Developing a Model Physical Fitness Training Program for Recruit Firefighters With a Focus on Acclimatizing and Preventing Heat Related Illnesses.

Leading Community Risk Reduction

By: Richard E. Himes
Frederick County Department of Fire and Rescue Services
Frederick, Maryland

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ABSTRACT

After a devastating line-of-duty death of a career firefighter from Hyperthermia the Frederick County Department of Fire and Rescue Services needed to reevaluate its training practices. An investigation by the Maryland Occupational Safety and Health Agency identified that the Department had failed to provide a safe and healthy working environment for its' employees.

This research paper discusses the development of a model physical conditioning program as part of a recruit firefighter training course. The focus was on developing physical ability over time with an emphasis on health and safety issues and preventing heat related illness.

Heat related illness is a significant problem in the fire service, not just in exercise related activities but, in day-to-day operations. The recommendations that are discussed in this document were developed through an analysis of information from organizations that deal with heat related illness as a consequence of their operations. The overwhelming theme is that heat related illnesses should be prevented.

The recommendations contained in this research are for a comprehensive physical training program that is designed to produce firefighters who are physically capable of performing the work related tasks required of the modern fire service. A secondary emphasis is on preventing the effects of heat and work related activities from becoming health problems due to heat exposure.

The research also includes the preferred methods of monitoring environmental conditions and the effects the environment has on the human body. Recommended heat exposure charts and fluid replenishment actions are also indicated as well as worker guidelines for recommended work and rest periods under various conditions.

INTRODUCTION

Physical strength, agility and stamina have always been fundamental requirements for personnel with a desire to become firefighters. The tasks associated with firefighting activities require personnel to be capable of performing at maximal effort for prolonged periods of time under harsh environmental conditions.

Because of the inherent dangers of firefighting, fire and rescue training programs have always been arduous and pushed recruit candidates to the edge of their physical ability and endurance. This is necessary in order to insure they will be capable of performing the required tasks in real life situations. Firefighting has been determined to be one of the most demanding jobs in the world.

There have been numerous legal challenges by organizations and individuals to the selection processes that have been used by employing agencies for a number of years. The International Association of Fire Fighters (IAFF) and the International Association of Fire Chiefs (IAFC) have developed a physical evaluation program that meets the requirements of the Department of Justice (DOJ) because of these legal challenges. The DOJ had a special interest in this activity since many of the programs that had been independently developed by each local jurisdiction had desperate impact on minority and female applicants and had generated discrimination lawsuits.

As a result of the collaborative efforts of the IAFF and the IAFC, a Candidate Physical Ability Test (CPAT) was developed to physically screen entry-level personnel prior to beginning fire service recruit academies. This screening was designed to be job related but at the same time give some reliable indication of the recruit's physical capabilities. The CPAT does not consider environmental factors or the candidate's lack of acclimatization. Although there is a training program to assist candidates in preparing

for the exam, there is no consideration for preparing them for the environmental conditions that may be present on the day of the exam.

Environmental conditions should be factored in to the CPAT and strict guidelines should be followed based on environmental factors that may influence health and safety. There are many Occupational Safety and Health Administration (OSHA) regulations that require employers to provide for the health and welfare of their employees. There is, however, no specific OSHA regulation on heat-related exposure. Instead OSHA relies on the General Duty Clause of their regulations as a catch-all for this type of injury. In Maryland, OSHA regulations are enforced by the state through the Maryland Occupational Safety and Health Administration (MOSH).

A model physical fitness program would allow for varying degrees of firefighter candidate fitness and begins with a period of conditioning that gradually works up to the desired level of performance. It would also lead to additional credibility for the fire service if a uniform physical training program could be adopted. Consideration must also be given to the health effects of the environment and the firefighter candidate's degree of acclimatization.

Historical and Action research were employed in the preparation of this study. Historical research was used to review numerous journals, articles and texts and web-based articles to determine material appropriate for the preparation of the guidelines that will be presented. Action research was utilized for the development of A Model Firefighter Recruit Physical Training Program that will be a final result of this project. The program will be applicable to any jurisdiction and the guidelines will provide a framework which any agency will be able to implement.

There are several areas that require more in depth understanding in order to develop a model firefighter recruit physical fitness program with emphasis on reducing heat related injuries.

1. What are the recommended hydration levels with respect to work activity in order to be in compliance with MOSH regulations?
2. How much physical activity is permissible under the MOSH regulations during hot weather?
3. What are the recommended heat or environmental monitoring methods that are acceptable to MOSH/OSHA?
4. Are there other organizations or fire departments that have already developed such a program and is it applicable to our use?

BACKGROUND AND SIGNIFICANCE

Frederick County is the largest land area county in the State of Maryland, encompassing 664 square miles. Frederick County is located in the center of the state and is within 45 miles of Baltimore and Washington, D.C. The county has a small regional airport that has approximately 300,000 operations per year. The primary flight paths for Baltimore Washington International and Dulles International Airports run directly across the county. Several interstate highways transect the area; U.S. 15 is the main north-south transportation route, U.S. 270 is the primary route from Frederick to Washington D.C., U.S. 70 is the main east-west highway from Western Maryland to Baltimore, and U.S. 340 runs from Frederick to Northern Virginia.

Fire and rescue services in the county are provided by a combination career and volunteer system. There are 26 volunteer fire and rescue corporations operating from 29 stations providing all aspects of emergency services. Recruitment of career personnel is

handled by the Frederick County Human Resources Office and the Department of Fire and Rescue Services.

Career firefighters are put through a twenty-week training program that includes Emergency Medical Technician, Firefighter I and II, Hazardous Materials Technician and Rescue Technician. During recruit training the students are also required to participate in physical fitness training. There is no required training or physical fitness standard for volunteer firefighters on a county level but it is at the discretion of the individual corporation where they are members to establish these requirements. There is no physical fitness requirement for volunteers.

Prior to being hired as a career employee, a candidate must successfully complete the CPAT, a comprehensive medical physical in compliance with National Fire Protection Association (NFPA) Standard 1001, and a background investigation. During the last class, Recruit Class 6, which began July 1, 2002, all candidates had successfully completed all of the prerequisite requirements.

Physical training was the first scheduled activity for the recruit class. It began each morning at 0700 hours. On the third day of class the, training academy coordinator was off on annual leave and the class was being directed by the Instructor-in-Charge, a Maryland Certified Level II Emergency Services Instructor. The physical activity for the day was scheduled to be a three-mile run.

As the recruit class was completing their run and returning to the training center, one of the recruits experienced an episode of disorientation and lightheadedness. The Instructor-In-Charge lead the rest of the class back to the training center and summoned Emergency Medical Services (EMS) assistance. The second instructor remained with the ill recruit just outside the main gate of the training center waiting for EMS to arrive.

During this brief time the recruit lapsed into unconsciousness and then, shortly thereafter, cardiac arrest. The recruit died from exertional hyperthermia.

An investigation was begun by the Maryland Occupational Safety and Health Agency (MOSH) into the events and activities leading up to the firefighter recruit's death. After a lengthy investigation, MOSH issued two serious citations to the Board of County Commissioners for not providing a safe work place. The first citation identified that the County had failed to provide a safe workplace as required under the OSHA General Duty Clause. This was for failure to appropriately monitor the environmental factors to which the recruit personnel were exposed. Although the National Weather Service heat index was used, this was determined to not be sufficient by the inspectors. They cited the guidelines of the American Council of Governmental Industrial Hygienists (ACGIH) as the recommended guidelines for exposure of personnel to hot environments.

The second citation identified that the County had not followed their own identified exercise program and that the class had exceeded the written program guidelines. They further concluded that no base-line evaluation had been completed that would have established that all the recruits were at an acceptable level of fitness to begin the program. Unfortunately, although the CPAT infers equivalence to a particular level of fitness it does not insure it. Another factor was the time frame from when candidates completed CPAT until they were actually hired may have been too long. There is no established timeline between satisfactory completion and actual employment.

Several fire service agencies in the State of Maryland are currently discussing this time issue and are trying to determine what the acceptable period may be between CPAT completion and actually being hired in a career capacity. Another point for discussion is whether CPAT should be administered again at the time the candidate begins the Recruit

Training Course. These findings will be implemented into future guidelines for the county.

This project is directly related to the National Fire Academy (NFA) five-year goal of reducing loss of life from fire by 15%. Physically fit firefighters are better capable at performing their jobs. It also applies to the Leading Community Risk Reduction course by attempting to provide better trained and prepared firefighters to respond to community related emergencies, through preparedness, mitigation, response and recovery.

LITERATURE REVIEW

On average, more than 300 people die of heat-related illness in the United States each year. However, this number has been surpassed in a single week during heat waves of recent years. In July 1995, for example, 91 people in Milwaukee and 465 in Chicago died from heat-related illnesses. While deaths from all causes increase during extremely hot weather, deaths directly related to heat are preventable (Hett, 1998).

Firefighters and law enforcement officers must be physically and emotionally prepared to perform tasks requiring maximal exertion at a moment's notice. However, the majority of duty time for both firefighters and police officers is spent in a sedentary fashion, making it difficult to maintain an adequate level of fitness through job experience alone. The National Fire Protection Association's survey on firefighter fatalities from 1984-1993 noted that 55.1% of all training deaths in the fire service resulted from heart attacks. It is important to consider what strategies might be utilized to educe improved performance and longevity for these public heroes (Dempsey, 2002).

The NFPA 2001 Firefighter Fatality Report concluded that, stress and overexertion, usually resulting in heart attacks, continued to be the leading cause of fatal

injury, as it has been in almost all of the twenty-five years of this annual study. All 40 (40%) of the 2001, stress-related deaths resulted in heart attacks.

The largest proportion of deaths the ninety-nine deaths (40 percent) was due to heart attacks. All of the heart attack deaths in 2001 were attributed to stress or overexertion. Heart attack is typically the leading nature of injury and usually accounts for close to half of the total deaths, but over the 25 years that NFPA has published this study, the number of heart attack deaths has dropped by more than one third, (NFPA, 2002).

M. Fragen has a lot of experience with firefighters, “Firefighting is one of the most hazardous jobs in America. Injury rates are four to five times higher than other occupations. Providing care for these important emergency response personnel includes setting up and overseeing department fitness programs, because metabolic deconditioning is a preventable risk factor in the life of a firefighter" (ACSM, 2002).

The human body uses thermoregulatory mechanisms, such as retention of sodium and water, vasodilation, and increased sweat production, to maintain body temperature at about 37°C (98.6°F). Heat illnesses, ranging from heat edema to heat stroke, occur when the body’s physiologic responses are no longer effective for dissipating heat. When the physiologic mechanisms are overwhelmed, potentially fatal heatstroke develops (Hett, 1998).

Heat stroke is defined as a state of severe hyperthermia. When this condition occurs, the body is unable to expel its heat. This occurs most often in conditions of high humidity greater than 90 percent and temperatures greater than 90 degrees.

There are two forms of heat stroke. The first is Classic Heat Stoke (CHS). This generally affects older adults who are chronically ill, living a sedentary life and or in

conditions of elevated temperatures because of inadequate environmental controls, such as a broken air conditioner. Symptoms of CHS include hot, dry, flushed skin and body temperatures of greater than 106.4 degrees. There is also a decrease in the level of awareness.

The second form, Exertional Heat Stroke, (EHS) primarily affects the younger generation and is seen in conditions of high heat and in combination with heavy physical exertion. Victims of EHS have a core body temperature of greater than 106 degrees, have impaired consciousness, and may have cool, clammy skin.

Predisposing factors in both courses of heat stroke are numerous. People who are using medications (diuretics, antihistamines, some beta blockers and antidepressants), have chronic disease (hyperthyroidism, diabetes mellitus, schizophrenia and obesity), are dehydrated, or are in poor physical condition and lack adaption to heat are potential victims of heat stroke.

Heat illness may be viewed as a continuum of illnesses relating to the body's inability to cope with heat. It includes minor illnesses, such as heat edema, heat rash (eg., prickly heat), heat cramps, and tetany, as well as heat syncope and heat exhaustion. Heat stroke is the most severe form of the heat-related illnesses and is defined as a body temperature higher than 41.1°C (106°F) associated with neurologic dysfunction.

Beyond the above physiological causes, environmental effects on the human body must be considered. Primarily, sweating is a major regulatory mechanism in temperature control and the inability to sweat will contribute to heat stroke. At 60% humidity, sweat evaporation begins to decrease. At 90% humidity, sweat evaporation stops. For every 1 degree centigrade increase in body temperature, the heart rate increases by 10 beats per minute. This, as previously noted, increases cardiac demand, (Cox, Jr., 2002).

Two forms of heat stroke exist. Exertional heat stroke (EHS) generally occurs in young individuals who engage in strenuous physical activity for a prolonged period of time in a hot environment. Classic nonexertional heat stroke (NEHS) more commonly affects sedentary elderly individuals, persons who are chronically ill, and very young persons. Classic NEHS occurs during environmental heat waves and is more common in areas that have not experienced a heat wave in many years. Both types of heat stroke are associated with a high morbidity and mortality, especially when therapy is delayed.

Exertional heatstroke

- EHS is characterized by hyperthermia, diaphoresis, and an altered sensorium, which may manifest suddenly during extreme physical exertion in a hot environment.
- A number of symptoms (eg, abdominal and muscular cramping, nausea, vomiting, diarrhea, headache, dizziness, dyspnea, weakness) commonly precede the heat stroke and may remain unrecognized. Syncope and loss of consciousness also are observed commonly before the development of EHS.
- EHS commonly is observed in young, healthy individuals (eg, athletes, firefighters, military personnel) who, while engaging in strenuous physical activity, overwhelm their thermoregulatory system and become hyperthermic. Because their ability to sweat remains intact, patients with EHS are able to cool down after cessation of physical activity and may present for medical attention with temperatures well below 41°C.
- Risk factors that increase the likelihood of heat-related illnesses include a preceding viral infection, dehydration, fatigue, obesity, lack of sleep, poor

physical fitness, and unacclimatization. While unacclimatization is a risk factor for heatstroke, EHS also can occur in acclimatized individuals who are subjected to moderately intense exercise.

- EHS also may occur because of increased motor activity due to drug use, such as cocaine and amphetamines, and as a complication of status epilepticus (Helman, 2002).

Buck Tilton of the Wilderness Medicine Institute in Pitkin, Colorado, says overheating can ruin your day -- and your life. "Human heat is lost in four ways: conduction, radiation, convection, and evaporation," he says. "Conduction, heat loss through direct contact with something cooler than you, does not help much on a hot day. On a desert-like afternoon, you may actually take in heat from a hot environment. Radiation is energy lost directly from your skin's surface and, as the air warms up around you, it may effectively stop on a sunny summer day. Convection is heat loss through the movement of air around your body. Without wind, convective heat loss practically stops when you're not moving, and it stops when the air temperature reaches approximately 92 degrees Fahrenheit."

Tilton explains that sweat evaporation is the primary method of heat loss. "Evaporation of the sweat cools your skin, heat is drawn from your blood near the surface of your body, and the cooler blood circulates to keep your insides maintained at an acceptable temperature," he says. "In other words, if you don't sweat, you ain't gonna make it."

It's not unusual to sweat out a liter of fluid in an hour, but that rate can reach three liters per hour under extreme conditions. "Prolonged sweating may move you along the spectrum to heat exhaustion, characterized by headache, dizziness, nausea, rapid

breathing, and, of course, exhaustion," he says. "Sufferers are so sweaty they often feel cool, grow goose bumps and complain of chills. Treatment should include moving the exhausted person to a shady spot and oral rehydration with cool, very slightly salty water. Some experts prefer using an electrolyte-balanced drink such as Gatorade, but the drink should be watered down three or four times for more rapid absorption in a resting person. Maximum absorption ranges from 150 to 250 ml per 15 minutes, so it takes about an hour to get a liter back into circulation" (Andersson, 1997).

Water is the most important factor in sports nutrition. It makes up about 60 percent of body weight and is involved in almost every bodily process. Your body cannot make or store water, so you must replace what you eliminate (e.g., urine, sweat). Everyone should drink at least two quarts (eight cups) of water each day, and athletes need more. Drink plenty of fluids before, during and after sports events to stay hydrated and avoid overheating. When you workout or compete, especially in hot weather, try to closely match the amount of fluid you drink with the amount you lose to sweat.

Cool water is the best fluid to keep you hydrated during workouts or events lasting an hour or less. Sports drinks (e.g., 6-10 percent carbohydrates) are useful for longer events. Most of these types of drinks should be diluted approximately 50 percent with water. Drink even if you are not thirsty. Thirst is not a reliable way to tell if you need water. You won't start feeling thirsty until you have already lost about two percent of body weight – enough to hurt performance. And if you stop drinking water once your thirst is satisfied, you will get only about half the amount you need (AOSSM, 2001).

The American Conference of Governmental Industrial Hygienists (ACGIH), the National Institute of Occupational Safety and Health (NIOSH), and the Federal Occupational Safety and Health Administration (OSHA) recommend monitoring of

workers during periods of high heat stress/strain. Monitoring of workers consists of activities such as observing the workers at the beginning, during and at the end of the day and checking to ensure they are supplied with and consuming adequate amounts of fluids. The different forms of heat-related illnesses – heat rash, heat cramps, heat exhaustion, heat stroke - are points along a continuum of severity. Heat stroke is the most extreme form of heat-related illness. If an individual shows signs of one form of heat-related illness, it implies they will develop a more severe form if no intervention or relief occurs. The presence of any form of heat-related illness is an indicator that exposure controls are inadequate.

Many therapeutic and social drugs can have an impact on a worker's heat tolerance. Workers who are taking medication or have certain underlying health conditions and their supervisors or managers should be aware that some drugs and medical conditions exacerbate dehydration and increase the risk of heat-related illness. In general, the very young, the very old, the infirm and those in ill health are at greater risk of heat-related illnesses. Employees with risk factors for heat stress or strain should be evaluated by a health care provider on their fitness to work in a hot environment (Michigan FACE, 2002).

Air temperature, humidity, and dehydration are common risk factors associated with heat illness. In addition, the following factors also put student athletes at increased risk:

Nutrition Supplements. Nutritional supplements may contain stimulants, such as ephedrine, mahuang or caffeine*. These substances can dehydrate the body and or increase metabolism and heat production. They are of particular concern in people with underlying medical conditions such as hypertension, asthma and thyroid dysfunction.

Medication / drugs. Certain medications and drugs have similar effects. These substances may be ingested through over-the-counter or prescription medications or with food. Examples include antihistamines, decongestants, certain asthma medications, medications for attention deficit disorder (ADD), diuretics and alcohol*.

Medical conditions. Examples include illness with fever, gastrointestinal illness or sickle cell trait.

Acclimatization/fitness level. Lack of acclimatization to the heat or poor conditioning.

Clothing. Dark clothing absorbs heat. Protective equipment limits heat dissipation.

* NOTE: Stimulant drugs such as amphetamines, ecstasy, ephedrine and caffeine are on the NCAA banned substance list and may be known by other names. Appendix D lists all of the NCAA banned drugs.

The NCAA issued the following recommendations to all Division I athletic programs during the summer of 2002.

All coaches or athletic directors must understand the potential impact of nutritional supplements, medications/drugs, existing medical conditions, acclimatization, hydration and clothing/equipment can have on student-athletes participating in any strenuous workout during hot weather. It is the responsibility of the program to insure that athletes are properly monitored and provided sufficient fluids and periods of rest during these conditions

Emphasizing the presence of an individual at each conditioning session, other than the individual conducting the workout, with the unchallengeable authority to cancel

or modify the workout for the individual student-athlete or the team as appropriate. This is essential to the health and well being of our student athletes (NCAA, 2002).

Since most fire departments respond to all emergency situations when the alarm sounds, firefighters never know what physical or mental demands will be placed on them: battling a roaring fire, cutting people from wrecked cars or lifting a collapsed house off a storm victim. Keeping their bodies fit and ready for any situation is a job requirement.

"If we don't do our job, it's not like the mailman screwing up and not delivering a letter," says Capt. Michael Stefano of the New York City Fire Department. "Someone could die. You may have to climb 15 flights of stairs wearing 60 lb. of clothing and equipment and carrying a 75-lb. hose. You hear kids screaming. You keep going and pray that you have the stamina left to fight the fire" (Hall, 2002).

Strength and stamina are requirements for every aspect of emergency services. Firefighting is the most demanding, requiring both cardiovascular endurance and superior upper-body strength. Gaining access to buildings involves chopping with axes or using pry bars to break locks. Encased from head to toe in protective clothing, their faces covered by masks, firefighters crawl through smoky black interiors. Dragging a charged hose with one hand, they clear a path through heavy furniture and obstacles with the other. And it's not over when the fire is out. Wielding axes and long spiked poles, they dismantle walls and ceilings, searching out every flame or hot spot, (Hall, 2002).

A similar analogy can be drawn between the job of a firefighter and a soldier. A soldier's level of physical fitness has a direct impact on his or her combat readiness. The many battles in which American troops have fought underscore the important role physical fitness plays on the battlefield. The renewed nationwide interest in fitness has been accompanied by many research studies on the effects of regular participation in

sound physical fitness programs. The overwhelming conclusion is that such programs enhance a person's quality of life, improve productivity, and bring about positive physical and mental changes. Not only are physically fit soldiers essential to the Army, they are also more likely to have enjoyable, productive lives. Components of physical fitness include weight control, diet, nutrition, stress management, and spiritual and ethical fitness.

Certain factors must be part of any fitness training program for it to be successful. These factors are Frequency, Intensity, Time, and Type. The acronym FITT makes it easier to remember them. Army Regulation 350-15 specifies that vigorous physical fitness training will be conducted three to five times per week. For optimal results, commanders must strive to conduct five days of physical training per week. Ideally, at least three exercise sessions for cardiorespiratory fitness, muscle endurance, muscle strength, and flexibility should be performed each week to improve fitness levels. Thus, for example, to obtain maximum gains in muscular strength, soldiers should have at least three strength-training sessions per week. Three physical activity periods a week, however, with only one session each of cardiorespiratory, strength, and flexibility training will not improve any of these three components (U.S. Army, FM 20-21).

PROCEDURES

The project began with a literature search in the National Fire Academy Learning Resource Center. Several documents addressing the problem of heat stroke and its effects were identified but most were related to fire ground incidents and the need for rehabilitation. Information regarding physical fitness training and conditioning for firefighters was less easy to come by. Because of this lack of information, the U.S. military was contacted since they are probably the largest training organization in the

world. Their recruits have widely varied conditions of fitness and they are training their recruits to become involved in a physically demanding occupation.

A secondary source of information was a search conducted through the GOOGLE search engine over the Internet. This proved to be an extremely productive way of finding information. There were over 170,000 articles or references to heat related emergencies in the search conducted on August 15, 2002. This was a bit of a limitation in trying to sort through the tremendous number of websites to find useful information relevant to the topic.

Approximately seventy-five different publications and articles were reviewed and analyzed for information that would be appropriate for the final product. The final product is a comprehensive recruit physical training guideline in accordance with state and federal regulations for worker safety. Those seventy-five, after careful consideration, were pared down to about twelve that focused more closely on the subject to be discussed. This was a very time consuming and labor intensive process.

Limitations to the project were caused by additional responsibilities that were required by my employer. As part of the emergency management team more of my time has been delegated to homeland security efforts and preparedness. Two weeks after completion of the Leading Community Risk Reduction course my supervisor took a one-year sabbatical and I was given his responsibilities as well as my own. Our Divison Director was demoted and ultimately resigned over several controversial incidents that occurred within the department.

TERMS

ACGIH - American Council of Governmental Industrial Hygienists

CPAT – Candidate Physical Ability Test. This is a physical agility test developed to remove any gender, race, or ethnic bias from the firefighter selection process.

Classic Heat Stroke – CHS. Generally affects older adults who are chronically ill, living a sedentary life style and/or are in conditions of elevated temperatures.

Exertional Heat Storke – EHS Primarily affects the younger generation and is seen in conditions of high heat and high humidity and in combination with heavy physical exercise.

GOOGLE – an Internet search engine for finding specific text or phrases in websites on the Internet.

Hypohydration – An excessive loss of body fluid through perspiration and physical activity.

IAFC – International Association of Fire Chiefs. A professional membership organization serving career and volunteer fire officers from around the world.

IAFF – International Association of Fire Fighters. A labor union for professional firefighters.

Internet – A vast array of computer networks that share information among all parts of the world through telephone lines, satellites, cable, fiber optics or direct connections.

Heat transfer to and from the body occurs via the following four mechanisms:

- Conduction is the transfer of heat via direct physical contact; it accounts for 2% of the body's heat loss.
- Convection is the transfer of heat from the body to the air and water vapor surrounding the body; it accounts for 10% of the body's heat loss. When air temperature exceeds body temperature, the body gains heat energy.

- Evaporation is the transfer of heat by transformation of a liquid into a vapor; it accounts for 30% of the body's heat loss.
- Radiation is the transfer of heat via electromagnetic waves; it accounts for most heat dissipation. As long as air temperature is less than body temperature, 65% of the body's heat is lost by radiation.

MOSH – Maryland Occupational Safety and Health Adminsitration. The state agency responsible for enforcing OSHA workplace regulations in Maryland.

NFPA – National Fire Protection Association. A concensus standard making organization.

OSHA – Occupational Safety and Health Administration. Federal agency responsible for the development and enforcement of workplace safety regulations.

Physical Fitness Definitions.

Cardiorespiratory (CR) endurance - the efficiency with which the body delivers oxygen and nutrients needed for muscular activity and transports waste products from the cells.

Muscular strength - the greatest amount of force a muscle or muscle group can exert in a single effort.

Muscular endurance - the ability of a muscle or muscle group to perform repeated movements with a sub-maximal force for extended periods of time.

Flexibility - the ability to move the joints (for example, elbow, knee) or any group of joints through an entire, normal range of motion.

Body composition - the amount of body fat an individual has in comparison to his total body mass.

Website – A specific “address” or location on the internet, much like a mailbox or house number.

RESULTS

The information obtained during the literature search indicates that heat related illnesses are a problem for the general population and not just emergency service personnel. Heat related conditions are compounded by the nature of our work environment and the additional heat loading that firefighters must endure.

Several actions can be taken to improve firefighter performance and make them less susceptible to heat related illnesses. Prevention is the key factor. Prevention can be accomplished through acclimatization, physical conditioning, and maintaining proper hydration and nutrition. Careful monitoring of personnel by supervisors and appropriate training of personnel to recognize the early warning signs of heat related illness is essential.

The focus of the paper is the development of a firefighter recruit physical training program with primary emphasis on preventing heat related illness. The secondary emphasis is on developing a comprehensive program that is safe for the worker and meets the guidelines of state and federal health and safety regulations.

The following questions were the basis for the investigation:

1. What are the recommended hydration levels with respect to work activity in order to be in compliance with MOSH regulations?

Cool (50°-60°F) water or any cool liquid (except alcoholic beverages) should be made available to workers to encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets (OSHA, 1998).

Dehydration (hypohydration) must be avoided not only because it hinders performance, but also because it can result in profound heat illness. Fluid replacement must be readily available. Student-athletes should be encouraged to drink as much and as frequently as comfort allows. They should drink one to two cups of water in the hour proceeding practice or competition, and continue drinking during activity (every 15-20 minutes). For activity up to two hours in duration, most weight loss represents water loss, and that fluid loss should be replaced as soon as possible. Following activity, the athlete should rehydrate with a volume that exceeds the amount lost during the activity. A two-pound weight loss represents approximately one quart of fluid loss. Urine volume and color can be used to assess hydration. If output is plentiful and the color is "pale yellow or straw colored" the athlete is probably not dehydrated.

Carbohydrate/electrolyte drinks enhance fluid intake, and the electrolytes aid in the retention of fluids. In addition, the carbohydrate provides energy, helping maintain immune and cognitive functions, (NCAA, 2001).

By recording the body weight of each student-athlete before and after workout or practice, progressive hypohydration or loss of body fluids can be detected, and the potential harmful effects of hypohydration can be avoided. Those who lose five percent of their body weight or more over a period of several days should be evaluated medically and their activity restricted until rehydration has occurred (NCAA, 2001).

2. <u>How much physical activity is permissible under the MOSH regulations during hot weather?</u>

Training should be conducted in early spring whenever possible, because sudden changes in summertime weather may result in dangerous heat strain levels. Workers should be aware of the hazards of working vigorously in hot conditions before they are

exposed to these conditions, because they may not have had time to become physically and psychologically acclimated to (adjusted to) the heat. Lack of acclimatization places workers at risk of heat-related illnesses during brief, unexpected periods of high heat, because acclimatization is one of the major factors in determining how well an individual is able to respond to heat stress.

It generally takes five days of working at least 1½ hours a day in a particular environment before the body becomes acclimated. Some acclimatization can be lost in as little as 3-4 days if the individual is exposed to a substantially different environment. To protect workers while they are developing acclimatization, NIOSH recommends new workers be exposed to work in heat 20% on day 1 with a 20% increase each subsequent day. For workers who have had recent previous experience with the job, NIOSH recommends 50% exposure on day 1, 60% exposure on day 2, 80% on day 3 and 100% on day 4. Normal, healthy individuals can become gradually acclimatized to work in hot conditions in 5 to 10 days depending upon the degree of heat and humidity, their general health and their work schedule.

Heat exposure is based on the Wet Bulb Globe Temperature Index (WBGT) and it is a time-weighted average based on the intensity of the work load which the individual or group is performing. Appendix A gives an in depth explanation of the WBGT reading and its significance. Activity levels are based on the time weighted average of heat exposure and the intensity of the physical work being performed.

Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. However, even the type of clothing worn must be

considered. Prior heat injury predisposes an individual to possible future susceptibility to heat injury.

It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, the effects of UV radiation and relative humidity all affect an individual's response to heat. The following definitions are ACGIH classifications of workload intensity. This information is used to determine how long a healthy individual can work in a given heat condition performing at a prescribed work level.

Light work is defined by ACIGH as work levels up to 200 kcal/hour.

Medium work is defined by ACIGH as work levels up to 200-350 kcal/hour.

Heavy work is defined by ACIGH as work levels up to 350-500 kcal/hour. Appendix B explains the basis for these caloric expenditure levels and the work activities associated with each classification.

Workers must be allowed to become acclimatized to the environment before strenuous training activities are begun. Workers require training to be aware of the dangers of heat related illness in order to watch out for its effects and to monitor coworkers for the signs and symptoms in order to seek medical assistance. NIOSH (1986) states that a good heat stress training program should include at least the following components:

- Knowledge of the hazards of heat stress;
- Recognition of predisposing factors, danger signs, and symptoms;
- Awareness of first-aid procedures for, and the potential health effects of, heat stroke;

- Employee responsibilities in avoiding heat stress;
- Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;
- Use of protective clothing and equipment; and
- Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

Physical activity is basically unlimited under the guidelines, however, the employer has a responsibility to insure that employees remain adequately hydrated and are appropriately monitored for health and safety. The WBGT factors are just one part of a comprehensive worker safety program that includes education, acclimatization, providing rehydration fluids and monitoring of personnel.

The signs and symptoms of heat stress/strain leading to heat-related illnesses are well-recognized and well-documented. Workers should be aware of these indicators to protect themselves and anyone in whom they recognize the signs. Workers are often reluctant to admit to feeling bad, because they think it may be perceived as a sign of weakness. It may be necessary for others who suspect something is wrong to take control of the situation. Knowledge gives one the confidence one needs to step into such a situation (Michigan, FACE, 2002).

3. <u>What are the recommended heat or environmental monitoring methods that are acceptable to MOSH?</u>

MOSH and OSHA recognize the ACIGH Wet Bulb Globe Thermometer readings as the industry standard for evaluating exposure to high temperature environments and a worker's exposure time. Appendix C shows the relationship between the WBGT readings

and the various work load categories and provides a recommended schedule for work and rest periods.

The ACGIH has published a work/rest regimen based upon a heat stress/strain assessment that "represents conditions under which it is believed that nearly all adequately hydrated, unmedicated, healthy workers may be repeatedly exposed without adverse health effects." The assessment is based upon a Wet Bulb Globe Temperature (WBGT) index and general work demands.

The WBGT values are calculated using one of the following equations:

With direct exposure to sunlight:

$$WBGT = 0.7T_{nwb} + 0.2T_g + 0.1T_{db}$$

Without direct exposure to the sun:

$$WBGT = 0.7T_{nwb} + 0.3T_g$$

where: T_{nwb} = natural wet bulb temperature

T_g = globe temperature

T_{db} = dry bulb (air) temperature

According to ACGIH, because WBGT is only an index of the environment, the screening criteria are adjusted for the contribution of work demands and clothing as well as state of acclimatization. The following table provides WBGT criteria suitable for screening purposes for workers in light summer clothing. For other than light summer work clothes, values must be adjusted up or down.

WBGT Screening Criteria for Heat Stress Exposure for Acclimatized Workers			
	Work Rates that are:		
	LIGHT	MODERATE	HEAVY
HOURLY ACTIVITY	°F	°F	°F
100% Work	85.1	81.5	78.8
75% Work & 25% Rest	86.9	83.3	81.5
50% Work & 50% Rest	88.7	85.1	83.3
25% Work & 75% Rest	90.5	87.8	86.0

4. Are there other organizations or fire departments that have already developed such a program and is it applicable to our use?

The Fort Worth Texas Fire Department is the only fire department that could be found that has a comprehensive physical training program that appears to meet the guidelines that MOSH used as a standard. In fact the MOSH report issued on October 28, 2002 specifically referred to the Fort Worth Fire Department program as an acceptable model. A significant portion of the physical exercise information was obtained from the Fort Worth physical fitness training program.

DISCUSSION

In addition to the physical risks inherent in the job, firefighters are plagued by cardiovascular (CV) events; indeed, 55 percent of line-of-duty disabilities result from CV-related events, and deaths are 20-40 percent more frequent. The presentation reviewed data identifying the extrinsic risks as well as the intrinsic risk of metabolic

deconditioning, and provided proof that early detection and department fitness programs can modify CV disease/event risk, (Fragen, 2002).

The 2001 NFPA firefighter death analysis report indicated that heart attacks account for a higher proportion of the deaths among older firefighters as might be expected. Two out of three of the firefighters over age 50 who died in 2001 died of heart attacks. The youngest heart attack victims were two 27-year-old firefighters -- one had no known existing health condition while the other was found to have a previously undetected heart defect. During calendar year 2001, there were 99 line-of-duty deaths to firefighters; of all the deaths, heart attacks accounted for 40%.

The lowest death rates are for firefighters in their 30s. Their death rate is a little more than half the all-age average. The rate for firefighters in their fifties is almost double the average and for firefighters age 60 and over, it is four times the average. Firefighters over age 50 account for two-fifths of all firefighter deaths over the five-year period although they account for less than one-sixth of all firefighters (NFPA, 2002).

Environmental factors are no the only conditions that affect the fitness of fire service personnel. Noting that a lack of physical fitness sometimes results from the lifestyle habits and cultural traditions of both firefighters and police officers, Fragen urged non-surgeon sports clinicians to use this need as a niche within these agencies for their unique training and skills (Fragen, 2002).

Despite the obvious need, only about 50% of the country's fire departments have fitness programs. Most, including some of the largest departments, leave fitness to the firefighters. That may be changing soon, however, thanks to a national initiative that will standardize fitness requirements and testing.

The initiative is long overdue, says Jim Hilyer, PhD, an exercise physiologist who designed fitness programs for firefighters in Los Angeles and Birmingham, Ala. "An unfit firefighter puts himself, his co-workers and the public in danger. Any department that doesn't require and test for fitness is sending people to do life-threatening work without knowing whether they are capable," he says (Hall, 2002).

The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimatization. After a period of acclimatization, the same activity will produce fewer cardiovascular demands. The worker will sweat more efficiently (causing better evaporative cooling), and thus will more easily be able to maintain normal body temperatures.

A properly designed and applied acclimatization program decreases the risk of heat-related illnesses. Such a program basically involves exposing employees to work in a hot environment for progressively longer periods. NIOSH (1986) says that, for workers who have had previous experience in jobs where heat levels are high enough to produce heat stress, the regimen should be 50% exposure on day one, 60% on day two, 80% on day three, and 100% on day four. For new workers who will be similarly exposed, the regimen should be 20% on day one, with a 20% increase in exposure each additional day (OSHA Technical Manual).

Cardiovascular stamina is as important as muscle strength. In addition to four or five days of intense weight training, in which different muscle groups are targeted each day, the typical firefighter workout program should include a strenuous 30- to 40-minute aerobic session. Each workout begins and ends with flexibility training.

Based on the information gathered during the research this has proven to be an extremely beneficial project. The evidence is overwhelmingly in favor of providing new

recruits with a comprehensive physical training program. The experience that Frederick County had on July 3, 2002 is preventable but only through education of recruits and careful monitoring by supervisors.

All personnel require adequate hydration regardless of their assignment and duty for a particular shift. A department wide training program will be instituted to educate all members of the hazards of exertional heat stroke and how to prevent it. Exertional heat stroke is not an acceptable illness now that we understand it and know how to prevent it.

The WBGT temperature reading is the gold standard of industrial hygienists for monitoring the heat exposure of workers. It will become the standard of our training center to utilize this measurement in conjunction with all strenuous physical exercise whether indoors or out, winter or summer.

There must be a maximum time established from the time a candidate completes the CPAT until they begin a recruit training course or the test should be given again. If too much time is allowed to lapse between the CPAT and the time the class begins the CPAT result may become invalid and the recruit may suffer. This will require additional study and testing to determine what is an acceptable time frame.

All recruits should be tested at the beginning of the recruit training course to insure they are at an acceptable level of fitness. It is incumbent upon the employer to perform this testing prior to performing strenuous physical exercise or activity.

RECOMMENDATIONS

The most easily controlled factor in heat tolerance is hydration of workers. Providing convenient and copious amounts of fluids to workers is considered one of the most important precautions to prevent heat-related illnesses. Consumption of

approximately one pint of water every 15 to 20 minutes is suggested for most people at risk of heat stress. Urine should be clear, not dark and workers should urinate regularly.

When hydration is maintained, workers seem to be able to undergo several successive days of intense heat exposure without obvious cumulative adverse effects. Thirst alone cannot be relied upon to insure that adequate amounts of fluids are consumed.

Monitoring of body weights of workers chronically exposed to hot environments is a method for ensuring that sufficient fluids are being consumed. NIOSH suggests that body weight loss in a workday should not exceed 1.5%. This is a difficult range to maintain when doing work that causes heavy sweating. Regardless, rehydration should be complete before starting the next day's work (Michigan, FACE, 2002).

Recognizing heat-related stress, strain, and illness and knowing what measures to take is not common sense. Once the workers have been trained, reinforcement is necessary to ensure that they do not become complacent nor forget what they have learned. Highly trained personnel receive retraining and practice at regular intervals to ensure they remain at the top of their skills. Reinforcement of the importance of watching for, recognizing, and knowing how to react to heat-related illnesses is an element of the training that should not be overlooked (Michigan, FACE, 2002).

Cardiovascular-related deaths must be reduced. *NFPA 1582, Standard on Medical Requirements for Fire Fighters and Information for Fire Department Physicians*, lists the medical conditions that prevent an individual from serving effectively and safely as a firefighter and so preclude individuals from working as suppression firefighters. Given the large share of firefighter deaths that involve people with known histories of related serious medical conditions, attention to fitness and health throughout a firefighter's career

or volunteer service is essential. The fire service spends a great deal of money on continual vehicle maintenance. The same should occur for the firefighters as well (NFPA, 2002).

The fire service must take a more proactive approach to ensuring that its personnel are in good physical condition. In addition to pre-employment medical evaluations, applicants should be screened for previous episodes of heat-related illness. Successful completion of the CPAT exam must be within three months of beginning a recruit course.

Recruit training will only be conducted in strict accordance with written guidelines. Deviation will only be permitted if the Recruit Training Coordinator and the Physical Training Coordinator both agree on the change.

All candidates will be monitored continuously for signs of heat-related illness. All personnel taking part in physical training will hydrate prior to the beginning of exercise and weigh in with the Physical Training Coordinator. The WBGT reading will be obtained and the exercise level and duration will determined for that period.

Each recruit will be responsible for maintaining a written record of their hydration intake and weight. These records will be checked by the Physical Training Coordinator at the beginning and end of each physical training session. It is the recruit's responsibility to report any illness or adverse effect to the Physical Training Coordinator immediately.

In accordance with the detailed physical training guidelines, recruit personnel will be evaluated for physical performance levels. Candidates will be able to become acclimated to environmental conditions based on the pace of the physical conditioning program.

The program will require monitoring and analysis to insure it is providing a safe and healthy work environment. Recruit fitness levels will be evaluated and compared to previous classes to determine if the course is comparable to previous programs.

The training component which deals with recognizing the signs and symptoms of heat-related illness and prevention will be provided to all fire and rescue personnel. It shall become the supervisor's responsibility to make sure everyone on their respective shifts are trained and practicing these procedures for eliminating heat illness.

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APPENDIX A

Measurement of Wet Bulb Globe Temperature

Measurement is often required of those environmental factors that most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, the Wet Bulb Globe Temperature Index (WBGT) is the most used technique to measure these environmental factors. WBGT values are calculated by the following equations:

Indoor or Outdoor Wet Bulb Globe Temperature Indexes (WBGI)

Indoor or outdoors with no solar load

$$WBGT = 0.7NWB + 0.3GT$$

Outdoors with solar load

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

where: WBGT = Wet Bulb Globe Temperature Index

NWB = Natural Wet-Bulb Temperature

DB = Dry-Bulb (air) Temperature

GT = Globe Thermometer Temperature

The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry-bulb thermometer. The measurement of environmental factors shall be performed as follows:

1. The range of the dry and the natural wet-bulb thermometers should be -5°C to +50°C, with an accuracy of ±0.5°C. The dry bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet bulb thermometer should be kept wet with distilled water for at least one-half hour before the temperature reading is made. It is not

enough to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillarity. The wick must be wetted by direct application of water from a syringe one-half hour before each reading. The wick must cover the bulb of the thermometer and an equal length of additional wick must cover the stem above the bulb. The wick should always be clean, and new wicks should be washed before using.

2. A globe thermometer, consisting of a 15 cm (6-inch) in diameter hollow copper sphere painted on the outside with a matte black finish, or equivalent, must be used. The bulb or sensor of a thermometer (range -5°C to +100°C with an accuracy of ±0.5°C) must be fixed in the center of the sphere. The globe thermometer should be exposed at least 25 minutes before it is read.

3. A stand should be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs and the wet-bulb and globe thermometer are not shaded.

4. It is permissible to use any other type of temperature sensor that gives a reading similar to that of a mercury thermometer under the same conditions.

5. The thermometers must be placed so that the readings are representative of the employee's work or rest areas, as appropriate.

Once the WBGT has been estimated, employers can estimate workers' metabolic heat load and use the ACGIH method to determine the appropriate work/rest regimen, clothing, and equipment to use to control the heat exposures of workers in their facilities.

APPENDIX B

Type of work	***Average kcal/min***	***Range kcal/min***
Hand work		
Light	0.4	0.2-1.2
Heavy	0.9	
Work: One arm		
Light	1.0	0.7-2.5
Heavy	1.7	
Work: Both arms		
Light	1.5	1.0-3.5
Heavy	2.5	
Work: Whole body		
Light	3.5	2.5-15.0
Heavy	7.0	
Very heavy	9.0	

* For a "standard" worker of 70 kg body weight (154 lbs) and 1.8m^2 body surface (19.4 ft^2).

APPENDIX C

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

BASED ON WET BULB GLOBE TEMPERATURE READINGS

	---------- Work Load* ----------		
Work/rest regimen	**Light**	**Moderate**	**Heavy**
Continuous work	30.0°C (86°F)	26.7°C (80°F)	25.0°C (77°F)
75% Work, 25% rest, each hour	30.6°C (87°F)	28.0°C (82°F)	25.9°C (78°F)
50% Work, 50% rest, each hour	31.4°C (89°F)	29.4°C (85°F)	27.9°C (82°F)
25% Work, 75% rest, each hour	32.2°C (90°F)	31.1°C (88°F)	30.0°C (86°F)

*Values are in °C and °F, WBGT.

These TLVs are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4° F). They are also based on the assumption that the WBGT of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average should be used (consult the ACGIH 2001-*2002 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* (2001).

These TLV's apply to physically fit and acclimatized individuals wearing light summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLV's in Apendix B must be increased based on the insulating value of the protective clothing.

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APPENDIX D

2002-03 NCAA Banned-Drug Classes

Stimulants | Anabolic Agents | Substances Banned for Specific Sports
Diuretics | Street Drugs | Peptide Hormones and Analogues
Definitions | Nutritional Supplements

Updated August 13, 2002

The NCAA list of banned-drug classes is subject to change by the NCAA Executive Committee. Any changes will be incorporated in this page. The term "related compounds" comprises substances that are included in the class by their pharmacological action and/or chemical structure. No substance belonging to the prohibited class may be used, regardless of whether it is specifically listed as an example.

NOTE: Nutritional supplements are not strictly regulated and may contain substances banned by the NCAA.

NOTE: All body text in blue represents changes made for the 2002-03 academic year.

Bylaw 31.2.3.1 Banned Drugs

The following is the list of banned-drug classes:

(a) Stimulants:

amiphenazole
amphetamine
bemigride
benzphetamine
bromantan
caffeine[1] (guarana)
chlorphentermine
cocaine
cropropamide
crothetamide
diethylpropion
dimethylamphetamine
doxapram
ephedrine (ephedra, ma huang)
ethamivan
ethylamphetamine

fencamfamine
meclofenoxate
methamphetamine
methylene-dioxymethamphetamine (MDMA) (Ecstasy)
methylphenidate
nikethamide
pemoline
pentetrazol
phendimetrazine
phenmetrazine
phentermine
phenylpropanolamine (ppa) effective August 2003
picrotoxine
pipradol
prolintane
strychnine
and related compounds *

(b) Anabolic Agents:

anabolic steroids
androstenediol
androstenedione
boldenone
clostebol
dehydrochlormethyl-testosterone
dehydroepiandrosterone (DHEA)
dihydrotestosterone (DHT)
dromostanolone
fluoxymesterone
mesterolone
methandienone
methenolone
methyltestosterone
nandrolone
norandrostenediol
norandrostenedione
norethandrolone
oxandrolone
oxymesterone
oxymetholone
stanozolol
testosterone[2]
and related compounds *
Other anabolic agents
clenbuterol

(c) Substances Banned for Specific Sports:

Rifle:
alcohol
atenolol
metoprolol
nadolol
pindolol
propranolol
timolol
and related compounds *

(d) Diuretics:
acetazolamide
bendroflumethiazide
benzthiazide
bumetanide
chlorothiazide
chlorthalidone
ethacrynic acid
flumethiazide
furosemide
hydrochlorothiazide
hydroflumethiazide
methyclothiazide
metolazone
polythiazide
quinethazone
spironolactone
triamterene
trichlormethiazide
and related compounds *

(e) Street Drugs:

heroin
marijuana[3]
THC (tetrahydrocannabinol)[3]

(f) Peptide Hormones and Analogues
chorionic gonadotrophin (HCG - human chorionic gonadotrophin)
corticotrophin (ACTH)
growth hormone (HGH, somatotrophin)
All the respective releasing factors of the above-mentioned substances also are banned.

erythropoietin (EPO)
sermorelin

(g) Definitions of positive depends on the following:

[1] for caffeine-if the concentration in urine exceeds 15 micrograms/ml.

[2] for testosterone-if the administration of testosterone or the use of any other manipulation has the result of increasing the ratio of the total concentration of testosterone to that of epitestosterone in the urine to greater than 6:1, unless there is evidence that this ratio is due to a physiological or pathological condition.

[3] for marijuana and THC-if the concentration in the urine of THC metabolite exceeds 15 nanograms/ml.

* The term "related compounds" comprises substances that are included in the class by their pharmacological action and/or chemical structure. No substance belonging to the prohibited class may be used, regardless of whether it is specifically listed as an example.

APPENDIX E

A MODEL

FIREFIGHTER RECRUIT PHYSICAL TRAINING PROGRAM

A. PURPOSE

1. This program is designed to achieve and maintain an acceptable level of fitness that is determined to be appropriate for firefighting activities. This level of performance should allow recruits to perform assigned duties. There is reasonable assurance that recruits following this training program will be able to perform safely and effectively without undue risk to themselves, their coworkers, and the citizens whom they will be sworn to protect.

B. APPLICABILITY

1. This procedure is applicable to all recruit firefighters, instructors, or other fire department personnel participating in training activities.

C. DEFINITIONS

1. Acclimatization - Refers to the physiological changes that take place after prolonged exposure to environmental factors. Of particular importance is the response to high heat and high humidity that involves increased sweat production. If core body temperature can be controlled within acceptable limits, the body will become more efficient in the hot environment. Acclimatization takes place over several days, with the greatest benefit occurring during the first four to five days. However, acclimatization is reversible following cessation of exposure.

2. Heat Stress Index – A measurement of the effects of the environment using a Wet Bulb Globe Temperature (WBGT) meter that takes into account the combined effect of air temperature, air speed, humidity, and radiation.

3. Heavy Work – 350 – 500 kcal/hr. See Appendix "B" for a table of different levels of work.

4. Light Work – Up to 200 kcal/hr. See Appendix "B" for a table of different levels of work.

5. Maximum Heart Rate (MHR) – The maximum heart rate of an individual is usually based upon the person's age (220 – age = MHR). Standard deviation for this equation is 10 – 12 beats per minute.

6. Moderate Work – 200 – 349 kcal/hr. See Appendix "B" for a table of the different levels of work.

7. Target Heart Rate (THR) – The ideal heart rate sustained during aerobic exercise. For purposes of this procedure, the THR is 60-75 percent of the maximum heart rate. The maximum heart rate is calculated by subtracting the person's age from 220 (220 – age = maximum heart rate).

8. Web Bulb Globe Temperature (WBGT) – A measure of the combined effect of air temperature, air speed, humidity, and radiation (WBGT = 0.7 Tnwb + 0.3 Tg).

D. POLICY

1. The Department recognizes that physical fitness ability is an essential part of a firefighter's job performance. The Department will emphasize physical fitness throughout the Recruit Firefighter Training Course to prepare the recruit for the rigors of firefighting and the continuation of a healthy lifestyle throughout the recruit's career.

2. Physical fitness will be conducted during each week of the Recruit Firefighter Training Course. Physical training will normally occur at the first session of the day for a maximum of 1-11/2 hours. Based upon weather (thunderstorms, snow, etc.) or other conditions, the Recruit Training Coordinator or lead instructor may adjust the time of day and duration of physical training.

3. Utilize a minimum of two State certified Level II instructors during physical training activities.

4. Advanced Life Support (ALS) personnel will be on-duty at the training site during physical fitness training.

5. Acclimitized recruits to the environment in accordance with the State Occupational Safety and Health (MOSH) or Federal Occupational Safety and Health (OSHA) Guidelines.

6. Monitor recruits for required water intake by documenting fluid replacement and weight. Document fluid replacement for the quantity and time the fluid was consumed. Weigh recruits prior to and after moderate or heavy exercise to assure the recruit's weight loss does not exceed 1.5% of his or her total body weight.

7. According to the Congress of Neurological Surgeons, credible scientific evidence has been found that amphetamine derivatives and the ergonomic aid creatine may contribute to subclinical dehydration and heatstroke in selected individuals. Therefore, recruits are not to use these types of supplements during the Recruit Firefighter Training Course (Dr. Bailes, Canter, and Day, 2002, p. 283).

8. Recruits and instructors will wear reflective vests while jogging outside of the training facility property. A support or utility vehicle will follow the recruits on group runs outside of the training facility property. The support vehicle operator will have radio and cellular communications available at all times. The support

vehicle will be equipped with EMS equipment and water for the recruits and instructors.

E. PROCEDURES

Warm-up

1. Begin physical training with a minimum 10-minute warm-up including dynamic and static stretching maneuvers. The warm-up period will include a 2-3 minute muscle-warming phase (dynamic), 3-5 minutes of static stretching, and 2-3 minutes of additional mild activity including walking or light calisthenics. The following static stretches will be performed immediately after the general body warm-up: the back stretch, lower-back stretch, rotation twist stretch, groin stretch, seated hamstring stretch, hip flexor stretch, calf stretch, and standing hamstring stretch.

2. The purpose of the warm-up phase is to elevate the body's core temperature by one or two degrees and increase the heart rate while providing a gradual transition to the aerobic conditioning phase (LeCuyer, 2001, p. 173).

Aerobic Conditioning Phase

1. Gradually begin general aerobic conditioning phase following the warm-up period. An activity-related warm-up is preferable to a general-body warm-up (LeCuyer, 2001, p. 173).

2. The aerobic conditioning phase's main purpose will be to train at intensity between 60-75 percent of the maximum heart rate (MHR). Use a combination of group runs and calisthenics to maintain the target heart rate (THR).

3. On Monday, Wednesday, and Friday of the first week, recruits will properly perform three (3) sets of ten (10) push-ups and sit-ups, for a total of 30 each. Pull-ups and chin-ups will be performed to the maximum effort of the recruit. Each week, one repetition will be added to each set. For example, at Week 6 add three (3) sets of 15, for a total of 45 push-ups and sit-ups.

4. Follow weight training by aerobic conditioning to help in the removal of lactic acid when weight training is performed on the same day as aerobic conditioning, (LeCuyer, 2001, p. 174).

5. Recruits will check their heart rate every 15 minutes to assure that they are maintaining their THR. Training intensity will be individually modified to assure the recruit's THR is maintained within 60-75 percent of the recruit's MHR. An instructor will document that all firefighters check their heart rate. Anyone exceeding 75% of his or her MHR will notify the lead instructor immediately.

Group Runs

1. The following are the endurance standards and maximum time allowed for the group runs. This schedule could increase or decrease according to the overall fitness performance level of the class. This is at the discretion of the physical training instructor or the Recruit Training Coordinator.

WEEK	AVG. PER MILE	MINIMUM DISTANCE	MAXIMUM TIME
1	11:00	1.50	16:30
2	11:00	1.75	19:15
3	11:00	2.00	22:00
4	10:30	2.25	23:15
5	10:30	2.50	26:15
6	10:00	2.75	27.50
7	10:00	3.00	30:00
8	9:30	3.00	28:30

NOTE: The training will vary in distances and times beginning with Week 9, or possibly earlier depending on the overall fitness of the class, throughout the remainder of the academy (Fort Worth, 2002).

2. The recruits must maintain the pace for the class run as set by the Physical Training Instructor. A recruit will be considered below minimum standards for physical training if the recruit fails to complete the class run with the instructor within the maximum time allowed.

3. The Cooper Institute for Aerobic Research states that a person who runs 3-4 times per week should improve 10% each week (average).

Week 1

Monday	Class Orientation		
Tuesday	Class Run 1.50 miles	11:00 m/per/mile	16:30
Wednesday	Class Run 1.50 miles	11:00 m/per/mile	16:30
Thursday	Class Run 1.50 miles	11:00 m/per/mile	16:30
Friday	Class Run 1.50 miles	11:00 m/per/mile	16:30

Week 2

Monday	Class Run 1.75 miles	11:00 m/per/mile	19:15
Tuesday	Class Run 1.75 miles	11:00 m/per/mile	19:15
Wednesday	Class Run 1.75 miles	11:00 m/per/mile	19:15
Thursday	Class Run 1.75 miles	11:00 m/per/mile	19:15
Friday	Class Run 1.75 miles	11:00 m/per/mile	19:15

Week 3

Monday	Class Run 2.00 miles	11:00 m/per/mile	22:00
Tuesday	Class Run 2.00 miles	11:00 m/per/mile	22:00
Wednesday	Class Run 2.00 miles	11:00 m/per/mile	22:00
Thursday	Class Run 2.00 miles	11:00 m/per/mile	22:00
Friday	Class Run 2.00 miles	11:00 m/per/mile	22:00

Week 4

Monday	Class Run 2.25 miles	10:30 m/per/mile	23:15
Tuesday	Class Run 2.25 miles	10:30 m/per/mile	23:15
Wednesday	Class Run 2.25 miles	10:30 m/per/mile	23:15
Thursday	Class Run 2.25 miles	10:30 m/per/mile	23:15
Friday	Class Run 2.25 miles	10:30 m/per/mile	23:15

Week 5

Monday	Class Run 2.50 miles	10:30 m/per/mile	26:15
Tuesday	Class Run 2.50 miles	10:30 m/per/mile	26:15
Wednesday	Class Run 2.50 miles	10:30 m/per/mile	26:15
Thursday	Class Run 2.50 miles	10:30 m/per/mile	26:15
Friday	Class Run 2.50 miles	10:30 m/per/mile	26:15

Week 6

Monday	Class Run 2.75 miles	10:00 m/per/mile	27:50
Tuesday	Class Run 2.75 miles	10:00 m/per/mile	27:50
Wednesday	Class Run 2.75 miles	10:00 m/per/mile	27:50
Thursday	Class Run 2.75 miles	10:00 m/per/mile	27:50
Friday	Class Run 2.75 miles	10:00 m/per/mile	27:50

Week 7

Monday	Class Run 3.00 miles	10:00 m/per/mile	30:00
Tuesday	Class Run 3.00 miles	10:00 m/per/mile	30:00
Wednesday	Class Run 3.00 miles	10:00 m/per/mile	30:00
Thursday	Class Run 3.00 miles	10:00 m/per/mile	30:00
Friday	Class Run 3.00 miles	10:00 m/per/mile	30:00

Week 8

Monday	Class Run 3.00 miles	09:30 m/per/mile	28:30
Tuesday	Class Run 3.00 miles	09:30 m/per/mile	28:30
Wednesday	Class Run 3.00 miles	09:30 m/per/mile	28:30
Thursday	Class Run 3.00 miles	09:30 m/per/mile	28:30
Friday	Class Run 3.00 miles	09:30 m/per/mile	28:30

Cool-down

1. End physical training with a minimum 10-minute cool down that includes 3-5 minutes of mild activity followed by 5 minutes of static stretching that includes the same stretches used during the warm-up period.

2. After vigorous exercise is completed, a gradual reduction in the intensity of movement redistributes the flow of blood. As the metabolic rate progressively decreases, relaxation is enhanced. This helps prevent or minimize the "tightening" of muscles, which sometimes occurs after exercise. The cool down facilitates the return of venous blood to the heart and prevents the pooling of blood in the lower extremities. This redistribution is vital to the recovery process.

F. RESPONSIBILITIES

1. The Recruit Training Coordinator is responsible for:

    a. Monitoring the heat stress index using the wet bulb globe thermometer prior to the beginning physical training.

    b. Working with the physical training coordinator to adjust the physical training schedule as necessary based on environmental factors.

    c. Assuring that documentation is completed for each rest period and that the recruits are weighed at the end of each day

2. The Physical Training Coordinator is responsible for:

    a. Working with the recruit training coordinator to adjust the physical training schedule as necessary.

    b. Assuring that required breaks are afforded to the recruits and the physical training workload is performed in accordance with the WBGT temperature table.

    c. Insuring that each recruit is weighed prior to the start of the physical training component for that day.

3. The Physical Training Instructors are responsible for:

    a. Assuring the recruits drink the minimum amount of fluid according to the WBGT temperature table.

    b. Assuring the amount and duration of breaks are afforded to the recruit in accordance with the WBGT temperature table.

c. Working with the physical training coordinator and recruit training coordinator to adjust the physical training schedule as necessary.

4. The firefighter recruit is responsible for:

   a. Immediately notifying the recruit training coordinator of any injury, illness, or health related concerns of the recruits.

   b. Avoiding the use of dietary supplements during the Recruit Firefighter course.

   c. Drinking the minimum required amount of fluids during the mandatory rest periods.

   d. Notifying a physical training instructor of any health related concern or illness prior to the beginning of the physical training session.

   e. Immediately notifying the physical training instructor of any injury, illness, or health related concern that arises during the physical training session or when their THR exceeds 75% of their MPHR.

   f. Satisfactorily participating and completing the physical training program.

G. REFERENCES

LeCuyer, J. (2001). Designing the Fitness Program: A Guide for Public Safety Organizations. Saddle Brook, New Jersey: Fire Engineering Books & Video.

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Fort Worth, Texas Fire Department (2001). Recruit Physical Training. Retrieved September 1, 2002, from Fort Worth, Texas website http://www.fwfd.net/pt.htm.

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MODEL PROGRAM APPENDIX I

Recruit Physical Training Program Description

Physical fitness is the ability to carry out daily tasks with vigor and alertness, without undo fatigue and with ample energy to engage in leisure time pursuits and to meet the above average physical stresses encountered in emergency situations. The leading cause of injury and death of fire and rescue personnel is related to cardiac conditioning. Physical training is necessary to ensure personnel have endurance to perform physically with minimal risk of injury. Our goal as fitness instructors for the Firefighter Recruit Training Course is to bring your level of fitness to the standards outlined in this fitness program.

This physical training program is a rigorous and demanding process designed to improve the recruit's physical and mental conditioning. It will include calisthenics (push-ups, sit-ups/crunch ups, pull ups/chin ups, half squats, jumping jacks etc.), and running (sprints and long distance). This will prepare the recruit for structural fire training and victim rescue, which is the emphasis for physical training.

Physical fitness is a necessary part of training. The fitness level you maintain may determine the quality and quantity of life you will enjoy as a career firefighter. It is contingent upon each of you to successfully complete the physical training program and perform at the peak of your ability.

As a recruit in the Firefighter Recruit Training Course, you will be required to satisfactorily complete the physical training program. Recruits will be evaluated throughout the physical training program in the following areas: dynamic strength, flexibility, cardiovascular (aerobic) endurance, and body composition.

Flexibility

Flexibility is a major components of physical fitness. Although flexibility is specific to each joint, it is usually measured by the Wells-Dillon sit and reach test, which is a test of lower back and hamstring flexibility. This test is easy to administer and highly recommended (LeCuyer, 2001, p. 107). You could define flexibility as range of motion about a joint. Flexibility is improved by stretching the musculo-tendonous structures controlling movement of the joint.

Stretching can serve many purposes. It reduces muscular tension, assists in the ease and coordination of movement, prevents injuries, improves circulation, and relaxes the body. Stretching also eases transition into high intensity activities and prevents muscle imbalances and postural deviations. Stretching can be performed at any time: before activity, as part of your warm-up, after activity, as part of your cool down, at the start or end of a day, when feeling stiff, when feeling tension, or after sitting a long time.

There are two basic types of flexibility exercises: dynamic stretching and static stretching. Dynamic stretching, sometimes called warm up/cool down exercises, use repeated, fluid, gentle, dynamic range movements (i.e., avoid using uncontrolled movements). While performing dynamic stretching, it is important to stay within the "easy stretch" zone of mild tension. You should perform 10-20 repetitions to warm up the body orthopedically, cardiovascularly, and thermally. Dynamic stretching should not be exhaustive or painful. Avoid ballistic stretching that causes the stretch reflex. Can be activity specific, sports related (such as swinging a bat), or a low-level activity such as walking.

Static stretches use slow, controlled stretching with held positions (i.e., avoid bouncing or moving while the joint is fully extended). Static stretching is done within the "developmental stretch" zone. Static stretches are normally held for 10-20 seconds while breathing normally and are used in the warm up and cool down phase. You should use a variety of static stretches to stretch those areas that are typically tight and could lead to muscle imbalances. Proprioceptive Neuromuscular Facilitation (PNF) should be used as one type of static stretching. Use a static stretch immediately after isometrically contracting that muscle for 8-10 seconds.

The generic hold-relax PNF steps are:

1. Hold the body part to be stretched in a position of maximum extensibility.
2. Press against a resistance for 8-10 seconds. Your partner may provide the resistance.
3. Relax, and then move the limb to the new position of greater extensibility.
4. Repeat two or three times.

The hamstring hold-relax PNF steps are:

1. Lie on your back.
2. Bend one knee, placing foot flat on floor.
3. Lift other leg with knee extended.
4. Have partner hold extended leg (at the calf and hamstring) and lift slowly until you feel a stretch in the hamstring.
5. Press extended leg against partner's hand while partner resists this movement.
6. Press for 8 seconds.
7. Relax leg.
8. Partner should now be able to stretch your leg a little further than before.

9. Repeat.

Body Composition

Body composition has a considerable influence on performance ability. Therefore, it is assessed in a fitness test battery even though it isn't considered a performance measure (LeCuyer, 2001, p. 109). Body composition measures also indicate a person's health risk which is another primary concern and reason to document this measurement. The measure of a recruit's body composition will be used as a tool to assist the recruit in enhancing his or her overall physical fitness ability.

Cardiovascular Conditioning

Cardiovascular endurance, or aerobic ability, will be evaluated using a combination of group runs and calisthenics. The purpose of aerobic conditioning is to allow the recruit to perform at his or her maximum physical ability required for job performance with minimal risk of cardiac or other injury. Recruits will maintain their THR at 60-75% of their MHR for a minimum of 30 minutes. Group runs will be performed in accordance with section "E" of the Firefighter Recruit Physical Training Program.

Strength Training

Dynamic strength will be measured using an evaluation method for the upper body, lower body, and midsection. Strength training exercises may be modified pending the availability of free weights or weight machines at the training facility site.

Although the bench press has historically been regarded as the standard for upper body strength evaluation, the recruit's maximum repetition of push-ups will be used as an evaluation of upper body strength. Research has shown that absolute muscular endurance and absolute strength provide a positive relationship.

Callisthenic or body weight exercise options will be used for evaluating lower body strength. These options may include the one or two-legged squat, squat thrusts, or the isometric wall sit. The squat thrust is an excellent exercise used by the U. S. Navy Seals that can assess the anaerobic energy system well if performed in two-minute timed repetitions (LeCuyer, 2001, p. 107).

A maximal one or two-minute repetition of sit-ups will be used as the standard of evaluation for midsection strength. The crunch-style sit-up should be performed since this is the safest method, isolates the abdominal muscles, and reduces assistance from the hip flexors.

Strength Training Program

The basic strength-training program will include various exercises using the recruit's body weight. Table A-1 shows the most common exercises for each of the muscle groups using body weight exercises.

Table A-1

Body Weight Exercises

Group	Exercise
Quadriceps, Hamstring, Gluteals, Gastrocnemius, Hip abducters/adducters, Anterior tibialis	**Lunges, Squats (one-leg), Squats (two-leg), front lying leg lifts, hyperextensions, heel raises, side-lying leg lifts, toe raises**
Latissimus dori/rhomboid, low back	**Chin-ups (M), lying chest lift, hyperextensions**
Pectoralis major	**Push-ups**
Deltoids	**Decline push-ups**
Triceps, Biceps, Forearm	**Parallel dips, bench dips, chin-ups, fingertip push-ups**
Abdominals	**Trunk curls**

The exercise order for muscle groups should be: legs, chest or back, shoulders, arms, and abdominals and lower back (LeCuyer, 2001, p. 174).

Strength training exercises may be modified pending the future availability of free weights or weight machines at the Training Facilty. Changes in mode, intensity, frequency, or duration will be made by the Physical Training Instructor to enhance the physiological response of the body through exercise.

Strength pertains to the ability of a muscle or group of muscles to generate force. Absolute strength is the maximal amount of force that can be generated during one maximal effort. Dynamic strength (muscular endurance) is the ability of a muscle to contract repeatedly over time.

Resistance training is the maintenance or enhancement of muscular strength and muscular endurance, which enables an individual to perform such tasks with less physiological stress that will elicit such health benefits as: increase in bone mass, increase in strength of connective tissue, increase muscle strength and muscle mass, modest improvement in cardiovascular fitness, reduction in body fat, modest reduction in blood pressure, improved glucose tolerance, and improved blood lipid and lipoprotein profile.

Strength gains results from two factors. Hypertrophy is an increase in the size of muscle fibers. The greater the cross sectional area of a muscle, the more force can potentially be generated. Motor unit recruitment refers to the percentage of muscle fibers in a given muscle that can be used at one time. Sedentary individuals normally recruit

about 40% of the muscle fibers in a given muscle group for one maximal effort. Strength training increases this percentage considerably.

Adaptations will only occur in the specific muscles being used during the lift. Use a specific workload for a specific goal.

- □ If the goal is absolute strength, use greater resistance with fewer repetitions.
- □ If the goal is dynamic strength, use less resistance with more repetitions.

Overload Principle

The overload principle states that in order for adaptation (change) to occur, the muscle must be challenged into performing more work than it is used to performing. We can overload a muscle by using more resistance or by performing more repetitions. The training program should be guided by the individual's goal.

- □ If the goal is absolute strength, use heavy resistance, few repetitions.
- □ If the goal is dynamic strength, use less resistance, more repetitions.

Rate Of Development: Expect 3-5% initial strength gains per week with a beginner.

Principles of Resistance Exercise Training

1. Exercise R.O.M. - optimal R.O.M. with resistance.

2. Exercise Speed - approximately 1 second to complete every 900 of joint motion.

3. Breathing - exhale during the concentric (exertional) phase of each repetition.

4. Rest Between Sets - allow adequate rest based upon goals and fitness level.

5. Recommended Number of Sets: - 1-3 sets are generally recommended per body part.

6. Increasing Weight - generally increase the weight by 2-5% when deemed appropriate.

7. Exercise Intensity - attempt to achieve momentary muscle failure on each set. Momentary muscle failure should be accomplished with mechanically sound execution.

8. Muscle Balance - balance the muscle groups.

Repetitions and Load

% 1 RM	**100**	**93.5**	**91**	**88.5**	**86**	**83.5**	**81**	**78.5**	**76**	**73.5**
REPS	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Training Threshold: That amount of work necessary to produce adaptation.

1. The training threshold may be reached by exercising more often (frequency, harder (intensity), or longer (duration).

2. Greater strength gains would be derived from greater loads (resistance), fewer reps, and longer recovery periods.

3. Greater muscular endurance would result from lighter loads, more reps, and shorter rest periods.

Muscles must be worked in "opposition" to each other for symmetrical and balanced development.

1. Isometric (static) - no movement occurs in the joint although force is generated.

2. Isotonic (dynamic) - movement occurs at the joint and force is generated.

3. Concentric - muscles shorten as they generate force.

4. Eccentric - muscles lengthen as they generate force (referred to as negative reps).

NOTE: Muscles should be exercised utilizing full range of motion (ROM).

General Instructions

1. All exercises should be performed 2-3 times a week.

2. Two to three sets per exercise should be performed each training session.

3. Six to twelve repetitions per set should be obtainable.

4. Each repetition should be completed in approximately 4.5 seconds.

5. Weight loads for each exercise should be individualized.

Recommended Minimum Strength Training Exercises with Weights

1. Leg press (Gluteus, Quadriceps)

2. Leg extension (Quadriceps)

3. Leg curls (Hamstrings)

4. Lateral pull-downs (Latissimus Dorsi)

5. High seated rows (Rhomboids, Trapezius, Posterior Deltoid)

6. Bench-press (Pectorals Major, Triceps, Anterior Deltoid)
7. Butterflies (Pectorals)
8. Shoulder press (Deltoid, Triceps)
9. Lateral raise (Deltoid)
10. Triceps press (Triceps)
11. Biceps curls (Biceps Brachii)
12. Back extensors (Erector Spinae)
13. Crunch Sit-ups (Rectus Abdominis)
14. Calf raise (Gastrocnemius)

Note: Variations of exercises should be used while training each muscle group. Strength training at the PSTF will be performed primarily with exercises that use the recruit's own body weight.

MODEL PROGRAM APPENDIX II

Levels of Work Associated With WBGT Index

Easy Work	Moderate Work	Heavy Work
• Equipment Maintenance. • Drill and Ceremony. • Ladder Raise. • Pump Operations. • Ropes and Knots. • Walking on a hard surface at 2.5 M.P.H., with ≤ 30 lbs. of load.	• Auto Extrication. • Vehicle Fire Extinguishment. • Ladder Raise and Climb (Up and Over). • Search and Rescue in Tower. • Hose Line Advancement (Non-Fire Conditions). • Maze Building • Walking on a hard surface at 3.5 M.P.H., < 40 lbs. of load. • 1.5 mile run on a hard surface at 11:00 m/mile with no load.	• Burn Building Fire Extinguishment. • Hose Line Advancement (Live Fire Conditions). • Walking on a hard surface at 3.5 M.P.H., with ≥ 40 lbs. of load. • 3.0 mile run on a hard surface at 09:30 m/mile with no load.

Note: Modified from Fort Detrick, Md. website

Permissible Heat Exposure Threshold Limit Values in °F (WBGT)

Heat Category	WBGT Index (°F)	Easy Work/Rest (Minutes)	Water Intake/hr. (Qts.)	Moderate Work/Rest (Minutes)	Water Intake/hr. (Qts.)	Hard Work/Rest (Minutes)	Water Intake/hr. (Qts.)
0	< 78	NL	N/A	NL	N/A	NL	N/A
1	78 – 81.9	NL	½	NL	¾	40/20	¾
2	82 – 84.9	NL	½	50/10	¾	30/30	1
3	85 – 87.9	NL	¾	40/20	¾	30/30	1
4	88 – 89.9	NL	¾	30/30	¾	20/40	1
5	> 90	50/10	1	20/40	1	10/50	1

NL – No Limit
N/A – Not Applicable
This table copied from Fort Detrick Website – Planning work and training for heat conditions

Notes:

- The work/rest time and fluid replacement volumes will sustain performance and hydration for at least 4 hours of work in the specified heat category. Individual water needs will vary ± ¼ qt./hr.
- Rest means minimal physical activity (sitting or standing) and should be accomplished in shade if possible.
- Hourly fluid intake should not exceed 1-1/2 quarts. Daily fluid intake should not exceed 12 quarts.
- Wearing full protective clothing including SCBA adds 5° F to WBGT index. Wearing full protective clothing without SCBA adds 3° to WBGT index. Wearing fully encapsulating clothing adds 10° to WBGT index.