LOUISIANA DIVISION INDUSTRIAL HYGIENE REPORT
AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

VECTOR® SBC PLANT	LAD-VECTOR-92.02	10/1/92
Department	File Number	Date

TITLE: Evaluation of Employee's Exposure to Heat Stress Hazards at the Louisiana Division VECTOR® SBC Plant, Plaquemine, Louisiana during 1992.

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SUMMARY:

A heat stress evaluation was conducted at VECTOR® SBC during August/ September 1992 to determine the heat conditions for specific tasks during the warmer weather of the year. The survey was conducted in late August/early September versus considerably hotter days in mid-summer. Another survey will be conducted in 1993 to verify results.

Area measurements were taken on each level of the Finishing Building where specific tasks are performed. Measurements were taken of the dry Bulk, Wet Bulk and Globe Temperature to determine a Wet Bulb Globe Temperature Index (WBGT). The WBGT is used as an index for determining conditions of heat stress in a work environment. For further definitions of WBGT, see the Monitoring Methodology Section of this report.

(Continued on next page)

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The measured WBGT range from 82-90F° for areas in the Expeller room or around the shaker screen, heat exchanger and cyclone equipment throughout the 5 levels of the Finishing Building. Although dry bulb temperatures were recorded as high as 99°F, this as well as the relative humidity (a low 50%) can be expected to be higher during mid-summer in Louisiana.

In reviewing the survey sheets, the Globe temperature, which measures radiant heat, indicated high radiant heat measurements. By definition indoors WBGT index = (0.7)(Wet Bulb) + (0.3)(Globe temperature). Radiant heat Globe temperature is 30% of the indoors WBGT index. By shielding key areas where employees perform various tasks from the radiant heat, the Globe temperature will be reduced and thus the indoor WBGT will be reduced. Various materials and areas should be reviewed for implementation of this control concept. There are several hot zone areas in the VECTOR® SBC plant.

Hypothetical situations were developed to simulate actual work experiences for personnel. By utilizing area WBGT measurements and estimating employee work periods (and work level) within these areas, one or two hour TWA's can be determined for the job task. The heat exposure for these tasks are acceptable if a specified work/rest (in air conditioned area) is followed. Generally 15 minutes out of every hour or 30 minutes out of every 2 hours should be allowed in an air conditioned environment when moderate or moderate to heavy work is required.

Several recommendations in this report support a plan to continue a stress prevention program. These recommendations range from individual heat stress practices and supervisory functions to engineering controls. Employees should also participate in the Medical Surveillance Program.

A review of the Safety and Occupational Health records indicated no heat associated illnesses in the VECTOR® SBC plant from startup in October 1990 to September 1992.

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EVALUATION OF HEAT STRESS AT VECTOR SBC DURING AUGUST 1992

INTRODUCTION

In August 1992, an Industrial Hygiene heat stress evaluation was conducted at Vector® SBC to determine the heat stress potential and to incorporate administrative and/or engineering controls where applicable.

CONCLUSION

1. The measured wet bulb globe temperature (WBGT) ranged between 82-91°F in the 2nd floor Expeller Room, 84-92°F at the 4th floor E-2520 filter and 84°F at the 5th floor CY-2520 cyclone. Employee working in high temperatures (>90°F) could exceed the American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Value (TLV) heat stress guideline unless periodic breaks are taken in air conditioned areas.

2. Although dry bulb temperatures were recorded as high as 99°F inside the building, this is not as hot as it can get during the mid-summer months. Also the relative humidity was approximately 50%, which again is lower than can be expected for Louisiana.

3. Hypothetical situations were developed to simulate actual work experience for personnel at the various locations. The work regimen was defined as light, moderate, to moderate to heavy.

   Activities on 2nd floor: (Cleaning die in Expeller room)
   Calculated one hour time-weighted average (TWA) for heat stress exposures were found unacceptable for a work regimen of 45 minutes in the heat with the remaining 15 minutes (of the 1 hour period) resting in the air conditioned shop. However, if a floor fan could be positioned to blow cooler air towards the workers and drop the WBGT by 2°F would allow this 45/15 segment to be acceptable.

   Activities on 3rd floor: (Changing filters on E-2530)
   Calculated 1 hour TWA's were found acceptable for a moderate work regimen of approximately 40 minutes in the heat and the remaining 20 minutes at rest in an air conditioned break room. However, if the work level increased to moderate - heavy for a 40 minute period, this would represent a borderline situation.

   Activities on 4th floor: (Changing screen on E-2520 and making rounds through the outside process area)
   Calculated 2 hour TWA's were found unacceptable for moderate to heavy work regimen for 60 minutes in the heat, followed by 40 minutes of walking through the outside process area, and finally 20 minutes resting in the air conditioned break room. If, however, 30 minutes were spent in the break room, this becomes a borderline situation.

   Activities on 5th floor: (Unplugging CY-2520 cyclone)
   Calculated 1-1/4 hour TWA was found acceptable for a moderate work regimen of 60 minutes in the heat followed by a 15 minute rest period in an air conditioned break room.

4. Annual training in the recognition and prevention of heat stress hazards.

5. Radiant heat, (globe temperature) plays a major role in the overall employee's heat stress exposure

6. A review of the OSHA illness reports and the Louisiana Division medical reports revealed that no one in the Vector® SBC plant experienced a heat related illness since startup in October 1990.

RECOMMENDATIONS

1. Annual training in the recognition and prevention of the hazards of heat stress.

2. Allow time in a work regimen for personnel to cool down in an air conditioned environment.

3. Make sure that there is as much cross ventilation through the building as possible with the use of wall fans, open doors, etc.

4. Always use and position floor fans to blow cooler air towards the worker.

5. Enhance a heat stress prevention program. Include as a minimum, methods to prevent excessive body fluid loss, replacement of body salts, the importance of being physically fit, interactions of some medications and heat tolerance, proper clothing, personal cooling systems, symptoms and first aid for heat illnesses, and the need for resting in cool areas. Implement an acclimation schedule to allow non-acclimated employees to gradually acclimate to the heat stress environment.

6. Continue to investigate feasible engineering controls such as shielding of radiant heat when performing certain tasks.

7. Schedule follow-up studies as process changes or engineering controls are implemented.

EVALUATION OF HEAT STRESS AT VECTOR® SBC DURING AUGUST, 1992

MONITORING METHODOLOGY

EVALUATION CRITERIA

Heat stress monitors can be used to determine WBGT indexes. The monitor used in this survey is a Wibget Heat Stress Monitor Model RSS-214. The instrument performs all calculations necessary and gives a readout in WBGT degrees Fahrenheit ready for evaluation.

There is no OSHA heat exposure standard, but the "General Duty Clause" stipulates that employers must furnish employees "Employment free from recognized hazards likely to cause physical harm".

PERMISSIBLE HEAT EXPOSURE TLV's
(See Figure 5)

Wet Bulb Globe Temperature (Degrees Fahrenheit)

WORK/REST	LIGHT WORK	MODERATE WORK	HEAVY WORK
Continuous Work	86	80	77
Work 75%/Rest 25%	87	82.5	79
Work 50%/Rest 50%	88.5	85	82
Work 25%/Rest 75%	90	88	86

Light Work	(up to 200 KCAL/HR):	Sitting or standing to control machines, performing light hand or arm work.
Moderate Work	(200-350 KCAL/HR):	Walking about with moderate lifting and pushing.
Heavy Work	(350-500 KCAL/HR):	Pick and shovel work.

The permissible 1 hour TLV-WBGT Exposure Limit was determined by calculating the average metabolic rate and then using the Figure 5 graph, reading the WBGT °F from the continuous work line. The continuous work line is used because the actual WBGT data was taken from more than one location (i.e., work area and air conditioned area) rather than both work/rest regimen happening in the same location.

A heat stress survey was completed to determine potential for heat stress and incorporate administrative and/or engineering controls. See the heat stress survey forms which follows. A drawing showing locations where WBGT Index readings were taken is included. The readings were taken in areas where employees generally work.

High stress situations are usually areas with poor ventilation, high relative humidity, and air temperatures usually in excess of 80 degrees Fahrenheit. Special situations should be evaluated for heat stress prior to commencement. For example, a vessel entry situation should be closely evaluated prior to the actual entry. The next step is to determine the control necessary (if any) to reduce the potential for heat illness.

ANALYTICAL METH DOLOGY

Since measurement of deep-body temperature is impractical for monitoring the worker's heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. The following factors have been judged to be the most significant with regards to the body's ability to generate and dissipate heat energy:

1. Metabolic rate, or a rate of heat generation by the body which is dependent on the degree of activity.

2. Ambient air temperature, the temperature of the surrounding area exclusive of radiant energy.

3. Radiant temperature, that energy which is similar to visible light but has little heating effect on the air it passes through.

4. Relative humidity, the measure of water content in the air.

5. Air movement, the air velocity available for connective and evaporative heat transfer.

6. Body motion, which supplements the movement of air in the workplace environment.

Any survey must incorporate all of these factors into the final consideration.

The ACGIH has developed a TLV for heat stress based on the following empirical formula:

$$WBGT = 0.7\ WB + 0.3\ GT^*$$

The Reuters Stokes RSS214 Wibget® is a compact portable instrument to be used for measuring environmental factors contributing to human heat stress. The instrument is comprised of four parts; the meter, a wet bulb sensor, a dry bulb sensor and a globe sensor. The instrument electronics includes a digital readout, a function switch, and a switch allowing °C/°F selection. It is capable of determining dry bulb temperature (DB), naturally aspirated wet bulb temperature, Vernon globe equivalent temperature (GT) and can compute the wet bulb globe temperature (WBGT) indices.

The RSS-214 Wibget® requires an environment-dependent stabilization time. To achieve optimum accuracy, the instrument should be left in the environment to be measured at a height of 4 feet above the floor and at least 18 inches from the worker, 3 to 5 minutes before taking readings.

* This formula should be used indoors or outdoors when there is no solar load.

EVALUATION OF HEAT STRESS AT VECTOR® SBC
DURING AUGUST 1992

HEAT STRESS PREVENTION CONTROL METHODS

A. The individual employee should be aware of practices he/she should be using to prevent heat stress. The following is a summary of recommended heat stress practices at the Vector® SBC Plant.

1. Prevent excessive body fluid loss. Drink sufficient amounts of water throughout the day. Some tasks may require drinking small amounts of water every 15 minutes. Start drinking at the beginning of the work periods (thirst is not an adequate stimulus). Up to 1.5% body weight loss at the end of the workday is OK. More than 1.5% body weight loss increased the risk of heat illness.

2. Replace salt lost due to sweating. (In other words, help maintain the correct electrolyte balance in the body). This can be accomplished by eating well-balanced meals. The use of "Gatorade"/"Quick Kick" is available. However, water does not require as much energy to metabolize and should be used during normal working hours. The use of salt tablets is not recommended for salt replacement.

3. Emphasize keeping physically fit by exercising regularly. Fat layers act as insulators and slow the body's ability to remove heat. Your heart also works harder if you are overweight. Eat well-balanced meals and get plenty of sleep.

4. Some medications reduce heat tolerance. Inform your doctor of the heat stress demands on your job prior to the prescription of any medicine.

5. Wear proper work clothing.

6. Ice vests are available for personal use and can reduce heat stress and prolong work endurance.

7. Be familiar with the symptoms of heat illness so that additional precautions can be taken, if needed.

8. Take rest periods in cool areas.

B. Supervisory Functions

Supervisors should be aware of their role in preventing heat illness for those in the area of responsibility. A few specific recommendations are listed below.

1. Allow employees to adequately acclimate themselves to the heat. Acclimation increased heat tolerance while decreasing the risk of heat illness. Introduce new workers to heat exposure gradually. The following is a recommended schedule for introducing new, non-acclimated workers to hot work areas. This schedule can also include workers returning from illness, vacation, or any other prolonged absence.

Number of Days on the Job	Recommended exposure % of Usual Daily Exposure
1	50
2	60
3	70
4	80
5	90
6	100

2. Additional considerations include providing a cool place to rest when feasible and scheduling the hardest work early in the morning and saving the lighter work for the warmer time of the day. Provide fans for general ventilation if area ventilation is poor. Provide proper personal protective equipment to shield or reflect radiant heat. When possible, set up a rotation schedule so hot work can be shared thereby reducing individual exertion and body heat generation.

   Part of a supervisor's overall responsible responsibility is to be aware of the heat stressors affecting his employees. Utilizing preventive measures should help reduce heat illness in the area.

C. Engineering Controls

The third major way to prevent or control heat illness is by engineering controls. After evaluating the work environment, determining the principle heat stressors should help identify appropriate engineering controls. The following table lists several controls that have proved useful in controlling heat exposures.

Controlling Heat Stress:

Heat Component	Possible Action
Metabolism	- Mechanization - Sharing work load - Increasing rest time

C. Engineering Controls (Cont'd)

Radiation	- Minimize line-of-sight to source - Insulation of walls - Reflective screens - Reflective aprons - Cover exposed parts of body
Convection	If air temperature is above 95°F, reduce convection heat gain by; - Lowering air temperature - Lowering air velocity - Wearing clothing If air temperature is below 95°F, - Lowering air temperature - Increasing air velocity
Evaporation	Increase by: - Increasing air velocity - Decreasing humidity

HEALTH HAZARDS

Introduction

The human body has different mechanisms for regulating temperature. These mechanisms act to maintain deep body temperature within a narrow range centered about 98.6°F for normal brain and organ function. But, even with its ability to adjust for environmental temperature differences and its own metabolic, the human body's compensatory limitation, if exceeded, can result in serious effects, including death.

Ideal Working Temperature

The body must deal with two primary heat sources when trying to regulate its internal temperature. These two primary heat sources are the sources of heat in the work environment, and the heat generated by the natural metabolism of the individual. To allow for proper dissipation of its heat, the ideal working environment is approximately 72 degrees Fahrenheit. The ideal temperature, of course, would have to be adjusted for different extremes of work activity. But for performing light and moderate work, 72 degree Fahrenheit environment would allow an individual to adequately dissipate his excess heat under normal conditions of relative humidity and good air movement.

Heat Storage in the Body

Heat stored in the body depends on the heat gained or lost to the environment and heat gained from the body metabolism. The relationship of heat storage in the body is expressed by the following formula:

$$S = \pm C \pm F - E + M$$

Where:

S = Storage of heat in the body
C = Heat gain or loss by convection
R = Heat gain or loss by radiation
E = Heat loss by evaporation
M = Heat gain by metabolism

Evaporation can cause only heat loss, not heat gain. Heat can only be gained by body metabolism. Heat can either be gained or lost through convection and radiation. To maintain appropriate heat storage, the amount of heat gained must be offset by the heat loss in maintaining an average temperature of 98.6° Fahrenheit. When this balance is not maintained then heat illness can occur.

Heat Illness

The following represents the normal response to heat when the body is providing adequate cooling;

Skin Temperature Rises

Blood vessels dilate More blood flow to skin Increased heat flow from center of body to skin	Sweating begins
Reduction in body temperature	Heat is lost by evaporation

Whenever the normal cooling actions do not occur, a heat illness could be the result. Typical heat illnesses include the following: Heat rash (prickly heat), heat cramps, heat exhaustion, and heat stroke.

HEAT RASH

Symptoms - Signs of heat rash include a skin rash over arms, shoulders, chest and behind knees. Also included are a tingling or prickly feeling on the skin.

First Aid - When a heat rash has developed, stay away from hot environments and sunshine and avoid scratching.

Prevention - To avoid heat rash, take showers after working in the heat, dry the skin thoroughly, change undergarments, and stay in cool places after work.

HEAT CRAMPS

Symptoms - Muscles of the abdomen, arms, and legs are usually involved. Muscles are painful and usually knotted.

Physiology - The skin temperature rises and sweating begins, causing loss of body fluids and salts, and result in cramps.

First Aid - Gently message the affected muscle. Drink plenty of water/fluids and rest in a cool place.

Prevention - Drink sufficient water, starting at the beginning of the shift and maintain a proper balanced diet.

HEAT EXHAUSTION

Symptoms - Approximately normal body temperatures, pale and clammy skin, profuse perspiration, tiredness, weakness, headache, cramps, nausea, dizziness, vomiting, and fainting.

Physiology - The skin temperature rises, sweating begins, vessels to the skin dilate, drain on body fluids, dilation of vessels causes inadequate blood flow to vital areas leading to poor circulatory and heat exhaustion.

First Aid - Call for medical help: rest in a cool place; loosen clothing; drink plenty of water/fluids; have victim lie down and elevate the feet. If vomiting occurs, do not give fluids; take victim to the Medical Department.

Prevention - Maintain cardiovascular fitness through proper exercise and diet. Do not overdo it on hot days. Rest in a cool area at regular times during the work day. Drink fluids from the beginning of the work day; thirst is usually not an adequate stimulus to tell you when to drink.

HEAT STROKE

Symptoms - The initial symptoms of heat stroke include erratic behavior, hot dry flushed skin, unsteady gait, irritability and increased body temperature. Symptoms of fully developed heat stroke include elevated temperature (105°F or higher); convulsions; loss consciousness.

Physiology - The skin temperature rises, sweating begins, drain on body fluids and salts, dilation of blood vessels to the skin, inadequate blood return to the heart and other vital areas. Sweating continues but slows as body water is lost. Body temperature rises, causing failure of the brain's central control mechanism. The core body temperature continues to rise, leading to heat stroke.

First Aid - Call for ambulance. Take measures to cool the body quickly. Increase air movement; remove clothing; use cool water bath; rub skin constantly to increase circulation; place an ice bag on the head; place victim in a shady area if possible. Do not give the victim stimulants.

Prevention - Maintain cardiovascular fitness through proper exercise and diet. Work in shady areas if possible with plenty of ventilation. Rest often in cool areas. Drink fluids at regular intervals, such as every 20 minutes, starting at the beginning of the work shift. Share the work load with another worker when possible. Also, when possible complete the hardest work tasks when it's cooler.

As you can see, the body has many responses to a stressful heat situation. Being aware of preventative measures should help in avoiding heat illness.

SPECIAL SITUATIONS

Severe heat stress situations may arise out of a work environment when an employee is wearing special clothing or performing a task that do not allow for normal evaporation of perspiration and venting of heat.

Evaluation of the dry bulb temperature, wet bulb temperature, radiation heat, and metabolic heat load are not adequate to provide timely warning. A normal evaluation using WBGT would be meaningless. Only proper acclimation to the heat environment and proper training to recognize severe heat situations will help.

EVALUATION OF HEAT STRESS AT THE VECTOR® SBC PLANT
DURING SEPTEMBER, 1992

DISCUSSION AND RESULTS

The Heat Stress surveys identifies the work zones where WBGT were taken.

The activity tables lists the area heat measurements taken on each level of the Finishing Building where specific tasks are performed. Measurements were taken of the Dry Bulb, Wet Bulb, and Globe temperature using a Widget Heat Stress monitor model RSS-214. to determine a Wet Bulb Globe Temperature Index (WBGT). The WBGT is used as an index for determining conditions of heat stress in a work environment. For further definitions of WBGT Index see the Monitoring Methodology Section of this report.

In reviewing the survey sheets, the Globe temperature, which measures radiant heat, indicated high radiant heat measurements. By definition, indoors WBGT index = (0.7) (Wet Bulb) + (0.3) (Globe temperature). Radiant heat Globe temperature is 30% of the indoors WBGT index. By shielding key areas where employees perform various tasks from the radiant heat, the Globe temperature will be reduced and thus the indoors WBGT will be reduced. Various materials and areas should be reviewed for implementation of this control concept.

The heat stress evaluation was conducted in late August/early September versus considerably hotter days in mid-summer. Time studies will be completed on all job classification to determine estimated working periods within specific areas of the plant. By utilizing area WBGT measurements and estimated employee working periods within these areas; eight hour TWA WBGT indexes can be determined for each job classification.

The permissible 1 hour TLV-WBGT Exposure Limit was determined by calculating the average metabolic rate and then using the Figure 5 graph, reading the WBGT°F from the Continuous work line. The Continuous work line is used because the actual WBGT data were taken from more than one location (ie. work area and air conditioned area) rather than both work/rest regimen happening in the same location.

The heat exposures for some of the job tasks are permissible if a work/rest regimen is followed. Employee should also participate in a regular medical surveillance and in an effective heat stress prevention program. Review of safety and occupational health records did not yield one heat associated illness in the VECTOR® SBC plant from startup in October, 1990 to September, 1992.

Several recommendations in this report support a plant established heat stress prevention program. These recommendations range from individual heat stress practices and supervisory functions to engineering controls.

TABLE 1

ACTIVITIES ON 2ND FLOOR

1. Using the example of unplugging the die on a hot day and taking into account the average WBGT 82.3° assuming a moderate work activity for 60 minutes and then 15 minutes in an air conditioned room.

Work Regimen	Time (min.)	WBGT°F		Metabolic Rate (BTU/hr)	BTU
Date: 8/29/92					
Moderate (2nd Floor)	60	82.3	4938	1100	66,000
Rest (Shop)	15	66.2	993	400	6,000
	75		5931		72,000

or ave. WBGT of 81.7°F Ave. 960 BTU/hr

Permissible 1 hr TLV-WBGT is approximately 84.5°F.

WBGT of 81.7°F vs. guideline 84° is acceptable.

2. If the maintenance job involved maintenance in the expeller room with a WBGT of 91.4°F assuming a moderate work level for 45 minutes and then 15 minutes rest in an air conditioned room.

Date: 8/29/92					
Moderate(Expeller Room)	45	91.4	4113	1100	49,500
Rest (Shop)	15	66.2	993	400	6,000
	60		5106		55,500

or ave. WBGT of 85.1°F Ave. 925 BTU. hr

Permissible 1 hr TLV-WBGT is approximately 84.5°F.

WBGT of 85.1°F vs. guideline 84.5°F is not acceptable.

However, placing a floor fan to blow cooler air toward the expeller work locations, may be expected to lower the WBGT as much as 2°F or to 89.4°F.

Moderate(Expeller Room)	45	89.4	4023	1100	49,500
Rest (Shop)	15	66.2	993	400	6,000
	60		5013		55,000

or ave. WBGT of 83.5°F is acceptable assuming the floor fans would drop the WBGT in the expeller room by 2°F at the spot work is being performed.

TABLE II

ACTIVITIES ON 3RD FLOOR AREA

3. Cleaning polymer crumb from D-2530 on 3rd floor level/assuming a moderate work level. Readings were taken 9/8/92.

OUTSIDE CONDITIONS - DB 97°F
- RH 47%

Work Regimen	Time (min.)	WBGT°F		Metabolic Rate (BTU/HR)	BTU
Clean D-2530	30	84	2520	1100	33,000
Walking in area	15	84	1260	600	9,000
Break room (rest)	15	66	990	400	6,000
	60		4770		48,000

Average WBGT is 79.5 Average 800/BTU/HR.
Permissible 1 hour TLV - WBGT is 84.5.
>> This is acceptable.

4. Changing filters on E-2530 on 3rd floor level. Compare different work efforts. Readings were taken 9/9/92.

OUTSIDE CONDITIONS - DB 98°F
- RH 46%

A. 45/15 minute work regimen and a moderate work level

Change Filters on D-2530	45	92	4140	1100	49,500
Break room (rest)	15	66	990	400	6,000
	60		5130		55,500

Average WBGT is 85.5 Average 925/BTU/HR.
Permissible 1 hour TLV - WBGT is 84.5.
>> This is not acceptable.

B. 40/20 minute work regimen and a moderate work level

40	92	3680	1100	49,500
20	66	1320	400	8,000
60		5000		52,000

Average WBGT is 83.3 Average 867/BTU/HR.
Permissible 1 hour TLV - WBGT is 85.5.
>> This is acceptable.

C. 40/20 minute work regimen and a moderate to heavy work level

40	92	3680	1400	56,000
20	66	1320	400	8,000
60		5000		64,000

Average WBGT is 83.3 Average 1067/BTU/HR.
Permissible 1 hour TLV - WBGT is 83.0.
>> This is not acceptable but borderline.

TABLE III

ACTIVITIES ON THE 4TH LEVEL

5. Changing filter elements on E-2520/assuming a moderate to heavy work level and making rounds through outside process area. Readings were taken 9/9/92.

Work Regimen	Time (min.)	WBGT°F		Metabolic Rate (BTU/HR)	BTU
Based on 2 hr work segment					
Change Screens	60	92	5520	1400	84,000
Walking in Process	40 (outside)	90	3600	600	24,000
Break room (rest)	20	66	1320	400	8,000
	120		10440		116,000

Average WBGT is 87.0 Average 966/BTU/HR.
Permissible 2 hour TLV - WBGT is 84.5.
>> This is unacceptable.

Change Screens	60		5520	1400	84,000
Walking in Process	30		2700	600	18,000
Break room (rest)	30		1980	400	2,000
	120		10200		114,000

Average WBGT is 85.0 Average 950/BTU/HR.
Permissible 2 hour TLV - WBGT is 84.5.
>> This is unacceptable but borderline.

TABLE IV

ACTIVITIES ON THE 5TH FLOOR

6. Using an example of unplugging CY-2520 cyclone on a hot day and using an actual WBGT 84.2°F assuming a moderate work level for 60 minutes and then a rest period in an air conditioned room. Normally this job task takes 1 to 2 hours. Readings were taken 9/9/92.

OUTSIDE CONDITIONS - DB 96°F
- RH 40%

Work Regimen	Time (min.)	WBGT°F		Metabolic Rate (BTU/HR)	BTU
Based on 1 1/4 hr. segment					
Unplug CY-2520 Cyclone	60	84.2	5052	1100	66,000
Break room (rest)	15	66.0	990	400	6,000
	75		6045		72,000

Average WBGT is 80.6 Average 960/BTU/HR.
Permissible 1 hour TLV - WBGT is 84.5.
>> This is acceptable.

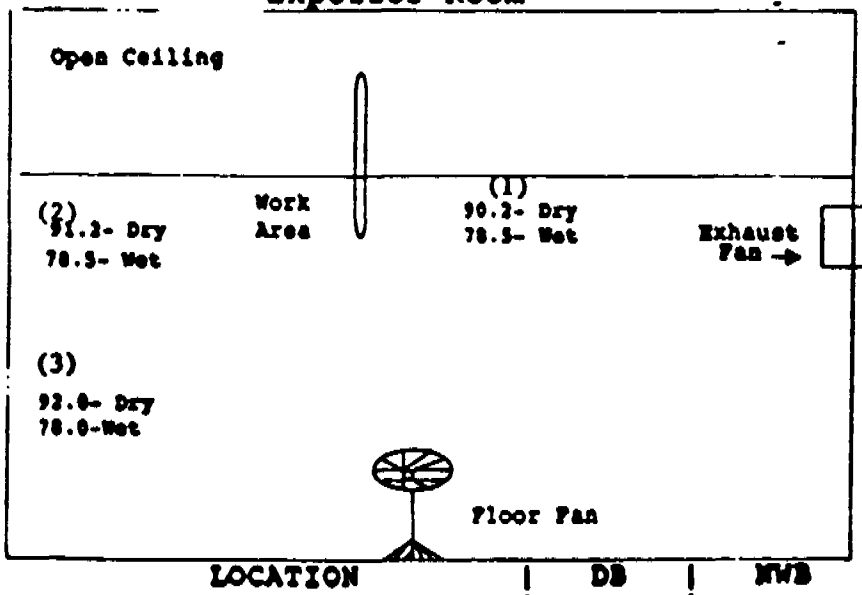
HEAT STRESS SURVEY Figure 1

LOCATION 2ND LEVEL - EXPELLER ROOM **DATE** 8-29-92

SURVEY INSTRUMENTS PSYCHROMETER - WET BULB APPARATUS

WIND 2 MPH **RELATIVE HUMIDITY** 40% %

Expeller Room



Estimated WBGT = 0.7 NWB + 0.3 DB

LOCATION	DB	NWB	GT	WBGT	TIME
1. EXPELLER ROOM	90.2	78.5		81.7	1:00 P.M.
2.	91.2	78.5		82.3	
3.	92.0	78.0		82.2	
4.					
5.					
6.					

WORK CATEGORY(S) LIGHT MODERATE HEAVY

COMMENTS WALL FAN WAS OPERATING AT THE TIME. FLOOR STAND FAN WAS BLOWING TOWARDS A MAINTENANCE CREW PERFORMING THE TASK OF UNPLUGGING A DIE FACE IN THE EXPELLER ROOM.

DATA COLLECTED BY BRENDA HEMO
HOWARD WILKERSON

Figure 2

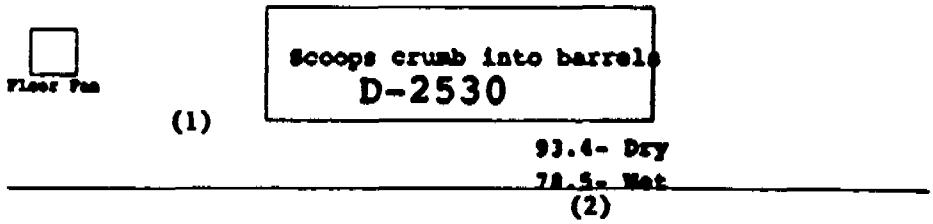
HEAT STRESS SURVEY

LOCATION 3RD LEVEL D-2530 **DATE** 9-8-92

SURVEY INSTRUMENTS WIBGET HEAT STRESS MONITOR SERIAL # 21401-235

WIND SE 2 MPH **RELATIVE HUMIDITY** 52% %

Finishing Building
3rd Level



S-2540

LOCATION	DB	NWB	GT	WBGT	TIME
1.	97.0	80.2	100.3	86.5	2:42 P.M.
2.	93.5	78.3	97.8	84.0	2:50 P.M.
3.					
4.					
5.					
6.					

WORK CATEGORY(S) LIGHT MODERATE HEAVY

COMMENTS OPERATOR SCOOPS CRUMB FROM THE DRUM WITH BASKETS WITH HANDLES AND PLACE THE BASKETFULL OF CRUMB INTO A 30 GALLON PACK.

DATA COLLECTED BY BRENDA HERD
HOWARD WILKERSON

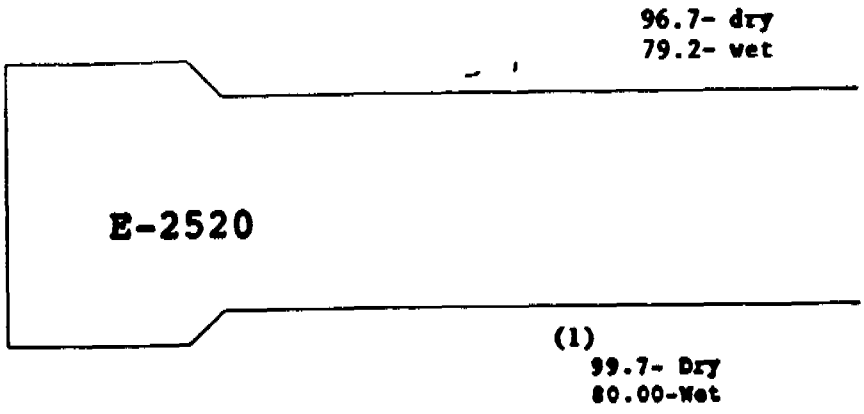
Figure 3

HEAT STRESS SURVEY

LOCATION 4TH LEVEL E-2520 **DATE** 8-29-92

SURVEY INSTRUMENTS WIBGET HEAT STRESS MONITOR **SERIAL #** 21401-235

WIND 2 MPH **RELATIVE HUMIDITY** 47% &



	LOCATION	DB	NWB	GT	WBGT	TIME
1.	E-2520	99.7	80.0		85.9	
2.		96.7	79.2	121.5	89.2	
3.						
4.						
5.						
6.						

WORK CATEGORY(S) LIGHT MODERATE HEAVY

COMMENTS CHANGES FILTERS ON THE FBC APPROXIMATELY 1/MONTH.

EMERGENCY SHUTDOWNS OF THE FBC REQUIRES OPENING THE DOORS AND CLEANING THE

FBC WHILE IT'S IN OPERATION.

DATA COLLECTED BY BRENDA HERO
HOWARD WILKERSON

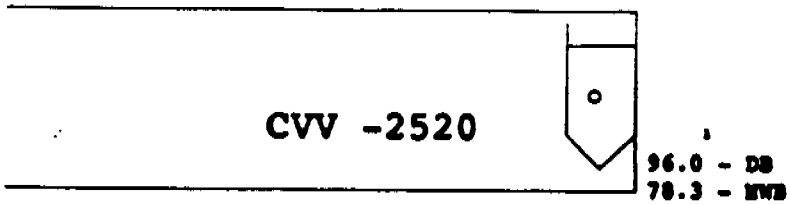
Figure 4

HEAT STRESS SURVEY

LOCATION 5TH LEVEL DATE 9-8-92

SURVEY INSTRUMENTS WIBGET HEAT STRESS MONITOR SERIAL NO. 21401-235

WIND SE 2 MPH RELATIVE HUMIDITY 46% %

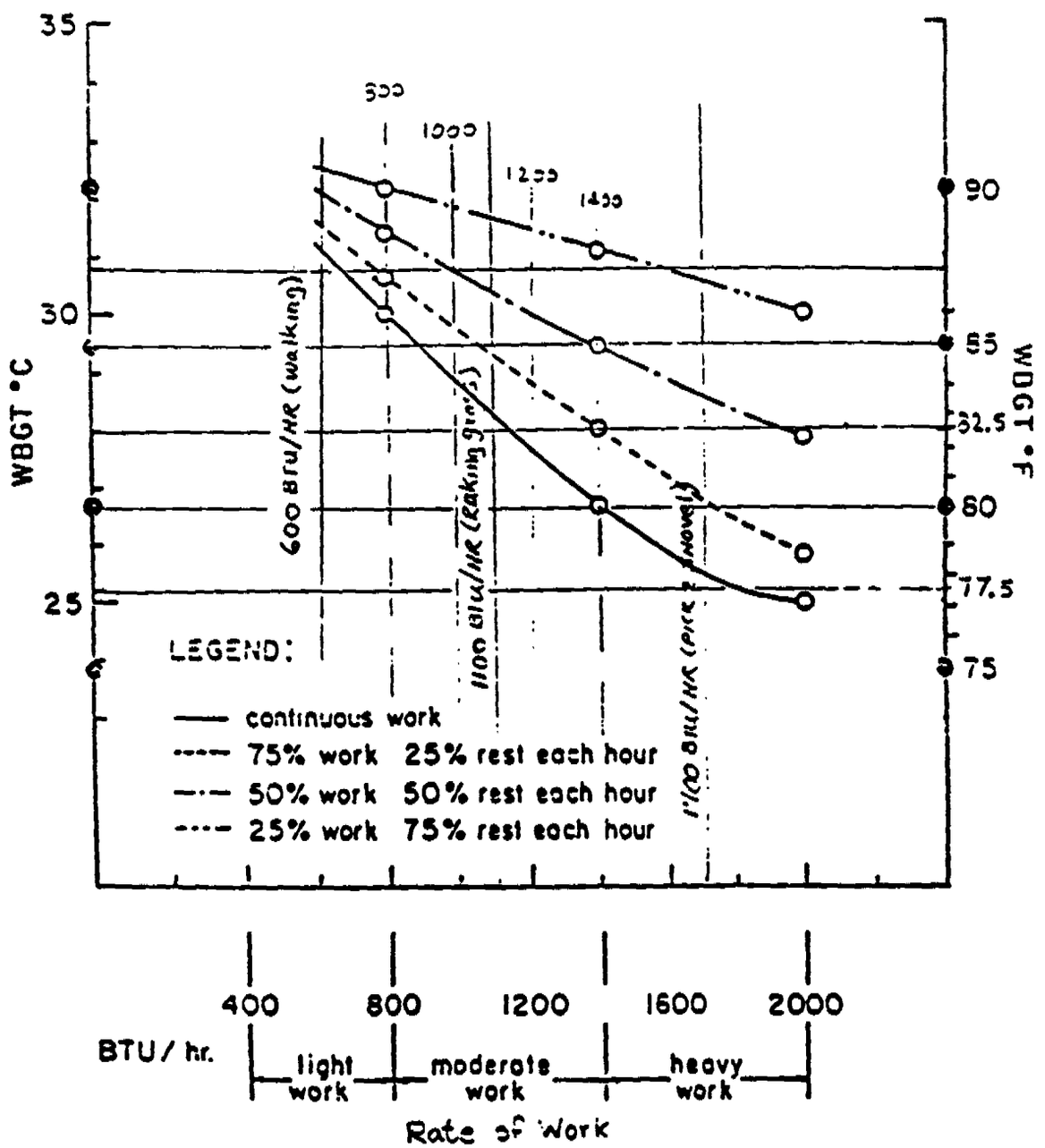


	LOCATION	DB	NWB	GT	WBGT	TIME
1.	CVV 2520	96.0	78.3	96.3	84.2	2:55 P.M.
2.						
3.						
4.						
5.						
6.						

WORK CATEGORY(S) LIGHT MODERATE HEAVY

COMMENTS UNPLUGGING CY-2520 CYCLONES. IT MAY TAKE 1 TO 2 HOURS TO COMPLETE THIS TASK.

DATA COLLECTED BY BRENDA HERO
HOWARD WILKERSON



American Conference of Governmental Industrial Hygienists: Cincinnati, Ohio, 1971.

Figure 31-8. Permissible Heat Exposure Threshold Limit Value.