

THE  
ROCKEFELLER  
FOUNDATION



## GUIDELINES

**TO RAISE KNOWLEDGE AND DETAIL  
PREVENTIVE MEASURES OF HEAT STRESS -  
IMPROVING LABORERS' HEALTH AT WORKPLACES  
IN THE CONTEXT OF CLIMATE CHANGE**

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# PREFACE

In the context of climate change occurring and causing numerous effects all over the world, the related increase in temperature is impacting people's livelihood and also production activities. Workers in big cities, especially workers at construction sites and trade villages are considered the most vulnerable to high temperatures. Extreme weather events and heat waves can lead to adverse impacts such as reducing workers' health and productivity and even occupational accidents. Therefore, protecting workers' health from the effects of high temperature should be adequately considered and assessed to ensure timely prevention measures. This is the responsibility of all stakeholders, research organizations and especially enterprise operators.

Under the sponsorship of the Rockefeller Fund, COHED has collaborated with ILSSA to develop this guide book "Guidelines: To raise knowledge and detail preventive measures of heat stress – Improving laborers' health at workplaces in the context of climate change". This guide book has been published to provide information and prevention methods in order to raise awareness and knowledge on how to reduce heat stress at workplaces. This book aims to give support to the enterprises and the employers who care about reducing heat stress and enhancing the working environment for their workers. It also provides information for management, the authorities, medical staff and workers. This book is the result of efforts from COHED, ILSSA of Danang and experts of occupational health and safety. We thank all experts, organizations and officers who contributed to publishing this book.



**Director of COHED**

# FOREWORD

Improving the capacity of enterprises to prevent heat stress of workers at workplaces, in the context of climate change, is the content of this program implemented by COHED in collaboration with ILSSA. This program is being piloted at firms which work in construction and industry and it is for poor workers and factories which cannot afford enough equipment to reduce heat stress.

This model will equip the employers, the managers and union members with knowledge, in an effort to help workers and prevent adverse impacts of high temperatures at workplaces. This is done through simple and effective methods such as: planting trees, utilizing ventilation systems and using eco-friendly products.

Compilation of the book "Guidelines: To raise knowledge and detail preventive measures of heat stress – Improving laborers' health at workplaces in the context of climate change" will contribute to strengthening documents and knowledge on occupational health and safety. It is also a useful reference for promoting and training in labor hygiene and laborers' health. It provides guidance to help apply appropriate methods to enhance the working environment in enterprises.



**Vice President of the Bureau for Safe Work**

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## PART 1: OVERVIEW

**Purpose:** This program will enhance the knowledge of enterprise operators and stakeholders on heat stress in the workplace and its impacts on workers' health

### I.1. HEAT STRESS

A person working on a hot, humid day will not be able to cool down as easily by sweating as he/she would be able to on a cooler and less humid day.

When the body can no longer cool itself down, the person can suffer heat stress.

### I.2. HEAT STRESS INDICES

The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. It indicates how hot it actually feels to people based on the measure of humidity, temperature, wind and radiation.

#### I.2.1. Reference values for heat of Vietnam

**Standard quoted:**  
TCVN 5508-2010  
On working air  
**Decision BYT**  
**No.3733/2002/QĐ-BYT**  
on Occupational  
Standards applicable to  
company with employees

**Table 1: Requires measures of temperature, humidity, wind velocity and radiation at the work place**

Season	Work-load	Air temperature		Humidity (%)	Wind speed (m/s)	Radiation (W/m <sup>2</sup> – Wat/m <sup>2</sup> )
		Max	Min			
Cool	Lower		20	Under 80	0,2	35 when exposing over 50% body surface area
	Moderate		18			
	High		16			
Hot	Lower	34		Under 80	1,5	100 when exposing over 25 % body surface area
	Moderate	32				
	High	30				

**Details:**

1. Temperature should not exceed 32°C in the outside environment or 37°C for inside the work place
2. The difference of temperature between the workplace and outside is from 3-5°C
3. Humidity: 75-85%
4. Wind speed does not exceed 2m/s
5. Radiation: 1 cal/cm<sup>2</sup>/ minute

When temperature exceeds the maximum, dangerous heat stress conditions can rapidly develop and endanger workers' health. When humidity is higher than 80%, the maximum temperature thresholds are even lower and minimum temperature thresholds are higher, hence the safe zone is narrowed.

### I.2.2. Simple heat stress index

It is very difficult and complex to determine the heat stress index based on all four factors: temperature, humidity, wind speed and radiation. There is a simple heat index table from the U.S National Oceanic and Atmospheric Administration (NOAA), which describes an approximate relationship between air temperature and humidity and how hot it feels

		temperature (°C)																
		27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
Relative Humidity (%)	40	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
	45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
	50	27	28	30	31	33	34	36	38	41	43	46	49	52	55	58		
	55	28	29	30	32	34	36	38	40	43	46	48	52	55	59			
	60	28	29	31	33	35	37	40	42	45	48	51	55	59				
	65	28	30	32	34	36	39	41	44	48	51	55	59					
	70	29	31	33	35	38	40	43	47	50	54	58						
	75	29	31	34	36	39	42	46	49	53	58							
	80	30	32	35	38	41	44	48	52	57								
	85	30	33	36	39	43	47	51	55									
	90	31	34	37	41	45	49	54										
95	31	35	38	42	47	51	57											
100	32	36	40	44	49	54												

Caution  
 Extreme Caution  
 Danger  
 Extreme Danger

**Table 2: Range of heat index values at which a healthy person doing strenuous physical activity or prolonged exposure will begin experiencing health impacts (NWS 2014).**

Temperature	Impacts on health
27–32°C	Caution: fatigue possible with prolonged exposure and activity. Continuing activity could result in heatcramps.
32–41°C	Extreme Caution: heat cramp and heat exhaustion are possible. Continuing activity could result in heat stroke
41–54°C	Danger: heat cramps and heat exhaustion very likely. Heat stroke is possible with continued activity
> 54°C	Extreme danger: heat stroke is imminent and can cause fatalities

**Note:**

When workers go home in the evening and are faced with hot nights, it can become very difficult for them to cool down. This can make them more prone to heat stress and heat.

### I.3. HEAT SOURCES IN THE WORK PLACE

The human body can increase in temperature through two ways: producing heat when working or absorbing heat from the environment. Both activities and environment are important heat sources and in some cases, working can also be the main source of heat. It is known that some people working in average temperatures but with huge workloads become exhausted because of heat.

#### Heat from working

The amount of heat produced by a worker depends on the workload he/she has. This table provides some examples of workload (from lower to high):

Workload	Types of activities	Example
Lower	- Sitting, moving hands and legs slightly - Standing, low level workloads, moving hands mostly - Walking slowly	- Paperwork, typing, driving (not in rush hour) - Working on assembly line/production - Lines supervising workplace
Moderate	- Walking fast - Sitting, moving hands and legs strongly - Carrying and pushing items(moderate weight)	- Delivering mail - Controlling heavy equipment - Picking fruits and vegetables - Working at a warehouse
High	- Construction work - Carrying, pushing and pulling heavy items - Bringing heavy item upstairs	- Sawing, digging etc - Loading and unloading goods - Extinguishing fires

#### Heat from the environment

The amount of heat absorbed from the environment depends on the temperature of the surrounding environment, the amount of air movement and the heat from any heat source. Examples of heat sources are: ovens, fireplaces, fire and the sun. These additional heat sources can raise the temperature of the surrounding environment even when the original air temperature is not high.



#### I.4. THE RELATIONSHIP BETWEEN HEAT STRESS, HUMAN HEALTH AND CLIMATE CHANGE

There is a direct link between climate change, heat stress and human health. Four key factors, temperature, humidity, radiant heat and wind speed have a significant effect on how the body releases heat into the environment. During extremely hot weather the human body's ability to cool itself is challenged and people may experience heat stress: heat stroke, heat exhaustion, heat cramps, or heat rashes.

This also means that any change of climate also has impacts on human health and these impacts depend on the level of change. Recently the climate is changing and global average temperatures are rising. As temperatures rise, there is an accompanying increase in maximum daily temperature, extreme weather events and heat waves. The burden of heat stress will become ever more serious, especially in regions of the world already experiencing intense heat extremes. Vietnam is already experiencing climate change, with average temperatures increasing by between 0.5°C to 0.7°C in the past 50 years. By 2100, average temperature is estimated to increase by 2.3°C, although changes will vary across the country. Over the past 10 years temperatures in urban areas have increased, particularly evident with regards to the number and duration of days exhibiting temperatures above 35°C. This increase has been in tandem with, and is partly a result of, the increased pace of construction and urban development. Buildings and roads trap heat and can make the urban areas up to 10°C hotter than the surrounding rural areas. This phenomenon is known as the urban heat island effect and can expose people in urban areas to higher heat stress risk. Between 1960 and 2011 there was, on average, 194 days per year when the heat stress index was the same or higher than the Ministry of Health (MOH) regulation, 34°C or 30°C when undertaking heavy work.

#### I.5. RELATED DOCUMENTS

##### The Secretariat of Central Committee Communist Party

- Directive no.29-CT/TW of September 18, 2013 on occupational health and safety

##### Ministry of Health Promulgate Documents of Workplace Health And Safety

- Circular no.19/2011 TT-BYT of June 6, 2001 on guiding the management of labor hygiene, laborers' health & occupational diseases
- Circular no.09/TT-BYT of April 28, 2000 on guiding healthcare for laborers at medium and small-size enterprise
- Circular no.13/2007/TT-BYT on guiding medical examination

##### Environmental Law

- TCVN 5508-2010 on air in the workplace

## PART 2: AWARENESS OF HIGH TEMPERATURE IMPACTS ON WORKERS' HEALTH

### II.1. THE BODY'S COOLING SYSTEM

The human body has its own cooling system and 37°C is the ideal temperature for much of the body's internal chemical reactions and processes to function efficiently and effectively. The body can maintain this constant internal temperature through two processes:

- Thermogenesis or chemical thermoregulation and,
- Heat elimination, also known as physical thermoregulation

The body normally cools itself using four mechanisms: radiation whereby the heat generated within the body is given-off to the surrounding atmosphere, convection whereby water or air crosses the skin and carries away body heat, conduction through a cooler object being in contact with the skin and evaporation of sweat. However, the metabolic heat of the body also depends on temperature, humidity and the wind speed of the surrounding environment.

### II.2. RISK FACTORS THAT INCREASE HEAT STRESS

There are a number of risk factors that contribute to causing heat stress. Having knowledge about these can help employers and workers undertake necessary heat stress prevention.

Risk Factors	Characteristics
Working in hot environments	Working in hot places, particularly near machinery which generates heat will cause the body to gain more heat, compared with other workers
Exposure to direct sunlight	When the body is under direct sunlight, it is exposed to the sun's thermal radiation. On a sunny day direct exposure will cause heat gain in addition to the heat of the surrounding environment. If the body cannot release this additional heat, internal core temperature will rise.
Heavy physical work	Heavy physical work will stimulate muscle movement, which in turn generates heat within the body. Continued heavy physical work in a hot environment can cause the body to generate more heat than it can expel.
Clothing	Clothing worn over the body can both induce heat gain and prevent heat loss. Dark colored clothing such as black and dark color varieties will absorb more heat. While semi permeable or impermeable clothing and/or protective equipment can severely inhibit heat loss through evaporation.
Dehydration and salt depletion	Dehydration and salt depletion can be a result of reduced food and liquid uptake, intestinal problems, use of certain medication as well as alcohol and caffeine consumption. If a person becomes dehydrated, the body's ability to lose heat is decreased as there is not enough water within the body to sweat properly and cool the body, causing internal core temperature to rise.

Poor physical fitness & excessive body weight	Body fat acts as an insulating barrier to conductive heat flow. In an overweight person, less heat can be produced per unit mass before the temperature of body tissue increases.
Lack of heat acclimatization	Subsequent to repeated bouts of exercise in a hot environment, there is a marked improvement in the physiologic responses of healthy humans. This improved tolerance to exercise in heat is known as heat acclimatization. This process, called acclimatization, involves a collection of internal body adjustments to the outside environment that improve heat tolerance.
Certain illness	Some chronic illnesses, such as heart or lung disease, may increase the risk of heat stress as they place additional stress on the body and reduce the body's ability to maintain core temperature.
Certain medications	Some medications place you at a greater risk of heat stress because they affect your body's ability to stay hydrated and therefore lose heat. Specifically medications that narrow your blood vessels (vasoconstrictors), regulate your blood pressure (betablockers), rid your body of sodium and water (diuretics) or reduce psychiatric symptoms (antidepressants or antipsychotics). Stimulants for attention-deficit/hyperactivity disorder (ADHD) and illegal stimulants such as amphetamines and cocaine also make the body more vulnerable to heat stress.
Age	The body's ability to cope with extreme heat depends on the strength of the central nervous system. In the very young, the central nervous system is not fully developed and in adults over 65, the central nervous system begins to deteriorate, which makes your body less able to cope with changes in body temperature. Both age groups also usually have difficulty remaining hydrated, which also increases risk of heat stress.
Highly motivated people	People who are highly motivated and committed to performing given tasks at all costs may overlook the signs of heat illness and increase their chance of overextending themselves. People under stressful situations or under tight deadlines to complete work clearly can fall victim to this problem.
Genetics	People who have genetic mutations, such as cystic fibrosis and malignant hyperthermia, should be monitored closely in high heat situations.

### II.3. HOW HIGH TEMPERATURE AFFECTS HUMAN HEALTH

During heat waves workers can easily dehydrate, causing salt depletion, and the body temperature becomes too high. When this occurs, workers may face:

#### 1. Heat-related illnesses

Heat-related illnesses include heat cramps, heat rash, heat exhaustion and heat stroke. Heat stroke especially can lead to a medical emergency. It can result in cell death, organ failure, brain damage or death if not treated promptly and properly.

#### 2. Psychological fatigue, bad memory and mathematical calculation

The impact of extreme heat and the associated illnesses will also influence a worker's reaction time, awareness, memory and mathematical calculations. Furthermore, reactions to extreme heat such as sweating may affect a worker's grip and cause distraction due to discomfort and fatigue. Overall the temperature within a workplace and heat stress can affect output, accident rates, behavioral and cognitive performance of employees.

#### 3. Reduced work productivity and economic impact

Heat conditions are a significant factor in productivity, particularly when the associated outputs require physically demanding work. This is related to the fact that the most natural reaction for a worker suffering from extreme heat is to reduce their physical activity, which in turn reduces the body's internal heat production. As a result of this, hourly work capacity and economic productivity will be reduced. In the long term this will affect individual, local, national and regional economic productivity.



## II.4. HOW TO RECOGNIZE AND TREAT HEAT ILLNESS

### 1. Heat Rash/Prickly Heat

Heat rash (malaria rubra), also known as prickly heat, is a rash of small red bumps caused by blockage of the sweat glands. It can be due to high fever, excessive sweating, or being over-clothed. It is commonly seen in hot, humid tropical climates. It can cause discomfort, itching, and sometimes stinging or "prickly" type pain. Heat rash can occur after exposure to hot conditions. There can be many small, red bumps all over the body. The bumps of heat rash usually occur in highest concentration in covered areas where there is a lot of friction, such as the neck, chest, and body folds. The face, palms, and soles of the feet are generally not affected by heat rash. The rash can cause intense itching and stinging, which can become worsened by heat. The individual may feel fatigued and become intolerant of heat because of little or no sweating at the affected areas.



**KEEP THE AFFECTED AREA DRY  
REST IN A COOL AND SHADED AREA**

#### Symptoms

- A rash comprising a red cluster of pimples or small blisters
- The rash can cause intense itching and stinging
- Most likely to occur on the neck and upper chest, in the groin, under breasts, and in elbow creases and other skin folds.

#### Treatment

- Provide a cooler and less humid environment for the subject
- Keep the affected area dry
- Avoid using ointments or creams as they keep the skin warm and moist and may make the condition worse
- Treating heat rash is simple and usually does not require medical assistance

### 2. Heat Cramps

Heat cramps are painful cramps in the stomach, arm, and leg muscles. These cramps are caused by not replacing salt and fluids during intense, prolonged exercise in the heat. The spasms may be more intense and more prolonged than typical nighttime leg cramps.

#### Symptoms

- Muscle spasms in the arms, legs, or abdomen referred to as heat cramps
- Body temperature is usually normal, and the skin will feel moist and cool, but sweaty.

#### Treatment

- Stop all activity and rest in a cool and shaded area
- Do not return to the strenuous activity for a few hours after the cramps subside, as further exertion may lead to heat exhaustion or heat stroke.
- Drink fluids such as water, fruit juices and sports drinks to rehydrate and replace salt and mineral levels.
- Seek medical attention for the subject:
  - If heat cramps do not subside within one hour
  - If the subject has a heart problem
  - If the subject is on a low sodium diet



**WORKERS WITH HEAT CRAMPS SHOULD  
DRINK FLUIDS TO REHYDRATE AND REPLACE  
SALT AND MINERAL LEVELS**

### 3. Heat Syncope

Fainting or dizziness are the chief symptoms of heat syncope. They are typically brought on by exercising hard in the heat. Too much salt and water are lost through perspiration, and are not replaced. Heat syncope often occurs during the first five days of adjusting to a new activity. It can also occur in people taking diuretic medicines or those with pre-existing heat illness.

#### Symptoms

- Sudden onset of dizziness or fainting after exposure to high temperatures
- Similar to heat cramps, the skin is pale and sweaty but remains cool
- Pulse may be weakened, and the heart rate is usually rapid
- Body temperature is normal

IF THE SUBJECT IS STILL SWEATING, IT IS NOT AT THE EXTREME DANGER LEVEL

MOVE THE SUBJECT TO SHADED/COOL AREA TO TAKE A REST

DO NOT COOL DOWN TOO MUCH STOP COOL DOWN IF THE SUBJECT SHIVERS

#### Treatment

Typically individuals who experience heat syncope will recover relatively quickly, within 10-15 minutes with minimal treatment and monitoring

- Move the subject to shaded/cool area to decrease their body temperature
- Monitor vital signs of the subject to ensure the person does not progress into another condition
- Elevate legs to promote blood flow to the core
- Rehydrate the subject to promote expanded plasma volume



#### 4. Heat Exhaustion

Heat exhaustion occurs when your body gets too hot. The hypothalamus, the part of the brain that controls thirst and hunger, also controls the body's core temperature. Normally, the body cools itself by sweating. When you are exposed to high temperatures for a long time (working outdoors in the summer, for example) and don't replace the fluids you lose, the body systems that regulate temperature become overwhelmed. As a result, your body produces more heat than it can release. Heat exhaustion requires immediate attention because it can progress to heat stroke, a life-threatening illness.

#### Symptoms

- May be thirsty, giddy, weak, uncoordinated, nauseous, and sweating profusely
- Similar to heat syncope and heat cramps, the body temperature is usually normal
- Heart rate (pulse rate) is normal or elevated
- Skin is usually cold and clammy
- Heat cramps may also be a symptom of heat exhaustion

#### Treatment

Individuals experiencing heat exhaustion should respond quickly to treatment. If not, heat stroke should be suspected. To treat heat exhaustion cooling measures that may be effective include:

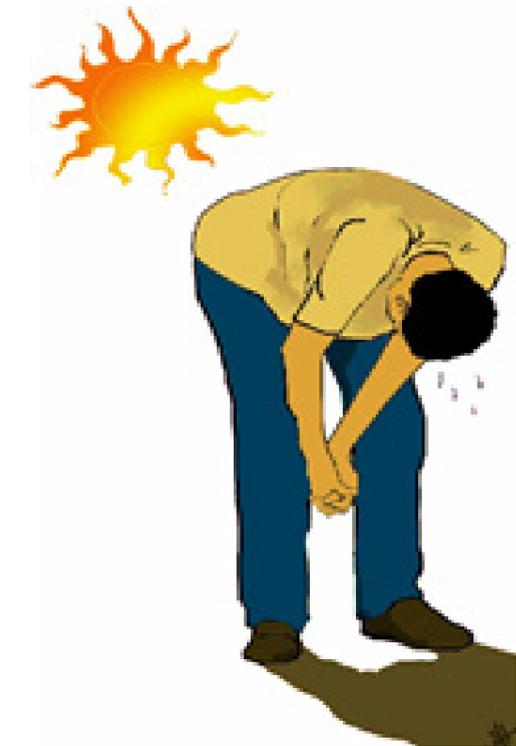
- Drink cool, non-alcoholic beverages, as directed by medical personnel
- Have the subject rest
- Have the subject take a cool shower, bath or sponge bath
- Take the subject to an air-conditioned environment, or a cool shaded area

#### 5. Heat Stroke

Heatstroke is caused by prolonged exposure to high temperatures or by doing physical activity in hot weather. You are considered to have heat stroke when your body temperature reaches 40°C or higher. Heatstroke is the progression of two worsening heat-related conditions. When your body overheats, you first may develop heat cramps. If you don't cool down, you may progress to symptoms of heat exhaustion, such as listed above. Heatstroke occurs if your body temperature continues to rise. At this point, emergency treatment is needed. In a period of hours, untreated heatstroke can cause damage to your brain, heart, kidneys and muscles. These injuries get worse the longer treatment is delayed, increasing your risk of serious complications or death.

#### Symptoms

- A person develops a fever that rapidly rises to dangerous levels within minutes
- Body temperature is usually above 40°C, but the temperature may rise even higher



THE LONGER THE TREATMENT IS DELAYED, THE HIGHER THE RISK OF SERIOUS COMPLICATIONS OR DEATH

- Other signs may include confusion, combativeness, bizarre behavior, feeling faint, staggering, strong rapid pulse, dry flushed skin, and lack of sweating
- Delirium or coma can also result from heat stroke
- The longer treatment is delayed, the higher the risk of serious complications or death
- Heat stroke can be a life-threatening emergency, the victim needs immediate cooling and call for medical assistance



**HEAT STROKE CAN BE A LIFE THREATENING EMERGENCY, IMMEDIATELY CALL A HOSPITAL/EMERGENCY SERVICES**

### Treatment

Heat stroke can be a life-threatening emergency. Immediately begin cooling the victim and call for medical assistance. Heat stroke has had a 100% survival rate when immediate cooling (via cold water immersion or aggressive whole body cold water dousing) was initiated within 10 minutes of collapse.

- Get the victim to a cool and shady area
- Remove the person's unnecessary clothing to help cool the subject down
- Rapidly cool the subject using whatever methods are available, for example:
  - Wrap the subject in a cool, wet sheet and fan vigorously
  - Spray or sponge the subject with cool water and fan
  - Immerse in a tub of cool shallow water only if awake and alert
  - Place in a cool shower
  - Apply ice packs to the subject's armpits, groin, neck and back, where there are a lot of blood vessels close to the skin
- Monitor body temperature, and continue cooling efforts until the subject's temperature drops to 37-38° C
- If emergency medical personnel are delayed, call a hospital emergency department for further instructions

## PART 3: HEAT STRESS PREVENTION

### III.1. THE BENEFITS OF HEAT STRESS PREVENTION

#### FOR WORKERS:

- Strengthen health for themselves
- Avoid heat-related illnesses such as heat rash, heat cramps, heat exhaustion and heat stroke or loss of attention because of temperature change
- Avoid/ reduce the feelings of discomfort and psychological stress caused when the body temperature increases
- Maintain efficiency of work: productivity and quality

#### FOR EMPLOYERS:

- Increase profit because work productivity and the quality of products will be maintained and enhanced
- Avoid/ reduce workplace accidents, occupational illness, reduce compensation expenses and allowances at firms
- Reduce the leave days of workers
- Improve the working environment and also create better relationships between the employers and workers

### III.2. WORK PRACTICES FOR THE PREVENTION OF HEAT STRESS

#### III.2.1. For the workers

These approaches should be applied first, because they are not only *simple but also effective and low cost or even no cost.*

##### 1. Acclimatize workers

Acclimatizing to the hot environment can help the cardiovascular system and the body's core temperature adjust to hot conditions. The body can sweat more and cool itself down.

#### Recommendations

- New workers who have not worked in hot conditions before
  - Should begin with 20% of their workload on the first day
  - Increasing this by 10-20% each subsequent day
- Those returning from seven days absent
  - Should begin with 50% of their work load on the first day
  - Increasing this by 10-20% each subsequent day

##### 2. Appropriate work schedule

Be proactive in organising an appropriate work schedule which limits sun exposure

#### Recommendations

- Do not work close to equipment and machines which are heat sources
- Schedule work during the coolest time of day.
- If possible, move to work in shady areas, avoid heat and heat sources



**SCHEDULE A WORK PLAN AND GRADUALLY BUILD UP TO HEAVY WORK**

**ARRANGE WORK TO MINIMIZE HEAT EXPOSE AND HAVE TIME TO TAKE BREAKS**

### 3. Keeping Hydrated

During hot weather a worker will need to increase their fluid intake, regardless of their activity level. A worker should not wait until they are thirsty to drink. During heavy exercise in a hot environment, a worker should drink two to four glasses of cool fluids each hour. (0.5 – 1 liter/hour).

#### Recommendations

- Drink about two glasses of water before commencing work
- Drink approximately one glass of water every 20 minutes throughout the working day
- Suitable drinks include: tap water, mineral water, fruit juice. Fluids do not need to be iced. Do not drink too much at a time.
- Avoid alcohol and drinks with large amounts of caffeine or sugar as they increase dehydration



**DRINK WATER FREQUENTLY EVERY HOUR – DO NOT WAIT UNTIL YOU ARE THIRSTY**

### 4. Wear Appropriate Clothing and Sun Protection

Where possible, workers should wear loose-fitting, lightweight, light-colored clothing. They should avoid dark colors because these absorb the sun's rays. Reflective clothing such as safety vests, worn as loosely as possible, can minimize heat illness. Water-dampened cotton whole-body suits are an inexpensive and effective personal cooling technique. Cooling vests with pockets that hold cold packs are comfortable and effective. If workers have skin exposed to the sun they should avoid getting sunburnt as it affects the body's ability to cool itself and causes a loss of body fluids. It also causes pain and damages the skin. If workers must be outdoors and have skin exposed they should be protected from the sun by wearing a widebrimmed hat along with sunglasses, and by putting on sunscreen of SPF 15 or higher, 30 minutes prior to going out.



**WEAR LIGHT-COLORED, LOOSE-FITTING, BREATHABLE CLOTHING SUCH AS COTTON**

### 5. Workers have to be aware of their own health status. Report to the medical staff and the manager

The workers have to be aware of their own health status. It should be advised to the medical staff and the managers if they are suffering from heart, cardiovascular or respiratory diseases or are overweight; in order to rearrange work and apply appropriate prevention measures

### 6. Rest in shady area

If workers must be outdoors, their work should be limited to morning and evening hours if possible. If they must work during mid-day hours, workers should rest often in shady areas so that the body's heat system will have a chance to recover.

### 7. Eat and Drink Properly

Workers should eat regular meals and snacks as this helps to provide enough salt and electrolytes to replace those lost through sweating. This is effective as long as enough water is also consumed.

#### Recommendations:

- Eat more fish, eggs, milk and vegetables
- Regularly drink fresh water, fruit juice and mineral water

#### Should not over use :

- Alcohol, beer, coffee
- Fat and spicy food
- Workers on low-salt diets should ask the doctor or medical staff first

**EAT AND DRINK PROPERLY, DRINK ENOUGH WATER, REPLENISH SALTS AND MINERALS FOR THE BODY**

**"YOU ARE YOUR OWN BEST DOCTOR"  
-HIPPOCRATES-**



### 8. Use a buddy system

When working in the heat, workers should monitor the condition of their co-workers. Heat-induced illness can cause a worker to become confused or lose consciousness and not always identify the signs that they are suffering from heat stress. If possible, workers should be joined in pairs during a heat wave so that they can monitor for signs of heat stress in each other.

#### Recommendations:

- Apply the buddy system in high temperature workplaces
- Provide training to assist workers to understand the health effects of heat stress, the symptoms of heat illness and how to respond and prevent heat illnesses



### MONITOR PHYSICAL CONDITION OF CO-WORKERS

#### III.2.2. For medical staff, occupational safety and health staff at sites

### 9. Enhance knowledge for the workers

Enhance knowledge on heat stress prevention, heat related symptoms/ illnesses and how to respond through periodical trainings, meetings, conferences and also through regular monitoring and evaluation

### 10. Monitor and evaluate the implementation of heat stress prevention

Monitor and evaluate regularly the manufacturing team / segment and places which have high temperature and heavy physical workloads

### 11. Practice emergency preparedness and response

Emergency planning and preparedness is in place at sites and be ready to cope with heat-related illnesses

### 12. Suggest measures to care for and manage occupational health to management

Advise the managers of the enterprise to plan and coordinate activities to raise awareness of the impacts of heat stress for workers as well as how to prevent and mitigate its effects on health at work

### 13. Monitor the health profiles of workers

Monitoring and regular medical examinations will help early detection and prevention of serious diseases. Some people are more at risk of heat due to cardiovascular disease, respiratory illness and obesity, so patients should be monitored for appropriate work assignment

#### Recommendation :

The enterprise can follow the periodical health check to evaluate signs and symptoms of heat-related illnesses that the workers often suffer from (how many times, sick days)



### III.2.3 FOR THE EMPLOYERS AND MANAGERS AT WORK

In many cases of working outdoors, it is impossible to prevent heat stress by using technical and engineering controls. This can only be prevented by management and operation measures

#### MANAGEMENT MEASURES:

##### 1. Building an appropriate working plan

The company needs to arrange work appropriately in order to limit the exposure to heat sources exposure or for workers to have time to take breaks and recover their health

##### Recommendation (especially for outdoor work)

- Arrange to do heavy work at the coolest time of the day.
- Rotate work in groups to reduce exposure time 'to' heat sources
- Arrange a cool rest area and cool and full drinking water for workers recovery and rehydration on site
- When there is an opportunity, relocate work to a cool place, away from heat sources.

##### 2. Equip workers with appropriate clothing for sun protection and heat protection

The workers work in hot place should wear the clothes for protection



ARRANGE WORK APPROPRIATELY IN ORDER TO LIMIT EXPOSURE TO HEAT SOURCES OR HAVE TIME TO TAKE BREAK AND RECOVER HEALTH

##### 3. Make decisions and approve the budget to implement the policies of management and health care for the workers

- The policies to support heat stress prevention
- Training and advocacy
- Working hours
- Equip PPE
- Shifts, breaks, refreshments diet

#### TECHNICAL AND ENGINEERING CONTROLS

Technical methods to prevent heat stress focus on:

- Isolating workers from and reducing the exposure of workers to heat sources

- Creating a working environment that is less hot

There are plenty of methods to prevent heat stress

Two effective ways to find out which method is most feasible for your organization are:

- Develop and apply ideas/initiatives of your workers

- Learn about initiatives/solutions from other companies

Here are some suggested solutions:

##### 1. Reduce heat stress directly at the workplace

###### 1.1. Mechanization & automation

Automation and mechanization normally help to increase work productivity, but it is also one way to prevent heat stress by saving the use of human muscles and insulating workers from heat sources.

##### Advantages

- Helps to eliminate occupational hazards, increase productivity and reduce labor costs

##### Weaknesses

- High initial investment
- High level technical requirements and can be difficult to operate

###### 1.2. Cover or shield heat sources

- This is a simple and effective approach using shields or boxes to cover and insulate heat sources from workers
- Using a water shield to isolate the heat sources. This water shield should be set up in front of doors of the oven, and it should be 2mm thick. It can absorb 80-90% heat radiation. The water shield should be clean water with a droplet size of 50-60µm

##### Advantages

- Easy to manufacture and low cost
- Can be combined with other methods to collect dust and toxic gases



### Weaknesses

- Can sometimes hinder working
- May occupy a large space
- Necessary to determine the humidity at the place before this approach is used

### 1.3. Use fans

*This moves the air from place to place; we feel cool because the wind makes sweat evaporate, taking the heat with it as it goes.*

We have: ceiling fans, stand fans, mounted fans

Today, there are some types of misting fans used to cool outside areas of the house. We can apply these at outdoor workplaces

### Advantages

- Simple, cheap, easy to install and move

### Weaknesses

- Does not reduce hot air in factories
- In cases where the temperature inside a factory is higher than 34°C, it is not a good method because it can make the skin dry quickly and dehydration can occur
- Misting fans can cause humid and damp conditions



### 1.4. Use water to cool the temperature

Use a water pump to push water into a water pipe, then spray the water through small holes on the PVC pipe onto the roof. Otherwise, we can also use 360° spinning nozzles to wet the surface of the roof. Used water can be cycled through and reused again, However in this case it will be ineffective in reducing the temperature. We should drain the used water and utilize new water.

### Advantages

- Simple and cheap - it costs approximately 3-4 million dong/ 500 square meter of factory

### Weaknesses

- Can be ineffective and may damage the roof
- It is an inefficient use of water if the water is not being re-used



### 1.5. Roof mist cooling system, wall insulation

Spinning nozzles spray water droplets (size: 50 microns or smaller) which can easily evaporate in the air. In hot conditions the mist can evaporate immediately without condensing. Air containing water vapor can easily and quickly cool the temperature. To gain the best results in heat prevention we should note heat sources such as: machines, the surface of the road and walls made of metal which can absorb heat and have mist cooling systems to prevent the heat from these sources.

### Advantages

- Effective and reasonably priced
- Does not cost too much money to operate (water, electricity)
- Low noise

### Disadvantages

- There are no disadvantages when the temperature outside is under 32°C and the humidity is higher than 70%
- Some products and materials have to be stored in low humidity so it should be considered carefully before applying or check the humidity regularly when using this measure



### 1.6. "Double plant-wall"

The outer layer prevents direct sunlight from hitting the inside wall. Air can circulate between the two wall layers and cools the inside wall.

### Advantages

- Simple
- Suitable for west facing walls

### Weaknesses

- Not suitable for houses or buildings that need a lot of wind



### 1.7. Greenhouse

The roof and walls are covered by plants. This can prevent heat and sunlight effectively

#### Advantages

- Environmentally friendly and trees can help to purify the air within a workplace

#### Weaknesses

- High initial investment
- Needs regular care and maintenance



## 2. Prevent Heat Stress By Using Insulation Materials In Construction

### 2.1. Use heat-resistant metal roof or heat-resistant plates

A heat-resistant metal roof (galvalum roofing) is covered with a zinc oxide (ZnO) nanoparticle layer, so it can prevent heat from the sun

Heat-resistant paint also helps to protect and cool the house or building

Heat resistant aluminum plates (also named: insulation plate) can reflect heat radiation and insulate heat and also noise

#### Advantages

- Some products made in Vietnam are reasonably priced
- A heat-resistant metal roof can reduce the temperature by 1-2 degrees in summer
- Heat-resistant paint can reduce the temperature by 3-5 degrees in summer
- Insulation plates can reduce 50% of noise and decrease the temperature by 5-10 degrees in summer

#### Weaknesses

- The main use of this method is to prevent heat radiation and insulate heat, thus it needs to be combined with other methods to create a cooler place to work



## 3. Prevent heat using natural air flow ventilators for buildings

### 3.1. Use natural air flow in buildings

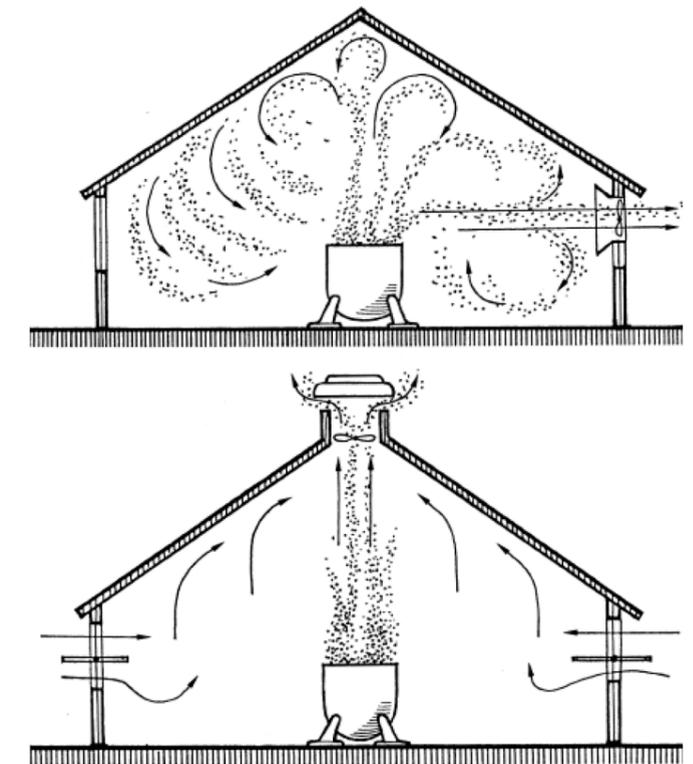
Window openings in a house or a factory can be positioned to set up a convection flow, which is induced by the density difference between cool and warm air. Hot air rises because it is pushed out by the denser cooler air. Convection can be used to create a flow of air in the house exhausting the hot air and replacing it with the cooler air. This cooler air absorbs the heat from the inside of the building and transfers this heat outside. Factories must have windows on the roof to let the hot air out

#### Advantages

- It is easy to design, saves money and helps to remove toxic gases

#### Weaknesses

- It is not enough to reduce the temperature inside the factory, especially on hot days.



### 3.2. Design for natural ventilation

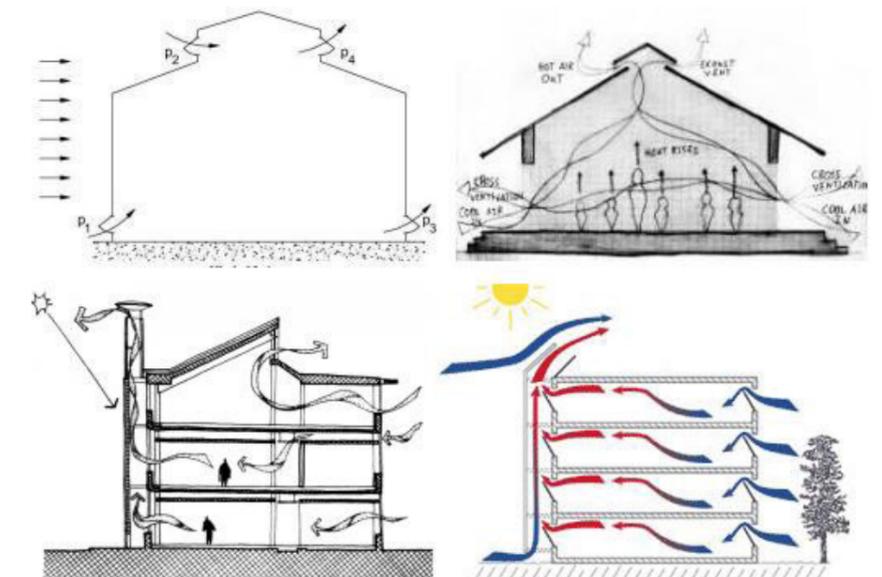
Houses can be designed to make use of convection to generate breezes inside the house. In fact, temperatures inside a house or factory are often higher due to the absorption of heat from machines and other heat sources

#### Advantages:

- Houses and factories designed for natural ventilation can help save money, energy and the cost of other forced ventilation systems
- It also provides fresh air from outside in to the house

#### Weaknesses

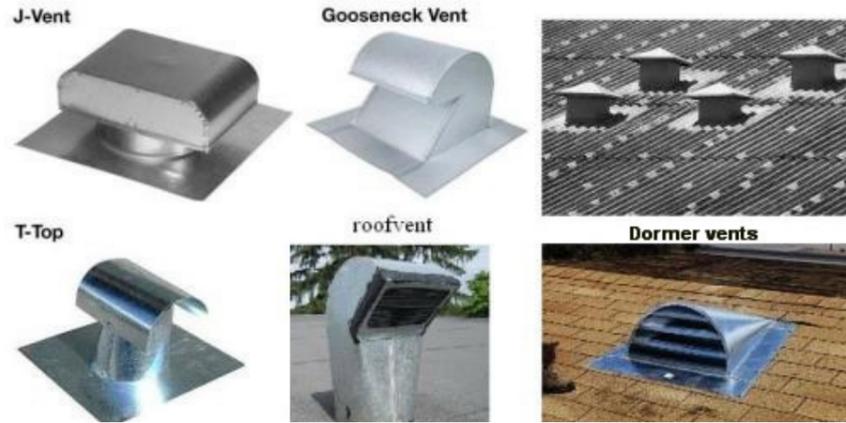
- It is not enough to reduce the temperature inside the factory, especially on hot days



#### 4. Prevent heat stress using forced ventilation systems

##### 4.1. Roof ventilation system

Install an exhaust pipe on the roof (with a cap or lid), which will let hot air out from the ceiling. The cap will prevent water leaking in when it rains. This non-mechanical ventilation operates based on wind and natural air flow. Based on the thermal effect, hot air from inside will rise and be released through the ventilation pipe. A natural circulation of air occurs and cooler air enters through doors, windows and other entry points. The presence of wind will help to increase this effect, if the ventilation system is designed appropriately



##### Advantages

- Works through natural processes and does not need to be powered
- Able to reduce the inside temperature by 1-3 degrees, depending on the quality of the pipe

##### Weaknesses

- Not as effective as the more innovative version

##### 4.2. Roofturbine ventilation system

This is a more innovated version of the above method. Utilizing a rotary turbine, when this spins more hot air is released

##### Advantages

- Environmentally friendly, does not use power
- Designed to withstand rain and material is not corrosive
- Able to reduce the inside temperature by 2-4 degrees, depending on the quantity of vents and the quality

##### Weaknesses

- The amount of air moved is small and it is only able to let hot air out

##### 4.3. Industrial exhaust fan (mounted on wall or roof)

This method builds on the above roof ventilation techniques. These standard methods depend on the outside air movement and air convection process. The temperature will not necessarily decrease a lot and it is very dependent on the environment. Using an exhaust fan can help to increase the ventilation effect. By helping to move the air faster, the temperature decreases more quickly.

##### Advantages

- Cooling for workers inside
- Able to reduce the inside temperature by 3-5 degrees

##### Weaknesses

- Still dependent on the outside air temperature



##### 4.4. Industrial exhaust fan (mounted on wall or roof)

Improving on the above method, this method adds water to the flow of air, which evaporates to cool the air. There are two methods:

##### 1. Negative pressure cooling

A fan draws air in to the factory workshop. As the air pressure will be lower than outside, the air flows through the cooling pad, causing water to evaporate, increasing the humidity of the air stream and thereby reducing the temperature of the workshop.

##### 2. Positive pressure cooling

Machines are placed outdoors and suck the air out of the factory through the cooling pads, increasing the humidity and dropping the temperature. To ensure the humidity does not increase too much, industrial exhaust fans should also be mounted to the wall.

##### Advantages

- Able to reduce the inside temperature by 4-8 degrees using negative pressure cooling
- Able to reduce the inside temperature by 4-10 degrees using positive pressure cooling
  - This is the most effective method for houses made of corrugated iron

##### Weaknesses

- Low amount of air transportation, usually only enough hot air intake



#### 4.5. Industrial air conditioning

An industrial air conditioning system is a system utilizing a cold gas compressor, evaporator and condenser. It operates on a gas cooling coil or water based system to cool the air as required. There are a number of different types of air conditioning systems:

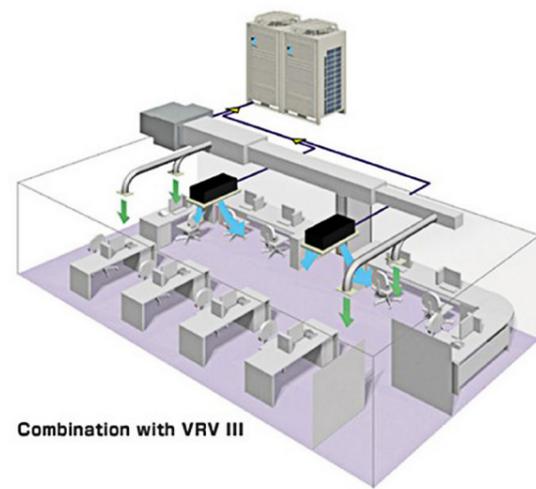
1. Industrial central conditioning: often applied to a department or part of a workshop
2. Central Air Conditioner VRV, VRF: This system can be used for both workshops and buildings

##### Advantages

- Changes in temperature can be made irrespective of the ambient temperature outside
- This type of central air conditioner is connected to a computer or processor and can adjust the humidity

##### Weaknesses

The price is high and is not suitable for factories that have strict requirements for temperature and humidity



Combination with VRV III



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