Operational Activities
Under
High Temperature and Humidity

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Objectives

Upon Completing this lesson You will able to Know:

1. Temperature and Humidity
2. Heat Release source from body
3. Heat stress and it's impact on Human body
4. Heat stroke, symptoms, pre-hospital treatment
5. Heat Cramps, symptoms, pre-hospital treatment
6. Heat exhaustion, symptoms, pre-hospital treatment
7. Rhabdomyolysis, symptoms, pre-hospital treatment
8. Heat Cyncope, symptoms, pre-hospital treatment
9. Heat Rash, symptoms, pre-hospital treatment
10. Firefighter needs to know

Temperature

Temperature is a measure of the warmth or coldness of an object or substance with reference to some standard value. Temperature is measured in degrees Fahrenheit or degrees Celsius

37.0 °C (98.6 °F)	Average normal human oral/body temperature
38 °C (101 °F)	Typical body core temperature for a working fire fighter

Humidity

Humidity is the concentration of water vapor present in the air. Water vapor, the gaseous state of water, is generally invisible to the human eye. Humidity indicates the likelihood for precipitation, dew, or fog to be present.

Absolute Humidity describes the water vapor in air and is expressed in either grams per cubic meter or grams per kilogram

Relative humidity, expressed as a percentage of water vapor in air.

Specific humidity is the ratio of water vapor mass to total moist air mass.

Humidity

Humidity plays an important role for surface life. For human beings or animal dependent on perspiration (sweating) to regulate internal body temperature, high humidity impairs heat exchange efficiency by reducing the rate of moisture evaporation from skin surfaces. This effect can be calculated using a heat index table, also known as a humidex.

NOAA national weather service: heat index

Temperature / Relative humidity	80 °F (27 °C)	82 °F (28 °C)	84 °F (29 °C)	86 °F (30 °C)	88 °F (31 °C)	90 °F (32 °C)	92 °F (33 °C)	94 °F (34 °C)	96 °F (36 °C)	98 °F (37 °C)	100 °F (38 °C)	102 °F (39 °C)	104 °F (40 °C)	106 °F (41 °C)	108 °F (42 °C)	110 °F (43 °C)
40%	80 °F (27 °C)	81 °F (27 °C)	83 °F (28 °C)	85 °F (29 °C)	88 °F (31 °C)	91 °F (33 °C)	94 °F (34 °C)	97 °F (36 °C)	101 °F (38 °C)	105 °F (41 °C)	109 °F (43 °C)	114 °F (46 °C)	119 °F (48 °C)	124 °F (51 °C)	130 °F (54 °C)	136 °F (58 °C)
45%	80 °F (27 °C)	82 °F (28 °C)	84 °F (29 °C)	87 °F (31 °C)	89 °F (32 °C)	93 °F (34 °C)	96 °F (36 °C)	100 °F (38 °C)	104 °F (40 °C)	109 °F (43 °C)	114 °F (46 °C)	119 °F (48 °C)	124 °F (51 °C)	130 °F (54 °C)	137 °F (58 °C)	
50%	81 °F (27 °C)	83 °F (28 °C)	85 °F (29 °C)	88 °F (31 °C)	91 °F (33 °C)	95 °F (35 °C)	99 °F (37 °C)	103 °F (39 °C)	108 °F (42 °C)	113 °F (45 °C)	118 °F (48 °C)	124 °F (51 °C)	131 °F (55 °C)	137 °F (58 °C)		
55%	81 °F (27 °C)	84 °F (29 °C)	86 °F (30 °C)	89 °F (32 °C)	93 °F (34 °C)	97 °F (36 °C)	101 °F (38 °C)	106 °F (41 °C)	112 °F (44 °C)	117 °F (47 °C)	124 °F (51 °C)	130 °F (54 °C)	137 °F (58 °C)			
60%	82 °F (28 °C)	84 °F (29 °C)	88 °F (31 °C)	91 °F (33 °C)	95 °F (35 °C)	100 °F (38 °C)	105 °F (41 °C)	110 °F (43 °C)	116 °F (47 °C)	123 °F (51 °C)	129 °F (54 °C)	137 °F (58 °C)				
65%	82 °F (28 °C)	85 °F (29 °C)	89 °F (32 °C)	93 °F (34 °C)	98 °F (37 °C)	103 °F (39 °C)	108 °F (42 °C)	114 °F (46 °C)	121 °F (49 °C)	128 °F (53 °C)	136 °F (58 °C)					
70%	83 °F (28 °C)	86 °F (30 °C)	90 °F (32 °C)	95 °F (35 °C)	100 °F (38 °C)	105 °F (41 °C)	112 °F (44 °C)	119 °F (48 °C)	126 °F (52 °C)	134 °F (57 °C)						
75%	84 °F (29 °C)	88 °F (31 °C)	92 °F (33 °C)	97 °F (36 °C)	103 °F (39 °C)	109 °F (43 °C)	116 °F (47 °C)	124 °F (51 °C)	132 °F (56 °C)							
80%	84 °F (29 °C)	89 °F (32 °C)	94 °F (34 °C)	100 °F (38 °C)	106 °F (41 °C)	113 °F (45 °C)	121 °F (49 °C)	129 °F (54 °C)								
85%	85 °F (29 °C)	90 °F (32 °C)	96 °F (36 °C)	102 °F (39 °C)	110 °F (43 °C)	117 °F (47 °C)	126 °F (52 °C)	135 °F (57 °C)								
90%	86 °F (30 °C)	91 °F (33 °C)	98 °F (37 °C)	105 °F (41 °C)	113 °F (45 °C)	122 °F (50 °C)	131 °F (55 °C)									
95%	86 °F (30 °C)	93 °F (34 °C)	100 °F (38 °C)	108 °F (42 °C)	117 °F (47 °C)	127 °F (53 °C)										
100%	87 °F (31 °C)	95 °F (35 °C)	103 °F (39 °C)	112 °F (44 °C)	121 °F (49 °C)	132 °F (56 °C)										

Key to colors: Caution | Extreme caution | Danger | Extreme danger

For example, if the air temperature is 96 ° F (36 ° C) and the relative humidity is 65%, the heat index is 49 ° C (120 ° F)

The table of Heat index is from the U.S. National Oceanic and Atmospheric Administration.

Effects of the heat index (shade values)

Celsius	Notes
26–32 °C	Caution: fatigue is possible with prolonged exposure and activity. Continuing activity could result in heat cramps.
32–41 °C	Extreme caution: heat cramps and heat exhaustion are possible. Continuing activity could result in heat stroke.
41–54 °C	Danger: heat cramps and heat exhaustion are likely; heat stroke is probable with continued activity.
over 54 °C	Extreme danger: heat stroke is imminent.

Heat Release Source of Body

- About 80% temperature of the body is released through the skin (in the process of conduction, convection, radiation and evaporation) and 15-20% through respiration. As a whole Excess heat is released from the body in three ways, namely:

- Breathing
- Radiation through the skin
- Evaporation by sweat through the pores

Heat Release Source of Body

Breathing

- Warm air in high temperatures is inhaled by firefighters (40° C or above).

When the body is naturally overheated during the fire, body tries to remove the excess heat by releasing breathe in outside of the body. But outside heat exists higher than the internal temperature of the body, the level of heat intake through inhalation is higher and the heat removal through inhalation is less. As a result, the amount of heat loss in the body is less than the heat received.

So firefighters have to wear breathing apparatus to deal with this situation.

Heat Release Source of Body

Radiation through the skin

- Excess heat inside the human body is radiated through the skin and maintains the thermal balance in the body. When excess temperature is created in our body, the blood flow to the lower part of the skin increases and heat flows. In this way, the heat is transmitted to the skin from the muscles or body cells and the excess heat is relieved by radiation. When the temperature conduction rate is higher than the radiation, the body temperature rises and the possibility of heat stress is created.

Heat Release Source of Body

Radiation through the skin

- Firefighters transfer body heat to the fireman suit through perspiration. As a result this suit provides some coolness at one stage.

- However, the fireman suite loses its capacity when the ambient temperature rises above 300-350 degrees Celsius. This creates the possibility of firefighters being burned.

Heat Release Source of Body

Evaporation by sweat through the pores

- The heat of the human body is appeased by evaporation through sweat. As a result the body feels somewhat cooler. However, excessive heat often stops sweating, which can lead to danger, causes heat strokes.

Level of Heat Stress

- Mild or moderate heat stress may be uncomfortable and may affect performance and safety of Firefighter, but it is not usually harmful. When heat stress is more extreme, the possible health effects or heat-related illnesses include:

✓ Rhabdomyolysis: death of muscle

✓Heat rashes: tiny red spots on the skin, which cause a prickling sensation

✓ Heat cramps: sharp pains in the muscles

✓Heat exhaustion: excessive loss of water and salt

✓Heat syncope: fainting

✓ Heat stroke: the most serious level of heat stress

Rhabdomyolysis

Rhabdomyolysis is a medical condition associated with heat stress and prolonged physical exertion, resulting in the rapid breakdown, rupture, and death of muscle. When muscle tissue dies, electrolytes and large proteins are released into the bloodstream that can cause irregular heart rhythms and seizures, and damage the kidneys.

Rhabdomyolysis

Symptoms

- Muscle cramps/pain
- Abnormally dark (tea or cola colored) urine
- Weakness
- Exercise intolerance

Rhabdomyolysis

Pre-hospital treatment:

- Stop activity.
- Getting out of the heat
- Resting
- Increase oral hydration (water preferred).
- Seek immediate care at the nearest medical facility.
- Ask to be checked for rhabdomyolysis (i.e., blood sample analyzed for creatine kinase).

Heat Rash

Heat rash is a skin irritation caused by excessive sweating during hot, humid weather.

Heat Rash

Symptoms of heat rash include:

- Looks like red cluster of pimples or small blisters
- Usually appears on the neck, upper chest, groin, under the breasts, and in elbow creases

Heat Rash

Pre-hospital treatment

- **Send the Cooler place and less humid area.**
- **Keep rash area dry.**
- **Powder may be applied to increase comfort.**
- **Ointments and creams should not be used according to doctor's advice.**

Heat Cramps

Heat cramps usually affect firefighter who sweat a lot during strenuous activity. This sweating depletes the body's salt and moisture levels. Low salt levels in muscles causes painful cramps. Heat cramps may also be a symptom of heat exhaustion.

Symptoms

Muscle cramps, pain, or spasms in the abdomen, arms, or legs

Heat Cramps

Pre-hospital treatment

- Drink water and have a snack and/or carbohydrate-electrolyte replacement liquid (e.g., sports drinks) every 15 to 20 minutes.
- Needs water more than the salt, Do not delay giving water to look for salt. Oral rehydration solution (ORS) can also be used.
- Avoid salt tablets.
- Get medical help if the firefighter has heart problems or if cramps do not subside within 1 hour.

Heat Exhaustion

Heat exhaustion is the body's response to an excessive loss of the water and salt, usually through excessive sweating. Firefighters most prone to heat exhaustion are those that are elderly, have high blood pressure during hot environment

Heat Exhaustion

Symptoms of heat exhaustion include:

Headache
Nausea
Dizziness
Weakness
Irritability
Thirst
Heavy sweating
Elevated body temperature
Decreased urine output

Heat Exhaustion

Pre-hospital treatment :

- Resting
- Remove or loosen clothing as necessary to cool the firefighters body
- Place him in a supine position with legs elevated 20 to 30 cm.
- Administer oxygen if need.
- Give water, but not to an unconscious patient.
- Move to hospital if necessary.

Heat syncope

Heat syncope is a fainting (syncope) episode or dizziness that usually occurs with prolonged standing or sudden rising from a sitting or lying position. Factors that may contribute to heat syncope include dehydration and lack of acclimatization.

Heat syncope

Symptoms of heat syncope include:

Fainting (short duration)

Dizziness

Light-headedness during prolonged standing or suddenly rising from a sitting or lying position

Heat syncope

Pre-hospital treatment

Sit or lie down in a cool place.
Slowly drink water, clear juice, or a sports drink.

Heat Stroke

Heat stroke is the most serious heat-related illness. It occurs when the body becomes unable to control its temperature: the body's temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. When heat stroke occurs, the body temperature can rise to 106°F or higher within 10 to 15 minutes. Heat stroke can cause death or permanent disability if emergency treatment is not given.

Heat Stroke

Signs and symptoms

- Deep, rapid breathing
- Rapid, strong pulse followed by a rapid, weak pulse
- Dry, hot skin, sometimes red
- Dilated pupils
- Loss of consciousness
- Convulsions or muscular tremors
- Confusion, altered mental status, slurred speech

Heat Stroke

Pre-hospital treatment

•Cool the patient quickly in any way possible. Move the patient far from the source of heat. Remove his or her garments and wrap the patient with wet sheets. Pour cold water on the sheets. This should normalise the patient's core temperature and help prevent brain cells from dying.

•Place cold bags or ice packs below each armpit, behind the knees and around the ankles, and one on each side of the neck.

Heat Stroke

•Look for a large container or bathtub and submerge the patient in cold water up to the neck. Use ice to cool the water.

•May use water spray to the body to cool down (using branch pipe).

• Transport to hospital if temperature does not go down.

Heat emergency comparison Chart			
	Heat Cramps	**Heat Exhaustion**	**Heat Stroke**
Muscle cramps	YES	NO	NO
Sickness	YES	YES	YES
Breathing	Varies	Quick & Superficial	Deep initially, later superficial
Pulse	Varies	Weak	Rapid & Strong
Skin	No change	Cool, clammy & pale	Dry, red & hot
Loss of consciousness	Rarely	Sometimes	Frequently

Firefighter's Needs ……

Safety is everybody's business….

To avoid the above situation during firefighting, firefighters should not work in excessive heat and humid environment for extra time of their endurance / capacity.

Know signs/symptoms of heat-related illnesses and first aid treatment

Worn full PPE during Operational activities.

Firefighter's Needs ……

Rotation should be maitained for firefighter.

Drink more and more water during operational activities.

Avoid alcohol, caffeinated drinks, smoking or heavy meals.

Your Opinion to Express

Thank You