Suppression" California State Fire Marshal, June 2004.
<b><u>MATERIALS NEEDED:</u></b>	PC projector, projection screen, VCR, multimedia slide show on CD-ROM, speakers.
<b><u>PREPARATION:</u></b>	Basic concepts of combustion involve the transition of a material from a solid to a liquid to a vapor. This is true with tires as it is with almost any combustible material. One distinguishing difference between wood fires and tire fires is in a tire's ability to absorb radiant heat and to then transfer that heat to the internal steel belts and bead wires found in most modern tires. In this section we will explore how a tire pile burns and how it effects firefighting operations.

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PRESENTATION	APPLICATION
<p><b>I. Objective</b></p> <ul style="list-style-type: none"><li>A. Identify the stages of a tire fire</li><li>B. Identify the burn characteristics of whole and altered tire material</li><li>C. Encourage site operators to take an active role in fire prevention and protection</li></ul> <p><b>II. Tire Fire Dynamics (Stages of Combustion)</b></p> <ul style="list-style-type: none"><li>A. The tire's ability to absorb heat makes them more difficult to ignite than wood fires, but this same quality makes tire fires more difficult to extinguish than wood fires.</li><li>B. Tire fires typically progress through three stages: the Incipient or Ignition and Propagation Stage; the Free Burning Stage; and the Smoldering Stage.</li><li>C. The Free Burning Stage can be further separated into the Compression Stage and the Equilibrium and Pyrolysis Stage.</li></ul>	<p>From the Response Menu click on Fire Behavior button.</p> <p>Fire Behavior Slide 01 Objective</p> <p>Fire Behavior Slide 02</p>





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<p>E. Fire spread during this phase is influenced by the tire product configuration.</p> <p>F. Whole tire piles will tend to burn down into the middle of the pile because the shape of the tires allows heat and gas to rise vertically, bringing oxygen up with the cool air, through the pile from below.</p> <p>G. After whole tires have burned, the covering formed by the remaining steel cords effectively break-up water streams, producing steam before the water affects the burning tire pile.</p> <p>H. Fire tends to spread over the surface of shredded tire and crumb rubber piles.</p> <p>I. This results in a ceramic clay-like covering that deflects water and prevents water penetration from dousing the fire, allowing the internal fire to continue burning.</p>	<p>Fire Behavior Slide 09</p>
<p><b>VI. Smoldering Stage</b></p> <p>A. As tire pile fires burn during the smoldering stage, products of incomplete combustion are released.</p> <p>B. Of particular concern is pyrolytic oil, which will begin to pool and run-off and/or leach into the soil</p> <p>C. Pyrolysis is defined as a chemical change brought about by the introduction of heat.</p> <ol style="list-style-type: none"><li>1. In tire pile fires this occurs when tires breakdown in the fire and release pyrolytic oil.</li><li>2. Downward pressures then push this oil out of the fire.</li></ol>	<p>Fire Behavior Slide 10</p>

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<p>3. During a tire pile fire, the average passenger tire releases up to 2.0 gallons of pyrolytic oil</p> <p>D. The smoldering phase allows for a safe and aggressive attack on the fire</p> <p>E. Pull the smoldering pile apart using heavy equipment and incrementally extinguish the fire with water or foam</p> <p>F. It is possible for the heat from the tire pile fire to ignite the pyrolytic oil creating a secondary flowing oil fire</p> <p>G. Other products of concern released during this stage of a tire pile fire include carbon monoxide, polynuclear aromatic hydrocarbons and volatile organic compounds</p> <p>H. As the rate of propagation of the fire slows along the edges, the outer surfaces cool trapping intense heat internally</p> <p>I. At this point it can be extremely hazardous to open up the fire, as emissions of fire gasses are released at a high rate and can flash up at high speeds as available oxygen increases</p>	<p>Fire Behavior Slide 11</p> <p>Fire Behavior Slide 12</p> <p>Fire Behavior Slide 13</p>
<p><b>VII. Site Operators</b></p> <p>A. Site operators provide the first line of defense at a tire pile site since they are usually onsite at the onset of a fire before emergency responders arrive.</p>	

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PRESENTATION	APPLICATION
<p>B. With sufficient training and knowledge, the staff at the facility has the ability to respond to a fire emergency in a prompt, positive, and effectively manage the emergency until fire fighters arrive on site</p> <p>C. Listed below are several fire prevention practices that each tire pile facility should adopt, to minimize the breakout of a large tire pile fire:</p> <ol style="list-style-type: none"><li>1. Conduct a Fire Safety Audit;</li><li>2. Appointment and Organization of Supervisory Staff;</li><li>3. Develop Emergency Procedures;</li><li>4. Fire Drill Procedures and Training;</li><li>5. Maintenance of Building Facilities and Fire Protection Equipment;</li><li>6. Alternate Measures for Temporary Shutdown of Fire Protection Equipment or Systems;</li><li>7. Control of Fire Hazards;</li><li>8. Maintaining Fire Department Access for Fire Fighting and Related Fire Suppression</li><li>9. Preparing Schematic Diagrams and Site Plans; and</li><li>10. Posting Emergency Procedures and Emergency Phone Numbers.</li></ol>	
<p><b>VIII. Fire Fighting Techniques Owner/Operators</b></p> <p>A. In general, the approach to fighting a tire pile fire is the same as fighting most other fires. The general approach includes the following:</p> <ol style="list-style-type: none"><li>1. Rescue/Evacuation;</li><li>2. Exposure Protection;</li><li>3. Confinement;</li><li>4. Extinguishment; and</li><li>5. Overhaul</li></ol>	<p>Fire Behavior Slide 14</p>

# INSTRUCTOR GUIDE

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<p>B. In many other types of fires, the exposure, confinement, and extinguishment phases can occur almost simultaneously with good tactics of hose line placement</p> <p>C. However, with tire fires, each phase of the fire must be completed before the next phase can begin</p> <p>D. Until the exposure of unburned tires is removed, the fire cannot be contained, and until it is contained, it cannot be extinguished</p> <p>E. Extinguishment must be complete before overhaul can begin because of the tendency for tires to retain heat and re-ignite</p> <p>F. Tire fires rarely involve life-threatening rescue efforts, but many require evacuation of residential areas in the vicinity</p> <p>G. The speed and direction of the wind will dictate the extent of evacuation, and conditions may change during the course of the tire fire, which may warrant a change in the evacuation plan</p> <p>H. Evacuation efforts can often be delegated to police or other agencies</p>	<p><b>Instructors Note:</b> Give summary and then read evaluation questions</p> <p>Fire Questions Slide 15</p>



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### **SUMMARY:**

Understanding the behavior and being able to identify the stage of a tire fire will be extremely useful when choosing the strategy and tactics for this type of emergency. Note that every stage of a tire fire has its inherent hazards to personnel and equipment.

### **EVALUATION:**

1. What stage is a tire fire in when the tires begin to compress?

Answer: Free burning Stage

2. What is pyrolytic oil and why should you be concerned about it?

Answer: A product of incomplete combustion-- heat from the fire transforms the tires 2 gallons of oil from a solid to a liquid

3. Should your department help tire operators develop an effective site safety plan?

Answer: Yes! Tire yards are relatively unsophisticated operations. Help from local authorities would greatly improve fire safety.

### **ASSIGNMENT:**

None