

NO. 15287*RM01

JIMMY CAMURAL MANSEL,
INDIVIDUALLY AND AS PERSONAL
REPRESENTATIVE OF THE
HEIRS AND ESTATE OF
JAMES CAMURAL MANSEL,
DECEASED

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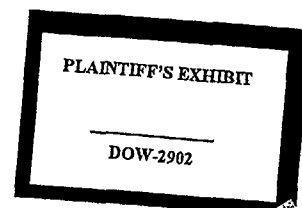
IN THE DISTRICT COURT

VS.

U.S. GYPSUM COMPANY,
ET AL.

BRAZORIA COUNTY, TEXAS

149TH JUDICIAL DISTRICT



CERTIFICATE OF WRITTEN DISCOVERY

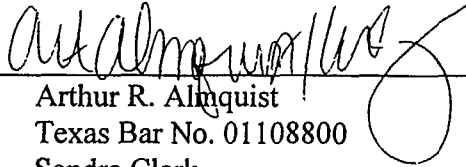
TO THE HONORABLE JUDGE OF SAID COURT:

Defendant, The Dow Chemical Company, certifies under the Texas Rules of Civil Procedure that the following document(s) have been served on plaintiff(s) on this the 31st day of May, 2002.

1. Exhibit List for Defendant The Dow Chemical Company.

Respectfully submitted,

MEHAFFY & WEBER, P.C.

By: 

Arthur R. Almquist
Texas Bar No. 01108800
Sandra Clark
Texas Bar No. 04294520
One Allen Center
500 Dallas, Suite 1200
Houston, Texas 77002
Telephone: (713) 655-1200
Facsimile: (713) 655-0222

**ATTORNEYS FOR DEFENDANT
THE DOW CHEMICAL COMPANY**

CERTIFICATE OF SERVICE

I hereby certify that true and correct copies of the foregoing instrument were served upon all attorneys of record on this the 31st day of May, 2002, in accordance with Rule 21 and 21a of the Texas Rules of Civil Procedure.

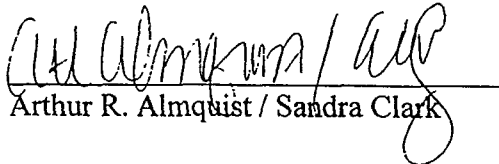

Arthur R. Almquist / Sandra Clark

Exhibit List for Dow Chemical

- 1. Standard Rules and Regulations (TX Div, Apr 1941, ST0014088-95):**
- 2. Safety Rules and Regulations (TX Div, ST0014096-119):**
- 3. Industrial Hygiene Survey of Various Operations at the Chlorine Cells (Finished 3/20/1951, ST006739-56):**
- 4. Evaluation of Chemical Exposures Received by R.R. Spencer of Coatings Technical Service, Bldg 433 (1/22/58, ST006828-39):**
- 5. General Plant Safety Rules (TX Div., Revised 3/24/1958, ST0014120-35):**
- 6. Safety Rules and Safety Regulations for Paint Dept. (Jan. 1961, ST0014177-84):**
- 7. General Plant Safety Rules (TX Div., Freeport, 5/1/1962, ST0014136-54):**
- 8. Insulation for Personnel Protection: Pipe and Fittings (TX Div., 12/14/1962, ST0534422-26):**
- 9. Letter from H.R. Hoyle of Biochemical Research Lab to R.C. Middleton of the Ludington Division of the Safety Dept. (Midland, MI, 10/26/1964, ST0000018-19):**
- 10. Exposure to Fine Dusts Encountered by Workers Cutting Various Types of Pipe Covering Material (7/21/1965, ST0000568-77):**
- 11. Preface to Insulation Standard Specifications (TX Div., Revised 10/4/1965, ST0402983-91):**
- 12. A Survey and Evaluation of Pipe Coverers' Exposures to Dusts from Asbestos Containing Insulation Materials Encountered During Routine Pipe Covering Operations Within the Midland Location of the Dow Chemical Co. (3/21/1969, ST006806-19):**
- 13. Survey and Evaluation of Pipe Coverers' Exposures to Dusts Containing Asbestos or Fiberglass, Ludington Plant (10/23/69, Hoyle Ex. #6, ST0000647-59):**
- 14. Safety and Loss Prevention Manual for Contractors (Feb. 1970, ST0198666-89):**
- 15. Safety and Loss Prevention Manual for Contractors (April 1970, ST0014185-226):**
- 16. Report by Charles G. Kramer, M.D. of the Corporate Medical Department on a course he took on asbestos (6/24/1970, ST0000703):**

17. Asbestos and Health (7/17/1970, ST0002816):
18. Industrial Hygiene Survey of the Use of Asbestos in the Texas Division (7/27/1970, ST0014389-91):
19. Summary on Asbestos in the Midland Division (7/30/1970, ST0000704-5):
20. Asbestos Insulation-Status Report (9/11/1970, ST0002817-25):
21. Dust-Asbestos Sampling (10/27/1970, ST0014361-62):
22. Dust Respirator Usage (ST0614904A):
23. Environmental Conditions and Protective Equipment Specialist Team November Inspection of Magnesium I (11/6/1970, ST0654087):
24. Hazardous Dust (Houston Dow Center, 11/12/1970, ST0614903):
25. Handbook for Handling Asbestos Material (TX Div., Mar. 1971, ST0540027-39):
26. Handbook for Handling Asbestos Material (TX Div., July 1972 Rev., ST0002863-81):
27. Pipe Coverer's Handbook and Field Notes (1971, ST0000707-867):
28. Safety Standard No. 45: Asbestos (ST0002983):
29. Guidelines for Handling Asbestos Materials (9/6/1972, ST0574415-28):
30. Evaluation of Asbestos Exposures, Dow Industrial Services, Highway 332 (9/10/73, ST0684751-58):
31. Re-evaluation of Asbestos Exposures, Cell Service, A-1323 and A-1022 Bldg. (9/12/1973, ST0580542-53):
32. R&D Report on Asbestos Exposures During Maintenance, Demolition and Transite Fabrication (9/24/1973, ST0000982-96):
33. Evaluation of Asbestos Exposure to Insulators at Glycol "A" (11/21/1973, ST 0015109-13):
34. Safety and Loss Prevention Manual for Contractors (Nov. 1973, ST0028264-300):

35. Service Contract between Dow and U.S. Contractors, Inc. (3/12/1976, ST0533120-27):
36. Environmental Health Report on Airborne Asbestos Survey Chlorine VI, A-5024 (5/13/1976, ST0014619-24):
37. Environmental Health Report on Airborne Asbestos Personnel Monitoring in Chlorine 6, Bldg A-5024 (10/17/1977, ST0607026-30):
38. Service Contract between Dow and U.S. Contractors, Inc. (10/23/1978, ST0025437-49, plus a hold harmless agreement ST0533800-01):
39. Carpenter's Handbook (1978, ST0221386-406):
40. Environmental Health Report on Asbestos Monitoring of Magnesium III, B-800 (1/26/1979, ST0003260-64):
41. Environmental Health Report on Asbestos Fibers Magnesium Casting B, B-842 (6/1/1979, ST0003272-78):
42. Environmental Health Report on Evaluation of Exposures to Chlorine and Asbestos at Chlorine VI A-5000 (7/14/1980, ST0606964-74):
43. Testing Schedule for Asbestos for Brickmasons, Carpenters, Insulators, and Salvage (10/16/1980, ST0582823):
44. Protocol for Health Surveillance of the Plant A & B Carpenters (2/16/1982, ST0582822):
45. Statistical Evaluation of Respiratory System Indicators Among Insulators (ST0002927-ST0002936).
46. Letter to R.L. Buell from R.E. Flake Re: Insulators (5/13/1968, ST0583215).

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46. **Letter to R.L. Buell from R.E. Flake Re: Insulators (5/13/1968, ST0583215).**

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2002 JUN -3 AM 9:20

May 31, 2002

Re: Cause No. 15287*RM01; *Jimmy Camural Mansel, Individually and as Personal Representative of the Heirs and Estate of James Camural Mansel, Deceased, vs. U. S. Gypsum Company, et al*; In the 149th Judicial District Court of Brazoria County, Texas (M/W No. 0829-0450; Dow No. 0100915)

Mr. Jerry Deere
District Clerk, Brazoria County
111 E. Locust Street
Angleton, TX 77515-4678

Dear Mr. Deere:

Enclosed for filing in the above-captioned cause, please find the following:

1. Exhibit List for Defendant The Dow Chemical Company.

As noted below, a copy of same is being furnished to all known counsel of record. Please place your file stamp on the enclosed extra copy of this document and return same to me in the envelope provided herein for your convenience.

Thank you for your attention to this matter.

Very truly yours,

/s/ Arthur R. Almquist

Arthur R. Almquist
For the Firm

ARA/fmh
Enclosure

cc: Mr. Richard I. Nemeroff
Mr. William K. Tapscott, Jr.
Baron & Budd, P.C.
3102 Oak Lawn Ave., Ste. 1100
Dallas, TX 75219

VIA CM/RRR

123461.1

C. Porter

**STANDARD RULES
AND
REGULATIONS**

Texas Division

**THE
DOW CHEMICAL
COMPANY**

Freeport, Texas



INCLUDING THE
**SAFETY RULES AND
REGULATIONS**

April, 1941

ST0014088

FOREWORD

The Dow Chemical Company is made possible by the combined efforts of every employee, by the use of capital and equipment furnished by stockholders, and by the patronage of customers who buy our products. This great enterprise will be successful if these three groups are well served and to whatever degree we understand one another.

The employee is entitled to advance as much as possible, receive courteous and fair treatment at all times, and work with the surrounding conditions maintained at the highest possible standard.

The stockholders are entitled to a fair return from their investment. It is the duty of all employees to protect this investment by the proper use and care of equipment, by elimination of waste, and by giving a fair return for wages received.

The customer must receive as much or more for his money than our competitors can give if our business is to be permanently successful.

To accomplish these things in the fullest measure, a real challenge is continually before each and every employee.

PURPOSE OF THIS BOOK

This book is presented to you as a basis for friendly understanding. It is hoped that it will prove to be of mutual benefit, and a contributing factor in creating and maintaining harmonious relations between you, your employer, and your fellow workers.

ABSENCE FROM WORK

Every employee should think enough of his job to promptly notify his superior when it is necessary to be absent. This is only asking good business practice. Starting January 1, 1941, all unexcused absences in excess of one regular work period will be investigated.

Employees will be discharged for failure to report for work for three consecutive working days unless the employee notifies his superior or the Employment Department and receives permission for absence from work.

ST0014089

ASSIGNMENT OF WAGES

In all cases where an assignment of wages involving an employee is served on The Dow Chemical Company, the employee will be automatically discharged for cause.

BADGES

An hourly employee when hired is furnished with two badges so that it will not be necessary to change badges from street clothes to work clothes. The small badge must be in plain sight on your outer garments when you pass through the clockroom. Pay checks are given to employees only when they are wearing their badge. In case of loss, badges will be replaced at a cost of \$1.00 each; this is deducted from your pay check.

CLEANLINESS

It is the duty of all Service and Construction Crews to clean-up after completing their work. Remove all the litter and scrap to places provided for the same, and turn the equipment back to the Production Department in a workmanlike manner.

Workmen are particularly cautioned to conform to special practices in various places to guard against the contamination of products. The use of a little grease or oil in the wrong place can spoil a valuable product.

By the practice of cleanliness every employee can contribute a great deal in promoting the sale of our products. Many prospective customers visit our plant. The appearance of equipment, aisles, and work benches, and the cleanliness and attitude of all employees are very important factors in helping to favorably impress such visitors.

DELIVERY SERVICE

Express delivery service is maintained from the Stockroom to all parts of the plant. Learn the service available from this system before making yourself subject to criticism by calling personally for items of stock.

GRIEVANCES

In case an employee has a grievance it should first be presented to the foreman for settlement. If

ST0014090

no satisfactory answer is given, the grievance should be taken to the superintendent. Any complaint not settled in this manner may be taken up with the Employment Manager, who will present the grievance to the management.

HOLIDAYS

Six holidays are observed as follows:

New Year's Day	Labor Day
San Jacinto Day	Thanksgiving Day
Independence Day	Christmas Day

INSURANCE

Metropolitan Life and Health and Accident Insurance paying \$1700.00 upon death and \$14.00 per week for up to 13 weeks during disability resulting from sickness or accident has been made available to all employees at a cost to them of 84c per month, the balance of the cost being borne by The Dow Chemical Company. The \$1700.00 life insurance benefit is paid to your named beneficiary upon your death, regardless of cause, while the weekly sickness and accident benefits are paid when you are disabled from causes not connected with your employment.

Benefits are payable after the seventh day of disability. It is your responsibility to contact the Employment Department for the necessary blanks and instructions needed in filing your claim.

A large number of insurance checks, both large and small, have been received by employees or their families since this insurance plan was first offered, and the benefits of the plan have been proven.

LAUNDRY SERVICE

Wear clean clothing. Laundry service for the following personally owned cotton work garments is free:

Work pants	Coveralls
Work shirts	Shop Coats
Overalls	Shop Aprons
Jackets	Shop Caps

There is danger in dirty greasy clothing, and certain chemicals may cause irritation or damage to the skin. Frequent washing of garments removes these

ST0014091

LOANING OF COMPANY TOOLS

NO COMPANY TOOLS ARE LOANED FOR PERSONAL HOME USE. Adequate tool rooms and loan service are provided throughout the plant to supply employees with special tools: such tools are charged to the employee by tool checks or loan slip method. Tools lost or broken by workmen are charged to their account, when it is felt that such loss or breakage is the result of carelessness or negligence.

MAIL

All personal mail should be addressed to your home and not to you in care of the company. For your convenience the company will handle outgoing mail if deposited in any one of the various department mail boxes. All first class mail received at the main office will be opened and the receiving date stamped thereon.

PAY DAYS

You will be paid by check on the 5th and 20th of each month for time worked prior to 8:00 a. m. on the 1st or 16th, respectively. Checks are available after 3:00 p. m. on pay days.

PERSONAL TOOLS

Personal tools may be taken for home work by a pass out card issued by stock room department.

Removal of personal tools belonging to employees who have been released is executed the same way. Department heads are asked to cooperate fully in this regard by giving the Stockroom Department sufficient notice in all cases of release.

PLANT RULES—BULLETIN BOARDS

Any changes in or additions to Company rules or general instructions will be posted on departmental bulletin boards before the rules or instructions are to take effect.

All notices of departmental or general interest must be approved by the department superintendent before being posted.

ST0014092

SMOKING

SMOKING IS PROHIBITED AT ALL TIMES IN CERTAIN PLANTS.

In plants where smoking is prohibited, NO SMOKING signs have been posted on all building doors, or to include specific areas.

Employees violating this regulation will be automatically discharged.

SOLICITATIONS

No solicitation of any kind will be permitted within the plant or offices of the plant, unless the same is authorized by the department head and approved by management and conducted under the supervision of the department head.

SUGGESTIONS

THE COMPANY WELCOMES SUGGESTIONS FROM ANY OF ITS EMPLOYEES AND ALWAYS APPRECIATES CONSTRUCTIVE CRITICISM.

TIME CLOCKS

Every employee of The Dow Chemical Company, including the President and General Manager, has a time card and rings it regularly. No exception to this rule is made. Employees are positively forbidden to ring for each other. Ringing late will not be tolerated. You are expected to be at your place of work a few minutes before the whistle blows.

USE OF COMPANY AUTOMOBILES

Drivers of company cars must conform to all rules and regulations pertaining to the same. The maximum speed limit within the plant is twenty-five miles per hour. All signs must be observed.

It is not permissible for passengers to ride on the outside of cars. The maximum number of passengers in the driver's seat is two besides the driver.

Use the company car the same as you would your own.

ST0014093

USE OF TELEPHONE

During working hours the use of the telephone for personal calls cannot be extended to employees. However, urgent incoming messages will be delivered.

Quite often urgent messages are received at the plant at times when workmen are off duty; therefore, it is important for workmen to report changes of address to their foreman and the Employment Department.

WASTE

Compressed air costs money; the required amount of air (5c per 1,000 cu. ft.) for two shops is 300 cu. ft. per minute. A few leaks could double this requirement and also make it impossible to reach the best working pressure. Watch for and report all leaks.

Provision for strict observance of economy in light must be planned and carried out by the foreman. Definite responsibility must be placed or assumed by the foreman to avoid wasting of light.

Water is so much used that it is very easy to misuse. Equipment requiring water cooling is quite often found shut down after the work shift but the water is left running.

Industrial wastes cause losses of millions of dollars yearly; most of it could be stopped. Your attitude toward waste is very important. You are more valuable, as an employee, if you help prevent waste.

WORKING HOURS—OVERTIME

1. The work-day shall begin at 8:00 A. M. and end at 8:00 A. M. on the following day. The work-week shall begin at 8:00 A. M. on any Monday and end at 8:00 A. M. on the following Monday.
2. Time and one-half will be paid for all work done on the following holidays: New Year's Day, San Jacinto Day, Independence Day, Labor Day, Thanksgiving Day and Christmas.
3. Time and one-half will be paid for all work done in excess of 8 hours in any work-day except

ST0014094

ST0014095

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by utility or relief operators or shift men filling in for other operators off duty unless the shift man is on a job other than his own.

4. Time and one-half will be paid for all work done in excess of 40 hours in any work-week.

5. (a) Except for shift men $\frac{1}{2}$ hour will be deducted when Company furnishes meal.

(b) No schedule allowable calling for more than 8 hours per day.

(c) Minimum pay for emergency calls: one hour at time and one-half rate.

6. In any event time and one-half will be paid whenever required by the Federal "Fair Labor Standards Act of 1940."

TEXAS DIVISION
THE
DOW CHEMICAL COMPANY
Freeport, Texas



SAFETY RULES
and
REGULATIONS
FOR ALL EMPLOYEES



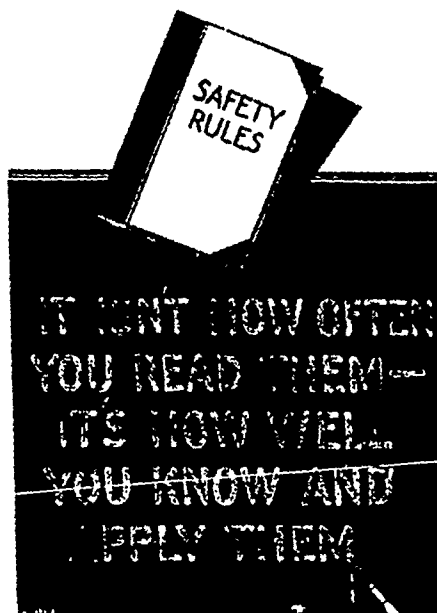
You Are Not Required to Take Un-
necessary Chances—Do Your
Work the Safe Way

ST0014096

DEPARTMENT OF SAFETY

The purpose of this section is to set forth the active duties of the Safety Department of (Texas Division) The Dow Chemical Company and to present to you certain recommended practices and policies which have been worked out while studying the subject of health and safety.

Your company is more concerned with the problem of health and safety than with any other problem with which it has to deal. There is no recommendation that any employee can make re-



NATIONAL SAFETY COUNCIL

garding safety that is too insignificant to be considered. This is the attitude of the company, but the company cannot practice safety. The practice of safety and the effectiveness of safety measures, safety devices and safety rules are all dependent upon the attitude of the employee. Employees must be safety minded and assume the greatest part of the responsibility of promoting safety.

Safety is the Right Way of Doing Things

ST0014097

SAFETY

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practices and
while studying

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There is no
can make re-

Take safety seriously. Be as good about protect-
ing your fellow workman as you would about
helping them if they were hurt. It is kinder and
more profitable to all.

COMPENSATION

The Dow Chemical Company operates under the
Workman's Compensation Law of the State of
Texas in settlement of all claims for personal in-
juries of employees arising out of and in the course
of their employment with the company. Under this
act an employee who is so injured will receive com-
pensation at the rate of sixty percent of his weekly
wage, but not more than \$20.00 per week nor less
than \$7.00 per week for such time as he is unable
to work. This payment starts on the eighth day
of incapacity following the date of injury. If inca-
pacity continues for four weeks or longer, the first
week's compensation is also paid. Various standard-
ized schedules have been incorporated in the law
in regard to the length of time for which compensa-
tion shall be received for total, or partial, tempor-
ary or permanent disability. During the first ninety-
one days after the injury the employer furnish-
es reasonable medical, surgical and hospital service.

All matters pertaining to compensation are
handled by the Employment Department.

FIRST AID

It is the policy of the Company to maintain, for
the benefit of its employees, the best possible First
Aid facilities. The First Aid room is located at the
garage, 901 building. The Department is sufficiently
equipped to handle emergency first aid cases. The
personnel includes four graduate nurses. There is a
nurse on duty twenty-four hours a day.

The First Aid is maintained solely for you: con-
sider it your duty to use it at any time for even
the slightest injury received while at work.

It is considered to be in order to call at the First
Aid for relief treatment for minor AILMENTS
NOT ATTRIBUTABLE to your employment, when
such treatments will permit you to complete your

g Things

Think! Is It Safe?

ST0014098

Page 12

regular work period. You are urged, however, to consult your family physician as neglect to do so often results in acute cases. The First Aid is not intended to completely diagnose such cases and no responsibility is being assumed in rendering relief treatments of this nature.

SAFETY ENGINEERING

The Dow Chemical Company is showing, through the Safety Department, its sincere interest in maintaining safe working conditions for its employees. One member of the department devotes his full time to safety engineering, establishing safe practices, and safety education throughout the plant. The facilities of this Department are constantly at the service of any of the employees of the company.

If you have a carefully thought out suggestion for improving working conditions from the standpoint of health or safety—explain it to your foreman and submit a written report of the suggestion to the Safety Department.

At the Safety Department a complete display of safety equipment is arranged to assist foremen and employees in selecting the proper equipment to safely handle their jobs. You are urged to visit this room and keep in touch with the new types of equipment.

Accidents Are Preventable and Repeatable—
Be Careful

ST10014099

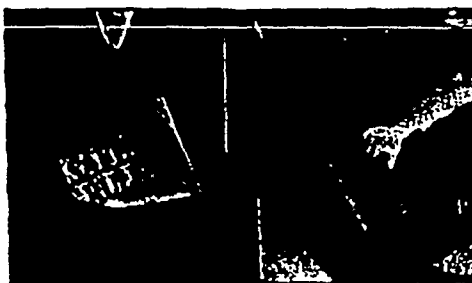
SAFETY RULES

The following safety standards have been adopted by The Dow Chemical Company (Texas Division) and govern all persons in its employ. Certain departments or classes of work have further detailed instructions for the men in those departments or undertaking that type of work.

Before starting to work, ask your foreman for safety instructions.

Every effort is being made to safeguard all operations as far as possible. Various machines are provided with guards, and special tools are provided for certain operations. **Use Them.** Guards can prevent only a small number of accidents. **Most accidents are caused by using defective tools, disregarding safety instructions, or neglecting to use safety appliances.**

RULES AND GUARDS ARE FOR YOUR PROTECTION



WHY CHEAT?

NATIONAL SAFETY COUNCIL

You will be expected to be thoroughly familiar with the information on the following pages, and.

Personal Caution is the Most Efficient Safeguard

therefore, are asked to read them carefully. After you have read and studied the booklet, sign the printed statement on the last page and return it to the Safety Department.

GENERAL RULES

1. While no attempt will be made to set up definite procedures in case of a serious accident, the following general rules should be studied as a guide:

- (a) The ambulance and First Aid phone number are in large letters on the cover of the phone book. Call the ambulance immediately. Call the First Aid as well, so that the nurse on duty may call for help if needed.
- (b) Be calm and explicit. Deliver the message so that there is no chance for a mistake. Be sure to give the building name, the building number, and the type of accident.
- (c) Unless specific instructions have been given you what to do—remove the person from further danger, make him as comfortable as possible, and make sure that there is no danger from exposure.
- (d) In moving an injured person to a place of safety, extreme care must be exercised as there may be fractured bones. Move the patient as little as necessary.
- (e) In cases of bad acid or caustic burns, flood the burned area with water—and lots of it—and get the patient to the First Aid. Running water is far better than just immersing the burned area.

2. It is hereby declared to be a rule of The Dow Chemical Company, that **WHENEVER AN EMPLOYEE RECEIVES AN INJURY, EVEN THOUGH IT BE CONSIDERED SLIGHT, HE MUST REPORT AT ONCE TO THE FIRST AID STATION.** If the foreman or crew leader is present, the injured employee shall advise him of the injury before reporting to the First Aid; but if the foreman or crew leader is not present, then the injured

We Need Your Help in Preventing Accidents

ST0014101

employee shall go direct to the First Aid. THE FOREMAN SHALL MAKE A WRITTEN REPORT TO THE FIRST AID OF THE DETAILS OF ALL INJURIES RECEIVED BY EMPLOYEES UNDER HIM.

Prompt and proper treatment of a minor injury will prevent unnecessary suffering and loss of time. Our First Aid staff is for your benefit and protection—many bad cases of infection have been caused by home use of iodine by men in our own plant.

	IDENTICAL INJURIES This man spent ten minutes in the First Aid room.
This man waited 5 days before reporting injury---He lost 12 weeks with blood poisoning	

3. The practice of fellow employees removing foreign particles from eyes is strictly forbidden. This practice often results in serious if not permanent infection to the eye. Each time a particle enters the eyeball a slight laceration is made which is easily infected. Go to the First Aid.

4. We will not be responsible for any bills of outside doctors unless a properly written order granting permission to call upon such doctors is obtained in advance.

Learn by the Experience of Others

ST0014102

5. Horse play, scuffling, throwing things, and fooling with compressed air in the plant are dangerous and will not be tolerated.

6. Few men realize the danger in the use of compressed air. The air hose should never be directed toward an individual.

Before using compressed air, as an aid to removing dust from clothing, the equipment used for the purpose must meet the approval of the Department of Safety.

7. Personal cleanliness is an important item in the maintenance of healthy and safe working conditions:

(a) Always wash up before eating—particularly if you have been handling paint, lead, or chemicals.

8. Watch the Safety Bulletin Boards. Each poster is a lesson in itself; you can easily profit by reading it.

9. When you see a warning or danger sign, be sure you are safe before going ahead. Not to do so is to invite injury.

10. Boards with nails sticking up must not be left lying around. When you see such boards, turn them over, pull the nails, or put the boards where they can do no harm.

11. Do not climb through, under, over, nor between railroad cars. Wait until the train passes, or walk around the end of the train. With the exception of the engine or switching crew, no one is allowed to ride yard locomotives or freight cars.

12. Do not attempt to lift or push objects which are too heavy for you—ask for help when you need it. Learn to lift the right way to avoid strains; bend your knees, keep your body erect; then push upward with your legs. It is much easier and safer.

13. When working on any kind of a pressure line be sure that the supply is shut off and a warning sign placed on the supply valve. Never open or close a valve on a pipe line unless you know it is safe to do so.

Practice Safety Yourself—Others Will Follow You

ST0014103

A SPRAINED BACK *Caused by Wrong Lifting*



14. All excavations, open manholes, and other places where persons might fall must be protected by suitable railings and lights.

15. When walking on plant roadways walk on the left hand side of the road, unless paths or walks are established.

16. The speed limit in the plant for all company and private cars or trucks is twenty-five miles per hour. This limit must not be exceeded.

17. The driver of a company car, truck, or taxi is responsible for the condition of his car while it is entrusted to him. Any irregularities of brakes, lights, horn, fumes in cab, or general operation of the automobile must be reported to the garage on the regular form provided for the purpose. It is requested that drivers of plant cars keep on the roads designated for travel and refrain from driving on areas not designated for car traffic as much as possible.

Good Housekeeping is Good Safety

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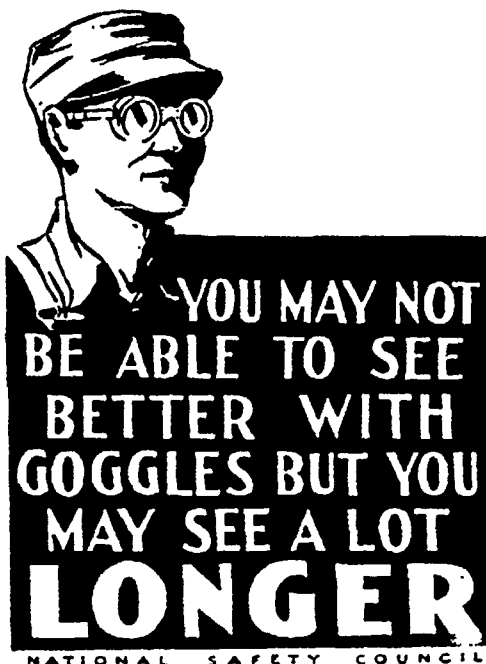
18. Pickup trucks carrying passengers must be equipped with the standard seating arrangement. The Service Department is responsible for seeing that new pick-up trucks are so equipped before being issued to individuals or departments.

19. If your work requires you to enter other departments, familiarize yourselves with the rules and dangers of these departments.

GOGGLES—CLOTHING

1. Goggles or face shields must be worn as protection on the following jobs:

- (a) While working on or around magnesium cells.
- (b) While working with or pouring molten metal.
- (c) On any grinding operation.
- (d) On any chipping operation—goggles only.
- (e) Breaking up concrete or brickwork—goggles only.



Wear Safe Shoes

ST0014105

(f) Any welding or burning operation.

(g) When the handling of chemicals is particularly hazardous.

2. You are required to wear goggles when and where you are instructed to do so. For the safety of your eyes do not neglect to do it. Protect your eyes when working near welding equipment.

3. Where the heat is excessive, men are advised to wear sweatbands on the forehead to keep perspiration out of the eyes. Anti-fog sticks may be secured from the Safety Department. A small amount applied to goggle lenses will prevent steaming. Goggles should be adjusted to fit the face comfortably. Head straps should fit over the tops of the ears and well down on the back of the neck.

4. You are especially cautioned to roll up your sleeves, not wear a necktie, and not wear gloves while working around any revolving machinery.

5. Rings, watch chains, key chains, loose jackets are all potential accident makers and should not be worn in the shops or around moving machinery. The results from an accident caused by one of these factors are often extremely serious.

6. If you are working where there are heavy fumes or dust you will be required to wear the respirators provided for your protection.

TOOLS—EQUIPMENT

1. Safety devices and guards are for your protection. Keep them in place at all times. Removing or tampering with safety guards is forbidden by law.

2. In using grinder—be sure that the tool rest is within one-eighth of an inch of the wheel and that guards and hood provided are in proper position and in good repair. Wear goggles for all grinding work, unless the grinder is equipped with an approved glass shield.

3. Stop machinery to clean, oil, adjust or repair by pulling the main switch. Lock the switch or hang a warning sign on it if there is a hazard due to someone starting the equipment before it is ready.

You Can't See Through a Glass Eye



NATIONAL SAFETY COUNCIL

4. Never use defective punches, wrenches, chisels or other tools. Flying chips from tools with mushroomed or split heads cause many injuries. In the use of personal tools, the man is wholly responsible for the condition of his tools. If you are using plant tools insist upon getting proper tools for the work you have to do.

5. All gears where exposed to contact must be guarded.

6. All drive belts exposed to contact, except those moving so slowly that there is no possibility of danger, must be properly guarded. Proper lacing of belts is important. The joint should be made close and smooth. Rawhide lacing must be used in cases where belts are to be shifted by hand.

7. Whenever possible, line shafts should be shut down while belt is being put on—employee should be stationed at starting switch as a precautionary measure. Never allow inexperienced men to replace belts on moving pulleys.

You Can't Depend on Luck; You Can on Safety

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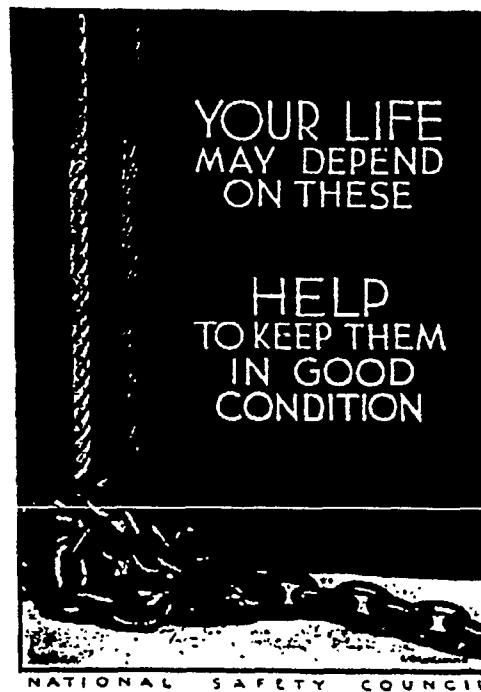
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8. All belt shifters must be within easy reach of the operator. Shifters which will not stay in position without fastening should be reported to the proper service department.

9. All chains, hooks, and cables used under heavy stress must be regularly inspected and annealed.

10. No worn or frayed rope slings are to be used. Whenever rope becomes frayed or worn, notify your foreman—who will either have it repaired or replaced. Do not take any chances.



11. Keep the floor space around machinery as clean and as free from obstructions as possible. Loose material, oil, and grease are all definite hazards in any location, particularly so around machinery of any kind.

CRANES

1. Never stand or walk under a crane load. Obey the man handling the load from the floor;

Follow You

We Can Furnish Goggles, But Not Eyes

ST001410015

listen for the crane horn or other signalling device. When entering a shop floor, over which there is a crane, look for the crane—determine its location before crossing the floor.

The responsibility of carrying a load safely is placed upon the crane operator. You must hook your load to his satisfaction at all times.

2. Riding a load handled by a crane or riding crane chains or slings is strictly prohibited with the exception of crews working on steel erection.

3. The practice of moving oxygen or acetylene cylinders, by means of cradling one or more cylinders in the crane chain, is strictly prohibited. Gas cylinders are not to be hoisted or lifted, under any circumstances, by crane except in specially constructed holder.

4. Certain men are designated as crane operators. No one other than these operators are to operate a crane except in case of emergency and with the permission of the Shop Superintendent.

5. Do not leave a load hanging or hooked on. Make sure that everyone is out from under load, lower and place load, unhook immediately and hook up chain or remove sling. See that hook or chain is hoisted above head level immediately after unhooking.

6. After finishing any repair work, make sure that all tools and materials are removed from crane or track.

7. No employee is allowed to work under a suspended load without same being blocked in such a manner that any failure of crane or part would not allow load to fall on him.

ELEVATORS

1. In case any elevator equipment is found out of repair, the Machine Shop Office must be notified at once. Do not try to repair the elevator yourself.

2. All elevator gates are to be in a closed position—except at the level at which the elevator

A Good Safety Record is a Fine Recommendation

ST0014109

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car is standing. If the gates do not close auto-
matically, do not consider that as an excuse for
leaving them up.

3. Do not allow material, rubbish, stock, etc.,
to accumulate near elevator gates. The space
directly in front of the elevator shaft must be
kept clear at all times.

4. When doing any repair work on elevators
of any type—close and lock, or tag, the main
switch.

5. The following definite rules apply to the
use of the various man elevators in the plant:

- (a) When you step onto the elevator—grasp
the handle with one or both hands and
face the belt.
- (b) When shutting the elevator off, after reach-
ing your floor, make sure that no one is
riding the elevator at the time.
- (c) No material or tools are to be carried on
the elevator which cannot be easily and
safely handled with one hand. No hand
tool or material over 18 inches in length
is to be carried.
- (d) The practice of placing tools, tool boxes,
or material of any kind on the elevator
steps—to be carried to a higher or lower
level—is strictly prohibited.
- (e) Report to your foreman, or the Safety De-
partment, any hazardous conditions around
the elevator landings.

LADDERS

1. Never use a ladder which is defective in any
respect, such as with broken or split side rails or
rungs. The tool room is equipped to renew broken
rungs with rung replacers.

2. In placing ladders—the best angle at which
to lean the ladder is that in which the horizontal
distance from the foot of the ladder to the base
of the wall or beam against which the ladder is
resting is one-quarter of the length of the ladder.

Think How Much Suffering First Aid Prevents

ST0014110

LADDERS



**to avoid
this**

- 1 Place ladder at proper angle
- 2 Have top and base firm
- 3 Do not lean out too far

NATIONAL SAFETY COUNCIL

3. When a ladder is left standing over night, tie up the top of the ladder.

4. Never place a ladder on a slippery floor unless the base of the ladder is securely anchored so it cannot slip, or unless somebody is holding the ladder at the bottom.

5. Use caution when carrying boxes, tools, chainfalls, or other material in your hands when climbing or descending a ladder. Use a rope, or crane, with excessive loads so that both hands will be free to grasp the ladder.

6. Never descend a ladder while facing outward.

7. Be careful when carrying ladders in aisles, through doorways, or around blind corners. Always carry it with the end ahead of you elevated high enough to clear a man's head in case you should meet some one unexpectedly.

Keep Fit By Keeping Clean

ST0014111

WELDING EQUIPMENT

1. Never look at an electric arc with the naked eye. When observing or working near arc welding operations—the eyes must be protected from direct exposure.

2. Heavy canvas (or metal) screens must be used to afford protection to all others from electric welding wherever possible, particularly when welding is being done in the shop.

3. When welding wherever there is the least chance of causing a fire, keep a fire extinguisher within reach. Welders are required to have a quart hand extinguisher as a part of their equipment.

4. Gas motor driven portable generators or air compressors must not be located inside buildings. The exhaust vapors are extremely dangerous and these machines must be operated out of doors.

5. Never allow oil or grease in any form to come into contact with part of the oxy-acetylene welding equipment. An explosion may occur if you violate this rule.

6. Use extreme care in handling gas cylinders. Do not drop tanks over steps, off of trucks or platforms.

7. Keep cylinders away from salt and other corrosive chemicals and fumes.

8. Carrying or lifting tanks by crane or hoist is absolutely forbidden, unless a sling or cradle constructed for this purpose is used—see Cranes—3, page 22.

9. Put nothing on top of tanks—you may damage the safety plug or regulator, or interfere with the quick closing of the valve. Valves must be closed when cylinders are not being used.

10. Cylinders must be secured to prevent their being knocked over while in use.

11. All cylinders should be protected against excessive rise of temperature. On storing cylinders in the open—see that they are protected against extremes of weather.

Report Every Injury

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12. Foremen and welders should study thoroughly the more detailed "Safety Precautions for Arc and Acetylene Welders."

13. The Boiler Shop is equipped to service and repair all acetylene welding equipment. Worn and defective gauges, regulators, etc., must be turned in for repair.

ELECTRICAL EQUIPMENT

1. There is no line of work where it is more necessary to be always on the alert for danger. Do not take chances.

2. Do not fail to report any electrical trouble whatsoever, or any apparently dangerous installations, to your foreman.

3. Employees not authorized are forbidden to work or tamper with any electrical wire or equipment.

4. Treat all circuits, so far as possible, as if they are alive, even though you believe them dead.

5. In handling live or control parts on circuits such as are exposed on switches, switchboards, etc., use only one hand if possible. When closing a switch, close it solidly and abruptly. This will greatly reduce the chance of the switch "arcing".

6. Electric wires which seem to be unused or are hanging free are sometimes charged and are dangerous. Report them but do not touch them.

7. When opening a switch, in order to shut down a machine for maintenance or repair work, the switch must be properly tagged with a warning or do not start sign. When the work is done get the proper authority to start the equipment.

8. Get the voltage off the line—in case of any electrical fire. Open the switch or circuit breaker, or call the power house to have the switch opened on that line.

9. In case of fire on or near electrical equipment, do not use water to extinguish the fire. Proper extinguishing units of C-O-Two or Pyrene are located near all large electrical machines.

Foot Note—Remove Nails from Boards

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10. In case of severe electrical shock—remove the person from the source of current immediately and call the ambulance and First Aid at once.

- (a) Use a dry coat, dry rope, a dry stick or board or any other dry non-conductor to move either the victim or the wire, so as to break the electrical contact.
- (b) If the victim is conducting the current to ground and is convulsively clutching the live conductor, it may be easier to shut off the current by lifting him than by leaving him on the ground and trying to break his grasp.
- (c) Open the nearest switch if that is the quickest way to break the circuit.

11. Accidental electric shock usually does not kill at once, but may only stun the victim and for awhile stop his breathing. Under these circumstances artificial respiration is recommended immediately.

FIRE PROTECTION

1. In case of fire—call the Dow operator and report the fire, giving building name and number and location of fire. In cases of fires after regular working hours, the watchman will notify all production and service men directly affected by the fire.

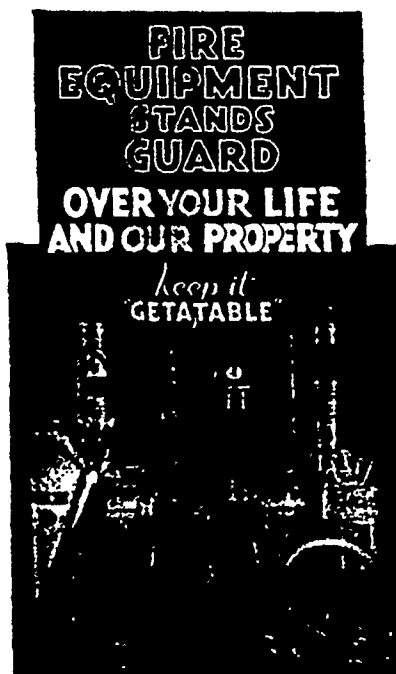
2. Learn the location and proper use of the fire fighting equipment in your department.

- (a) Do not use water where extinguishers are provided.
- (b) Never hang up an extinguisher. If you have used one or see one which is not on a hook, notify the Pipe Shop at once.
- (c) Use extreme caution in fighting hot fires in closed rooms or badly ventilated areas. Toxic products of combustion often provide a serious hazard.

3. The plant fire department is under the supervision of the Pipe Shop. All maintenance of fire fighting equipment, automatic sprinkler systems,

Safety and Efficiency Go Hand in Hand

ST0014114



NATIONAL SAFETY COUNCIL

fire hydrants, and fire hose is taken care of by that department. Notify the Pipe Shop at once if any of the above equipment is not in perfect working order.

4. Never pile any material on any floor beyond its load limit or to a height within less than eighteen inches of the level of any sprinkler head.

5. Except in times of immediate use, aisleways, passages, stairways and elevator approaches must be kept clear; a closed passage might result in the loss of an entire plant. There must be unrestricted passage to all fire hose and fire protection equipment at all times.

6. Keep the places around you clean. Put all oily waste, rubbish, or papers in the covered containers provided for that purpose.

7. Do not work on any electrical apparatus or wiring unless it is part of your work.

Double Your Caution in Rain, Snow or Sleet

ST0014115

8. Some plants of The Dow Chemical Company are a definite fire hazard because of the materials handled. These particular plants are prominently posted with signs prohibiting smoking and the carrying of matches while in or around the buildings and requiring the personal O. K. of the plant superintendent before doing any welding in or around the plant—look for these notices and obey them to the letter.

9. When doing any welding—use extreme caution in lighting the torch and make sure that the hot slag will not fall where there is danger of its igniting inflammable material. Welders are required to have a hand extinguisher as a part of their equipment.

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LABORATORY SAFETY

The importance of safe practices in all laboratory work or handling of chemicals cannot be overemphasized. While the previous sections of this booklet apply to laboratory workers as well as to others, the following instructions must be kept particularly in mind. Your laboratory director or supervisor is aware of the importance of safety and will welcome your suggestions.

GENERAL—HANDLING CHEMICALS

1. Keep all bottles labeled. Serious accidents have resulted from neglecting this simple precaution.
2. Know the materials with which you are working so that you are able to handle them properly and caution others in their use.
3. Deposit waste chemicals in crocks or jars provided for the purpose. These waste jars must be emptied daily.

4. IN THE CASE OF A CHEMICAL BURN—IMMEDIATE FLUSHING WITH WATER IS THE BEST EMERGENCY TREATMENT.

5. Keep goggles or a face shield on hand and use them on any hazardous operation. Remember, it is YOUR eyesight which is being protected and accidents usually happen when least expected.
6. Aisleways and approaches to apparatus and fire equipment must be kept clear so that quick exit is unhampered.
7. Guard your apparatus with suitable glass or metal shields so that those nearby are safe. Men working near one another on different projects are not aware of what each may be doing.
8. Read carefully the specific safety instructions for your particular laboratory. Each man must realize his individual responsibility for the safety of himself and others.

A safety minded person is a valuable asset to plant and community

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SAFETY EQUIPMENT

1. Each worker must become familiar with the location and proper use of standard laboratory safety equipment. This equipment includes:

- A. Fire hoses, sand pails and chemical fire extinguishers.
- B. Fire blankets and fire showers.
- C. Gas masks and dust respirators.
- D. Eye and face protection—goggles and face shields.
- E. Protective clothing—rubber gloves, sleeves, aprons, etc.
- F. Safety shields—shatter-proof wired glass and steel shields.

Make sure you understand the relationship between your job and the available equipment before you begin work. Your immediate superior or the Safety Department will be glad to answer any questions you may have.

FLAMMABLE LIQUIDS

1. Low boiling flammable liquids should be heated with steam whenever possible.

2. Extreme care must be used when distilling flammable liquids. Look over any nearby equipment for open flames, electric heaters or open relays, any of which may provide a source of ignition for flammable vapors.

3. Flammable liquids must be stored in a safe location in metal containers except when small quantities are to be used immediately. Regulation safety cans are available for this purpose.

4. Be careful to avoid static electricity in pumping or transferring flammable liquids. Metal tanks, lines or other equipment should be grounded before use. In transferring flammable liquids, both containers should be grounded either by contact or through the use of battery clips and a short length of cable.

Don't let familiarity with your job make you forget safety

ST0014118

PRESSURE EQUIPMENT

1. When working with pressure apparatus, make sure of the temperature and pressure for which the equipment has been designed.

2. Always work with a safety factor of at least two over hydraulic tests made on pressure equipment. Under unusual conditions a greater safety factor may be necessary and the choice of equipment must rest upon an individual who has had such authority delegated to him. Be certain the strength has not changed due to corrosion or high temperature use since the last hydraulic test.

3. Conform to recommendations in the use of frangible disc safeties.

4. Make sure you are not exceeding allowable working pressures on the pipe and fittings being used.

5. The volume of a pressure vessel must be considered carefully in relation to the volume and possible expansion of the material with which you may be working. In general a pressure bomb should not be filled to more than six-tenths of its capacity. High temperature operation will reduce this figure.

6. When opening pressure equipment, do not remove any nuts or bolts on the closure before first loosening all closure fastenings. Make sure the closure is free, releasing any pressure, before removing any bolts or nuts completely.

7. NEVER ATTEMPT TO REMOVE OR BLOW OUT EQUIPMENT OR PIPING WITHOUT FIRST BEING POSITIVE THAT ALL INTERNAL PRESSURE HAS BEEN RELIEVED OR THAT YOUR FACE AND EYES HAVE BEEN ADEQUATELY PROTECTED. DO NOT DEPEND UPON GAUGE READINGS TO INDICATE LACK OF PRESSURE.

NEGLECT OF THIS SIMPLE PRECAUTION IS THE GREATEST SINGLE CAUSE OF CHEMICAL ACCIDENTS. IF THE ACCIDENT RESULTS IN PERSONAL INJURY YOU ARE THE ONE TO BLAME AND THE ONE TO SUFFER.

Your job is only as safe as you make it

ST0014119

OFFICE COPY

Biochemical Research Department

THE DOW CHEMICAL COMPANY

5601

Subject: INDUSTRIAL HYGIENE SURVEY
OF VARIOUS OPERATIONS AT
THE CHLORINE CELLS, BLDGS:
261, 196, 137, 295, 236,
270, 303, 207.

File T34.21-21-3(E)
Chg. 1219
Rec'd. 5/7/48.
Fin'd. 3/20/51
Work by H. Hoyle
E. J. Schneider

to:

Dr. D. L. ...
4-30-51

E. J. Schneider
4/10/51

I. F. Harlow, Bldg. 309 (1)
R. M. Hunter, Bldg. 261 (1)
W. R. Perry, Bldg. 261 (1)
Medical Department (1)
Att: H. H. Gay, M. D., Bldg. 256
Safety Department (1)
Att: S. M. MacCutcheon, Bldg. 401

THIS REPORT IS THE PROPERTY
OF
THE DOW CHEMICAL COMPANY

SUMMARY AND CONCLUSIONS

1. Significant amounts of chlorine, sufficient to cause inflammation and swelling of the respiratory system from short periods of exposure, were found in areas where men were working on and among the chlorine cell series.

2. Men working in these areas have been getting by without severe exposure by using respirators, however, it must be kept in mind that excessive amounts of chlorine above the maximum allowable concentration of 1 p.p.m. for an eight-hour exposure do exist among the cell series.

3. No excessive amounts of chlorine were found in the making of bleach solution at the cell brine plant, 303 building.

4. Excessive concentrations of chlorine occurred in the loading of ton cylinders with liquid chlorine when the delivery line became plugged and insufficient time was taken to purge the connecting lines to the cylinder before removing them.

ST006739

5. No excessive amounts of chlorine were found during the normal loading of cylinders and no odor of chlorine was noticed during normal operations to purge, test and load tank cars.

6. Excessive amounts of chlorine and sulfuric acid were found while dumping the sulfuric acid drying tower to the sewer.

7. No excessive amounts of alkali dust were found among the chlorine cell series.

8. No significant amounts of mercury vapor were found at the discharge of the vacuum pumps for the mercury arc rectifiers.

9. Excessive amounts of pitch dust must be considered to exist, since men who are working at the pitch grinding operation do become photo-sensitized and must limit their outdoor activities.

10. Large amounts of graphite dust were found during the loading of plates into the buckets to be impregnated with phenol formaldehyde resin solution. Since the loading operation involves only an hour or so, the exposure to the graphite dust can not be considered excessive.

11. The graphite dust concentrations found in the machine shop were well within the limits for an inert dust.

12. The worker using the band-saw was found to be exposed to more fine dust than workers at the other machines, possibly because there was no spot exhaust ventilation provided.

13. No excessive amounts of formaldehyde or phenol vapors were found during the making of the phenol formaldehyde resin or during the various drumming operations.

ST006740

14. The millions of particles per cubic foot of air of asbestos was found to run higher than the maximum allowable concentration of 5 for an eight-hour exposure for the handling of dry asbestos in covering the cell diaphragms. Since the exposure occurs only eighteen times a day for a short period with a total exposure of less than two hours, the amounts of asbestos found cannot be considered excessive.

CHLORINE

I. Significance of Chlorine Exposure

1. For many years a gas concentration of 1 p.p.m. (by volume) has been used as a standard for evaluating workmens' exposures. Recently there has been some expression of opinion that 2 or 3 p.p.m. could be tolerated up to 8 hours daily without adverse effect. Gas concentrations much above 3 p.p.m. unquestionably produce irritation (tissue injury) to the eyes, nose, and throat; concentrations above 10 p.p.m. may cause serious effects on single relatively short exposures. Beginning at about 3 p.p.m. chlorine causes unmistakable pain in the eyes, nose and throat to which very little tolerance develops. This painful action serves as an excellent warning of the presence of harmful concentrations of gas. There appears to be no evidence of chronic effects from repeated exposures at concentrations of less than 2-3 p.p.m. (concentrations having no immediate acute effects). Repeated exposures above 2-3 p.p.m., however, may maintain an irritation of the eyes and respiratory passages, produce an erosion of the teeth, and possibly a nonspecific debility.

ST1006741

2. To a large extent the data of Table I, II, III, and IV merely give numerical expression to what has been apparent by sensory perception and experience, that excessive gas concentrations are encountered rather frequently if not routinely. Considering the nature of the operations and that much chlorine comes from unpreventable or accidental leaks, it may not be practical to reduce these concentrations of chlorine. Accordingly, it is necessary to emphasize the need for proper respiratory protection, the training of workmen, and the provisions for handling leaks. The results emphasize the desirability of medical examinations to assure the workmen are receiving adequate personal protection. If the men show no evidence of injury that is persistent or frequent, then our principal additional recommendation is that every opportunity to lessen chlorine contamination be utilized.

II. Observation and Presentation of Data

1. The odor of chlorine was ever present throughout the cell buildings and from time to time it was noticed that the men were required to use their respirators in order to go about their work.

2. Air samples were collected at several locations and on different days. The results of the air analyses are collected in Table I and II and can be compared with the accepted maximum allowable concentration of 1 p.p.m. for an eight-hour exposure.

ST006742

TABLE I

Vapor Concentration of Chlorine Found
Among the Cell Series in Building 137

<u>Location</u>		<u>p.p.m. (by Volume)</u>			
			and		
1. Center aisle between series 45 and 46	(10-4-49)	1.44	cloudy/raining		
2. Center aisle between series 41 and 42	(10-4-49)	0.72	" " "		
3. Center aisle between series 37 and 38	(10-4-49)	0.31	" " "		
4. Center aisle between series 33 and 34	(10-4-49)	0.31	" " "		
5. Between series 45 and 47	(10-4-49)	0.31	" " "		
6. Between series 41 and 43	(10-4-49)	2.16	" " "		
7. On top series 43	(10-5-49)	1.13	cool and clear		
8. Between series 46 and 48	(10-5-49)	6.80	" " "		
9. Between series 42 and 44	(10-5-49)	4.00	" " "		
10. On top series 46	(10-5-49)	3.30	" " "		
11. Between series 35 and 37	(10-5-49)	1.44	" " "		
12. On top series 35	(10-5-49)	1.44	" " "		
13. Between series 31 and 32	(10-5-49)	2.16	" " "		
14. Between series 38 and 40	(10-5-49)	1.13	" " "		
15. On top series 36	(10-5-49)	1.13	" " "		
16. Between series 32 and 34	(10-5-49)	0.31	" " "		
17. Near compressors	(10-5-49)	0.31	" " "		
18. Center aisle near 13,14,15,16,17,18 series		0.31	" " "		
19. On top series 39 repairing leak	(10-6-49)	2.16	cloudy /raining		
20. Near two mechanics repairing compressor	(10-4-49)	4.40	" " "		
21. On top series 46 (when back pressure operator added water)	(10-6-49)	7.30	" " "		
22. Between series 15 and 17	(10-6-49)	0.72	" " "		
23. On top series 15	(10-6-49)	0.31	" " "		
24. Between series 16 and 18	(10-6-49)	1.44	" " "		
25. On top series 16	(10-6-49)	0.72	" " "		
26. On top series 36 repairing leak	(11-18-49)	3.29	cool and clear		

ST006743

TABLE II

Vapor Concentration of Chlorine Found
Among the Chlorine Cell Series in
Building 295

Location		p.p.m. (by Volume)
1. Between series 93 and 95	(11-18-49)	0.36 clear and cool
2. Between series 92 and 94	(11-18-49)	0.36 " " "
3. Between series 93 and 95 and on top	(11-18-49)	0.72 " " "
4. On top series 103	(11-18-49)	1.53 " " "
5. On top series 104	(11-30-49)	1.13 " " "
6. On top series 110	(11-30-49)	0.36 " " "
7. On top series 109	(11-30-49)	4.4 " " "
8. On top series 103	(11-30-49)	3.6 " " "
9. On top series 101 (men setting it up)	(11-30-49)	14.8, 9.4 " "
10. On top series 99	(11-30-49)	11.5 " " "
11. On top series 98	(11-30-49)	10.8 " " "
12. Center aisle near series 92, 93, 94, 95	(11-30-49)	2.56 " " "

3. In the chlorinating of the cell caustic for bleaching solution at the cell brine plant no irritating or excessive amounts of chlorine escaped during the normal operation.

The results of air analyses collected during the preparation of the bleaching solution are shown in Table III

TABLE III

Vapor Concentrations of Chlorine Found in the
Making of Bleach Solution, Building # 303

Location	p.p.m. Chlorine (by Volume)
1. Platform near tank for making bleach solution. In the fumes at the start of bubbling chlorine through the sodium hydroxide	1.1
2. In the fumes after one-half hour of bubbling	1.1
3. In the fumes after one-hour of bubbling and finishing batch up	1.1

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4. The possibility of exposure to chlorine vapors during the loading of tank cars and cylinders was investigated, sensory perception usually being employed as a measure of exposure. If a good vacuum was pulled on the tank car and the connecting lines purged, there was little chance for exposure when removing the valves and testing the car for moisture. With properly repaired valves and tight connections, there was no exposure during loading.

5. In the loading of cylinders, an inside job, there was more chance for exposure to chlorine. During one visit the delivery line for the liquid chlorine became plugged. In removing the connecting lines, insufficient time was allowed for purging and excessive amounts of chlorine were found to exist.

6. During normal operation of the filling of the cylinders no excessive amounts of chlorine were found. The results of air analyses taken during the loading operation of ton cylinders are collected in Table IV.

ST006745

Table IV

Vapor Concentrations of Chlorine Found During the Filling
of Ton Cylinders of Liquid Chlorine, Bldg. 270 (11/15/50)

Location	p.p.m. (by volume)
1. Breathing zone of operator as he disconnected purge lines from empty ton cylinder	3.12
2. Breathing zone of operator as he disconnects lines from full ton cylinder of liquid chlorine (line became plugged and insufficient time was allowed for purging)	8.2

7. In the operation of changing the drying towers in the cell buildings, high enough concentrations of chlorine and sulfuric acid were encountered to saturate a respirator.

Table V shows the concentrations of chlorine found during this operation.

SULFURIC ACID (PLUS CHLORINE)

I. Significance of Sulfuric Acid Exposure

1. Sulfuric acid fume or mist has an acute irritating action not too different from that of chlorine. The problem presented by this mixture is practically the same as that presented by chlorine alone. The exposure is short and the concentrations sufficiently low that no great hazard is presented by the operation. It is one that occurs regularly, however, the one can question whether or not it is really necessary.

II. Observation and Presentation of Data

1. The odor of sulfuric acid fumes was masked by the chlorine. Air analyses during the operation showed the presence of considerable acid fumes, however, the exposure was of short duration.

2. The results of the air analyses are collected in Table V and can be compared with the maximum allowable concentration of 0.25 p.p.m. for an eight-hour exposure.

(Table V - page 9)

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Table V

Concentrations of Chlorine and Sulfuric Acid Fumes
Found During the Emptying of a Drying Tower to the
Sewer, Building 137

<u>Location</u>	<u>p.p.m. Cl_2 (by volume)</u>	<u>p.p.m. H_2SO_4 (by volume)</u>
1. Operators breathing zone as he opens valve to release sulfuric acid from tower to sewer (first series of towers)	3.3 (5 min.)	5.7 (5 min.)
2. Area near sewer after the tower was dumped (first series of towers)	1.3	2.3
3. Operators breathing zone as he opens valve to release sulfuric acid from tower to sewer (second series of towers)	13.8 (5 min.)	3.9 (5 min.)
4. Area near sewer after the tower was dumped (second series of towers)	2.9	2.1

ST006747

ALKALI DUST (PROBABLY SODIUM CARBONATE)

I. Observations and Presentation of Data

1. No maximum allowable concentration has been established for alkali, however, based on plant experience, no significant amounts of sodium hydroxide were found.

2. The presence of finely dispersed titratable alkali was checked by air analyses among the various cell series and the results are collected in Table VI.

Table VI

Dust Concentration of Sodium Hydroxide Found
Among the Chlorine Cells Series in Buildings
137 and 295

<u>Location</u>	<u>Bldg. 137</u>	<u>Mgs./cu. meter as NaOH</u>
1. On top of series 47	(10-6-49)	same as blank
2. Between series 45 and 47	(10-6-49)	"
3. Between series 41 and 43	(10-6-49)	"
4. Between series 50 and 48	(10-6-49)	"
5. Between series 42 and 44	(10-6-49)	"
6. Between series 14 and 16	(11-18-49)	2.44
7. Between series 34 and 36	(11-18-49)	2.44
8. Between series 15 and 17	(11-18-49)	2.18

Table VI (cont'd)
Blag. 295

9. Between series 92 and 94	(11-18-49)	1.95
10. Between series 95 and 97	(11-18-49)	0.66
11. Between series 109 and 111	(11-18-49)	0.80
12. Between series 104 and 106	(11-18-49)	1.14

MERCURY

I. Observations and Presentation of Data

1. Air is constantly being evacuated from the mercury arc rectifiers and discharged into the rectifier room. The possibility of some mercury vapor being given off was checked by sampling at the outlets of the vacuum pumps. The results of the air analyses are collected in Table VII and can be compared with the maximum allowable concentration of 0.1 mg./cu. meter. These concentrations of mercury have no significance whatever.

Table VII

Vapor Concentrations of Mercury found in the
Rectifier Room, Building 137 (11-13-50)

<u>Location</u>	<u>Conc. Hg. Vapor (by volume)</u>
1. Directly beneath the outlet of the low pressure vacuum pump for G-2 skid of mercury arc rectifiers	<0.006 mgs./cu. meter
2. Directly beneath the outlet of the low pressure vacuum pump for G-1 skid of mercury arc rectifiers	<0.006 mgs./cu. meter
3. Directly beneath the outlet of the low pressure vacuum pump for H-2 skid of mercury arc rectifiers	<0.006 mgs./cu. meter
4. General air sample taken between skids G-1 and H-2. Circulating air shut off for winter conditions	<0.006 mgs./ cu. meter

ST006748

PITCH

I. Significance of Pitch Exposure

1. Coal tar pitch from many different sources has produced a variety of effects in the skin: photosensitivity; acne and other dermatosis; pigmentations and growths, some of which are benign, others malignant. It is said that about half of the cancers attributable to occupational exposures are due to pitch. The heavier fractions and tars of some petroleums and of shale oil have similar actions. One obtains the impression from published information that the rather heavy exposures among pitch workers cause a high incidence of skin injuries.

2. It is apparent that the men handling pitch in the chlorine cells come in direct contact with the material, resulting in prolonged and repeated contacts upon some portions of the body. The data in Table VIII indicate a moderately dirty atmosphere.

3. The data in Table IX represent counts of small particles, roughly of particle size 0.1 to 5 microns which may be inhaled. This data indicates that relatively small amounts of pitch dust are being inhaled. Since the literature contains no reference to toxic effects attributable to inhalation, we are not greatly concerned about inhalation of pitch dust.

4. Excessive skin contact with pitch dust is to be controlled by arrangement and design of the process to eliminate manual handling and dispersion of dust, by personal protection of workmen, and measures to assure a high degree of personal cleanliness. The clothing and bath requirements on these jobs have been indicated. It is recommended that the men working directly with pitch be given medical examinations at regular intervals.

ST006749

II. Observations and Presentation of Data

1. Several exhaust hoods had been installed to control the dust exposure when grinding pitch. The men working on the pitch grinding equipment, however, through known experiences, are apparently exposed to amounts of pitch sufficient to cause photosensitivity.

2. The results of air analyses taken in the worker's breathing zone and in the work area during various operations encountered in pitch grinding are collected in Table VIII.

Table VIII

Dust Concentrations of Pitch Found During the Grinding and Handling Operations in Preparation of Making Cell Cement - Building 196

<u>Location</u>	<u>Conc. Mgs./cu. meter</u>
1. Breathing zone of worker as he opens metal drum of pitch tar and breaks up the contents	63
2. Breathing zone of worker as he shovels broken pieces of pitch into the grinder and dumps buckets of pitch into mills	306
3. Breathing zone of worker as he rakes pulverized pitch from the cyclone and shovels it into the buckets	94
4. Breathing zone of worker as he sweeps area after grinding and filling buckets	453
5. Breathing zone of worker as he operates the cable hoist to dump bucket of pulverized pitch into hopper for the mixer	209,249

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3. The results of dust counts taken in the general area and during the various pitch grinding operations are shown in Table IX.

(Table IX - page 13)

Table IX

Dust Concentrations Found During the Various Pitch
grinding operations and in the General Area

<u>Location (Breathing zone samples taken whenever possible)</u>	<u>m. p. c. f. (average of several counts)</u>
1. Shaking out broken pitch from metal drum	5
2. Breaking up lumps	7
3. Shoveling broken up pitch into grinder	8
4. Dumping buckets of ground pitch to mills	5
5. Sweeping up area where pitch is ground.	7
6. Raking out pulverized pitch	5
7. Filling buckets with pulverized pitch	5
8. Sweeping area where buckets are filled	2
9. Dumping bucket to mixer	5
10. Gen. atmosphere near foreman's desk	5
11. Area in front of small mixer while dumping cement to the small mixer with pitch	4
12. Area in front of small mixer while dumping the pitch cement mix	4
13. Area in front of small mixer with men working on poured casting	5
14. Area of building where men are working to prepare the cell forms	5

GRAPHITE DUST

I. Significance of Graphite Dust Exposures

1. There are a few reports of lung injury (pneumoconiosis) among persons working with graphite. Nearly all reports have dealt with natural graphite containing an appreciable amount of other minerals so that it is not definite that graphite dust alone has an adverse effect.

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2. It is apparent that considerable amounts of graphite are dispersed in the air, but the counts of particles susceptible to inhalation fail to indicate any exposures that are questionable. If workmen were regularly and uniformly exposed to counts of more than 50,000,000 particles per cubic foot, correction would be called for.

II. Observations and Presentation of Data

1. A dusty atmosphere was created when a worker used an air hose to remove the loose graphite from the plates before loading. There was still sufficient loose graphite remaining on the plates to make the loading of them very dusty.

2. The results of air analyses made during the loading operations are shown in Table X.

Table X

Dust Concentrations of Graphite Found During the Loading of Plates into the Buckets in Preparation for Pregnating with P.F., Elda. 261

<u>Location</u>	<u>Dust Conc. : Mg./cu. meter</u>
1. Breathing zone of worker blowing loose graphite off a stack of plates with an air hose (room closed up for winter conditions)	2260
2. Breathing zones of two workers as they load a bucket with graphite plates	2870

3. Several dust counts were taken during the plate loading and in the general atmosphere. The results of these counts are shown in Table XI. These values can be compared with the maximum allowable concentration of 50 m.p.c.f. for an inert dust.

4. Several dust counts were taken in the machine shop, both during the operation of the machines and in the general atmosphere through the area. The results of these counts are shown in Table XI also.

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Table XI

Dust Concentrations of Graphite Found
During the Loading of Plates and Various
Operations in the Machine Shop.

Treating Room

Location (Sample taken in the breathing zone of worker whenever possible)	m.p.c.f. (aver- age of several counts)
1. Blowing the loose graphite off the plates before loading them	50
2. General atmosphere in the room after blowing	35
3. Piling the plates into the buckets	50
4. General atmosphere of the treating room after finishing the loading of the plates	10 min. 20.1 15 min. 28.3 20 min. 35.2 30 min. 30.8 45 min. 41.0
5. General atmosphere in the treating room in the morning when the plates are unloaded	2.0

Machine Shop

6. General atmosphere in the machine shop early in the morning before work is started	7
7. Cutting corners off of boards at band saw	20
8. Running plates through bevel machine	8
9. Near new machine for grooving boards	10
10. Near old machine for grooving boards	9
11. Placing boards in machines	8
12. Removing boards from machines	9
13. Where operator sits after loading machines	10
14. Blowing small area from machines so board is locked in	11
15. Blowing machine off for cleaning	10
16. Sweeping up area around machines	8

(Table cont'd on page 16)

ST006753

Table XI -(cont'd)

17. General atmosphere near foreman's desk	8
18. General atmosphere near crib	5
19. General atmosphere other end of shop	5
20. General atmosphere office area	4
21. Janitor sweeping floor	5

FORMALDEHYDE

I. Significance of Formaldehyde Exposures

1. None of the exposures measured during normal operation were excessive.

II. Observations and Presentation of Data

1. In the making of the phenol formaldehyde resin, the odor of formaldehyde was noticed throughout the room, however, only during the blowing of the mixing tank was there evidence of eye irritation.

2. In all cases where air analyses were made, the concentration of formaldehyde found was below the maximum allowable concentration of 5 p.p.m. The results of air analyses are collected in Table XII.

PHENOL

I. Significance of Phenol Exposures

1. None of the exposures measured during normal operation were excessive.

II. Observations and Presentation of Data

1. Very little odor of phenol was noticed during the various operations of making phenol formaldehyde resin. The results of the air analyses can be compared with the concentration of 10 p.p.m. phenol found through past company experience to be an acceptable limit.

2. Table XII also shows the results of air analyses for phenol concentration.

ST006754

Table XII

Vapor Concentrations of Formaldehyde and Phenol
Found During Various Operations of the Phenol
Formaldehyde Resin Process, Building 236

<u>Location (Winter conditions - doors and windows closed)</u>	<u>p.p.m. Formaldehyde (by volume)</u>	<u>p.p.m. Phenol (by volume)</u>
1. General air sample taken in front of reactor and near operator's desk (reactor up to temp.)	1.0	0.40
2. From an elevated platform between the reactor and mixing tank (reactor up to temp.)	1.0	0.87
3. Next to the mixing tank and oper- ator's desk	0.44	
4. Near the mixing tank as phenol was blown in from trailer outside		0.69
5. Near the mixing tank as formaldehyde was pumped in from storage tank	1.27	
6. Near the mixing tank as air was blown to mix contents	2.6, 2.6	1.04
7. Near the mixing tank and operator's desk after blowing had stopped	4.0	
8. Near the vacuum still (operating) in the area where operator spends considerable time making insulating plugs	1.5	1.19
9. Breathing zone of operator filling 100 gal. drum with evaporated P.F. solution	2.9	1.11
10. Breathing zone of operator filling four 50-gal. drums with neutralized and evaporated P.F. solution for the Texas Division	2.4	0.87
11. Operators breathing zone filling six 50 gal. drums of formaldehyde for interplant use. (work done outside on cold, windy day)	.60	

ST006755

ASBESTOS

I. Observations and Presentation of Data

1. The handling of dry asbestos in making up a slurry of caustic, water and asbestos does offer an exposure to finely divided particles of asbestos.

2. The results of dust counts taken in the breathing zone of a worker as he weighs, dumps, and stirs the asbestos into the slurry are shown in Table XIII. These values can be compared with the maximum allowable concentration of 5 m.p.c.f. for an eight-hour exposure. None of the exposures measured during normal operation were excessive since the duration of exposure is short.

Table XIII

Dust Concentrations Found During the Handling of
Dry Asbestos in the Covering of Cell Diaphragms

<u>Location (samples taken in worker's breathing zone)</u>	<u>m.p.c.f. (average of several counts)</u>
1. Dumping bag of weighed asbestos (48 lbs.) to slurry tank	8
2. Stirring and mixing the asbestos with water	10
3. Weighing out a bag of asbestos	5

ST006756

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Biochemical Research Laboratory
The Dow Chemical Company

Noted E. E. D.

FEB 07 1958

EVALUATION OF CHEMICAL EXPOSURES
RECEIVED BY R. R. SPENCER OF
COATINGS TECHNICAL SERVICE,
433 BUILDING

File: T2.1-1-³²5 (F)
Chg.: 1219
Date: 1-22-58
By: J. E. Peterson

Signed

J. E. Peterson

Checked

H. R. Angle

Date

1-29-58

Date

1-30-58

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OF
THE DOW CHEMICAL COMPANY

PROBLEM

Recently, R. R. Spencer has become ill. The Environmental Research Laboratory was requested to determine chemical exposures received by him, and to assess these data.

ST006828

CONCLUSIONS

1. Exposures to airborne materials during the formulation, mixing, and calendering of vinyl asbestos tile in 433 Building were evaluated on 12-23-54 and on 1-15-58. Results of these evaluations are used to assess exposures received by R. R. Spencer during his work with this material.
2. From December 1953 to December 1954, R. R. Spencer worked with vinyl asbestos tile formulations, and in the course of that work was occasionally exposed to somewhat excessive concentrations of airborne asbestos.

During this period of time exposure to lead occurred, but his blood lead level on 3-7-55 was only 0.024 mg./100 cc. blood, a normal figure. Exposures to cadmium during this period were to airborne concentrations of " $<0.7 \text{ mg./m}^3$ " at intermittent periods. No effect is expected as a result of these exposures.

3. From the first part of 1955 to late 1956 Mr. Spencer worked mostly with latex in concrete, and exposures to vinyl-asbestos tile ingredients were reduced accordingly.
4. From the last part of 1956 until the present he has been working with vinyl-asbestos tile formulations in a supervisory capacity. During this work he was probably exposed a maximum of 1-2 days per week to airborne dust concentrations of less than 3 mppcf of a material analyzing 20-30% asbestos, less than 5% SiO_2 , and about 0.02% cadmium. No effect can be expected from such exposure.
5. If Mr. Spencer's difficulty is the result of chemical exposure, the causative agent is unknown at present. Further air analyses are to be made during a time when chlorinated polyethylene is used as the resin binder in the tile formulations.

ST006829

PRESENTATION OF DATA

R. R. Spencer has been ill with a lung difficulty, and overexposure to chemicals encountered during the formulation, mixing, and calendering of vinyl-asbestos tile formulations was suspected to be the cause of his illness. The Environmental Research Laboratory was requested to determine and evaluate his exposures.

On 12-23-54 an environmental survey of the vinyl-asbestos tile formulating operation was made by S. R. Johann; the results of this work were reported on 5-5-55 (File Number, T2.1-1-32). This survey found that air concentrations of "inerts" (asbestos plus calcium carbonate), barium, and lead were too high for repeated 8-hour exposures, and even though exposures were not that prolonged, recommended the installation of local exhaust ventilation. Cadmium was determined in the air samples, but in all cases the amount present was below the limit of sensitivity of the analytical technique employed, leading to air concentration figures of "less than" 0.66 mg./m^3 and "less than" 0.45 mg./m^3 .

As a result of this investigation several changes were made. First, the use of lead and barium compounds in the formulation was sharply curtailed. Second, operational techniques were changed so that each batch was completely formulated before mixing in the Banbury or Baker-Perkins machines, and mixing in these enclosed machines was always to be done prior to

S1006830

Third, canopy hoods were installed over the large 2-roll mill and over the calender, but not over the small 2-roll mill usually used for preliminary compounding of these formulations. Finally, the Building Products group recently moved into new quarters where a bench-type hood is always available to control dust from dry mixing.

In connection with the environmental survey of December 1954, samples were taken for blood-lead determinations for the men involved on this project. R. R. Spencer's blood lead concentration was found to be 0.024 mg./100 cc. of blood, a normal figure, indicating insignificant exposure to lead. The other two men involved also had normal blood lead values.

On 1-15-58 a second environmental survey of the vinyl-asbestos tile operations was made, partly to assess the value of indicated changes in reducing exposures of personnel, and partly to gain more insight into the chemical exposures that R. R. Spencer may have received recently.

The ingredients used in vinyl-asbestos tile formulations have adhered quite well to the same basic recipe for over a year.

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The recipe is as follows:

<u>Material</u>	<u>Weight Ratio</u>
Resin - May be chlorinated polyethylene or resin 2716, the copolymer of 15% vinylidene chloride, 85% vinyl chloride.	17.5
Diethyl phthalate or tricresyl phosphate	2.25
Monoplex S-38 - An epoxidized oil purchased from Rohm and Haas.	2.25
Metasap 624 - Contains cadmium laurate	1.5
Aluminium stearate	0.1
Paraffin wax	0.1
Lesimit.- Calcium carbonate	39.8
No. 18 graining sand - A very fine sand	12.5
Titanox RA50- Titanium dioxide	5.0
Asbestos shorts, type 7M	19.0

With the exception of diethyl phthalate and monoplex S-38, which are liquids, all of these materials are dry powders, and normally are weighed into a stainless steel mixing bowl in the open. This operation takes about 5 minutes. The mixing bowl is then placed under a mixer within a hood, mixed for a few minutes, and then the two liquids are added. After further mixing, the batch (which is still a dry powder) is poured into a paper bag held within the hood.

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When it is done, weighing and blending of the ingredients takes place at a maximum frequency of about 3-half-days per week; an average frequency is difficult to establish because two or three weeks may pass with no activity in this area at all. Mr. Spencer normally would be involved in about 10% of this work which is usually done by a lab technician.

Dry powder from the paper bag is poured directly into the Baker-Perkins or Banbury mixer - usually the Banbury. Here the material is forced into a heated mixing chamber with an air-powered ram and is mixed for about two minutes. The resulting mass is semi-plastic, and is removed (sometimes with difficulty) from the mixer and carried to the differential speed heated (200-300°F.) 2-roll mill. On this mill it is further blended and occasionally marbilizing chips are added. Such blending may take from 2 or 3 minutes to a half-hour depending upon the difficulties encountered.

After being thoroughly mixed on the 2-roll mill the plastic mass is carried to the calender (basically a cooler heated 2-roll mill) a few feet away. Here the material is squeezed to a pre-determined thickness by a pass through the rolls; the surface of the resulting strip is improved by a second pass through this machine. The strip of tile material is then cut into pieces of the correct size for testing with a shear. From Banbury mixer to finished pieces of tile may take from 15 minutes to an hour or so for a single batch.

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The maximum frequency of this job is about the same as for weighing and blending, 3 half-days per week, and again, an average frequency is almost impossible to establish. For reasons of safety, two men always work together in these operations; Mr. Spencer has been associated with about 80% of this work since the latter part of 1956.

On 1-15-58 several air analyses were made during vinyl-asbestos tile manufacture. Air sampling equipment used was the Bausch and Lomb dust counting microscope and the electrostatic precipitator. Results of these air analyses are presented in Table I. Samples 1-11 were taken with the B and L dust counting microscope and the concentrations are expressed in terms of millions of particles per cubic foot of air. (mppcf). Samples 12-14 were taken with the electrostatic precipitator, and normally concentrations would be expressed as milligrams of air contaminant per cubic meter of air (mg./m^3), but the samples were unfortunately of too short duration to obtain weighable quantities of dust.

ST006834

Table I

<u>Sample No.</u>	<u>Description</u>	<u>Dust Concentration, mppcf</u>
1	An air sample taken directly over a paper bag of dry materials shaken to produce dust. This sample was mainly to establish the size range of the airborne particles.	Most particles $\approx 5\mu$ in diameter, average about 2-3 μ
2	Breathing zone sample as a paper bag of formulation was dumped into the Banbury mixer.	3.2
3	Sample of fume from the hot semi-plastic mass as it was withdrawn from the mixer, not a breathing zone sample.	0.7
4	Breathing zone of a man removing the semi-plastic mass from the Banbury mixer with steel picks.	1.0
5	Breathing zone while working the material on the 2-roll mill.	0.9
6	Breathing zone while working the material on the 2-roll mill.	0.2
7	Breathing zone of man as he put the material through the calender.	0.7
8	Breathing zone while cutting the tile to size on the shear.	0.5
9	Room air in the office.	0.2
10	Breathing zone of lab technician as he added dry asbestos fiber to the mixing container on a scale in the laboratory.	1.4

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Sample No.	Description	Dust Concentration, MPPCF	
11	Immediately outside of the bench hood where the dry batch of material was being mixed.	0.5	
		Length of Time of Sample	Dust Conc. mg./m. ³
12	Electrostatic precipitator sample in the breathing zone while formulation being mixed in the Banbury.	2 min.	Too little to weigh
13	Breathing zone while working the formulation on the 2-roll mill.		Too little to measure.
14	Sample taken in bench hood over the container where the dry mixture was being stirred. This sample was taken only to determine the relative proportions of the dust constituents in air.	CaCO ₃ - Main Constituent Asbestos - 20-30% SiO ₂ < 5% Cd 0.02%	

The resin used for the tile formulation involved in the work described in Table I was resin 2716, consisting of the polymer made from 15% vinylidene chloride, 85% vinyl chloride. Analysis of Sample 14 was by x-ray diffraction and emission spectrograph; the organic materials are not "seen" by this method.

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The dust concentrations shown in Table I may be compared with the appropriate Industrial Hygiene Standards, listed in Table II. Industrial Hygiene Standards are concentrations which may be inhaled as much as 8 hours per day, 5 days per week indefinitely without ill effect.

Table II

Industrial Hygiene Standards

<u>Material</u>	<u>Standard</u>
Asbestos	5.0 mppcf
Silica (quartz)	5.0 mppcf
Cadmium	0.10 mg./m ³
Calcium Carbonate	15.0 mg./m ³
Resin 2716	probably 15.0 mg./m ³

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An examination of Tables I and II readily shows that at no time were the standards for asbestos or silica exceeded. Since the dust counting microscope determines the number, not the weight of particles in the air some assumptions must be made before the cadmium exposure can be evaluated: (1) assume that the dust encountered near the Banbury mixer, 2-roll mill and callender had the same particle-size distribution as the dust of the dry mixture (confirmed by dark-field microscopic examination); (2) assume the dust particles were spherical with an average diameter of 2.5 μ ; (3) assume the density of the particles was approximately 2.0 g./cc.

Using these assumptions, the weight concentration of dust corresponding to the highest observed particle concentration (3.2 mppcf) would be 1.85 mg./m.³. Then, assuming that the particles were 0.02% cadmium, the air concentration of cadmium was about 0.0004 mg./m.³, well below the 0.10 mg./m.³ Standard, especially considering that all of the assumptions made were conservative.

Thermal decomposition products of the resin and plasticizers used could conceivably be the cause of trouble except that a great amount of experience at Dow and at other companies with these materials has shown that no adverse effects are to be expected even under much worse conditions than have been prevalent in 433 Building.

ST006838

Remaining as a possibility is the dust and/or thermal decomposition products from chlorinated polyethylene, a new material. A survey will be made when this material is again used in vinyl-asbestos tile formulations in order to determine what materials are inhaled, and in what concentrations. Also, this dust, along with the dust of other materials, is soon to be investigated by the Toxicology Laboratory to determine the degree of irritation caused by subdermal injections. This investigation should help to decide whether or not Mr. Spencer's lung injury could have been caused by the resins used in vinyl-asbestos tile formulations.

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The bench hood used in the laboratory for dry mixing was evaluated by measuring air velocities at the face of the hood with an Anemotherm Air Meter. The attached "Hood Survey Data Sheet" is self explanatory regarding findings and recommendations.

ST006839

C.F. Porter

GENERAL PLANT

SAFETY

RULES

ST0014120



THE DOW CHEMICAL COMPANY

TEXAS DIVISION
FREEPORT TEXAS

1958

ST0014121

GENERAL SAFETY RULES
REVISED MARCH 24, 1958

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GENERAL SAFETY RULES

A completely safe operation is one of the important objectives of The Dow Chemical Company and the following rules are designed to aid in achieving that objective. It is impossible to list here all safety rules that are necessary to insure maximum safe conditions and work habits. These rules cover only the general points and more detailed and specialized rules are in effect in various areas and departments throughout the plant.

The omission of any specific rule from this list should not be regarded as minimizing the importance of such rule, and in no way relieves the individual employee of the responsibility for doing every job in the safest manner possible.

Violation of any safety rule is considered a serious offense and this offense is subject to a penalty that may include discharge, depending on the seriousness of the violation.

The primary responsibility for personal safety lies with each individual and the effectiveness of the accident prevention program of the company depends upon the wholehearted cooperation of every employee.

A. FIRST AID

1. Whenever an employee receives an injury, even though it be considered slight, he must report as soon as possible to First Aid for treatment. The employee must notify his supervisor of the injury, preferably before reporting to First Aid, or as soon as possible thereafter, depending upon the circumstances.
2. Employees must not attempt to remove foreign particles from the eyes, except by washing with water. If a corrosive material, such as caustic or acid, gets in the eye, it must be washed immediately with running water

and the washing continued for at least fifteen minutes. The ambulance must be called so that washing of the eye can be continued enroute to the Industrial Medical Department. If any doubt exists as to the corrosiveness of the material that may get into the eye, the washing procedure must be carried out.

3. If corrosive chemicals come in contact with the body, the affected parts should be washed with running water for at least fifteen minutes. If necessary, clothing should be removed to make sure that adequate washing is being accomplished.

B. CONDUCT

1. All employees are expected to know and abide by their departments' safety rules.
2. Horseplay in any form must not be engaged in by employees in the plant or on duty.
3. Running in the plant must be avoided except in case of an emergency.
4. Pedestrian paths and walkways must be used whenever provided. In their absence, employees using streets and roadways must walk on the left side, facing approaching traffic.
5. Employees must not climb through, under, over or between railroad cars except in performance of assigned duties.
6. Employees entering other departments must familiarize themselves with and be governed by the written safety rules of that department.
7. Compressed gases must not be used for cleaning of clothes or the body.
8. Safety belts, with lifelines attached, are to be worn by employees when performing work in elevated positions where the use of scaffolds or ladders is impractical and where a slip might result in a serious accident.

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9. Employees must not make inoperative, as a matter of convenience, such safety devices as relief valves, solenoid controls and swing guards.
10. Unsafe short cuts, such as walking across ditches on pipelines and cutting corners to save a few steps, must be avoided.
11. Before beginning work in areas where contact with corrosive chemicals is possible, employees must familiarize themselves with the location of the nearest safety shower, eye bath and telephone.
12. All containers such as bottles, jugs, or cans of hazardous chemicals must be properly labeled. This includes all chemicals that are toxic, corrosive or flammable.
13. All glass containers of one gallon or more capacity must be properly crated before shipment in the plants and while in use. All glass containers of material that is toxic, corrosive or flammable must be properly crated while being transported.
14. Employees, when riding on open type trucks, must not stand up or hang their feet over the sides.
15. Smoking is strictly prohibited in the plant in those areas posted with "No Smoking" signs. Reference is made to Section. VI B1 of the Employee's Manual for further information on policy regarding smoking.
16. Maintenance personnel must report to the operating supervision before beginning work in a production plant area on a non-routine job, and daily thereafter until the job is completed. Upon completion of the work, operating supervision must be notified that they are leaving the area.
17. Employees must familiarize themselves with the location of emergency equipment such as gas masks, fire extinguishers and fire blankets in the area in which they work.

18. Employees must not drop or jump on to a transite roof.

19. Flammable materials must not be dumped into sewers without permission of the supervisor.

C. VEHICLES AND TRAFFIC

1. The driver of company motorized equipment is responsible for the condition of the equipment while it is entrusted to him. Any irregularities of brakes, lights, horn, fumes in cab or general operation must be reported to the garage on the regular form provided for this purpose.

2. Drivers of plant vehicles must keep on roadways designated for such traffic as much as possible.

3. All traffic signs in the plant must be obeyed. Emergency vehicles on call may be exempt, but drivers of same shall be responsible for driving with due regard for the safety of others.

4. The speed limit in the plant is 25 miles per hour unless otherwise designated by signs. The speed limit must not be exceeded except in emergencies.

5. The maximum number of people who may ride in a pick-up truck is three in the cab and six seated on the pick-up bed or on approved "built in" seats. Under no circumstances should arms or legs hang outside the vehicle cab or bed.

6. Hauled material that overhangs the sides or ends of trucks must be properly flagged.

7. Personnel newly authorized to operate motor scooters must be given proper instructions in the safe operation of the same.

8. The speed limit for motor scooters is 20 miles per hour. The removal of, altering or otherwise tampering with the carburetor or governor settings to increase the speed is prohibited.

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9. No more than two people may ride on a package car scooter (box in front) and then only when the passenger is seated inside the box.

10. The load capacity for pickup model No. 781 scooters is 500 pounds. Not more than two passengers and the driver may ride in pickup model scooters and then only when an approved seating arrangement is provided by the Garage.

11. Night operation of scooters without lights is prohibited.

12. Passengers standing on Plant route busses must stay to the rear of the front row of passenger seats.

13. Motor scooter engines must not be left running while scooter is unattended.

D. PROTECTIVE EQUIPMENT & CLOTHING

1. When entering any designated compulsory eye protection area, all persons are required to wear eye protection as specifically approved for that area.

2. Proper type goggles must be worn when chipping, grinding, buffing, cleaning welds, loading or unloading material or any similar operation or condition where flying particles constitute an eye hazard.

3. Departmentally-approved eye protection must be worn by employees when transferring corrosive materials (such as acid, caustic, etc.) from one container to another by pouring and when taking process samples of such materials.

4. Employees working with or around electric arc welding or cutting must wear approved eye protection.

5. It is recommended that employees also wear proper goggles under the following conditions:

(A) When handling carboys or glass bottles of corrosive liquids.

(B) When a high wind is blowing.

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(C) When riding motor scooters or open trucks on plant roadways.

6. All employees subject to any hazardous exposure, including dust, chemicals or toxic irritants, must wear adequate protective equipment approved by their supervisor and the Safety Department, such as: Head protection, rubber jackets, slicker suits, coveralls, fire resistant clothing, protective sleeves, spats, gloves, aprons, protective footwear, respirators and gas masks. Company-furnished clothing and protective equipment must not be altered without permission.

7. All employees must wear personal clothing that is safe and proper for their jobs.

8. In no case shall an employee in the plant work in an undershirt, shorts only, or stripped to the waist.

9. Metal safety hats must not be worn in areas that are electrically hazardous. Plastic hats are available and recommended for such use.

10. Adequate protective equipment, such as slicker suits, rubber gloves, rubber boots, as well as face and eye protection must be worn when breaking into pipelines, vessels or other equipment that may contain acid, caustic, or any other corrosive material.

11. Adequate ventilation must be maintained when using solvents. If ventilation is inadequate, then respiratory protection must be worn.

12. When flammable liquids are transferred from one metal container to another, proper bonding must be provided to prevent accumulation of static electricity.

13. All full-face gas masks must be sent to the Safety Department at least annually for checking.

E. MACHINERY, TOOLS, AND EQUIPMENT

1. Machines must have all guards in place before being operated, unless the specific job is approved by the supervisor.

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2. Defective tools are to be tagged with a "Defective Tool Tag" and returned to the Tool Room for repairs.
3. Tools, material or equipment must not be intentionally dropped or thrown from a higher to a lower level unless adequate precautions have been taken to make sure that no injury to persons or damage to equipment will occur.
4. Neckties, loose clothing and jewelry, such as tie chains and watch chains, must not be worn around moving machinery.
5. Air pressure on pneumatic tools must be bled down before disconnecting them from the air supply.
6. Tool rests on grinders must be set not more than 1/8 inch from the wheel. Buffers are not to be operated with tool rests.
7. All pedestal and bench grinders and buffers must have a satisfactory guard over the wheel. Portable grinders and buffers must have a satisfactory guard over the wheel except in cases where special conditions make the use of a guard impractical and the employee's supervisor has approved its use without a guard. The guards on wire buffing wheels mounted on pedestal or bench grinders should be cut back at the bottom about 30 degrees from the vertical center line of the guard.
8. Grinding on the side of emery wheels must be done only on wheels that are designed for this purpose.
9. Moving machinery and process equipment in service must be shut down before adjustments or repairs are made except as follows: If it is not feasible to shut the equipment down before performing work upon it, then it is necessary for department supervision to:
 - (A) Determine for each item of such equipment what jobs must be performed with a listing of those jobs made for the use and information of the workmen and

their supervisors. Any non-listed jobs of any nature are not to be done.

(B) Prepare a detailed safe job procedure for each listed, permitted job and also a list of personnel authorized to perform these jobs.

10. Gloves must not be worn while using grinders, buffers, or drill presses unless permission to do so is secured in advance from the foreman.
11. Gasoline tanks on motorized equipment must not be filled while the engine is running.
12. Blue flags must be used on railroad tracks when the entrance of a train would present a hazard to personnel or equipment. Removal of blue flags must be authorized by the person who put them up.
13. The use of nonferrous tools is to be given consideration on jobs and in areas where an explosion or fire hazard exists.
14. In the event it becomes necessary to enter a vessel that may not be completely free of hazardous contents, a safety belt and life line must be worn in addition to the other protective equipment needed. Safety belts and life lines must be worn by those entering vessels whenever it is deemed advisable by the supervisor.
15. Vessels moved to the shops and salvage must be cleaned whenever practical, and tagged as to condition and previous contents.
16. Employees must not ride a load that is being handled by a crane. The riding of crane slings is prohibited, except where a bosun's chair is provided or permission is given by the supervisor.
17. Spring-loaded snap-on "Cleco" quick hose connections must be reserved for use on air and water service. A part of the "Cleco" connector must not be left connected to a process line. This does not exclude the use of other type quick connectors on the above or other service.

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18. "Boss-type" hammer union connectors must be used on steam hose service.

F. HOUSEKEEPING

1. Compressed air from a hose must not be used in an attempt to clean a work area nor should it be used to clean machinery or parts unless specific safe procedures are established to protect the user as well as others in the area.
2. Walkways and stairways must be kept clear of all tripping hazards such as material, tools, hoses, etc.
3. Job sites must be kept as orderly as practical during the performance of the work. When a job is completed, the work area must be left in a neat and orderly condition.

G. LADDERS AND SCAFFOLDS

1. The following rules are to be observed when using ladders:
 - (A) Make certain that ladders are in good condition and of proper length before using them.
 - (B) Face the ladder and keep both hands free for climbing.
 - (C) Where practical, grasp the ladder by the side rails rather than the rungs.
 - (D) Set straight ladders so that the bottom is out from the vertical about one-fourth of the distance from the upper support to the bottom.
2. All straight ladders must be made secure at the top or must be held while in use.
3. Makeshift scaffolds, such as boxes, crates, and drums must not be used.
4. The following rules are to be observed while working on or over transite roofs:
 - (A) Where a permanent platform or walkway is not provided, a temporary walkway or spread-footing

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should be used to distribute the load over a large area of the transite.

(B) Where it is absolutely necessary for employees to walk on transite roofs, permission must be secured from the supervisor and care must be taken to place the weight on the purlins or lap of the transite.

5. Use ladders rather than the cross braces when climbing scaffolds.

6. The following rules apply to rolling scaffolds:

(A) Rolling scaffolds of a height greater than three times the minimum base dimension must be guyed or tied off while being used.

(B) All caster brakes must be applied when scaffold is not in motion.

(C) Riding rolling scaffolds is prohibited.

7. Do not attempt to use scaffolds as material hoists or for mounting derricks unless they have been designated for this purpose.

8. Platforms and scaffolds must be kept clear of tripping and slipping hazards.

H. RED TAGS AND PERMITS

1. Valves, switches or any other equipment must not be operated when RED TAGS are attached to them. These red 3" x 6" cardboard tags, bearing the word "Warning" in black letters as a heading, are attached to equipment to signify that the operation of it would be hazardous.

Persons responsible for the equipment on which work is being done or anyone whose safety would be endangered if the equipment were operated, may attach the red tag. When red tags are attached to equipment by persons other than those responsible for its operation, prior approval from the person responsible shall be obtained.

Red tags may be removed prior to operation of equipment only upon the authorization of the person so designated on the tag. The only exception to this procedure is when the designated individual cannot be contacted. In such cases his supervisor may authorize the removal of the tag. If this is done, the supervisor must first determine to his complete satisfaction that the equipment can be operated in a safe manner. The prompt removal of tags upon full completion of a job will help keep such cases to a minimum. Red tags may be exchanged at the end of a shift or for some other reason; but again, only the person authorized to remove the tag may do so except as stated above.

2. At the discretion of the supervisor, locks may be used on valves and switches in addition to red tags.

3. "Safe Work Permits" are designed to provide a convenient means of checking the safety of such jobs as entering closed vessels, breaking into or repairing pipelines that have contained hazardous materials or pressures, work involving the use of flame or spark producing equipment in hazardous areas and work on machinery. These permits are to be requested and/or issued at the discretion of the departmental supervision involved in any jobs where the "Safe Work Permit" is applicable.

I. ELECTRICAL

1. 32 volt transformers are to be used in connection with drop lights when working inside metallic vessels. Exceptions to the above shall be considered when the use of 115 volts is required to accomplish the work. Special precautions shall be taken in grounding, handling, and inspecting electric cords, and permission shall be obtained from the supervisor before entering a vessel.

2. In locations where grounded and polarized electri-

cal receptables are not provided and there is a possibility that personnel may come in contact with ground or a grounded object, all portable electrical tools and equipment must be grounded before use. If three-conductor cord with ground clip attached is used, the grounding clip must be made secure to a grounded pipe or conduit before the plug-in is made to the outlet. Disconnecting should be done in reverse order. Exceptions to the above are the operating floors of Rectifier buildings and areas listed in the Magnesium Department's safety rules.

3. When electric motor driven equipment is to be worked on, the safety switch to the motor should be opened and "red-tagged" or the breaker lowered and "red-tagged". Blocking starter stations open is insufficient precaution against accidental starts.

J. EXCAVATIONS AND FLOOR OPENINGS

1. Where a safety hazard would be created for the personnel involved, and/or others, excavations such as ditches, trenches, or bell holes, should be sloped sufficiently to prevent cave-ins or slides. If sloping is impractical, shoring must be used in cases whenever the vertical dimension exceeds four feet. Unattended excavations in frequently traveled areas should be barricaded.

2. All floor or trench openings where grating or floor plates have been removed must be barricaded or marked by suitable warning signs.

K. PRESSURE CYLINDER AND SAMPLE BOMBS

1. Compressed gas cylinders must be secured to prevent falling when stored or being used.

2. Hoses must be disconnected from oxyacetylene torches before torches are stored in tool boxes or cabinets. These torches and hoses must be removed from

vessels that have been vacated by personnel.

3. All compressed gas cylinders must be properly labeled as to contents.

4. Pressure cylinders must not be filled except by, or with the consent of the owner.

5. Only those who have been properly instructed may fill pressure cylinders.

6. Compressed gas cylinders designed for caps must have caps securely in place while in transit or not in use, with the exception of those on portable welding equipment.

L. EMERGENCY PROCEDURE

1. In the event of an emergency such as a spill, fire or explosion in any area of the plant, all except those charged with the responsibility of taking care of the situation must leave the area and remain at a safe distance until the emergency is over. Exceptions to the above may occur when a specific request for assistance is made by supervision of the plant area involved or by the Plant Protection or Fire Department.

2. The following procedure should be used to call an ambulance, report a fire, spill of volatile materials or release of hazardous gases: Dial 666 and state that you want to report an emergency. The telephone operator will connect you with the emergency telephone system at which time you should give your name, the exact location (building number, door, etc.) and the nature of the emergency. The person reporting the emergency should stay on the line until sure that the message is understood and confirmed.

M. RADIATION

Note: In locations where a radiation source is used or stored, regulations require that it be marked with a "Radiation Material" sign. This sign is for the purpose

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of informing anyone in the area that such material is present, and not that a safety hazard due to radiation exists.

1. Only authorized persons may enter an area marked by "Radiation Area" signs.
2. All areas where a radiation hazard exists must be marked conspicuously by standard signs at a safe distance from the source of radiation. These signs bear the radiation symbol of magenta (or purple) on a yellow background with the words "Caution-Radiation Area".
3. "Radiation Area" signs must be removed when a radiation hazard no longer exists in the affected area.

ST0014135

W. B. ZETTEL

PAINT DEPARTMENT

SAFETY RULES
&
SAFETY REGULATIONS

JANUARY 1961

ST0014177

PAINT DEPARTMENT
SAFETY RULES AND SAFE WORK PROCEDURES

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ST0014178

January, 1961

PAINT DEPARTMENT
SAFETY RULES AND SAFE WORK PROCEDURES

Permanent Orders

1. Eliminate "almost-safe" practices.
2. Clean up your work area and keep it that way.
3. Stop looking for explanations and excuses for your accidents.
4. Start looking for causes and cures.
5. Translate the cures into action.
6. Build Safety into every step of every job.

S. C. Cutshall

S. C. Cutshall, Section Superintendent
Building and Yard Maintenance

January, 1961

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ST0014179

FOREWORD

Completely safe operation is the objective of the Dow Chemical Company and it should be the objective of each employee. To achieve this goal, diligent planning, proper communication and the complete cooperation of everyone on each job is required.

Accidents are the result of an improper understanding or lack of knowledge of conditions existing and hazards involved. These Rules and Safe Work Procedures are to help us in working safely. Many of you participated in formulating some rules and procedures; some were learned the hard

way. No set of rules can possibly cover all contingencies that may arise from changing conditions. To strictly follow the rules is not enough. Everyone is to be constantly on alert to detect and avoid unforeseen accidents.

These are our rules and safe work procedures; follow them and observe them. It is important that we change and improve as better and safer methods are learned.

W. Cutshall

W. Cutshall
Plant & Yard Maintenance

May, 1961

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DISASTER EMERGENCY PROCEDURES

In the event of an explosion, fire, or a large gas release, Paint Department employees working in the area affected are to observe the following procedures.

1. If you are in the area where the disaster occurs, shut down any of your equipment in operation and leave the block at once.
2. Report to the Paint Shop office by phone as soon as possible giving your name and location.
3. Do not re-enter the area under any circumstances until authorized by supervision.

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PAINT DEPARTMENT

SAFETY RULES AND AID IN COMPLIANCE

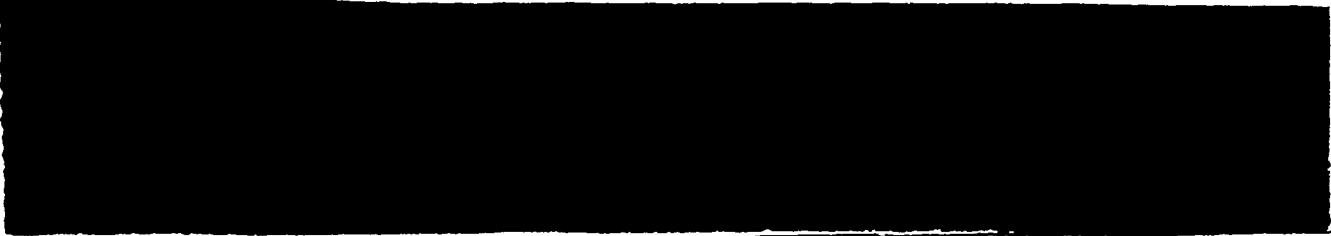
Accident prevention is your business. No employee will allow an unsafe condition to exist; remedy the defect or report it to your immediate supervisor.

General

1. Appropriate warning signs must be displayed before starting spray painting, sandblasting, steam cleaning, and overhead work.
2. Means of exit must be provided from both ends of the work area when working on overhead pipe lines carrying hazardous materials.
3. Proper signs, barricades and/or flag men must be used when working on highways.
4. Location of safety showers and eye bath in the area of work must be known.
5. An approved type plastic safety helmet must be worn during all hours of work. Safety hats will be inspected daily by the owners. Broken brims, crowns, defective sweat bands, or head saddles will be repaired or the safety hat will be replaced.
6. Operating Department safety rules and safe work procedures must be followed when working in their area. Should there be a conflict between the Paint Department's safety rules and the Operating Department's rules, Supervision will confer and insure a safe condition or operation.
7. Good housekeeping will be planned at the beginning of the job, and carefully followed to the final cleanup of the job.

January, 1961

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8. Access to pipeways or other structures must be by stationary ladders, stairs or by portable ladder. The only exception will be when a safe job procedures is approved and only then when safe access can be had.
 9. Necessary scaffolding must be built for all jobs where a safe work area cannot be obtained otherwise.

ST0014183

January, 1961

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RESPIRATORY PROTECTION

1. Fresh air mask must be worn while blasting. (Sand, Silicon, etc.).
2. Dust type respirator must be worn in areas where there is excessive dust that could be injurious.
3. Air supplied hood or proper type respirators will be worn in places where toxic materials are present and adequate ventilation cannot be provided.
4. Fresh air mask must be worn in tanks or tight enclosures while spray painting.
5. Approved type respirators must be worn when there is a possibility of inhaling over spray or vapors. A respirator must be worn while spray painting.
6. Only filtered air will be used in fresh air masks.
7. Adequate ventilation will be provided for closed tank interior work.
8. Men working in Chlorine Cells, Mag Cells, or on Chlorine lines must have a chemical respirator on his person.

ST0014184

ST0014136

C. F. Porter
1962

**TEXAS DIVISION
GENERAL
PLANT
SAFETY
RULES**



**THE DOW CHEMICAL COMPANY
FREEPORT, TEXAS**

ST0014137

GENERAL PLANT SAFETY RULES
REVISED MAY 1, 1962

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soon as possible to Industrial Medicine for treatment. The employee must notify his supervisor of the injury, as soon as practical.

2. Employees must not attempt to remove foreign particles from the eyes, except by washing with water. If a corrosive material (either solid, liquid or gas) gets in the eye, the eye must be washed immediately with running water preferably at an eyewash station and the washing continued uninterrupted for at least fifteen minutes. The ambulance must be called so that washing of the eye can be continued en-route to the Industrial Medical Department. The fifteen-minute procedure must be carried out in all eye-wash cases.
3. If corrosive chemicals come in contact with the body, the affected parts must be washed with running water for at least fifteen minutes. If necessary, clothing should be removed to make sure that adequate washing is being accomplished.

B. EMERGENCY PROCEDURE

1. In the event of an emergency such as a spill, gas release, fire or explosion in any area of the plant, all except those charged with the responsibility of taking care of the situation must leave the area and remain at a safe distance until the emergency is over. Exception to the above may occur when a specific request for assistance is made by supervision of the plant area involved or by the Plant Protection or Fire Department.
2. The following procedure should be used to call an ambulance, report a fire, spill of volatile materials or release of hazardous gases; Dial 666 and state that you want to report an emergency, give your name, the exact location (building number, door, etc.,) and the nature of the emergency. The person

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reporting the emergency should stay on the line until sure that the message is understood and confirmed. If there is a malfunction on the "666" number, emergency calls may be placed by dialing "0" as stated in the plant telephone directory.

3. The Standard Emergency signals are:

Gas Release _____ (Continuous)

This signal is sounded by the department where the release occurs. All personnel downwind of the signal must standby and be prepared to use necessary protective equipment, or to leave their area if necessary.

Alert- - - - - (series of short blasts)

This signal cancels welding permits and all personnel in the area where this signal is given must be prepared to use proper protective equipment if required to stay, to evacuate if ordered, or return to work at the All Clear signal.

Evacuate- - - - - (series of 3 short blasts)

Upon hearing this signal in your work area, leave the area according to your Unit Emergency Plan. After evacuation you should remain clear of the area, but ready to return when the All Clear signal is given.

All Clear- - - - - (series of 3 long blasts)

When this signal is given, return to your work area as soon as possible.

4. If operating a motor vehicle in an area where a Gas Release signal is given, turn off the engine, get out of the vehicle, and be prepared to leave the area if necessary. Never drive a motor vehicle into an area where there is a gas release.

Always be alert for the standard emergency signals given above.

C. INDIVIDUAL ACTION

An individual's actions must constantly reflect safety consciousness. Always work with safety for yourself and your fellow employee in mind.

1. All employees are expected to know and abide by their departments' safety rules. They must familiarize themselves with, and be governed by the written safety rules of any department they might enter.
2. Horse-play in any form must not be engaged in by employees in the plant or while on duty.
3. Running in the plant must be avoided except in case of an emergency.
4. Employees must not climb through, under, over or between railroad cars except in performance of assigned duties.
5. Compressed gases, including air, must not be used for cleaning of clothes or the body.
6. Employees must not make inoperative, as a matter of convenience, such safety devices as relief valves, electrical and mechanical interlocks, or guards.
7. Unsafe shortcuts, such as walking across ditches or pipelines, and cutting corners to save a few steps, must be avoided.
8. Before beginning work in areas where contact with corrosive chemicals is possible, employees must familiarize themselves with the location of the nearest safety shower, eye bath, and telephone, and know the location of emergency equipment such as gas masks, fire extinguishers and fire blankets in the area in which they work.
9. All containers such as bottles, jugs, or cans of chemicals must be properly labeled.

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10. Smoking is strictly prohibited in the plant in those areas posted with "No Smoking" signs, except in smoke shelters at designated times.
11. Maintenance personnel must report to the operating supervision before beginning work in a production plant area on a non-routine job, and daily thereafter until the job is completed. Upon completion of the work, operating supervision must be notified that they are leaving the area.
12. Flammable materials must not be dumped into sewers without permission of the supervisor.
13. Every employee must insist on the observance of safe practices of fellow workers.

D. VEHICLES AND TRAFFIC

1. Pedestrian paths and walkways must be used whenever provided. In their absence, employees using streets and roadways must walk on the left side, facing approaching traffic.
2. The driver of a company vehicle is entrusted with the responsibility for its proper use. Any malfunction of brakes, lights or horn, or fumes in the cab or any unsafe condition must be reported to the Garage at once, and the vehicle repaired before any further use is permitted.
3. Drivers of plant vehicles must keep on roadways designated for such traffic as much as possible.
4. All traffic signs in the plant must be obeyed. Emergency vehicles on call may be exempt, but drivers of the same shall be responsible for driving with due regard for the safety of others.
5. The speed limit in the plant is 30 miles per hour for cars and trucks and 20 miles per hour for scooters, unless otherwise designated by signs. The removal of, altering or otherwise tampering with the

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carburetor or governor settings on motor scooters to increase the speed is prohibited.

6. The maximum number of people who may ride in a pick-up truck is three in the cab and six seated on the pick-up bed, or on approved "built-in" seats. Under no circumstances should arms or legs hang outside the vehicle cab or bed.
7. Employees, when riding on open type trucks, must not stand up or hang their feet over the sides.
8. Hauled material that overhangs the sides or ends of trucks must be red flagged at the extent of the overhang.
9. Personnel newly authorized to operate motor scooters must be given proper instructions in their safe operation.
10. The load capacity for truckster model scooters is 500 pounds. Not more than two passengers and the driver may ride in truckster model scooters, and then only when an approved seating arrangement is provided by the Garage.
11. Motor scooter engines must not be left running while scooter is unattended.
12. Night operation of bicycles, scooters and power-buggies without lights and reflectors is prohibited.
13. Passengers standing on plant route busses must stay to the rear of the front row of passenger seats, and passengers must not attempt to get on or off busses while they are in motion.
14. Smoking is not permitted in vehicles in designated no smoking areas.
15. Gasoline tanks on motorized equipment must not be filled while the engine is running.

E. PROTECTIVE EQUIPMENT AND CLOTHING

Protective equipment is provided and specified in these and departmental rules. This equipment must be periodical-

ly checked to assure good working order.

1. When entering any designated compulsory eye protection area, all persons are required to wear eye protection as specifically approved for that area.
2. Proper type goggles must be worn when chipping, grinding, buffing, cleaning welds, loading or unloading material, or any similar operation where flying particles constitute an eye hazard.
3. Departmentally-approved eye protection must be worn by employees when transferring corrosive materials (such as acid, caustic, etc.,) from one container to another by pouring and when taking process samples of such materials.
4. Chemical goggles must be worn in areas where corrosive materials may be splashed or spilled. In addition, adequate protective clothing, such as face shields, slicker suits, rubber gloves and rubber boots must be worn when breaking into, or disconnecting, piping, pumps, vessels, or related equipment that contains, has contained, or may contain acids, caustic, or other corrosive materials.
5. Employees working with or around electric arc welding or cutting must wear approved eye protection, and provide adequate ventilation.
6. Employees should wear proper eye protection under the following conditions:
 - (a) When handling carboys or glass bottles of corrosive liquids.
 - (b) When a high wind is blowing.
 - (c) When riding motor scooters or open trucks on plant roadways.
7. All employees subject to any hazardous exposure, including dust, chemicals, or toxic irritants, must wear adequate protective equipment approved by their supervisor and the Safety Department, such as

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face shields, head protection, rubber jackets, slicker suits, coveralls, fire resistant clothing, protective sleeves, spats, gloves, aprons, protective footwear, respirators and gas masks. Company-furnished clothing and protective equipment must not be altered.

8. All employees must wear personal clothing that is safe and proper for their job. Life jackets, and/or life belts, must be worn as required by department rules. In no case shall an employee in the plant work in an undershirt, shorts only, or stripped to the waist.
9. Metal safety hats are prohibited in areas that are electrically hazardous. An approved safety hat must be worn by all employees while in areas where there is a hazard of falling objects.
10. Adequate ventilation must be maintained when using solvents. If ventilation is inadequate, then respiratory protection must be worn.
11. Safety belts, with lifelines attached, are to be worn by employees when performing work in elevated positions where the use of scaffolds or ladders is impractical and where a slip might result in a serious accident.
12. All full-face respiratory protective equipment must be sent to the Fire Department at least annually for checking.
13. In the event it becomes necessary to enter a vessel that may not be completely free of hazardous contents, a safety belt and lifeline must be worn in addition to other protective equipment needed. Safety belts and lifelines must be worn by those entering vessels whenever it is deemed advisable by supervision.

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CHINERY, TOOLS, AND EQUIPMENT

Machines must have all guards in place before operated, unless the specific job is approved by the supervisor. When permission is given by the supervisor to remove a guard from a machine or tool, the supervisor must instruct the employee on special precautions to be taken while operating the machine or tool with the guard removed.

All pedestal and bench grinders and buffers must have a satisfactory guard over the wheel. Portable grinders and buffers must have a satisfactory guard over the wheel except in cases where special conditions make the use of a guard impractical and the employee's supervisor has approved its use without a guard. The guards on wire buffing wheels mounted on pedestal or bench grinders should be cut back at the bottom about 30 degrees from the vertical center line of the guard.

3. Grinding on the side of emery wheels must be done only on wheels that are designed for this purpose.
4. Tool rests on grinders must be set not more than 1/8 inch from the wheel. Buffers are not to be operated with tool rests.
5. Gloves must not be worn while using grinders, buffers, or drill presses unless permission to do so is secured in advance from the supervisor.
6. Neckties, loose clothing and jewelry, such as tie chains, watch chains, and rings, must not be worn around moving machinery.
7. Moving machinery and process equipment in service must be shut down before adjustments or repairs are made, except as follows: If it is not feasible to shut the equipment down before performing work upon it, then it is necessary for department supervision to:

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- (a) Determine for each item of such equipment what jobs must be performed, with a listing of these jobs made for the use and information of the workmen and their supervisors. Any non-listed jobs of any nature are not to be done.
 - (b) Prepare a detailed safe job procedure for each listed permitted job, and also a list of personnel authorized to perform these jobs.
8. Vessels to be entered, or worked upon, must be made safe for personnel by such means as disconnecting, blinding, or double-block and bleed. If such precautions are impractical, a detailed procedure for performing the work in a safe manner must be prescribed by supervision.
 9. The use of non-ferrous tools is to be given consideration on jobs and in areas where an explosion or fire hazard exists.
 10. Tools, material or equipment must not be intentionally dropped or thrown from a higher to a lower level unless adequate precautions have been taken to make sure that no injury to persons or damage to equipment will occur.
 11. Defective tools are to be tagged with a "Defective Tool Tag", and returned to the Tool Room for repairs.
 12. Air pressure on pneumatic tools must be bled down before disconnecting them from the air supply.
 13. Spring-loaded snap-on "Cleco" quick hose connections must be reserved for use on air and water service only. A part of the "Cleco" connector must not be left connected to a process line or equipment.
 14. Unmarked, or unlabeled, lines must not be used without approval of the owner. Service Lines commonly used must be identified on the valve end. In

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addition, all methane lines one inch and smaller must be identified on the valve end, and approval must be obtained before use.

15. "Boss-type" hammer union connectors must be used on steam hose service.
16. All power transmission couplings must be guarded unless the design or location is such that the chance of personal contact is extremely remote.
17. Employees must not ride a load that is being handled by a crane. The riding of crane slings is prohibited, except where a bosuns' chair is provided.
18. Vessels moved to the shops and salvage must be cleaned whenever practical, and tagged as to condition and previous contents before they can be moved from one location to another. See Safety Standard #1.

G. HOUSEKEEPING

1. Compressed air from a hose must not be used in an attempt to clean a work area nor should it be used to clean machinery or parts unless specific safe procedures are established to protect the user as well as others in the area.
2. Walkways and stairways must be kept clear of all tripping hazards such as material, tools, hoses, etc.,
3. Job sites must be kept orderly during the performance of the work. When a job is completed, the work area must be left in a neat and orderly condition.
4. It is the responsibility of each employee to help keep lunch rooms, change rooms, and toilet facilities orderly, clean and sanitary.
5. Empty soft drink bottles must be replaced in the racks provided.

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H. LADDERS AND SCAFFOLDS

1. The following rules are to be observed when using ladders:
 - (a) Make certain that ladders are in good condition and of proper length before using them.
 - (b) Face the ladder and keep both hands free for climbing.
 - (c) Where practical, grasp the ladder by the side-rails, rather than the rungs.
 - (d) Set straight ladders so that the bottom is out from the vertical about one-fourth of the distance from the upper support to the bottom.
 - (e) Employees must not stand on the top step of a stepladder.
2. All straight ladders must be made secure at the top or must be held at ground level while in use.
3. Makeshift scaffolds, such as boxes, crates, and drums must not be used.
4. The following rules are to be observed while working on or over transite roofs:
 - (a) Employees must not walk, drop or jump onto a transite roof.
 - (b) Where a permanent platform or walkway is not provided, a temporary walkway or spread-footing should be used to distribute the load over a large area of the transite.
5. Ladders must be provided on scaffolds, and cross braces are not to be used for climbing.
6. The following rules apply to rolling scaffolds:
 - (a) All caster brakes must be applied when scaffold is not in motion.
 - (b) Riding rolling scaffolds is prohibited.
7. Any scaffold of a height greater than three times the minimum base dimension must be guyed or tied off during use.

8. Do not attempt to use scaffolds as material hoists or for mounting derricks unless they have been designed for this purpose.
9. Platforms and scaffolds must be kept clear of tripping and slipping hazards.
10. Permanent ladders on towers or vessels are not to be blocked by scaffolding inserted through the cage.

I. DANGER TAGS

1. To insure that equipment is not operated while it is being worked on, Danger Tags are attached to the controls so that personnel will know not to use them. These tags must be used to protect personnel exposed to the hazards of the equipment involved and must be respected by all personnel. The personnel responsible for the operation of equipment must clear and tag the equipment; any personnel whose safety could be endangered while working on this equipment may affix their tag. Violation of Danger Tag Rules must result in disciplinary action up to and including discharge.
2. No control such as a valve, switch, clutch, etc., is to be operated by anyone while a Danger Tag is attached. If a control must be operated intermittently such as for testing equipment, the Danger Tag must be properly cleared and removed before each operation.
3. Whenever the operation or use of any equipment may endanger anyone, a request must be made to supervision of the group which operates the equipment to clear and tag the equipment. "Clearing" means making the equipment inoperable and safe for others to work on. The authority to clear and tag equipment may be delegated by this supervision to qualified personnel after supervision has assured themselves that the person delegated can clear the

particular job involved properly.

4. After the group which operates the equipment has cleared and tagged the equipment, each worker or group of workers who may be exposed to the hazards may tag the equipment for their protection.

When Danger Tags are attached to equipment by persons other than those responsible for its operation, prior approval from the person responsible shall be obtained.

5. As the individual jobs have been completed each worker or group of workers must remove their tags immediately.
6. The group responsible for the equipment must place their tag first and remove their tags last.
7. Danger Tags may be removed only upon authorization of the person designated on the tag. The supervisor of any person who fails to remove a Red "Danger" Tag when a job has been completed may authorize the removal of the tag after he has determined to his complete satisfaction that the equipment can be operated in a safe manner.
8. At the discretion of the supervisor, locks may be used on valves and switches in addition to, but not replacing, Danger Tags.

J. WARNING TAGS (green)

1. When it is necessary to convey instructions or information prior to operation of equipment controls, Green "Warning" Tags are to be attached to the controls.
2. Green "Warning" Tags should be removed when conditions set forth on the tag have been met.

K. SAFE WORK PERMITS

1. "Safe Work Permits" are designed to provide a convenient means of checking at the job site the safe-

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ty of such jobs as entering closed vessels, breaking into or repairing pipelines that have contained hazardous materials or pressures, work involving the use of flame or spark producing equipment in hazardous areas and work on machinery. These permits are to be requested and/or issued at the discretion of the supervision involved in any jobs where the "Safe Work Permit" is applicable. A Safe Work Permit must be re-issued for a job if there is evidence that conditions have changed subsequent to the issuance of the original Safe Work Permit.

L. ELECTRICAL

1. 32 Volt transformers are to be used in connection with drop lights when working inside metallic vessels. Exceptions to the above shall be considered when the use of 115 volts is required to accomplish the work. Special precautions shall be taken in grounding, handling, and inspecting electric cords, and permission shall be obtained from the supervisor before entering a vessel.

M. EXCAVATIONS AND FLOOR OPENINGS

1. Where a safety hazard would be created for the personnel involved, and/or others, excavations such as ditches, trenches, or bell holes, should be sloped sufficiently to prevent cave-ins or slides. If sloping is impractical, shoring must be used in cases whenever the vertical dimension exceeds four feet. All excavations must be barricaded by the persons performing the work.
2. All floor or trench openings where grating or floor plates have been removed must be barricaded or marked by suitable warning signs by the persons performing the work.

N. PRESSURE CYLINDERS & PRESSURE SAMPLE CONTAINERS

Each individual responsible for filling, handling, & storage of Pressure Cylinders & Pressure Sample Containers must be familiar and comply with the requirements of Safety Standard #9 Compressed Gas Cylinders and Pressure Sample Containers.

1. Hoses must be disconnected from welding and cutting torches before torches are stored in toolboxes or cabinets. Torches and hoses must be removed from vessels that have been vacated by personnel.
2. The supply of oxygen and fuel to torches that are left unattended must be shut off at the cylinder valves when a job has been completed and the regulators and hoses must be depressured.

O. GLASSWARE

1. All broken glassware must be repaired or discarded.
2. Do not heat glass bottles on a hot plate without precaution against breakage.
3. No pressure systems are to be used with glass without approval of personnel completely familiar with the possible hazards.
4. Hand protection is required when force is applied to glass, such as in inserting or removing glass tubing from stoppers or in breaking off at a file mark.
5. Broken glass should be removed by use of broom and dust pan and placed in dumpster box or suitably marked container. In no case place broken glass in waste baskets.
6. To prevent breakage in transit, all glass containers shall be properly crated or otherwise suitably packaged before being transported from the immediate area in which they are being used or stored.
7. All glass bottles with capacity on one gallon or

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more, containing toxic, corrosive or flammable materials, and all glass bottles larger than four liters, regardless of contents, shall be kept in crates or provided with other suitable means of protection to prevent breakage. If necessary, bottles may be removed from their protective devices to facilitate the safe filling of the bottles, or the safe removal of their contents.

P. RADIATION

Note: In locations where a radiation source is used or stored, regulations require that it be marked with a "Radiation Material" sign. This sign is for the purpose of informing anyone in the area that such material is present, and not that a safety hazard due to radiation exists.

1. Only personnel completely familiar with the possible hazard may enter an area marked by "Radiation Area" signs.
2. All areas where a radiation hazard exists must be marked conspicuously by standard signs at a safe distance from the source of radiation. These signs bear the radiation symbol of magenta (or purple) on a yellow background with the words "Caution - Radiation Area."
3. "Radiation Area" signs must be removed when a radiation hazard no longer exists in the affected area.

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R. TEXAS DIVISION SAFETY STANDARDS

1. Plant Shipping Tags
2. Pressure Gauge Mountings
3. Isolation Motor Circuits for Work on Motors & Motor driven Equipment.
4. Gas Cylinder-Type Pressure Regulators, Gauges & connections.
5. Railroad Derails and Blue Warning Flags
6. Grounding of Portable Electrically Operated Equipment and Tools
7. Electrical Bonding and Grounding
8. Procedure for the Disposal of Waste Materials in Drums and other Containers.
9. Compressed Gas Cylinders and Pressure Sample Containers
10. Acetone used in Laboratories.
11. Inspection of hand operated hoisting equipment.

INSULATION
FOR
PERSONNEL PROTECTION

PIPE AND FITTINGS

1. Insulation Material

1.1 Pipe

The insulation material for piping shall be one, or more, of the following, or Dow-approved equal:

- 1.1.1 "Hinged" type sectional fiber glass insulation, 3 foot or 6 foot lengths, suitable for continuous service at 350° F., such as:

Gustin-Bacon Snap-On,

Johns-Manville Micro-Lok, or

Carey Thermoglas;

} For Class
G-P only,
From 140° F.
to 350° F.

Note: Plain fiber glass pipe insulation, or insulation with factory applied jacket may be used. See Sections 4 and 5 for type of jacket required.

- 1.1.2 Mineral wool industrial pipe insulation, standard lengths, fabricated to fit pipe, such as:

Baldwin-Ehret-Hill #101 pipe insulation, or

Carey mineral wool industrial pipe insulation; or

} For Classes
C-P, D-P,
E-P, F-P,
and G-P.
From 140° F.
to 1000° F.

- 1.1.3 Insulating materials specified in Dow Standard 8-601, page 3, may be used.

1.2 Pipe Fittings and Valves

Note: The insulation shall be omitted from all valves and all flanges for Class G-P insulation.

The insulation material for pipe fittings and valves shall be the same material specified for piping or the material specified for vessels and equipment (See Dow Standard 8-647).

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2. Insulation Thickness

CLASS	Temperature of Pipe or Equipment	NOMINAL INSULATION THICKNESS																
		NOMINAL PIPE SIZE																Over 24" and Flat Surf
		1" and Under	1 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	2	3	4	5	6	8	10	12	14	16	18	20	24	
C-P	1000°F. to 800°F.			2"				2 $\frac{1}{2}$ "					3"					3"
D-P	800°F. to 700°F.			1 $\frac{1}{2}$ "									2"					2"
E-P	700°F. to 600°F.	1"						1 $\frac{1}{2}$ "							2"			2"
F-P	600°F. to 350°F.			1"									1 $\frac{1}{2}$ "					1 $\frac{1}{2}$ "
G-P	350°F. to 140°F.				3/4"									1"				1"

NOTES:

1. For temperatures 800°F. and over, insulation shall be applied in double-layer construction with staggered joints, or in single-layer construction with Dow-approved expansion joints.
2. For temperatures 350 to 800°F. (Class D-P, E-P, and F-P) insulation shall be applied in single-layer construction with Dow-approved expansion joints.

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3. Application

3.1 Pipe

3.1.1 Fiber Glass, Plain

All end joints shall be tightly butted and the single longitudinal seam shall be held together with copper clad outward clinch insulation staples, 4 staples per 3-foot section.

No bands are required except over asbestos felt jacket. See Section 5.

3.1.2 Fiber Glass with 6-ounce Canvas Jacket

Apply the same as plain fiber glass. Paste down all canvas laps with white adhesive such as Foster's Lagfas 81-42W, Airbol, or Dow-approved equal.

3.1.3 Fiber Glass with 55-pound Asbestos Jacket, White Exterior

Apply the same as plain fiber glass. Seal asbestos laps with asphalt seam sealer.

Apply bands over the asbestos jacket as specified in Section 5.

3.1.4 Mineral Wool

Butt end joints. Secure longitudinal seams with lead wires furnished with the insulation, or with 16 gage 302 or 304 stainless steel wires on 9" centers.

3.2 Fittings, Valves, and Flanges

3.2.1 The insulation shall be stopped short of all flanges and valves on Class G-P insulation. The ends of the insulation shall be beveled to permit removal of the flange bolts. Flanges and valves with insulation hotter than Class G-P shall be insulated.

3.2.2 The insulation for fittings and the body of valves (when insulated) on pipe 2" and smaller shall consist of a built-up layer of insulating cement or other material suitable for the temperatures involved. Total thickness of insulation to equal that on adjoining pipe.

3.2.3 Fittings on piping 2 1/2" and larger and the bodies of the flanged valves (when insulated) shall be insulated with blanket or sectional insulation to a thickness equal to that on adjacent piping.

3.2.4 Flanges (when insulated) shall be covered with sectional pipe or blanket insulation to a thickness equal to that of the insulation on the adjacent piping.

3.2.5 The insulation on the body of 2 1/2" and larger fittings and valves and on all flanges shall be securely wired or banded in

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place. On flanges, the insulation shall be of such length as to extend not less than 2" or a distance equal to the insulation thickness, whichever is greater, over the adjacent pipe insulation on each side of the flange. The total thickness of the insulation shall be equal to that on the adjacent piping.

3.3 Bends

- 3.3.1 Bends shall be covered by mitering sectional insulation, or by using blanket insulation.

4. Finish Indoor

4.1 Pipe

- 4.1.1 The finish for pipes indoors in all areas, except in production plants, shall be 6-ounce white canvas lapped at least 2" at all joints and pasted over the insulation with white adhesive such as Foster's Lagfas 81-42W, Airbol, or Dow-approved equal. After the canvas is in place, apply a full coat of white adhesive.

Pipe furnished with 6-ounce canvas jacket will require sealing of the seams (See Section 3.1.2), followed by one full coat of white adhesive, Foster's 81-42W, Airbol, or Dow-approved equal.

4.2 Fittings, Valves, Flanges, and Bends

- 4.2.1 These items shall be finished with a two-coat application of a white PVA resin emulsion; such as Foster's 31-99 Sealfas Mastic or Dow-approved equal; reinforced with a layer of open-weave glass cloth. Lap all edges at least 2". All voids and pinholes must be covered, leaving a smooth, neat finish.

5. Finish Outdoor

5.1 Pipe

- 5.1.1 All piping outdoor, or otherwise exposed to the weather, shall be finished with a waterproof jacket of asbestos roofing felt, white one side, tightly wrapped on, with a cold seal of adhesive applied evenly over the entire surface of all lap joints. The weight of asbestos felt shall be 50 to 55 pounds/100 square foot. All joints shall be lapped as follows:

Insulated Outside Diameter	Minimum Joint Lap
Less than 8"	2"
8" and larger	3"

On horizontal pipes, the seams of the waterproof jacket shall be placed at the side of the pipe with the lap turned down in order to shed water.

Secure waterproof jackets with 302 or 304 stainless steel bands spaced a maximum of 10" from center to center of bands, with one

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band not more than 3" from the end of each jacket. Bands shall be 3/8" wide by .015" thick for all sizes of pipe.

5.2 Fittings, Valves, Flanges and Bends

5.2.1 Finish the same as indoor. See Section 4.2.

6. References

6.1 Dow Standards:

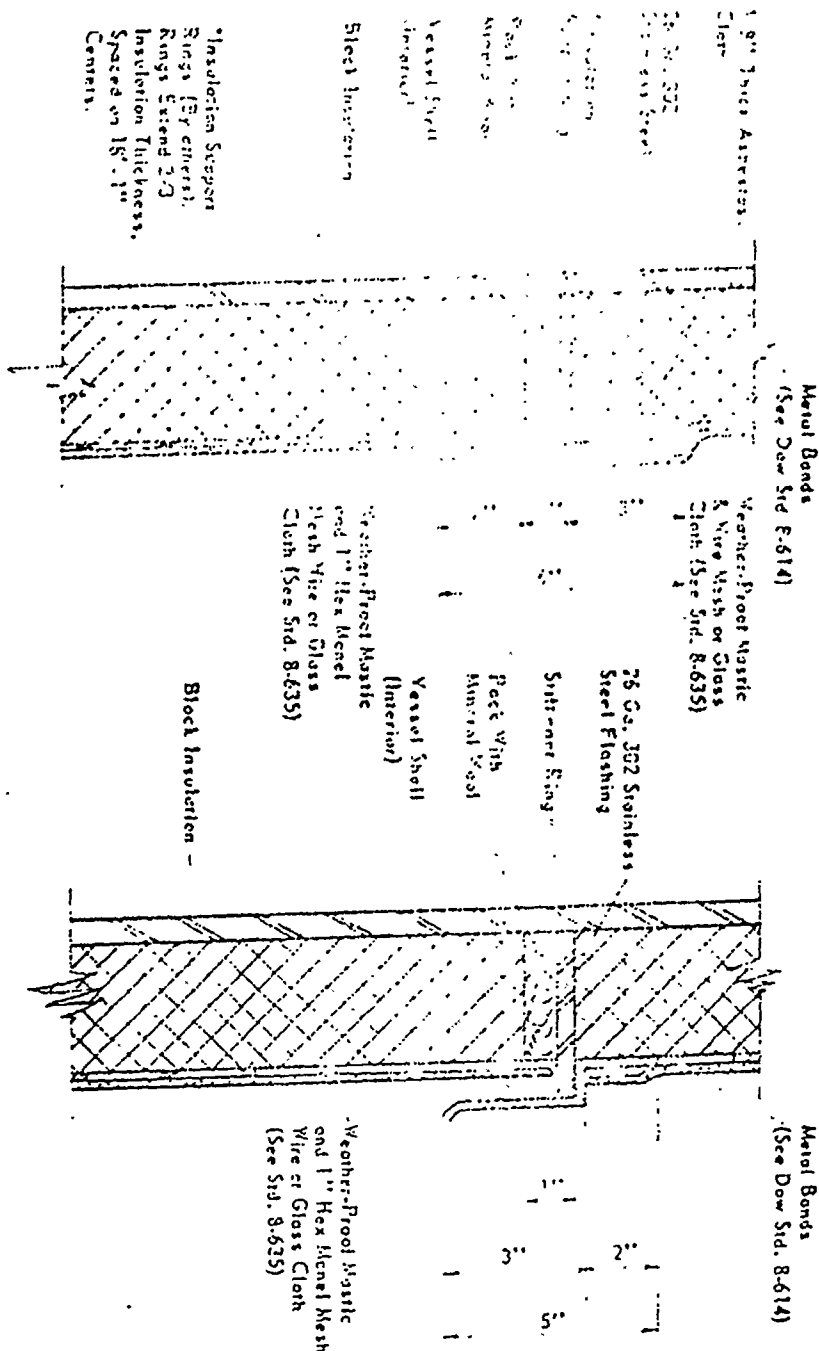
<u>Standard No.</u>	<u>Title</u>
8-647	Insulation of Personnel Protection - Vessels and Equipment.

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INSULATION SPEC. 8-672 REV. A
Dated 3-11-63 Page 1 of 1

EXPANSION JOINT AT INSULATION
SUPPORT RING

EXPANSION JOINT AT
STIFFENER RING
(WIDER THAN INSULATION THICKNESS)



R. C. Middleton

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10/26/64

The question concerning asbestosis had to do with sawing Transite. Although the dust from such an operation will probably contain respirable particles of asbestos it is highly unlikely that enough exposure would exist in the use of Transite to represent a real hazard.

It was explained to the men that in using the epoxy resins it is necessary that contact with the skin does not occur. We explained that the seriousness of the rash stems from the fact that exposures which appear to be acceptable can result in sensitization and that once a person is sensitized he can no longer work with the epoxies.

We explained that the plant air was free of carbon monoxide and mercury and explained our plan for checking the air for oil mist and other particulate material. There was some discussion concerning the use of an oil trap in the air line. The equipment used in Midland was shown.

The men reported that those who had been involved in sand blasting equipment in the Catalyst Plant had been plagued with rashes which they associated with nickel salts. We stated that there is such a thing as dermatitis due to nickel and that surely the appearance of rashes associated with such contact indicated the need for keeping the material off the skin and for removing it if any contact should occur.

I hope you will forgive the tardiness of this report. My only excuse is that entirely too many demands have been placed on my time since last I saw you.

Best personal regards,

H. R. Hoyle / reh

H. R. Hoyle
Biochemical Research Laboratory
1701 Building

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Biochemical Research Laboratory

The Dow Chemical Company

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EXPOSURE TO FINE DUSTS ENCOUNTERED
BY WORKERS CUTTING VARIOUS TYPES OF
PIPE COVERING MATERIAL

File: T2.1-3-1
Date: July 21, 1965
By: E. J. Schneider

Signed E. J. Schneider Date 7/22/65

Checked H. R. Hoyle Date 7-22-65

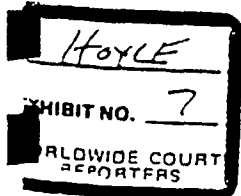
DOW CONFIDENTIAL PROBLEM

A question was raised by shop personnel after reading an article of the health hazards associated with exposure to asbestos. Is there a health hazard from asbestos in cutting various types of pipe covering material used at Dow Corning? The Environmental Research Laboratory was asked to evaluate the exposures to the fine dusts encountered by workers cutting the pipe covering material and to determine the possible health hazard.

CONCLUSIONS

1. Concentrations of total dust in excess of acceptable levels can be encountered by workers cutting pipe covering material both by hand and in using a table saw.
2. A total dust count or the number of particles per million cubic feet of air also exceeds acceptable levels at times.
3. The amount of asbestos fibers of significant length found within the dust exceeds 25 per cent of the fiber content,

DAK 01161



however, fibers constitute only 10 per cent of the total dust. The possibility that Dow Corning workers are being exposed to excessive amounts of asbestos fibers within the important fiber lengths (20-50 microns) is unlikely, however, it is advisable and prudent to have workers wear respiratory protection while cutting pipe covering material. This is especially true when using a table saw.

4. No one type of pipe covering material was found to have a significantly greater amount of asbestos fibers than the others. The Phillip Carey FiberCel material does produce considerable more fine dust than the others when cut.

ASBESTOS

In reviewing the literature⁽¹⁾ it is learned that the most common form of asbestos is known as chrysotile, a hydrous magnesium silicate containing from 12.5 to 14 per cent water of crystallization. There is another form of asbestos derived from amphibole which occurs as a variety of minerals consisting of iron, calcium and magnesium silicates with little water of constitution. This latter type of asbestos consists of shorter fibers but is more stable chemically than chrysotile and more resistant to acids and heat.

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⁽¹⁾ Industrial Toxicology - L. T. Fairhall, pp. 19-21, 1957.

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It is this latter type of asbestos which is thought to be used in the various pipe covering material tested because x-ray diffraction analysis of the materials showed them to contain tobermorite, a calcium silicate form of asbestos.

The inhalation of asbestos dust produces a condition known as asbestosis. Asbestos is the only silicate apart from talc and mica which does not contain free silica and yet produces pulmonary lung fibrotic changes. The fibrogenic action differs from silica in that the effects are produced only by long asbestos fibers. Very short fibers appear to have little or no effect. The long fibers apparently block the finer bronchioles of the lungs and produce fibrotic changes as a result of irritation.

The literature⁽¹⁾ states that in the case of asbestosis unlike silicosis fibrosis does not progress indefinitely after cessation of exposure. It further states that in order to produce asbestosis in workers exposures must be in excess of 5 millions particles per cubic foot for extended periods (greater than 10 years) and the fibers in the range of 10-250 μ in length. Some authorities⁽²⁾ indicated that only those asbestos fibers in the 20-50 μ range are significant for producing asbestosis.

The present Industrial Hygiene Standards state that for control the number of particles of asbestos dust be kept below

⁽²⁾ Industrial Hygiene and Toxicology - Frank A. Patty, Vol. 2, pp. 398-399, 1958.

5 mpcf and that for nuisance dusts of any type the number of particles must be below 50 mpcf or 15 mgs total dust per cubic foot of air.

PRESENTATION OF DATA

Early in 1965 a visit was made to Dow Corning to make measurements on the dust exposures encountered by workers cutting pipe covering material. In a small room (approximately 10' x 15') adjacent to the carpenter shop building 409 a worker was asked to hand saw several pieces of the various types of pipe covering material used at Dow Corning. Air samples were collected in his breathing zone while sawing the materials. Analyses were made for both total dust and the number of particles of dust in the contaminated air.

In another small room (approximately 8' x 8') part of the pipe shop building 316 tests were repeated for two different pipe covering materials while a worker used a table saw to cut the materials.

At both locations only general ventilation was used with no local exhaust system for dust collection.

The air samples collected for total dust load were later sent to Dow Laboratories for x-ray diffraction analysis and then microscopic evaluation.

Table 1 shows a summary of the results obtained for the air samples by the various analytical techniques.

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Table 1

EXPOSURE TO FINE DUSTS ENCOUNTERED BY WORKERS CUTTING VARIOUS TYPES OF PIPE COVERING MATERIALS

Industrial: Wytheville Standard, Nulstrand Dusts . . . 15 mg/m³
 Industrial: Wytheville Standard, Asbestos Fibers . . . 5 M.P.C.P.

Material	Total Dust Exposure -g/m ³	X-ray Diffraction Analysis	Electron Microscope Analysis		Fibers (No. of Total Fibers)	
			Particle Size	Fiber Size	Fiber Size	Fiber Size
Cutting zone of wooden band on the 1" x 1" flat block 2" thick at 12" curved block 2" thick	0.45	3.2 3.4 4.3 4.6 12.0 Avg. 14.5	35% 95% 45% 95%	<10 μ <20 μ <10 μ <20 μ	15 55 155 155	<10 μ <20 μ <10 μ <20 μ
	0.03					
Cutting zone of wooden band on the 1" x 1" flat block 2" thick at 12" curved block 2" thick	3.50	17.3 22.2 Avg. 19.3	45% 90%	<10 μ <20 μ	15 55 155 155	<10 μ <20 μ <10 μ <20 μ
	17.90					
Cutting zone of wooden band on the 1" x 1" flat block 2" thick at 12" curved block 2" thick	7.20	11.0	55% 95%	<10 μ <20 μ	15 55 155 155	<10 μ <20 μ <10 μ <20 μ
	0.02					
Cutting zone of wooden band on the 1" x 1" flat block 2" thick at 12" curved block 2" thick	77.90	--	45% 95%	<10 μ <20 μ	15 55 155 155	<10 μ <20 μ <10 μ <20 μ
	53.90	53.5	55% 95%	<10 μ <20 μ	15 55 155 155	<10 μ <20 μ <10 μ <20 μ

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The total dust exposure is not excessive in hand sawing most of the types of pipe covering material, however, sawing the Phillip Carey FiberCel® material does produce a very fine dust and does produce excessive concentrations of dust.

The use of the table saw as would be expected produces very large quantities of dust even for a not too dusty material such as the Baldwin Enret Hill Unibestos®.

The dust count in millions of particles per cubic foot did exceed in all cases the 5 mpcf Industrial Hygiene Standard for asbestos. However, because asbestos fibers represent approximately 10% of the total dust and because only approximately 25% of the fibers are considered of significant size, it is doubtful that workers encounter a health hazard in their normal work load of cutting pipe covering material.

The practice of using a table saw either within a shop building or out in the field should not be continued without adequate control of the dust or the use of respiratory devices. It also seems advisable to encourage workers to wear respiratory protection when hand sawing material. Any Bureau of Standards approved dust respirator should prove adequate to filter out the asbestos fibers.

ST0000573

UNIT INDEX

Measurements were made of the dust exposures encountered by workers cutting pipe covering material, Pipe Shop Department, Dow Corning Corporation, Midland, Michigan. Concentrations of total dust in excess of acceptable levels can be produced both in hand sawing and in the use of a table saw. The amount of asbestos fibers found did not constitute a health hazard. Respiratory protection is recommended to be worn when cutting pipe covering material.

DISTRIBUTION

Jack Quinn, Safety Department, Dow Corning Corporation (4)
H. H. Gay, M.D., Medical Department, 607 Building
A. W. Wilson, Safety Department, 401 Building
P. C. Middleton, Safety Department, Ludington Division
W. Snodgrass, Maint. Service Admin., 49 Building (7/9/71)

SI0000574

PHOTOMICROGRAPHY

ALS 57-045

Photomicrographs were prepared employing Bright field x

Phase Contrast Oblique Transmitted Light

Dark field Polarized Light Oblique Reflected Light technique

to show particles and fibers

Label Data for 8 x 10 prints x
 contact prints

<u>Negative #</u>	<u>Sample</u>	<u>Microscopy</u>	<u>Magnif</u>
L5-525	Latex Filter # 2	B. F.	300X
L5-526	Latex Filter # 8	B. F.	300X

THE DOW CHEMICAL COMPANY
CHEMICAL PHYSICS RESEARCH LABORATORY

REPORT NUMBER 168499

TO

E. J. Schneider

DEPARTMENT

Biochem Res. Lab.

FILE NUMBER

1701

SUBJECT

X-ray Diffraction Analysis of dust samples from cutting pipe
covering at Dow Corning

CHARGE NO.

1219-26

DATE RECEIVED

2-2-65

SIGNED

H. W. Rinn

DATE

2-11-65

- #1 (.0001 g) Tobermorite - $\text{XCao} \cdot \text{SiO}_2 \cdot \text{yH}_2\text{O}$ where x varies between 0.8 and 1.5 and y between 0.5 and 2.0
- #2 (>.0001 g) Same as #1
- #3 (.0004 g) Same as #1
- #4 (.0020 g) Same as #1
- #5 (.0008 g) This sample gave a very weak pattern of hydromagnesite - $3\text{MgCO}_3 \cdot \text{MgOH} \cdot 3\text{H}_2\text{O}$. There could be amorphous material present.
- #6 (<.0001 g) Tobermorite and some calcite. Pattern quite weak, probably because of small sample.
- #7 (.0052 g) Mainly tobermorite with 10-20% Calcite - CaCO_3 .
- #8 (.0036 g) Mainly tobermorite with 5-10% calcite.

No quartz was detected in any of the samples.

Note on appearance of tobermorite - from Crystallographic Data for the Calcium Silicates by Heller and Taylor.

Natural mineral from Ballycraigy: minute, radiating aggregates of fibers with distinctive silky lustre on the cleavage faces.

Natural mineral from Mull or Skye: fine geared aggregates of minute, birefringent crystals.

Synthetic material: minute irregular crystals, birefringent.

HWR:abj

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3

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PREFACE TO INSULATION STANDARD SPECIFICATIONS
Revised October 4, 1965

A. COLD INSULATION

Cold insulation in the standard specifications is designed for nonsweating when the ambient temperature is 90° F, the relative humidity is 85% and the wind velocity is 0 mph. The dew point under these conditions is 85° F. The heat gain under the same conditions ranges from 4.6 to 7 Btu per hour per square foot of insulation. Maximum heat gain for flat surfaces and cylindrical vessels under the above conditions is 7 Btu per hour per square foot.

The year round average heat gain in the Gulf Coast area is less than that given above because the average temperature is less than 90° F. It is even less further north.

An additional insulation thickness of 50% only reduces the maximum heat gain, under the above conditions, to around 4.7 Btu per hour per square foot, or to 41,172 Btu per square foot per year.

If 25% less insulation is used than is specified in the standards, the maximum additional heat gain, under the above conditions, is approximately 2.3 Btu per hour per square foot, or 20,148 Btu per square foot per year.

For critical process temperatures, insulation thicknesses greater than those specified in the standards may be required.

For noncritical temperatures and where surface sweating is not objectionable, thinner insulation may be used. In some cases, insulation may be eliminated.

Vapor Barrier (Essential for All Cold Insulation)

Definitions:

Vapor Barrier. A vapor barrier is a material having a high resistance to the passage of water vapor. It should have a perm rating of not more than 0.1 perms for the thickness used.

Perm. A perm-inch or one perm equals one grain of water vapor per hour per square foot per 1" thickness (except where noted otherwise) per 1" difference in mercury vapor pressure.

A vapor barrier should be used on all cold insulation that allows migration of water vapor. This includes Styrofoam and Thurane which have perm ratings of 1 to 2 perm-inch, and 2.5 perm-inch respectively.

Why Vapor Barrier is Necessary:

Water vapor acts like a gas. It can pass through any substance that is not impermeable. The force that drives it through insulating material is the difference in vapor pressure between the warm side and the cold side of the insulation.

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Water vapor will always flow from a higher partial pressure area to a lower partial pressure area--never the reverse. The vapor pressure is a function of temperature--the higher the temperature, the higher the vapor pressure. (See Vapor Pressure Table, Page 3.) The insulated "cold" surface normally has a lower temperature than ambient; therefore, the partial vapor pressure gradient decreases from the outside of the insulation inward to the cold surface, which causes the flow of water vapor in this same direction. As the vapor flows toward the "cold" surface, the dew point is reached and the vapor becomes liquid. On insulated items that operate below the freezing point of water, this condensed water freezes as it proceeds toward the "cold" surface.

What Harm Does the Water Vapor Do?

1. It radically lowers the insulating property of the insulation. For example:

Thurane has a K value of .17 Btu per hour per square foot per °F per 1" thickness;

Water has a K value of 4.2, or 24.7 times that of Thurane, and

Ice has a K value of 15.6, or 91.8 times that of Thurane.

(K values are for a mean temperature of 70° F, except for ice, the mean temperature is 32° F.)

As the water vapor enters and condenses, it lowers the insulating quality of the insulation, which tends to accelerate the entrance of additional water vapor due to the lower partial pressure caused by the lower surface temperature of the insulation. Under these conditions, the surface temperature falls and remains below the dew point, which causes water to condense on the surface.

2. On insulated surfaces above the freezing point, corrosion is accelerated by the condensed water on the metal surface.
3. On insulated surfaces below the freezing point, the water freezes, as previously mentioned. The ice tends to crack the insulation, destroying the value of same.

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WATER VAPOR PRESSURE TABLE
(In Inches of Mercury)
(1" Hg = Approximately 1/2 psi)

Temp. - °F	Pressure (Saturated)
-160	0.1009 (10^{-6})
-150	0.3301 (10^{-6})
-100	4.666 (10^{-5})
- 75	3.441 (10^{-4})
0	3.7645 (10^{-2})
+ 70	0.73915 at 80% RH = 0.59132
+ 90	1.4219 at 80% RH = 1.1375
+100	1.9326
+120	3.446
+140	5.881
+160	9.653

Example:

Find amount of water vapor that will permeate 2" of Thurene (Class L) without a vapor barrier in one year with an average ambient temperature of 70° F and 80% relative humidity.

Vapor pressure at 70° F and 80% RH = 0.59132 (see table)

Vapor pressure at 0° F and 100% RH = 0.03765

Vapor pressure difference = 0.55367 inches of mercury

Water vapor transmitted per year through one square foot of surface =

$$\frac{2.5 \text{ grains by } 8,760 \text{ hrs. by } 0.55367" \text{ Hg}}{2"} = 6,063 \text{ grains/sq.ft./yr. or } 0.866 \text{ lbs/sq.ft./yr.}$$

This is equivalent to a layer of water or ice almost 3/16" thick.

Note: These calculations were based on a straight line function of water vapor transmission. Actually the transmission rate will vary with the temperature and the relative humidity, and will tend to increase as the insulation deteriorates.

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Vapor barriers used in the insulation standard specifications, such as cutback asphalt (Foster's 60-25) and Foster's 65X07 Safetee CI Mastic, have perm ratings of 0.02 for the thickness specified in the standards. With this type vapor barrier used in the above example, the water vapor transmission rate per year would be reduced to only 0.0138 pounds, or less than 3 mils (0.003"). Breathing type weatherproofing materials such as PVA emulsions (Foster's 30-76 or 31-99) and asphalt emulsions are not vapor barriers. Their perm ratings range from 1 to 3. In other words, they are from 10 to 150 times more permeable than good vapor barriers. Breathing type materials like these are necessary, however, on hot insulation.

Note: The vapor barrier described for Thurane FR (Dow Polyurethane) is black. Cold insulation is painted white to retard heat gain. For color coating, refer to Specification 57-211.

A white material, Benjamin Foster's Safetee Monolar Mastic 60X20 (Hypalon) is an alternate vapor barrier in Specifications 56-626 and 56-641. This material has a perm rating of .05 for a dry thickness of 22 mils. It has a flash point of 120° F when wet. When dry, it is fire-resistant.

See Note 1, Page 5, regarding use of aluminum jackets on insulation.

B. HOT INSULATION

Conventional hot insulation may be applied over bare steel surfaces provided that the temperature of the steel is such that moisture will be driven off, keeping the steel dry.

Where possible, hot insulation should not be used on steel pipe that is normally cold due to infrequent use, such as steam snuffer lines.

Hot insulation in the standard specifications is designed for a maximum exterior surface temperature of approximately 150° F with an ambient temperature of 80° F.

Approximate heat loss through hot insulation with an ambient temperature of 70° F and a wind velocity of 0 mph is shown in the table below:

Class and Temperature	Loss, Btu per Sq. Ft./Hr.	Loss, Btu per Sq. Ft./Yr.
C 1,000° F	150	1,314,000
D 800° F	108	946,000
D 800° F	156	1,367,000
D 700° F	130	1,139,000
E 700° F	130	1,139,000
E 600° F	104	911,000
F 600° F	134	1,174,000
F 400° F	86	753,000
G 400° F	108	946,000
G 200° F	38.2	335,000

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For critical process temperatures, more or less insulation may be used than that specified in the standards, except where personnel have ready access, less insulation should not be used unless guards or other protective means are used to prevent possible burns.

In areas where the insulation will likely be frequently removed, Unibestos or Thermobestos should be used.

Note 1 - Aluminum Surfaces

Do not apply conventional hot insulation over bare aluminum surfaces. The alkalis in the insulation will react with the aluminum and deteriorate the same. If surface is too hot for a barrier coat of mastic, insulate with rock wool.

Where aluminum jackets are used over hot insulation, it is essential that a moisture barrier is used (cemented to the aluminum jacket) to protect the jacket from the insulation.

Do not use aluminum jackets on cold or hot insulation in corrosive areas, such as where subject to fumes or spills of acids, alkalis, brines, acid or alkaline salts, or halides, to name but a few corrosives. The aluminum jackets should not be used in any areas other than those of low corrosion; that is, where the corrosion rate is *50 mdd or less.

Note 2 - Stainless Steel Surfaces

All 300 series stainless steels are subject to stress corrosion cracking caused by chlorides. (The 400 series stainless steels are immune from this phenomenon.)

All commercially available inorganic insulation contains sufficient leachable chlorides to cause cracking (according to published information on the subject).

Moisture from rain, leaky valves, etc., penetrates the insulation causing a chloride buildup on the hot stainless steel surface.

Failures are most common at 100° C (212° F) and probably will not occur above 170° C (338° F). This then would be in the lower ranges of Class "G" only. The most effective preventive would be to take great care to see that all 300 series stainless steel insulation is kept dry. Chloride leaching cannot take place without moisture. Extra care here could extend the life of an expensive stainless steel line or vessel.

As an additional precaution, in case moisture does get through the insulation, all 300 series stainless steel surfaces (pipes and vessels) in the above critical temperature range that are to be insulated should be cleaned and painted before being insulated as follows on the next page.

* Milligrams per decimeter square per day.

ST0402987



All mill scale should be removed, preferably by light sandblasting as per Specification 57-204, Page 7.

Apply one or more coats of Silicone Coating Thur-Ma-Lox 70 (Houston distributor: Stockdale, Incorporated, 1525 North Post Oak Road, Houston, Texas, 77024), or owner-approved equal to obtain a minimum total dry film thickness of 2.5 mils.

The first coat should be brushed. Subsequent coats may be brushed or sprayed.

When Foamglas insulation is to be used, coat the interior surfaces of the insulation with one coat of the silicone coating.

Clear Epoxy Coating 57-225, minimum dry film thickness 4 mils, may be used in lieu of the silicone coating provided the operating temperature is not above 300° F.

Eighty-five percent magnesia insulation should not be used on 300 series stainless steel except as the outer layer on double-layer insulation.

C. FIBER GLASS - MINERAL WOOL INSULATION

Specifications 56-627 and 56-647, Classes C-P, D-P, E-P, F-P, and G-P.

Fiber glass and mineral wool insulations are cheaper than standard hot insulation and are designed primarily for personnel protection rather than heat conservation. Where excessive abuse of insulation is likely, fiber glass and mineral wool should not be used. In such cases, use standard hot insulation.

Personnel protection insulation shall normally be installed on all pipe and equipment (except obvious items, such as furnace doors, etc.) whose operating temperatures are above 150° F and where insulation for heat conservation is not required. Such items shall normally be insulated from floor or walkway level up to 7' above the floor or walkway, and for a lateral distance of 3' (on all sides) from the floor or walkway. Protective insulation should be used only where needed. For example, in some areas condensate lines may be stenciled "Caution - Hot" and left uninsulated.

Fiber glass or mineral wool insulation should be used where temporary insulation is desired. These materials should also normally be used for heat traced lines and equipment.

D. ANTISWEAT INSULATION, SPECIFICATION 56-628

This insulation should be used in lieu of standard cold insulation where Class H, J, or Z is indicated in laboratories, mechanical rooms of office buildings, and similar locations. It is cheaper than standard cold insulation.

This insulation should not be exposed to the weather unless a weather-resistant vapor barrier is used.

ST0402988



E. INSULATING MATERIALS FOR ETHYLENE AND PROPYLENE OXIDE AREAS (GLYCOL PLANTS)

Certain inorganic high temperature insulations serve as catalysts to cause spontaneous reaction of these oxides with air.

Only materials that have been checked and approved by the Glycol Laboratory should be used in these areas.

The following materials have been approved:

Hot Insulation - Calsilite 1250	Cold Insulation - Thurane FR
Carey-Temp	Foamglas
Limpet	Perlite
Caltemp	
Unibestos	

F. EXTREMELY COLD (CRYOGENIC) INSULATION

A special study should be made for each installation where operating temperatures are minus 150° F or colder.

In some instances, double-wall vessels with perlite (expanded silica) between the walls might be more economical than our standard cold insulation. Conventional sealers will not perform at these temperatures. Even rubber becomes brittle as glass.

Perlite has a very good "K" factor. It is incombustible and performs from minus 400° F to plus 1,400° F.

CB&I, as well as others, has had considerable experience in designing vessels for perlite insulation.

G. RELATIVE COST OF INSULATION

All insulation is expensive and should therefore be used only where required for heat conservation, personnel protection, or to prevent freezing.

Insulation should not be walked on. This destroys the insulating quality of the material. Where walkways are not provided for necessary foot traffic, 1/2 pipe sections (transite or steel) should be placed on top of the insulation and banded to protect same.

Antisweat insulation (Specification 56-628) costs approximately 65% as much as our standard cold insulation.

The applied cost of Thurane and Styrofoam is approximately the same for a given size and class.

Fiber glass - mineral wool insulation (Specifications 56-627 and 56-647) cost approximately 65% as much as our standard hot insulation.

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Costs will vary depending on the size of the job, the accessibility of the work, etc. As an example, Class F insulation costs approximately \$4.40 per linear foot of 12" pipe. A 12" flanged valve, Class F, costs approximately \$22.

Class H insulation (Thurane 1" or Styrofoam 1-1/2") costs approximately \$7.85 per linear foot of 12" pipe; \$39.25 for a 12" flanged valve.

Monel bands cost almost three times as much as stainless steel bands, but Monel hex mesh is cheaper than stainless steel mesh, due to demand.

H. APPENDIX

To find heat loss or heat gain:

$$1. \quad Q = \frac{t_1 - t_3}{x/k + 1/f} = \text{heat loss in Btu per square foot per hour}$$

t_1 = hot side temperature (or cold side in the case of cold insulation)

t_2 = temperature of exterior surface of insulation

t_3 = ambient temperature

x = insulation thickness in inches

k = "k" factor at mean temperature

f = surface resistance, usually approximately 2 in the air

Where $t_1 = 400^\circ \text{ F}$; $t_3 = 70^\circ \text{ F}$; $x = 1"$; $k = .39$ --

$$\text{We have } Q = \frac{400 - 70}{1/.39 + .5} = 108 \text{ Btu per square foot per hour}$$

To find insulation surface temperature:

$$2. \quad t_2 = Q/2 + t_3 = 108/2 + 70 = 124^\circ \text{ F}$$

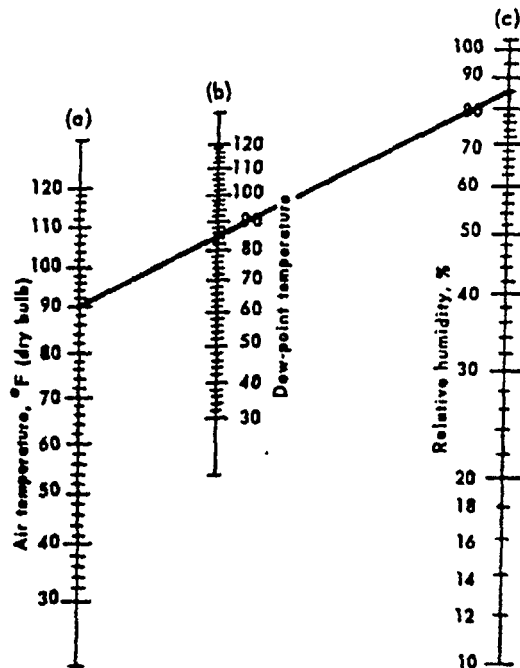
3. On cold insulation, when maximum desired heat gain is known, say 7 Btu per hour per square foot at 90° F ambient temperature, Equation 1 reduces to:

$$x = \frac{k}{7} \left[(t_1 - 90) - 3.5 \right] \text{ inches. By inserting the } k \text{ factor and } t_1 \text{ for various temperatures, the thickness } x \text{ is readily obtained.}$$

Notes

- Equation 1 is for flat surfaces. For pipes and circular equipment, use equivalent thicknesses $x_e = r_2 \log_e r_2/r_1$. Where r_1 and r_2 equal respectively interior and exterior radius of insulation.
- Surface temperature and total heat loss will depend on the emissivity (or radiation) of the outer insulation surface.

ST0402990



Nomograph to find dew point for given ambient
(dry bulb) temperature for a given relative
humidity.

To use nomograph, place a straightedge across the three vertical lines, so that it crosses Line A at the given air temperature and Line C at the known relative humidity; then read the dew point temperature on Line B. Two properties must be known to find the third unknown property on the nomograph.

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OFFICE COPY

Biochemical Research Laboratory

The Dow Chemical Company

1070

A SURVEY AND EVALUATION OF PIPE
COVERERS' EXPOSURES TO DUSTS FROM
ASBESTOS CONTAINING INSULATION
MATERIALS ENCOUNTERED DURING
ROUTINE PIPE COVERING OPERATIONS
WITHIN THE MIDLAND LOCATION OF
THE DOW CHEMICAL COMPANY

File: T2.1-1-64
Date: March 21, 1969
By: R. A. DeGesero

Signed Ray A. De Gesero Date March 24 1969
Checked A R Hogle Date March 24, 1969

PROBLEM

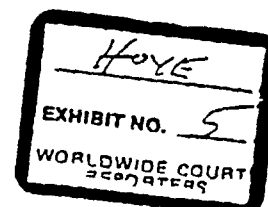
Supervision requested that the Environmental Research Laboratory survey and evaluate current levels of pipe coverer's exposures to dusts from asbestos-containing insulation materials commonly used within the Midland location.

CONCLUSIONS

1. The present Threshold Limit Value (TLV) for asbestos of 5 mppcf will remain in force until 1971. Barring information to the contrary, the TLV will then be lowered to 2 mppcf (million particles per cubic foot).
2. Men are encountering time-weighted exposures to dusts from insulation materials containing asbestos approaching but not exceeding the present TLV of 5 mppcf.

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3. Men are encountering time-weighted exposures to dusts from insulation materials containing asbestos exceeding the proposed TLV of 2 mppcf.
4. If exposures are to be reduced to within tentatively accepted levels (2 mppcf) either the use of asbestos-containing insulation materials must cease, or pipe coverers must be protected through effective use of approved respiratory devices and/or local ventilation.

RECOMMENDATIONS

1. Pipe coverers should be educated to the true hazards associated with the several types of insulating materials they presently use.
2. Pipe coverers should be made aware of the several ways of protecting themselves during unavoidable, potential exposures to dusts containing substances known to be highly toxic, such as asbestos.
3. In the future, pipe coverers should be educated to the true hazards associated with any new types of insulation materials to be used, prior to use.

PRESENTATION OF DATA

Indoor pipe covering operations were surveyed from 12/24/68 to 1/22/69. Outdoor pipe covering operations were surveyed from 2/20/69 to 3/5/69. Air samples to account for "miscellaneous" portions of the pipe covering functions were obtained from 3/1/69 to 3/5/69.

Sampling and Analysis

A total of 141 breathing zone samples were collected in midget impingers and analyzed employing standard light field microscopy techniques for determining dust concentrations from insulating materials containing asbestos. Concentrations found in samples were expressed in terms of millions of particles per cubic foot of air (mppcf), according to the following formula.¹

$$\text{mppcf} = \frac{(\text{mean particles/quarter field}) \times 4 \times 1000 \times \text{sample volume}}{\frac{\text{liters}}{\text{min.}} (\text{pump flow}) \times \text{minutes} \times 3.51 \times 10^{-2} \frac{\text{ft}^3}{\text{liter}}}$$

¹Patty, F. A., INDUSTRIAL HYGIENE AND TOXICOLOGY, Vol. I. Second Revised Edition, p. 198.

The means and ranges of concentrations found during sampling are listed in Table 1.

Job Analysis and Description

An environmental job analysis provides an estimate of the frequency and duration of men's exposures to dust concentrations surveyed. The job analysis expresses as per cent of the day (% day) the probable time distribution of pipe covering operations, averaged over several months. On any given day the pipe coverer's routines can be expected to vary from the estimate.

The job analysis reconciled input from discussions with pipe coverers and supervision, observations during sampling, estimates provided by an industrial engineering time study, and a questionnaire filled out by the pipe coverers. A sample questionnaire is found on page 1 of the Appendix.

The questionnaire requested that men estimate the per cent of time per day they spent working with the most common insulating materials. Men's averages were converted into ratios of time spent (% day) per operation and material, and are listed in Table 1.

Thirty-two per cent (26 men) of the Midland coverers responded. Responses concerning rarely used materials (e.g., cork, styrofoam, some putty adhesives, etc.) were set aside. Other information furnished by the coverers included:

Average age: 40 years
 Years covering within Dow: 18
 Years covering outside Dow: 0
 Wear respirator? Yes: 17 men; No: 9 men
 Which material(s) are the dustiest?
 Kaylo: 16 men
 Fiberglas: 14 men
 High temp.: 11 men
 Superpower: 6 men
 Mag oxide: 2 men
 Aircell: 2 men

Time-Weighting Exposures

Men's exposures to dusts from asbestos-containing insulation materials were estimated by "time-weighting." The exposure frequency and duration (% day) to each material is multiplied by the mean concentration in air of each material, giving a set of "time-weighted factors." The "factors" (product of % day x mean concentration) are then added up for the eight hour day:

$$\text{Time-Weighted Exposure} = \sum_{i=0}^{100\%} \% \text{ day} \times \text{concentration}$$

$$\text{or, } \sum_{i=0}^{100\%} = (\text{time-weight factors})$$

Table 1 lists the % day, mean concentrations found, time-weighted factors and ranges for each material encountered in the listed operations. The time-weighted exposures to dusts from asbestos containing materials were 4.9 mppcf (indoor operations) and 4.2 mppcf (outdoor operations).

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Table 1. TIME-WEIGHTED EXPOSURES OF PIPE COVERERS TO DUSTS FROM ASBESTOS CONTAINING MATERIALS

<u>Operations</u>	<u>Materials</u>	<u>% Day</u>	<u>Concentrations (mppcf)</u>		<u>Time-weight Factor: Asbestos</u>
			<u>Mean</u>	<u>Range</u>	
Remove	Air cell	1.2	11.4	0.3-24.9	0.137
	Kaylo	1.6	11.2	3.7-20.5	0.179
	Mag oxide	0.2	2.8	1.8-4.6	0.006
	Fiberglas	2.0	13.7	1.2-33.7	---
Mix	No. 1 Plus	1.6	13.4	2.2-30.5	0.219
	Armentite	0.1	9.6	2.7-13.5	0.010
	Superpower	0.8	34.9	19.6-6.14	---
Cut	Air cell	5.9	3.0	0.6-6.2	0.177
	Kaylo	8.8	11.7	4.9-23.1	1.030
	Fiberglas	2.2	1.7	0.8-2.6	---
	Others	0.6	--	---	---
Apply	Air cell	15.8	5.7	0.2-16.4	0.901
	Kaylo	19.9	5.7	0.4-22.3	1.123
	Fiberglas	4.5	2.4	1.2-3.8	---
	Others	2.6	--	---	---
	No. 1 Plus	4.8	9.6	1.1-39.5	0.461
	Armentite/ Superpower	2.4	2.1	0.9-3.9	0.050
Clean up removed covers		3.0	8.5	2.4-24.5	0.255
Stocking; get new covers		2.0	1.0	0.1-2.3	0.020
Move to job, set up		5.0	2.0	1.4-2.9	0.100
Breaks, lavatory		15.0	1.4	0.1-3.9	0.201

Time-weighted exposure to
asbestos containing dusts
(indoor) in mppcf

= 4.9

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Table 1. CONTINUED

<u>Operations</u>	<u>Materials</u>	<u>% Day</u>	<u>Concentrations (mppcf)</u>		<u>Time-weight Factor: Asbestos</u>
			<u>Mean</u>	<u>Range</u>	
Remove	Air cell	1.2	5.2	5.1-5.2	0.062
	Kaylo	1.6	9.0	3.6-14.0	0.144
	Fiberglas	2.0	10.0	5.5-20.2	---
	Others	0.2	--	---	---
Mix	No. 1 Plus	1.6	9.6	5.9-12.5	0.154
	Armentite	0.1	17.0	14.1-21.6	0.017
	Superpower	0.8	21.3	13.1-25.4	---
Cut	Air cell	5.9	2.5	0.9-3.4	0.148
	Kaylo	8.8	9.4	6.3-7.4	0.827
	Fiberglas	2.2	2.5	1.4-3.8	---
	Others	0.6	--	---	---
Apply	Air cell	15.8	1.5	0.3-3.5	0.237
	Kaylo	19.9	9.2	1.9-17.9	1.831
	Fiberglas	4.5	3.6	1.6-6.7	---
	Others	2.6	--	---	---
	No. 1 Plus	4.8	1.4	0.3-2.3	0.067
	Armentite/ Superpower	2.4	5.2	3.5-7.9	0.125
Clean up removed covers		3.0	8.5	2.4-24.6	0.255
Stocking; get new covers		2.0	1.0	0.1-2.3	0.020
Move to job, set up		5.0	2.0	1.4-2.9	0.100
Breaks, lavatory		15.0	1.4	0.1-3.9	0.210

Time-weighted exposure to
asbestos containing dusts
(outdoor) in mppcf

= 4.2

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Threshold Limit Values (TLV)

A TLV describes that time-weighted concentration of a material to which men can be repeatedly exposed for eight hours with no adverse effects on health. A TLV indicates a mean concentration which can be exceeded, provided there are corresponding exposures lower than the TLV.

At present the TLV for dust containing asbestos is 5 mppcf using standard light microscopy techniques. Based on best current information, the proposed TLV of 2 mppcf would provide better protection. A two year trial period preceeds acceptance of proposed TLV's. In 1971, 2 mppcf will be the TLV for asbestos, unless better information during the interim casts doubt upon the proposed figure.

This report evaluated current exposures using the proposed standard of 2 mppcf if the material in question had even trace (<5%) asbestos content. Manufacturers were consulted regarding the composition of the insulating product(s) found in common usage. The following table lists these materials and the per cent asbestos plus the appropriate TLV for that material.

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Table 2. MATERIALS MOST COMMONLY USED FOR FIRST TEN MONTHS OF 1968

<u>Tradename (and Manufacturer)</u>	<u>Use</u>	<u>% Asbestos</u>	<u>% Composition Inerts</u>	<u>Threshold Limit Value (mppcf)</u>
No. 1 Plus (BEH Company)	Adhesive	<5-7%	95% mineral wool	2.0
Superpowerhouse (BEH Company)	Adhesive	0%	100% mineral wool	50.0
Armentite (Johns-Manville Corporation)	Adhesive	100%	0%	2.0
Air cell (Carey Company)	Covers	80%	20% (?)	2.0
Mag Oxide (85%) (Carey Company)	Covers	15%	85% MgO	2.0
Fiberglas (Owens-Corning)	Covers	0%	100% amorphous silicates	50.0
Kaylo (Owens-Corning)	Covers	~5%	95% diatomaceous calcium silicates	2.0

DISCUSSION

Men were found to be working almost exclusively with asbestos-containing materials. Their time-weighted exposures to dusts from the asbestos-containing materials were in excess of the proposed TLV of 2.0 mppcf and barely under the present TLV of 5 mppcf. Steps should be taken to lower the time-weighted exposures to within proposed acceptable limits.

Several means of reducing the time-weighted exposures are apparent:

1. Cease using asbestos-containing materials. If use of asbestos-containing materials was stopped, exposures would be reduced to acceptable levels, even though some low-level exposure would be experienced until presently installed coverings have been replaced due to natural attrition.
2. Effective use of approved respiratory devices. Respiratory protection is practical for jobs which are of short duration and infrequent occurrence. It can be seen from Table 1 that jobs requiring respiratory protection are neither infrequent nor of short duration. Men encounter greatest exposures during the cutting and applying of Air cell and Kaylo. These two operations are done for 50% of the day -- sometimes 100% of the day. Many other operations listed in Table 1 could require

use of respiratory devices. Attempts to lower exposures to 2 mppcf by using respirators seem futile.

3. Use local ventilation. This method would be effective if the ventilation could be kept close to the dust source. Pipe coverers' work routines make this difficult; e.g., working aloft, or in cramped areas.

In the event new types of covering materials are used, men should be instructed regarding the toxic properties of the materials and the hazards associated with using the material. Protective measures to prevent or lower undesirable but unavoidable exposures to the material should be well understood. Any education effort must precede or be concurrent with first usage of new materials.

During this survey, most men voiced strong objection to fiberglass, asserting that fiberglass insulation materials were far more hazardous than asbestos insulation materials. This contention is not supported by 25 years available field experience and independent laboratory testing on fiberglass.

The Environmental Research Laboratory will survey and evaluate upon request any proposed types of insulating materials and relate their usage to the health hazards associated with these materials.

APPENDIX
ENVIRONMENTAL RESEARCH QUESTIONNAIRE

Please answer the following questions as completely as possible, using average estimates.

Name _____ Man # _____ Age _____

Number of years with Dow _____ Number of years covering pipe _____

Do you wear a respirator? Yes _____ No _____ What make _____

If yes, list those operations during which you wear a respirator _____

What per cent of the day is this? _____

Have you covered pipe or handled covering materials outside of Dow? _____

Yes _____ No _____ If yes, how long did you cover pipe? _____

Answer the following if they apply to you.

How much time per day do you:

(a) Remove old fiberglass covers? _____

(b) Remove other types of covers? _____

List other types you remove: _____

(c) Mix "plus one" webbers? _____ Other adhesives? _____

(d) Use power saws? _____

List what you cut with a power saw: _____

(e) Use hand saws? _____

List what you cut with a power saw: _____

How much time per day do you:

(a) Work with "air cell" _____

(b) Work with "Kaylo" _____

(c) Work with "Hi-temp" _____

(d) Work with fiberglass _____

Which job(s) do you consider most dusty? _____

How often do you do this job(s)? _____

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UNIT INDEX

Pipe covering operations were surveyed and evaluated.

Men received time-weighted exposures to asbestos near the present Threshold Limit Value of 5 mppcf and in excess of the tentatively proposed Threshold Limit Value of 2 mppcf. Steps should be taken to reduce exposures to the proposed new standard.

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Biochemical Research Laboratory

The Dow Chemical Company

SURVEY AND EVALUATION OF PIPE
COVERERS' EXPOSURES TO DUSTS
CONTAINING ASBESTOS OR FIBERGLASS,
LUDINGTON PLANT

File: T2.1-²¹~~3~~-1(N)
Date: 10/23/69
By: R. A. DeGesero

Signed Roy A. De Gesero Date 10/24/69

Checked H. R. Hoyle Date 10-24-69

PROBLEM

Exposures to dusts containing asbestos or fiberglass encountered by the men in the job classification "Pipe Coverer" were determined for the Ludington Plant.

CONCLUSIONS

1. Pipe Coverers currently encounter an average eight-hour time-weighted concentration of 4.4 mppcf from dust containing asbestos.
2. Pipe Coverers currently encounter a time-weighted eight-hour average exposure of 1.3 mppcf from dust containing fiberglass.
3. The present TLV (Threshold Limit Value) for exposure to dusts containing asbestos is 5 mppcf. A proposed change in the TLV for such dusts would lower the eight-hour permissible average

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exposure to 2 mppcf. The proposed TLV will go into effect in 1971, barring information to the contrary. The TLV for fiberglass is 15 mppcf.

4. Pipe Coverers encounter time-weighted exposures to dust containing asbestos approaching, but not in excess of, the present TLV of 5 mppcf. Pipe Coverers' exposures are in excess of the proposed standard of 2 mppcf. Pipe Coverers are exposed to dust containing fiberglass at levels within the TLV for fiberglass.

RECOMMENDATIONS

1. If eight-hour time-weighted exposures are to be reduced to within the 2 mppcf proposed standard for dust containing asbestos, then
 - a. the use of asbestos containing materials should be sharply curtailed or stopped,
 - b. Pipe Coverers should be protected through the effective use of approved respiratory devices,
 - c. local ventilation should be considered where feasible.

2. Pipe Coverers should be informed of the hazards associated with the several types of insulating materials presently used and made aware of the ways to protect themselves when handling asbestos containing products.
3. In the event that new materials are substituted for presently used insulating materials which contain asbestos, Pipe Coverers should be informed of the particular hazards associated with the substitute materials.

PRESENTATION OF DATA

Concentrations of dust containing asbestos and fiberglass in the breathing zone of workers were surveyed on 10/10/69 at the Ludington Plant of The Dow Chemical Company. A total of 14 breathing zone impinger samples were collected during: cutting of fiberglass, Kaylo and Super XM insulating boards, mixing of asbestos containing cements and clean up operations. Samples were subsequently analyzed using standard light-field microscopy techniques. Dust concentrations determined thus are expressed in terms of mppcf (millions of particles per cubic foot of air), according to the following formula*:

*Patty, F. A. INDUSTRIAL HYGIENE & TOXICOLOGY, Vol. I, Second Revised Edition, page 198.

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$$\text{mppcf} = \frac{(\text{mean particles/quarter field}) \times 4 \times 1000 \times \text{sample vol.}}{\frac{\text{liters}}{\text{minute}} (\text{pump flow}) \times \text{minutes} \times 3.51 \times 10^{-2} \frac{\text{ft}^3}{\text{liter}}}$$

Job Analysis and Description

An environmental job analysis provides an estimate of the frequency and duration of men's exposures to dust concentrations. The job analysis expresses, as per cent of day, the probable time distribution of pipe covering operations averaged over several months. On any given day the Pipe Coverer's routine might vary from the long term estimate. Two Ludington Plant Pipe Coverers and their supervision were questioned regarding exposure frequency and duration. Also, information from an industrial time study in Midland was utilized. Sampling is carried out on the basis of what Pipe Coverers do during the eight-hour day.

From January through April, 1969, a major survey of 81 Midland Pipe Coverers was conducted and data gathered from that report has been extrapolated at appropriate places in this report. Although Pipe Coverers at Ludington have a different time distribution than their counterparts in Midland, many of the materials used in Ludington are similar to, or are the same as, those used in Midland. It is assumed that the same materials, handled in the same way, will give rise to comparable concentrations of dust.

Time-Weighting Exposures

An exposure defines that time-weighted average eight-hour concentration (in mppcf) of dust containing asbestos or fiberglass encountered during the work day. In order to estimate an exposure, the independent variables of concentration and duration and frequency of exposure at any given concentration must be reconciled. Time-weighting provides a convenient method for integrating these two independent variables. Breathing zone concentrations are obtained for each operation of known duration with each different type of material Pipe Coverers commonly handle during the course of their work. The process of time-weighting the concentrations and times thus obtained is defined by the following formula:

$$\text{time-weighted average (8-hours)} = \sum_{i=0}^{100\%} x (\% \text{ day} \times \text{concentration})$$

$$\text{or, } \sum_{i=0}^{100\%} = (\text{time-weight factors}).$$

Table 1 lists the operation, the per cent of time spent at that operation, the concentration, the range of concentrations and the fraction per cent of day multiplied by the concentration (e.g., time-weight factors). The sum of these time-weight factors is the time-weighted exposure to

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asbestos or fiberglass containing dusts. For asbestos containing dust the eight-hour average time-weighted exposure is 4.4 mppcf. For fiberglass containing dust the eight-hour average time-weighted exposure is 1.3 mppcf. Appropriate labeled entries indicate which readings from the Midland survey have been extrapolated into this report.

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Table 1. EXPOSURES TO ASBESTOS AND FIBERGLASS CONTAINING DUSTS ENCOUNTERED BY
PIPE COVERERS (INDOORS) AT LUDINGTON PLANT

Range?

Job Analysis Operation	% Day	No. Of Samples	Survey		Time-Weight Factors (conc. x time)
			Concentration (mppcf)	Average	
Remove:					
Fiberglass & Monoblock	4.5	7	13.7*	1.2-33.7	0.6165
Kaylo	2.0	6	11.2*	3.7-20.5	0.2240
Super XM	3.0	6	11.2*	3.7-20.5	0.3360
Miscellany (Mag Ox, etc.)	0.5	5	2.8	1.8-4.6	0.0140
Mix:					
Asbestos muds	5.0	3	15.5	6.0-33.5	0.7750
Cut:					
Fiberglass & Monoblock	6.7	3	4.5	3.6-5.6	0.3015
Super XM	5.2	3	9.0	6.1-11.7	0.4680
Kaylo	3.4	3	3.9	3.1-4.3	0.1326
Miscellany	1.6	-	--	--	--
Apply:					
Fiberglass	16.8	4	2.4*	1.2-3.8	0.4032
Super XM	12.8	10	5.7*	0.4-22.3	0.7296
Kaylo	8.6	10	5.7*	0.4-22.3	0.4902
Muds, Thermon, Papgrs.	3.9	10	5.8*	0.9-39.5	0.2262
Set up:	5.0	3	2.0*	1.4-2.9	0.1000
Clean up:	4.0	2	16.9	9.9-23.9	0.6760
Stock shelves:	2.0	3	1.0*	0.1-2.3	0.0200
Breaks:	15.0	3	1.4*	0.1-3.9	0.2100

Time-weighted average 8-hour exposure, asbestos dust = 4.40 mppcf
Time-weighted average 8-hour exposure, fiberglass dust = 1.32 mppcf

*Midland data; assume Super XM is same as Kaylo.

Threshold Limit Values (TLV's)

The TLV describes that time-weighted concentration of dust containing asbestos or fiberglass in the breathing zone that men can repeatedly encounter for eight hours per day, five days per week, with no adverse effect on health. The TLV can be exceeded for brief periods provided there are corresponding exposures of equal duration lower than the TLV. The present TLV for dust containing asbestos is 5 mppcf using standard light microscopy techniques. Based on best current information, a proposed TLV of 2 mppcf would provide better protection of men's health. A two year trial period precedes acceptance of the proposed TLV. During this time contrary evidence can be brought forth. In 1971, 2 mppcf will be the TLV for asbestos containing dusts, barring information to the contrary.

Men currently encounter 4.4 mppcf of dust containing asbestos (time-weighted 8-hour average). This number approaches, but does not exceed, the present TLV of 5 mppcf. Such an exposure level is consistent with those found in a survey in the Midland location. Men were exposed in the Midland location to 4.2-4.9 mppcf. The men's current exposures to dust containing asbestos are in excess of the proposed 1971 TLV.

Men currently encounter exposure to dust containing fiberglass at 1.3 mppcf. This exposure is well within the TLV for fiberglass (15 mppcf).

DISCUSSION

Pipe Coverers at Ludington encounter concentrations of dust containing asbestos in excess of the proposed TLV of 2 mppcf. If supervision desires to lower exposures to within the proposed standard, several means of exposure abatement might be considered.

Replace asbestos containing insulating materials. At present, Ludington Plant Pipe Coverers use Kaylo and Super XM insulations predominantly. Occasionally, Thermobestos, 85% Magnesia, Cary Block insulation and BEH Monoblock insulations are used. All of these contain asbestos. The contribution to asbestos exposure from occasionally used materials is thought to be insignificant when compared to exposures caused by using Kaylo and Super XM. Insulation manufacturerers are beginning to produce materials which can take the place of Kaylo, Super XM, Thermobestos, and perhaps J M & Cary block insulation materials; Carytemp 1500 is one such material which could be substituted for the asbestos containing materials. Carytemp 1500 is an inert silicate which does not present any known toxicological hazards. Fiberglass can also be used in some areas where asbestos containing materials

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are currently used. Presently, no feasible substitute is available for the cements or muds containing asbestos.

The effective use of approved respiratory devices.

Respiratory protection is practical for jobs which are of short duration and/or infrequent occurrence. Approved respiratory protection means that the devices have Bureau of Mines approval. Two such devices on the market are the Dustfoe #66 and the Sureguard R2090. Respirators must be properly fitted and worn to provide protection.

Men work with asbestos containing materials for 57% of the day and may receive low level exposure the rest of the day from dust on clothes, in storage areas, etc. Attempts to lower exposures to 2 mppcf through the use of respiratory protection is undesirable but may be necessary until better replacements are available. Use of respiratory protection is recommended under any circumstances which appear dusty to personnel. In the Midland location Pipe Coverers use approved respiratory protection during most removing, mixing, cutting and applying operations of asbestos containing insulating materials in lieu of substitutes. Table 2 lists those Ludington Plant operations during which respiratory protection should be used.

Table 2. MINIMAL* RESPIRATORY PROTECTION REQUIREMENTS

<u>Operation</u>	<u>% Day</u>	<u>Time-Weight Factors Eliminated</u>
Mix muds	5.0	0.7750
Cut Super XM	5.2	0.4680
Apply Super XM	12.8	0.7296
Clean up asbestos containing cuttings	4.0	0.6760
	<u>27.0</u>	<u>2.6486 = 2.6</u>

Reduction in eight hour time-weighted
exposure is:

4.4
-2.6

New time-weighted 8-hour exposure = 1.8 mppcf

Proposed TLV = 2.0 mppcf

*Pipe Coverers should wear approved respiratory protection whenever they encounter obviously dusty conditions while removing, cutting and applying asbestos containing insulations.

Use local ventilation. This method would be effective if the ventilation could be kept close to the dust source. Pipe Coverers' work routines make this difficult; e. g., working aloft or in cramped areas.

In the event new types of covering materials are used, men should be instructed regarding any hazards associated with using the material. Protective measures to prevent or lower undesirable but unavoidable exposures to the materials should be well understood. Any educational effort must precede or be concurrent with the first usage of new materials.

Smoking is particularly discouraged among Pipe Coverers. Recent studies indicate a correlation between cigarette smoking and increased frequency of lung cancer among Pipe Coverers.

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UNIT INDEX

Pipe covering operations at the Ludington Plant were surveyed and evaluated. Data gathered at Ludington and in Midland indicate that men encounter a time-weighted average exposure to asbestos containing dusts of 4.4 mppcf. This exposure is within the present TLV (5 mppcf) for asbestos containing dust, but exceeds the proposed 1971 TLV of 2.mppcf. Current time-weighted exposure to dust containing fiberglass is 1.3 mppcf. This exposure is within the TLV for fiberglass (15 mppcf). Recommendations are made to lower asbestos exposures to within the proposed TLV.

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SAFETY AND LOSS PREVENTION MANUAL FOR CONTRACTORS

STD159666



THE DOW CHEMICAL COMPANY
Engineering & Construction Services

February, 1970

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SAFETY AND LOSS PREVENTION MANUAL FOR CONTRACTORS

"It is the objective of Engineering and Construction Services to establish and maintain an active, successful accident prevention program that will ultimately result in top safety performance by contractors doing work for The Dow Chemical Company."

ST0198667

THE DOW CHEMICAL COMPANY

Engineering & Construction Services

February, 1970

**SAFETY MANUAL FOR CONTRACTORS
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This manual supersedes Safety Manual and
Procedures for Contractors dated February, 1966.

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INTRODUCTION

This safety manual contains the minimum safety rules and procedures for performance of work by contractors and their subcontractors as required by Engineering and Construction Services, The Dow Chemical Company, for any division, subsidiary or affiliate, hereinafter referred to as "owner." This manual will apply at all Engineering and Construction Services project locations unless the owner has an existing set of safety rules specifically for contractors. Exceptions to this manual, or any part thereof, will be agreed upon prior to starting any field work. The owner will be represented on construction as defined in the contract and hereinafter referred to as "owner's representative."

Contractor assumes and has the full responsibility and liability for the safety of its agents, servants and employees and for the compliance of its subcontractors and anything contained herein does not relieve the contractor of such responsibility or liability.

Safety rules and procedures are an integral part of each contract and must be carried out fully, as any other specification for the job. The contractor will be held responsible for his subcontractors conforming with these safety rules and procedures. Any exception to the rules set forth herein, during the course of any project, must have prior written authorization from the owner's representative.

Contractors and contractor supervision unable or unwilling to secure personnel performance in keeping with these rules will not be acceptable as supervisors. Contractor employees who exhibit a poor attitude toward safe work and safety procedures will not be acceptable. Employees leaving a job due to safety violations will not be allowed to return to any owner's work without proper authorization from the owner. The contractor's safety record will be one criteria used to judge his qualifications for bidding.

In addition to the rules set forth herein, contractors working in or near an existing operating facility must be cognizant of and conform to owner's safety rules for that area and any federal, state or local laws governing.

Should any procedure set forth herein conflict with applicable federal, state or local laws, the latter will apply.

1.0 GENERAL SAFETY RULES

1.1 The contractor shall actively and adequately promote safe working performances on the part of his employees. He shall participate in activities to this end, such as safety organizations, incentive award programs, contractor-owner programs, etc. It is expected that each contractor will conduct his own safety programs to best suit his particular needs.

1.1.1 American Standards Association, Z-16.1 Standard, "Recording and Measuring Work Injury Experience," shall be used as a guide to classify contractor injuries.

1.2 Prior to starting any field work on each job, the owner's representative will conduct a prejob safety conference with an authorized representative of the contractor, a manufacturing representative, when available, available subcontractor's representatives and owner's Safety Department representative, when available. At this time, the nature of any chemical hazards or special safety rules for the area will be reviewed with the manufacturing representative and the contractor will be provided with printed copies of area rules where applicable. The "prejob safety check sheet" form (see sample) will be prepared by

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the owner's representative and a copy furnished to the contractor.

1.3 An effective system of indoctrination and education of employees in safety and loss prevention shall be provided by each contractor. Contractors shall inform all their employees of all safety rules and all safety procedures before working in an owner's plant.

1.3.1 Contractors shall inform all of their employees of the location and the use of nearest safety shower, eye bath and emergency equipment such as gas masks, fire extinguishers, and fire blankets.

1.4 Contractors shall use a regular system of work inspection to detect and correct hazardous conditions, safety rule violations and unsafe working conditions. These safety inspections shall be reported to owner's representative in writing each week.

1.4.1 Orderliness is a basic requirement for all jobs and must be maintained at all times. Special attention must be given to maintaining clear walkways and roadways, removal of trash, removal of slipping and tripping hazards and proper storage of materials. Contractors must make every effort to keep mud, slush or other slippery substances off of plant roads. In cases where this cannot be avoided, contractors must clean the roadways immediately.

1.5 Temporary buildings and material storage areas shall be set up as neatly as possible to present an orderly appearance.

1.5.1 Temporary building shall be sheeted with noncombustible material, such as transite or metal siding and roof, and each must be identified with the contractor's name.

E & C S CONSTRUCTION DEPARTMENT
PRE-JOB SAFETY CHECK SHEET

DATE _____ JOB _____ PLANT _____

C O NUMBER _____ CONTRACTOR _____

1. Standard Emergency signals fully understood?	Yes	No
2. Contractor responsibility in time of emergency understood?	Yes	No
3. Fire and telephone telephone numbers known?	Yes	No
4. Areas for possible evacuation designated?	Yes	No
5. First aid and emergency equipment known and plans made for provision of adequate treatment?	Yes	No
6. Special safety rules and signals for this area known?	Yes	No
7. Status of chemical or toxic hazards for area reviewed with Manufacturing Representative?	Yes	No
8. Special safety equipment for this area known?	Yes	No
9. Safety showers and eye wash locations known?	Yes	No
10. Safe work areas understood? (Designated areas or no access areas?)	Yes	No
11. Red Tag rule understood?	Yes	No
12. Locking area understood?	Yes	No
13. Contractor scaffold rules known?	Yes	No
14. Crane operation and critical lift procedure understood?	Yes	No
15. Do you have a copy of and understand "Safety & Loss Prevention Manual for Contractors"?	Yes	No
16. Contractor assumes responsibility for and control of their vehicles entering the plant for compliance with prior safety rules and regulations?	Yes	No
17. Are your Subcontractors aware of these rules and procedures?	Yes	No

REMARKS (Explain all No answers):

Contractor Representative	Date	Subcontractor	Date
Owner's Representative	Date	Subcontractor	Date
Manufacturing Representative	Date	Subcontractor	Date
Owner's Safety Representative	Date	Subcontractor	Date

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telephone as soon as possible that all employees in the area are accounted for or that specific employees cannot be accounted for.

1.5.2 Metal buildings served with electricity must have the skin of the building properly grounded as well as the service entrance switch.

1.6 Contractors must furnish trash containers made of metal, each with metal covers kept in place.

1.7 Contractors must report to the owner's representative, by name, those employees discharged for safety rule infractions.

1.8 Contractors shall maintain continuous safety planning to cover jobs where circumstances have changed and new hazards require new controls.

2.0 EMERGENCY PROCEDURES

2.1 Contractors must inform their employees of existing plant procedures for first aid and ambulance calls. If none exist, the contractor shall submit to the owner's representative prior to starting work, an outline of the procedure to be followed.

2.2 In the event of an explosion or fire, contractor personnel working in the area affected must observe the following rules.

2.2.1 Shutdown all equipment in operation and leave the area at once.

2.2.2 Report to your company field office immediately, in person or by phone.

2.2.3 DO NOT re-enter the area until authorized by the owner's representative.

2.2.4 The contractor shall notify the owner's representative in person or by

2.3 If operating a motor vehicle in an affected area, turn off engine, get out of the vehicle, and be prepared to leave the area if necessary. Motor vehicles, other than emergency units, must not be driven into an area downwind of a gas release. Barricades across plant roads must be honored by all vehicles at all times.

2.4 Contractors shall inform their employees of pertinent emergency signals and procedures for the area in which they work. If none exist, the contractor shall outline and inform employees of steps to be taken in the event of disaster emergencies that could arise.

3.0 FIRST AID—INJURIES—REPORTS

3.1 The owner's representative shall be notified immediately in the event of any death, occupational disease, disabling injury or potentially significant injury to a contractor employee (whether or not it is determined that "lost time" will be involved) while at work on the owner's job.

3.1.1 The contractor must thoroughly investigate, determine and report all details of an accident and cooperate with the owner's inspection teams.

3.1.2 A written report must be submitted on every injury requiring medical treatment of any kind, to the owner's representative on the job, no later than 10:00 a.m. of the day following the injury. Also any near miss, potentially serious or hazardous condition that occurs, must be reported in the same manner, although no injury

to personnel may be involved. Forms for these reports, "Notice of Contractor Accident and Property Loss," are available through the owner's representative (see sample).

3.1.3 All fires must be reported regardless of duration or extent.

3.2 Employees must report any injury to their immediate supervisor even though it may be considered slight.

3.2.1 The contractor will assure that all injured personnel report to a recognized medical facility.

3.2.2 In the event of any serious injury, an ambulance MUST be called.

3.2.3 In the event of accidents ambulance run, etc., contractors must exert all possible effort to keep onlookers from the scene. The only personnel required in such areas are those directly engaged in assisting in the emergency.

3.3 Employees must not attempt to remove foreign material from the eyes, except by washing with water. If foreign materials get in the eye, the eye must be washed immediately with running water, preferably at an eyewash station and the washing continued uninterrupted for at least fifteen minutes. It is vital that the injured employee and others who are able to help him make sure that thorough and complete washing of the eye is accomplished.

3.4 If chemicals come in contact with the body, the affected parts must be washed with running water for at least fifteen minutes. To



NOTICE OF CONTRACTOR ACCIDENT OR PROPERTY LOSS

THIS NOTICE FORM IS TO BE FILLED BY CONTRACTOR, AND TO THE OWNER REPRESENTATIVE AS SOON AS POSSIBLE, BUT NOT LATER THAN 10 P.M. THE DAY AFTER THE ACCIDENT. IT IS REQUIRED FOR THE TREATMENT OF ANY INJURY OR FOR ANY POTENTIALLY SERIOUS PROPERTY LOSS. IT IS NOT TO BE USED FOR ANY OTHER PURPOSES, AND IT IS NOT TO BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF THE U.S. ARMY.

CONTRACTOR _____ US CONTRACTOR _____

P. O. # _____ DATE _____ TIME _____ AM _____ PM _____ LOCATION _____

NAME OF INJURED _____ AGE _____

CRAFT _____ CIRCLE NUMBER _____

EXTENT OF INJURY _____

PHOTO TAKEN _____

IS THIS A DISABLING INJURY? YES ☐ NO ☐ INDEXED BY _____

WHAT HAPPENED _____

CAUSE _____

CORRECTIVE ACTION TAKEN _____

SAFETY INVESTIGATION MADE BY _____

_____ DATE _____ OWNER REPRESENTATIVE _____ DATE _____

_____ DATE _____ OWNER REPRESENTATIVE _____ DATE _____

_____ DATE _____ OWNER REPRESENTATIVE _____ DATE _____

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make sure that adequate washing is accomplished, shoes and clothing covering affected parts must be removed. The owner's representative must be consulted before reuse of clothing and shoes that may have been contaminated.

4.0 INDIVIDUAL ACTION

4.1 Horseplay in any form is not allowed.

4.2 Running in the job site must be avoided except in case of an emergency.

4.3 Personnel must not climb through, under, over, or between railroad cars of a train except in the performance of assigned duties.

4.4 Personnel must not make inoperative or operate safety devices such as relief valves, deluge valves, gate valves, electrical and mechanical interlocks, guards, electrical switches, etc.

4.4.1 Any accidental interruption of lines or equipment in service or any irregularities observed must be reported to the owner's representative immediately.

4.5 Unsafe shortcuts, such as walking pipelines, sliding down pipe or stanchions and cutting corners to save a few steps, must be avoided.

4.6 Tools, materials or equipment must not be intentionally dropped or thrown from one level to another unless adequate precautions have been taken to assure that no injury to persons or damage to equipment will occur.

4.7 Personnel must not ride a load being handled by a crane. Slings, hooks, etc., must not be ridden, except where a crane basket or a bosuns' chair and safety belt are used.

4.8 Personnel must not walk, drop or jump onto a transite roof. Care should be exercised while erecting new transite roofs.

5.0 VEHICLES AND TRAFFIC

5.1 Personnel will comply with all safety rules and signs regarding traffic and vehicles at all times.

5.2 The maximum speed limit on open roads in the plant is 25 miles per hour and 10 miles per hour within work areas, unless otherwise designated by signs.

5.3 Vehicles stopped on plant roadways for the purpose of loading or discharging passengers must not be passed in either direction except, after coming to a complete stop, the vehicle may be passed at no more than 10 miles per hour provided the way is clear.

5.4 Fuel tanks on motorized equipment must not be filled while the engine is running or when welding or other hot work is being done nearby. Smoking will not be allowed during fueling operations.

5.5 Equipment such as welding machines, pumps, etc., shall not be transported with the engine running.

5.6 All equipment must be in safe mechanical working condition at all times. In addition to complying with state requirements as to brakes, lights, signals, horns, mufflers, etc., vehicles must be periodically inspected by a representative of the contractor. Necessary repairs and adjustments must be made prior to their use on owner's property.

5.7 The use of winch trucks, flatbeds, stakebeds, etc., as transportation for personnel

will not be permitted unless adequate safety provisions are made and the vehicle is adapted for that purpose. In any case, the number of personnel must not cause overcrowding.

5.8 Riding of "Cherry Pickers" or cranes is permitted only when adequate safety provisions such as seats, platforms, rails, etc., are provided for passengers.

5.9 The maximum number of people who may ride in a pickup truck is three in the cab and six seated on the floor of the bed, or on approved "built-in" seats.

5.10 Personnel must be sitting down at all times when the vehicle they are riding is in motion and must not have any part of their body over the sides.

5.11 Pedestrian paths and walkways must be used whenever provided. In their absence, personnel using streets and roadways must walk facing approaching traffic, on left-hand side of road.

5.12 The following rules must be observed in the operation of cranes, cherry pickers, winch trucks and other equipment having booms or extended loads which extend 15 feet or more in front of or to the rear of the equipment.

5.12.1 Stop at all stop signs.

5.12.2 At intersections, when the equipment is to proceed straight across a thoroughfare or turn either way, the equipment must stop; the flagman must get off the equipment, clear all traffic, then flag the equipment through the intersection or around the corner.

5.12.3 Before entering any thoroughfare, street, road, etc., from a

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work area, the flagman must clear the traffic and flag the equipment onto the road.

5.12.4 All booms or loads extending more than 15 feet must be marked or flagged with high visibility material when moving on plant roads.

5.12.5 A flagman must be provided and swinging must be controlled with a tag line when moving in a congested area or where there is personnel.

5.12.6 Hauled material that overhangs the sides or ends of a truck must be red flagged at the extent of the overhang. Loads must not be hauled from a single suspension cable that allows free swinging beyond the sides of the vehicle. Loads or vehicles that extend out of the normal road lanes require flagman or escorts.

5.12.7 Contractors must check vertical clearances on the route to be used prior to moving equipment or high loads.

5.13 Contractors must determine from the owner's representative when and which roads are to be used, prior to moving extremely heavy loads such as large rubber-mounted equipment and low-boy loads.

6.0 PROTECTIVE EQUIPMENT AND CLOTHING

6.1 The contractor and his employees shall recognize the importance and the use of special protective equipment and clothing.

6.1.1 The contractor shall be responsible for knowing and enforcing special owner area or job rules requiring special personnel protection.

6.1.2 Contractors shall provide their employees with the proper protective equipment required.

6.2 Approved safety glasses shall be a minimum requirement on all jobs at all times. Safety glasses with side shields are required when grinding, chipping or performing any job where side shields would afford protection from flying particles.

6.2.1 Approved safety glasses must fulfill federal requirements (GGG-G-513) for drop ball testing and safety code for polarized "Strain" pattern.

6.2.2 Employees wearing contact lens must wear chemical goggles.

6.3 Chemical goggles, approved prior to their use, are required for working in or entering certain chemical areas which are posted with signs, or while doing chipping or power tool cleaning work on pressurized lines or equipment which contains hazardous chemicals.

6.3.1 All employees working in the vicinity of hazardous chemicals must know where the nearest safety shower and eye bath facilities are located.

6.3.2 When chemical type goggles are in use, the headband must be around the back of the head, not around the safety hat.

6.4 Approved safety hats are required for all contractor work. Metal hats must not be used where electrical hazards exist.

6.4.1 Approved safety hats must fulfill requirements in Federal Specification GGG-11-142b. The major requirement in

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this specification says, "The specimen must withstand the drop of an 8-pound spherical weight, approximately 3.8 inches in diameter, from a distance of 5 feet, without breaking the hat, bottoming out or breaking suspension." Most skull caps, scalp guards, bump helmets, etc., will not meet this test. Safety hats shall not be drilled or punched for ventilation holes, or edges trimmed off hats.

6.5 All personnel shall wear air hoods, or equivalent, supplied with filtered air, when sandblasting or applying volatile or toxic material inside tanks, rooms or any other area not adequately ventilated.

6.6 Safety belts or harnesses, with lifelines attached, are to be worn by employees when performing work in elevated positions where the use of scaffolds or ladders is impractical and where a slip might result in a serious fall.

6.7 Personnel must wear owner approved life jackets or otherwise be protected by handrails or lifelines when working over water wherein a drowning hazard exists.

6.8 Personnel shall wear personal clothing that is safe and proper for their job. Wearing of canvas shoes, sneakers or houseshoes and working in an undershirt, shorts or stripped to the waist is prohibited. Safety shoes are strongly recommended.

6.9 Fixed blade knives used as tools of the trade must be carried in sheaths while not in use.

7.0 FIRE PROTECTION

7.1 Accumulation of trash, oily rags, combustible materials and similar fire hazards of any nature will not be permitted.

7.2 The area around welding operations must be kept free of hoses and flammable material of all kind.

7.2.1 There must be a fire extinguisher or water hose easily accessible for each welding, cutting, burning or other such operations, located in close proximity to the operation. It is the contractor's responsibility to obtain the required fire extinguishers for his welding operations.

7.2.2 Special care must be taken during overhead welding operations to safeguard personnel and prevent falling sparks from starting a fire.

7.3 All tarpaulins shall be fire-retardant and identified as such by stenciling: "FR-treated (date)" with a minimum of 2" letters in diagonal corners. In lieu of this treatment, fire-proof blankets such as fiberglass or asbestos are acceptable.

7.3.1 Contractors must inspect and test all tarpaulins at least once each six months to be sure that they are still fire-retardant. Tarpaulins needing it must be retreated or removed from the plant immediately. At this time the tarpaulins must be restenciled in the same manner as in 7.3 above.

7.4 Fire plugs, extinguishers, hose racks and other emergency equipment, shall not be covered or blocked and fire equipment lanes must always be kept clear.

7.5 All heating units for offices, shops, work areas, change rooms, etc., must be in good working order and periodically inspected. Gas units must be provided with "flame-out" protective devices and electrical units must be

grounded. All heating units must be turned off at the end of each work day.

7.6 Flammable or explosive type material such as fuel, oil, cleaning agents, etc., must be properly contained, clearly identified, separately stored and kept clear of work areas. Appropriate signs must be provided in storage areas.

7.7 All cans used for transporting or transferring gasoline or fuel must be labeled by Underwriters' Laboratories or Factory Mutual Laboratories.

7.8 Fuel storage tanks, filler hoses and the dispensing vehicle or containers must be properly grounded.

7.8.1 A quick shut-off valve is required on the dispensing end of fuel hoses.

7.8.2 Equipment fuel tanks must not be filled while the engine is running.

7.8.3 Smoking, welding or any spark- or flame-producing operation must be stopped in the immediate area during refueling operations.

7.9 Welding rod cabinets presenting a fire or safety hazard will not be permitted. Cabinets of fireproof materials equipped with strip heaters are recommended. If light bulbs are used, they must be securely guarded with adequate spacing in regard to the cabinet and to stored material. Metal cabinets must be grounded in an approved manner.

7.10 Volatile materials must not be applied near an open flame. If such material is to be applied in a vessel, or other poorly ventilated, confined area, only explosion-proof lights and connections will be used. The contractor must designate such areas as "No Smoking."

7.11 Heating equipment for freeze protection of concrete must be approved by the owner's representative prior to use.

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8.0 MACHINERY, TOOLS AND EQUIPMENT

7.12 Welding or cutting torches and hoses must not be connected to cylinders when stored in any enclosure or building. When work is shut down and equipment is unattended, close all valves at the gas and oxygen cylinders, bleed lines and check five minutes later for pressure build-up. If there is no build-up, bleed hoses at the torch, remove hoses from cylinders and store. No smoking will be permitted during this shutdown procedure.

7.13 Gas and oxygen cylinders must be handled with care, properly supported in an upright position away from any source of heat or flame and securely tied off. All cylinders not in use must have their caps in place and stored as above.

7.13.1 Oxygen cylinders in storage and not in use must be separated from gas cylinders by a fire retardant partition or a minimum distance of 10 feet.

7.13.2 When gas and oxygen cylinders are lifted by hoisting equipment, a basket, a cradle, or similar handling device must be used. Cylinders must not be lifted by the valve protection caps.

7.14 All "No Smoking" restrictions must be strictly observed. Smoking is not permitted in vehicles in designated "No Smoking" areas.

7.15 Compressed gases must not be used for cleaning of clothes, the body or work areas. Oxygen must not be used for pressure testing purposes.

7.16 Adequate ventilation must be provided when cleaning agents are used.

7.17 Contractors must not dump flammable or toxic materials into sanitary sewers or waste water system without prior clearance of the owner's representative.

8.1 The safe designed capacity of any tool or piece of equipment must not be exceeded. Tools and equipment must not be modified in any manner that reduces the original safety capacity.

8.2 All contractor owned, leased or rented equipment must be in safe mechanical working condition to render safe service at all times.

8.2.1 Equipment must be inspected by contractor supervision prior to its use on a job and periodically thereafter to insure that it is in safe working order. Crane inspection must be submitted in writing to owner's representative using the owner's "Hoisting Equipment Inspection" form. (See Sample.) Special attention must be given to such items as cables, guards, booms, blocks, hooks, grounds, electrical cords and safety devices. Equipment must be shut down before repairs or adjustments are made.

8.2.2 Defective tools and equipment must be removed from the job immediately and if repairable, must be properly repaired before reuse on owner's job.

8.2.3 Machinery, tools and equipment must not be operated without all guards and safety devices in place and functioning properly.

8.2.4 The contractor has the complete responsibility for a safe operation when using hoisting equipment to make lifts. The contractor shall verify weights of loads to be lifted. No load shall be lifted which exceeds the manufacturer's rated capacity of the crane. When one of the

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following conditions prevail, the contractor must submit in writing, using the owner's "Critical Lift Check Sheet" (see sample), an outline of the safety planning for the lift to the owner's representative prior to starting the lift.

- The load exceeds 80% of rated load charts for crane.
- The load exceeds 50% of rated load chart for crane, and possible failure would endanger existing facilities.
- Two booms are required to make the lift.
- Poles or derricks have been erected for this specific lift.

8.2.5 If burning of lugs or other such flame producing operations may be required during crane hoisting operations, arrangements for proper safe work permits must be made before the lifting operations begins.

8.3 Equipment with exposed gears, belts, couplings, etc., must be provided with proper guards.

8.4 Electrical tools and equipment operating at more than 32 volts must be properly grounded. Certain test equipment such as oscilloscopes, vacuum tube voltmeters and signal generators, as well as certain areas where exposed d-c equipment is used, do not require grounding and proper operational procedures must be ascertained from the owner's representative.

8.5 Only 32-volt, or less electrical service is to be used in connection with drop lights when working inside metallic vessels, unless 115-volt service is essential for the operation of equipment.

HOISTING EQUIPMENT INSPECTION REPORT

(Use Hydraulic Crane Inspection Form for Hydraulic Cranes)

OWNER	DATE
EQUIPMENT NO.	
MANUFACTURER/MODEL	
RATING CAPACITY	
SERIAL NO.	
DATE OF MANUFACTURE	
OPERATING WEIGHT FOR NORMAL USE	
DESIGN LIMITS FOR NORMAL USE	
OPERATING WEIGHT FOR CAPACITY LIFT	
DESIGN LIMITS FOR CAPACITY LIFT	
CAPACITY CHART POSTED IN CAB () YES () NO	

	CONDITION
1. Identification and high visibility markings	
2. Hooks (pins-wireline)	
3. Boom endstops and blocks (straps)	
4. Traveling block (pinning/fittings)	
5. Cable drums (facing and brakes)	
6. Jaws of lock (catch on brakes)	
7. Clutch (hand-brake-control pins)	
8. Whip line (condition of cable, age)	
9. Load line (condition of cable, age)	
10. Boom line (condition of cable, sheath, age)	
11. Boom and jib pinpoints (condition of cable, sheath, age)	
12. Main boom (structural members - pins)	
13. Jib (structural members - pins)	
14. Carrier (a-frame) - (pins-sheaves-straps)	
15. Spring lock	
16. Hydraulic or air system	
17. Lighting system	
18. Painting	
19. Drive shafts (couplers)	
20. Tires (air pressure-damage)	
21. Steering mechanism	
22. Counterweights (sequence or seal)	
23. Cab, platforms, handrails, steps, glass, etc. (access)	
24. Fire extinguisher	
25. Boom hook safety device	
26. Power lowering - whip line	
27. Power lowering - load line	
28. Boom hook pin	
29. Boomhooking	

OVERALL EVALUATION OF CONDITION

() Good, Safe () Fair, Safe () Unsafe

Inspector (Name) _____

Assisted by (Name) _____

Tag No. _____ Date _____

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Check List for
Critical Lifts

Page 2 of 4

CHECK LIST FOR CRITICAL LIFTS

1. ACC.#/U.O.# _____
2. JOB DESCRIPTION _____
3. LOCATION _____
4. DOW REPRESENTATIVE _____
5. PLANNING DATA:
 - A. 1. CONTRACTOR _____
 2. SUPERINTENDENT _____
 3. SUPERVISOR RESPONSIBLE FOR LIFT _____
 - B. DESCRIPTION OF ITEM TO BE RAISED _____
 - C. MAJOR HOISTING EQUIPMENT TO BE USED (Must include inspection tag number and date, tags are valid for four months.)
 1. _____
 2. _____
 3. _____
 4. _____
 - D. EQUIPMENT AND LIFT RELATIONSHIP
 1. OPERATING RADIUS _____
 2. BOOM LENGTH _____
 3. ALLOWABLE LOAD (FROM LOAD CHART) _____
 4. RATION UP LIFT TO ALLOWABLE LOAD _____
 5. CLEARANCE BETWEEN BOOM & LIFT _____
 6. CLEARANCE TO SURROUNDING FACILITIES _____

- E. SCHEDULE OF OPERATIONS (INCLUDE TIME FOR RIGGING AND EQUIPMENT INSPECTIONS.)
6. BASIS FOR CRITICAL LIFT:
 - A. LOAD EXCEEDS 90% OF LOAD CHART FOR CRANE OR DERRICK _____
 - B. LOAD EXCEEDS 50% OF LOAD CHART, AND FAILURE WOULD ENDANGER EXISTING FACILITIES _____
 - C. TWO BOOMS ARE REQUIRED _____
 - D. POLES OR DERRICKS HAVE BEEN SELECTED FOR THIS SPECIFIC LIFT _____
7. HOW WEIGHT OF CRITICAL LIFT WAS OBTAINED:
 - A. CERTIFIED SCALE WEIGHT _____
 - B. CALCULATED INDEPENDENTLY BY MORE THAN ONE SOURCE.
 1. SOURCE _____ WEIGHT _____
 2. SOURCE _____ WEIGHT _____
 - C. IF LIFT IS AN EXISTING ITEM (BEING REMOVED OR DEMOLISHED), THE WEIGHT IS TO BE RECALCULATED, TAKING INTO ACCOUNT ALL MODIFICATIONS INCLUDING INTERNAL AS WELL AS AN ALLOWANCE FOR SCALE, SEDIMENT, SLUDGE, INSULATION, LIQUID, ETC.
 1. SOURCE _____ WEIGHT _____
 2. SOURCE _____ WEIGHT _____
8. CONDITION OF HOISTING EQUIPMENT & RIGGING
 - A. HAS EQUIPMENT BEEN REINSPECTED FOR THIS LIFT? _____
 - B. HAS ALL EQUIPMENT & RIGGING BEEN INSPECTED AND FOUND IN ACCEPTABLE CONDITION FOR THIS LIFT? _____
9. GUYS, ANCHORS AND GUYS:
 - A. ADEQUACY OF FOUNDATION FOR FOOT BLOCKS _____
 - B. ADEQUACY, NUMBER AND LOCATION OF GUYS & ANCHORS _____
 - C. FOOT BLOCKS ARE TO BE ANCHORED _____

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CHECK LIST FOR
CRITICAL LIFTS

Check List for
Critical Lifts

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D. CONDITION OF ALL CABLE, INCLUDING SPLICES, CLAWS, THIMBLES,
AND OTHER HARDWARE _____

NOTHING IN THIS SUBMISSION AND/OR ACCEPTANCE OF THIS CHECK LIST
IS TO BE CONSIDERED AS RELIEVING THE CONTRACTORS OF ANY RESPON-
SIBILITY FOR A SAFE OPERATION.

10. STABILITY OF GROUND AREA:

- A. CHECK SOIL BEARING ALLOWABLE LOAD _____
B. WILL MATS BE REQUIRED? _____
C. ANY UNDERGROUND INSTALLATIONS NEEDING SPECIAL TREATMENT

CONTRACTOR

11. OPERATORS:

WHAT IS OPERATOR'S EXPERIENCE ON THIS EQUIPMENT AND THIS TYPE OF
LIFT? _____

BY: _____
TITLE: _____

12. REMARKS:

RESUME OF ACTUAL SCHEDULE:

DATE OF LIFT _____
INSPECTIONS COMPLETED _____
LIFT STARTED _____
PERMANENT SUPPORTS COMPLETED _____
TOTAL TIME _____

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9.0 LADDERS AND SCAFFOLDS

8.6 When arc welding is being done in an area restricted by a safe work permit, the grounding lead must be connected to the work within the limits as provided in the safe work permit.

8.7 Any contract provision for connections to an owner's plant services for construction use must be cleared with the owner's representative. Authorized connections must be made under the direction of the owner's personnel. The turning off and on of the supply shall be done only by authorized owner's personnel.

8.8 Gloves must not be worn while using grinders, drills, saws or any tools where gloves are apt to become entangled.

8.9 Loose clothing must not be worn while working around machinery.

8.10 Personnel must not crank any machinery with their feet.

8.11 Hose connectors and adaptors must be of a standard manufacture and used only for the type of service intended.

8.11.1 In order to insure positive locking at all times, connectors must be in good condition and not abused. Sandblast hose connections shall be the safety lock type which prevents accidental disengagements.

8.11.2 Air pressure on pneumatic tools must be bled down before tools are disconnected from air supply.

9.1 All ladders must be of the proper length and in good condition before using them. All unacceptable ladders must be immediately removed from owner's property.

9.1.1 Ladders are not to be painted with anything other than clear paint or linseed oil.

9.1.2 All straight ladders must be tied off or held. Stepladders higher than ten feet must be tied off at the top or held at the bottom by another workman. Personnel must not stand on the top step of any stepladder.

9.1.3 When climbing a ladder, personnel must face the ladder and keep both hands free for climbing.

9.1.4 Set straight ladders so that the bottom is out from the vertical about one-fourth of the distance from the upper support to the bottom.

9.1.5 All ladders should be provided with nonskid adjustable feet or properly supported on a level surface.

9.1.6 The area around the bottom of all ladders must be free from slippery substance and tripping hazards.

9.1.7 Ladders are not to be used as pencil or scaffold boards.

9.1.8 The top section of extension ladders are not to be used by themselves.

9.2 The use of No. 9 soft annealed wire should be minimized on scaffolds.

9.2.1 When No. 9 soft annealed wire is used, a minimum of two separate strands must be used to tie scaffold handrails.

✓ Included

braces, etc. The ties must be crossed to form a lock and prevent slipping in any direction.

9.2.2 Do not reuse No. 9 wire for any purpose.

9.3 Makeshift scaffolds such as boxes, crates and drums must not be used.

9.4 Wood scaffolding, aluminum ladders, aluminum scaffolds and aluminum pencil boards are not permitted except in special cases as specified in operating area rules and job specifications or by prior written approval from the owner's representative.

✓ 9.5 The following rules apply to all patented metal scaffolds:

✓ 9.5.1 Scaffolds must be erected with proper fixtures made for each type of scaffolding. Scaffolds and associated equipment must not be modified in any manner that reduces the manufacturer's designed performance.

✓ 9.5.2 All scaffolds and allied equipment must be kept in good repair.

✓ 9.5.3 Equipment that is damaged or deteriorated to the extent that it is unsafe shall not be used. Such equipment shall be removed from the owner's property.

✓ 9.5.4 Compensate for unevenness of ground by using adjusting screws in addition to proper blocking.

✓ 9.5.5 Do not force braces to fit. Adjust evenness of scaffold until the proper fit can be made with ease.

✓ 9.5.6 Use ladders when climbing scaffold rather than the cross braces and handrails.

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? 9.5.7 Personnel shall use ladders when climbing scaffold rather than the cross braces.

✓ 9.5.8 Horizontal diagonal bracing shall be used at bottom and intermediate levels of thirty feet to prevent racking of all scaffolds.

✓ 9.5.9 Planking overhang shall be 3-5/8" on stackup scaffolds. 1" by 4" wood cleats shall be nailed across top of planking at each end outside end frames. 2" by 3" cleats shall be bolted underside each end of plank with 2-1/4" stove bolts.

✓ 9.5.10 The maximum span for guying or tying off all fixed towers is every 18' of elevation.

✓ 9.6 The following rules apply to rolling tower scaffolds:

9.6.1 The minimum base dimensions for towers shall be 5' x 7'.

✓ 9.6.2 Towers of a height greater than three times the minimum base dimension must be guyed or tied off while being erected, used or dismantled.

✓ 9.6.3 Castor brakes must be applied when not in motion.

✓ 9.6.4 Towers must be free of men, material and equipment while being moved. Care must be exercised while moving.

✓ 9.6.5 Surface area where tower is being moved shall be free of rubble or any material that may cause the tower to tip.

✓ 9.6.6 Do not attempt to move a rolling tower without sufficient help.

- ✓ 9.6.7 Do not extend adjusting screws beyond the limits specified by the equipment manufacturer.
- ✓ 9.6.8 The minimum size for casters shall be 6". Scaffolds higher than 25' must be stabilized either with outriggers or hand lines while being moved.
- ✓ 9.6.9 Horizontal diagonal bracing is to be used at the bottom and at intermediate levels of 30 feet.
- ✓ 9.6.10 Do not use knee braces or cantilevered brackets on rolling towers.
- ✓ 9.7 The following rules apply to suspended scaffolds:
 - ✓ 9.7.1 Chains or 1/4" (minimum) steel cable shall be used to support suspended scaffolds. All suspended scaffolds shall be anchored to prevent swinging. Chains so used shall be made of not less than 1/4" links* and shall be inspected immediately prior to each use.
 - ✓ "1/4" proof coil loading chain
Safe Load 900 lbs.
 - ✓ 5/16" proof coil loading chain
Safe Load 1,360 lbs.
 - ✓ 5/16" proof coil loading chain
Proof-tested Safe Load 2,720 lbs.
 - ✓ 5/16" proof coil loading chain
Unlimited Safe Load 5,440 lbs.
 - ✓ 9.7.2 The suspended support must be insulated when arc welding is to be performed from platform, thus avoiding accidental arcing and subsequent failure.
 - ✓ 9.7.3 Block and falls shall be a minimum of two sheaves for 3/4" rope and the minimum size rope shall be 5/8". Acid resistant rope shall be used in

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acid or caustic areas. Tail ropes shall be placed in an open container for protection while used in an acid area or above operating machinery, pumps, etc. All ropes and blocks must be inspected and tested prior to each use and taken down and stored inside at the end of each work day.

9.8 The following rules apply to all scaffolds:

- ✓ 9.8.1 Scaffolds and related material shall be carefully inspected at regular intervals and particularly just before using.
- ✓ 9.8.2 Provide sufficient sills or underpinning on all scaffolds to be erected on filled or otherwise soft ground. Scaffold boards shall not be used for this purpose.
- ✓ 9.8.3 All scaffolds must be plumb and reasonably level at all times.
- ✓ 9.8.4 Anchor running scaffolds to wall approximately every 28' of length and 18' of height. Use additional care when using pulley arms.
- ✓ 9.8.5 Handrailing and access ladders must be used on all scaffolds regardless of height. Scaffolds higher than 30' around columns, tanks, etc., must have access ladders constructed on the inside, unless a ladder cage is provided. Handrails must be at a height sufficient to provide maximum personnel safety.
- ✓ 9.8.6 Scaffolds must not be used as material hoist towers or for mounting derricks without first determining the loads and stresses involved.
- ✓ 9.8.7 Erect scaffolds in such a manner that ladder is accessible and lined up from top to bottom.

9.8.8 Lumber used in the construction of platforms shall be of good quality and reasonably straight grained. It shall be free from defects such as injurious ring shakes, checks, splits, cross grains, unsound knots, knots in groups, decay and growth characteristics or any other defect which materially decreases the strength of the lumber. Planking shall not be painted all over, as this would conceal any defects. Scaffold boards shall be identified by painting each end. All scaffold boards shall be used exclusively for that purpose. Nothing less than 2" x 4" material shall be used as handrails on wooden scaffolds.

9.8.9 The normal size of planking shall be determined from Table I. These values are for planks with the wide face up, with the loads concentrated at the center. Loads given in the table are net. Allowance has been made for the weight of the planking. If select structural coast region Douglas fir, merchantable structural square and sound southern pine are used, the loads may be increased 45 percent.

9.8.10 Planks used for platforms shall be of uniform thickness, laid close together. These planks must be overlapped at the bearers. An overlap of at least 2' must be allowed with the bearing in the center of the overlap. When planks overhang a bearer more than one-tenth of the length of the span, the planks must be securely fastened to the bearer at the opposite end to prevent tipping.

9.8.11 All nails used in scaffold construction shall be driven full length. If double headed nails are used, they shall be driven to the first head only and may not be used on platforms or walkways. No nail smaller than 8d shall be used in this construction. The design must be such that no nail is subject to a direct pull.

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9.8.12 Where beams are used in scaffolding, the schedule of loads shown in Table II shall be followed. Loading on cantilever type beams for tool and material hoists is shown in Table III. It should be noted that the loading at the center of bearing point is 4 times as great as the load being lifted and the bearing should be checked to ascertain if it will support the contemplated load. The inboard end of the beam has a force upward of twice the load and must be securely fastened with no nails in direct pull.

9.8.13 Platforms shall be kept clear of slippery substances and tripping hazards.

10.0 DANGER, WARNING & CAUTION TAGS

10.1 Danger Tags (Red)

10.1.1 To insure that operating status of equipment is not changed while it is being used or worked on, red danger tags must be attached to the controls so that personnel will know not to use them. These tags must be used to protect personnel exposed to hazards of equipment and must be respected by all personnel. The personnel responsible for the operation of equipment or their designee must clear and tag the equipment. Any personnel whose safety could be endangered while working on this equipment must affix their tag. Violation of red danger tag rules will result in disciplinary action up to and including rejection from any work on owner's property.

10.1.2 No control such as a valve, switch, clutch, etc., is to be operated by anyone while a red danger tag is attached. If a control must be operated intermittently such as for testing equipment, the red danger tag must be properly removed before each operation.

TABLE I
SAFE CENTER LOADS FOR SCAFFOLD
PLANK IN POUNDS

Span in Feet	SIZE OF PLANK			
	2 x 10 Dressed To 1-5/8 x 9 1/4	2 x 12 Dressed To 1-5/8 x 11 1/4	3 x 10 Dressed To 2-5/8 x 9 1/4	3 x 12 Dressed To 2-5/8 x 11 1/4
6	296	328	667	807
8	182	222	520	626
10	153	186	400	484
12	128	156	333	404
14	110	133	286	346
16		116	259	302

TABLE II
SAFE CENTER LOADS ON TIMBER USED AS
BEAMS IN POUNDS

Nominal Timber Size	LENGTH OF SPAN IN FEET							
	5	6	8	10	12	14	16	20
2 x 4	440	290	210					
4 x 4	725	575	420	330	260	215		
2 x 6	780	650	470	360	290	240	180	
2 x 8	1400	1150	850	640	530	440	370	270
2 x 10	2180	1830	1360	1060	860	710	600	460
2 x 12	2820	2630	1950	1530	1250	1050	880	670
3 x 8	2100	1730	1290	990	810	680	560	418
3 x 10	3280	2760	2120	1580	1300	1070	900	670
3 x 12	4520	3840	2920	2300	1880	1570	1340	1000

TABLE III
SAFE LOADING FOR SIMPLE MATERIAL
HOIST ON CANTILEVER BEAM IN POUNDS

Beam Size	LENGTH OF CANTILEVER IN FEET						
	2	3	4	5	6	7	8
4 x 4	220	180	106	80	65		
4 x 6	496	328	260	180	150	125	106
6 x 6	748	490	360	265	230	180	160
8 x 8	1375	875	650	515	420	350	300
8 x 6	1706	1165	865	685	560	470	400

Horizontal dimension from front bearing to rear anchor must be equal to or greater than cantilever projection "B" in table

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Attachment of danger tags to equipment controls does not mean that equipment has been cleared to work on. When work is to be done on tagged-out equipment, personnel responsible for the operation of the equipment are responsible for clearing the equipment and making it safe for others to work on.

10.1.3 Whenever the operation or use of any equipment may endanger anyone, a request must be made to supervision of the group which operates the equipment to clear and tag the equipment. "Clearing" means making the equipment inoperable and safe for others to work on. The authority to clear and tag equipment may be delegated by this supervision to any qualified personnel after supervision has assured themselves that the person delegated can properly clear the particular job involved.

10.1.4 After the group which operates the equipment has cleared and tagged the equipment, each worker or group of workers who may be exposed to the hazards must tag the equipment for their protection. When red danger tags are attached to equipment by persons other than those responsible for its operation, prior approval from the person responsible shall be obtained.

10.1.5 As the individual jobs have been completed, each worker or group of workers must remove their tags immediately.

10.1.6 The group responsible for the equipment must place their tag first and remove their tags last.

10.1.7 Red danger tags may be removed only upon authorization of the person designated on the tag. The supervisor of any person who fails to remove a red danger tag when a job has been

completed may authorize the removal of the tag after he has determined to his complete satisfaction that the equipment can be operated in a safe manner. In the space on the tag entitled "Removal Will Be Ordered By _____" it is permissible to designate a classification such as shift foreman, electrician, or machinist instead of a specific individual's name.

10.1.8 At the discretion of the supervisor, locks may be used on valves and switches in addition to, but not replacing red danger tags.

10.1.9 Tags removed must be filled out and turned in to the owner's representative.

10.2 Warning Tags (Green)

10.2.1 When it is necessary to convey instructions or information prior to operation of equipment controls, green "warning" tags are to be attached to the controls.

10.2.2 Green "warning" tags should be removed when conditions set forth on the tag have been met.

10.3 Caution Tags (White)

10.3.1 White caution tags are affixed to mechanical or electric equipment by the owner's representative to prevent operation of such equipment by anyone until items on the tag have been completed.

10.3.2 The tag provides spaces for meggering, rotation, final alignment and lubrication of equipment. When appropriate action has been taken, the personnel performing the work signs and dates the tag.

10.3.3 When tagged equipment is released to the owner, a representative of

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operations and the owner's representative sign the tag which is kept by the owner's representative until job completion.

11.0 SAFE WORK PERMITS

11.1 Safe work permits issued by the owner to contractor personnel may be required for certain hazardous locations and conditions. These permits are designed to provide a means of checking at the job site the safety of such jobs as, but not limited to, entering closed vessels; working on electrical gear; welding, cutting on, breaking into or repairing pipelines or vessels in operation or under pressure or that have contained hazardous materials. These permits also cover work involving the use of flame or spark producing equipment in hazardous areas or near an open ditch and work on machinery.

11.2 Contractor supervision must be in close contact with the progress of work as well as communicating with the owner's representative for up-to-date status of operations. Further, contractor supervision must be certain that all personnel involved are informed as to specific procedures and changes in the situation.

11.3 Safe work permits are to be initially requested through the owner's representative and issued by the owner's operating area or facility supervision involved on any job where the safe work permit is applicable. More than one safe work permit may be required on certain jobs which will be ascertained upon obtaining each safe work permit. Permits are issued on a day-to-day basis.

11.4 Personnel must give a careful and complete description of the work to be done to the person issuing the safe work permit.

11.4.1 Where a job presents a serious man hazard due to chemical, mechanical, electrical, temperature or height exposure, it is mandatory that a written safe job procedure accompany the

request for the safe work permit. This procedure is to be signed by the owner's representative, process representative, and the contractor, who thereby agree that the procedure allows the job to be done safely.

11.5 Directions and restrictions noted on safe work permits must be carefully followed.

11.6 A safe work permit must be reissued for a job if there is evidence that conditions have changed subsequent to the issuance of the original safe work permit.

11.7 Permits issued for jobs that last longer than one day will normally be issued for that job each day. By mutual consent of the parties involved, permits for these jobs may be issued for longer or shorter periods of time.

11.8 Vessels in an existing facility to be entered must be made safe for personnel by such measures as disconnecting, blinding, or double block and bleed on connecting piping. If such precautions are impractical, a detailed procedure for performing the work in a safe manner must be prescribed as specified in Paragraph 11.4.1.

11.9 Vessels in an existing facility to be welded on, or cut, must be positively checked inside for flammable or explosive gas and/or liquids and and safe work permits issued before heat is applied.

11.10 The contractor may request safe work permits for his own protection. Safety checks by the owner for dangerous gases or chemicals should be requested through the owner's representative when there is any uncertainty.

11.11 All safe work permits in the area affected are automatically cancelled when an emergency signal is sounded and must be reissued after the all clear signal.

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12.0 EXCAVATIONS, FLOOR OPENINGS, BARRICADES

12.1 Where a safety hazard would be created for any personnel, excavations such as ditches, trenches, or bell holes should be sloped sufficiently to prevent cave-ins or slides. If sloping is impractical, shoring must be used in cases whenever the vertical dimension exceeds four feet.

12.1.1 Personnel removing shoring after completion of work must not be in the bottom of the excavation. Shoring must be removed in such a manner to prevent cave-in on personnel.

12.2 Contractors must provide adequate barricades, covers, handrails, signals, flagmen, or other appropriate warning devices to protect personnel near any hazardous operation or excavation. Floor openings, open trenches, excavations, etc., shall be covered when handrails or barricades do not provide adequate protection to personnel.

12.2.1 Contractors must notify the owner's representative of necessary obstruction on road shoulders on the day it occurs.

12.2.2 Contractors must obtain approval from the owner's representative at least one day prior to cutting roads or otherwise obstructing traffic on plant roads.

12.3 Grade lines, ropes, chains, etc., must be sufficiently marked in order to be visible day or night.

12.4 No obstruction of any kind, whether permanent or temporary, is permitted within 8'-9" horizontally from the center line of any railroad track and within 22'-6" vertically from the top of the rail. Specific authorization from the owner's representative as well as blue flags are required prior to boring under or excavating adjacent to railroad tracks. Blue

Flags must be placed on railroad tracks when the entrance of a train would present a hazard to personnel or equipment.

12.5 In locations where strictly temporary loading or unloading operations are to be undertaken, portable derrails must be used by personnel engaged in these operations to prevent overrunning of the cars by a train.

12.6 Blue flags meeting ICC specifications, available through the owner's representative, must be placed on railroad tracks when the entrance of a train would present a hazard to personnel or equipment and in addition to, or in conjunction with, derrails during loading or unloading operations. Blue lights, available from the owner's representative, must be attached to blue flags at night.

12.6.1 Blue flags must be placed on the tracks so they will be in unobstructed view of the train crew and they must be placed a minimum of two-car lengths (100 feet) in front of the end car they are intended to protect. Exceptions to the minimum distance may be made by the owner's representative where existing installations do not allow sufficient space.

12.6.2 Blue flags must be removed immediately when the hazard for which they were installed no longer exists.

13.0 RADIATION

13.1 All state and/or federal laws governing use, storage or handling of a radiation source must be complied with.

13.2 A minimum of two qualified people are required for the performance of any radiographic work.

13.3 In locations where a radiation source is used or stored, regulations require that it be marked with a "Radiation Material" sign. This sign is for the purpose of informing anyone in

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the area that such material is present, and not that a safety hazard due to radiation exists.

13.3.1 Only authorized personnel may enter an area marked by "Radiation Area" sign.

13.3.2 All areas where a radiation hazard exists must be roped off and marked conspicuously by standard signs at a safe distance from the source of radiation. These signs bear the radiation symbol of magenta (or purple) on a yellow background with the words "Caution--Radiation Area."

13.3.3 "Radiation Area" signs must be removed when a radiation hazard no longer exists in the affected area.

13.4 Equipment containing a source of radiation must not be handled, uncrated or installed without prior clearance with the owner's representative.

14.0 DEMOLITION

14.1 This section specifically covers the demolition (removal of facilities that have been abandoned. Due to the inherent hazards in this type of work, special care must be devoted to safe procedures, scope understanding and communications concerning the safe clearance of work.

14.2 It is not appropriate to make assumptions in any stage of a demolition job. Responsibilities must be delegated only to those whose profession qualifies them to make the necessary judgments and decisions that are required to assure the safest possible prosecution of the job. From start to finish, each person connected with a demolition job must adopt an attitude of "prepare for any possibility."

14.3 The contractor shall make certain that all lines, services and equipment have been cleaned

or purged and properly cleared for safe removal. All lines (including water and steam) are to be considered hot until positive safe clearance has been obtained.

14.4 Special care shall be exercised to locate and mark old underground or otherwise hidden lines, cables and sewers using the best available information and owner's assistance.

14.5 The prejob safety meeting with the contractor, as covered in Section 1 of this manual, shall devote special attention to preplanning the safety aspects of demolition jobs.

14.5.1 Steps of dismantling and loads to be handled shall be reviewed with the owner's representative prior to starting work.

14.5.2 Temporary provisions must be made where safety showers, eyewash baths and fire extinguishers are being moved in the work area.

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**SAFETY AND LOSS
PREVENTION MANUAL
FOR CONTRACTORS**



AMBULANCE
FIRE
ACCIDENTS
EMERGENCIES



DIAL
666

THE DOW CHEMICAL COMPANY
TEXAS DIVISION
April, 1970

**SAFETY AND LOSS PREVENTION
MANUAL FOR CONTRACTORS**

**FOR USE BY ALL CONTRACTOR PERSONNEL
WORKING IN THE TEXAS DIVISION**

**THE DOW CHEMICAL COMPANY
TEXAS DIVISION**

April, 1970

*(Supersedes Safety and Loss Prevention Manual
for Contractors dated January, 1969)*

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INTRODUCTION

This safety manual contains the minimum safety rules and procedures for performance of work by contractors and their sub-contractors as required by the Texas Division, The Dow Chemical Company. Contractor assumes and has the full responsibility and ability for the safety of its agents, servants and employees and for the compliance of its sub-contractors, and anything contained herein does not relieve the contractor of such responsibility or liability. The Dow Chemical Company is hereinafter referred to as Owner. The Owner will be represented on construction as defined in the contract and hereinafter referred to as "Owner's Representative."

Safety rules and procedures are an integral part of each contract and must be carried out fully, as another specification for the job. The contractor will be held responsible for his sub-contractors conforming with these safety rules and procedures. Any exception to the rules set forth herein must have prior written authorization from the Owner's Representative.

Contractors and contractor supervision unable or unwilling to secure personnel performance in keeping with these rules will not be acceptable. Contractor employees who exhibit a poor attitude toward safe work and safety procedures will not be acceptable. EMPLOYEES LEAVING A JOB DUE TO SAFETY VIOLATIONS WILL NOT BE ALLOWED TO RETURN TO ANY OWNER'S WORK WITHOUT PROPER AUTHORIZATION FROM THE OWNER. The contractor's safety record will be one criterion used to judge his qualifications for bidding.

In addition to the rules set forth herein, contractors working in or near an existing operating facility must be cognizant of and conform to Owner's safety rules for that area and any federal, state or local laws governing.

Should any procedure set forth herein conflict with applicable federal, state or local laws, the latter will apply.

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1.0 GENERAL SAFETY RULES

1.1 The contractor shall actively and adequately promote safe working performance on the part of his employees. He shall participate in activities to this end, such as contractor safety organizations (e.g., Contractors' Safety Council of Brazosport), incentive award programs, contractor owner programs, etc. It is expected that each contractor will conduct his own safety programs to best suit his particular needs.

1.1.1 American National Standard, Z-16.1, "Recording and Measuring Work Injury Experience," shall be used as a guide to classify contractor injuries.

1.2 Prior to starting any field work on each job, the Owner's Representative will conduct a pre-job safety conference with an authorized representative of the contractor, a Manufacturing Representative, available subcontractors' representatives and Owner's Safety Department representative, when available. At this time, the nature of any chemical hazards or special safety rules for the area will be reviewed with the Process Representative and the contractor will be provided with printed copies of area rules where applicable. The "pre-job safety check sheet" form (see sample) will be prepared by the Owner's Representative and a copy furnished to the contractor.

CONSTRUCTION
PRE-JOB SAFETY CHECK SHEET

DATE _____
BLOCK _____

JOB NO. _____ CONTRACTOR _____

1. Employee Emergency escape route assigned?	Yes ☐ N.A. ☐
2. Emergency escape route in case of emergency assigned?	Yes ☐ N.A. ☐
3. Fire and extinguishing equipment assigned?	Yes ☐ N.A. ☐
4. Location of available medical first aid kit assigned?	Yes ☐ N.A. ☐
5. Access for accident investigation assigned?	Yes ☐ N.A. ☐
6. First aid kit assigned to person and placed under the protection of assigned supervisor?	Yes ☐ N.A. ☐
7. Second set of first aid kit assigned to the same person?	Yes ☐ N.A. ☐
8. Patient or supervisor or both on the scene for the assigned first aid kit assigned?	Yes ☐ N.A. ☐
9. Second set of first aid kit assigned to the same person?	Yes ☐ N.A. ☐
10. Before leaving the job the assigned person?	Yes ☐ N.A. ☐
11. Are there any other assigned? (If assigned assign to person assigned)	Yes ☐ N.A. ☐
12. Place of work assigned to the same person assigned?	Yes ☐ N.A. ☐
13. Red Tag rule assigned?	Yes ☐ N.A. ☐
14. Access and clearance?	Yes ☐ N.A. ☐
15. Control of assigned work assigned?	Yes ☐ N.A. ☐
16. Control of assigned work assigned to the same person assigned?	Yes ☐ N.A. ☐
17. Control of assigned work assigned to the same person assigned?	Yes ☐ N.A. ☐
18. Do not have a copy of the assigned work assigned?	Yes ☐ N.A. ☐
19. Contractor is not responsible for the control of their assigned work assigned?	Yes ☐ N.A. ☐
20. Are other assigned work assigned to the same person assigned?	Yes ☐ N.A. ☐

REMARKS _____

Contractor Representative	Date	Supervisor	Date
Owner's Representative	Date	Inspector	Date
Inspector's Representative	Date	Inspector	Date
Owner's Representative	Date	Inspector	Date

1.3 An effective system of indoctrination and education of employees in safety and loss prevention is expected of each contractor. Contractors shall inform all their employees of all safety rules and all safety procedures before working in an Owner's plant.

1.3.1 Contractors shall inform all of their employees of the location and use of nearest safety shower, eye bath and emergency equipment such as gas masks, fire extinguishers and fire blankets.

1.4 Contractors shall use a regular system of work inspection to detect and correct hazardous conditions, safety rule violations and unsafe working practices. These safety inspections shall be reported to the Owner's representative in writing each week.

1.4.1 Orderliness is a basic requirement for all jobs and must be maintained at all times. Special attention must be given to maintaining clear walkways and roadways, removal of trash, removal of slipping and tripping hazards and proper stacking of materials. Contractors must make every effort to keep mud, slush or other slippery substances off plant roads. In cases where this cannot be avoided, contractors must clean the roadways immediately.

1.5 Temporary buildings and material storage areas shall be set up as neatly as possible to present an orderly appearance.

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1.5.1 Temporary buildings or combustible materials must not be located under power lines or pipeways. Overnight parking of equipment or vehicles under power lines or pipeways is not permitted.

1.5.2 Temporary buildings shall be sheeted with non-combustible material, such as transite or metal siding and roof, and each must be identified with the contractor's name and building number.

1.5.3 Contractors' temporary buildings must be properly tied down upon placement at the job site. A minimum of four 4-inch screw anchors a minimum of two feet in the ground are required. A minimum of two such anchors are required for portable toilets.

1.5.4 Metal buildings served with electricity must have the skin of the building and the service entrance switch separately grounded. Jumpers must be used, if necessary, to tie the roof and sides of the building together to insure complete grounding.

1.5.4.1 Ground rods shall be $\frac{3}{4}$ " minimum galvanized steel and shall be driven to a depth of 10 feet.

1.6 Contractors must furnish trash containers made of metal with metal covers kept in place.

1.7 Contractors must report immediately in writing to the Owner's Representative, by name, those employees DISCHARGED for safety rule infractions. The reason for the discharge must be given.

1.8 Contractors shall maintain continuous safety planning to cover jobs where circumstances have changed and new hazards require new controls.

2.0 EMERGENCY PROCEDURES

2.1 The following procedure must be used to call an ambulance, report a fire, spill of hazardous materials or release of hazardous gases.

2.1.1 Dial "666" and state the type of emergency.

2.1.1.1 If the "666" number does not answer immediately, dial "O" (Operator).

2.1.2 Give your name, the nature of the emergency and its exact location, including building number and door letter, if applicable.

2.1.3 Stay on the line until sure that the message is understood and confirmed.

2.1.4 Station someone on the road to direct emergency equipment to the scene.

2.2 Personnel must know the location of any plant alarm horns. In case of a gas release, observe the wind direction as indicated by the alarm horn and wind vane indicator and proceed to go crosswind. STANDARD EMERGENCY SIGNALS ARE AS FOLLOWS:

2.2.1 GAS RELEASE _____
(Continuous)

Shut down all of your equipment in operation. Stop smoking. All Safe Work Permits in that area are automatically cancelled. Personnel in other areas downwind must be alert for signals in their area or verbal instructions.

2.2.2 ALERT
(Series of short blasts)

Shut down all of your equipment in operation. Stop smoking. All Safe Work Permits in that area are automatically cancelled. Personnel in other areas downwind must be alert for signals in their area or verbal instructions.

2.2.3 EVACUATE
(Series of 3 short blasts)

Evacuate according to the unit emergency plan of the plant in which you are working or, lacking such a plan, observe the wind direction as indicated by the alarm horn and wind vane indicator and proceed to go crosswind or, if that direction is not possible, upwind.

2.2.4 ALL CLEAR _____
(Series of 3 long blasts)

When this signal is given, personnel may re-enter the work area. Safe Work Permits must be reissued prior to starting work.

2.3 If operating a motor vehicle in an area where emergency signals are given, turn off the engine, get out of the vehicle, and be prepared to leave the area if necessary. Motor vehicles, other than emergency units, must not be driven into an area downwind of a gas release signal. Barricades across plant roads must be honored by all vehicles at all times.

2.4 In case of fire, explosion or other emergency, the contractor shall notify the proper Owner's Representative or his headquarters in person or by telephone as soon as possible that all employees in the area are accounted for or that specific employees cannot be accounted for.

2.5 Emergency horns are tested each Monday at 12:00 noon with the "All Clear" signal given first and last in the test cycles.

3.0 FIRST AID - INJURIES - REPORTS

3.1 The Owner's Representative shall be notified immediately in the event of any death, occupational disease, disabling injury or potentially significant injury to a contractor employee (whether or not it is determined that a "disabling injury" will be involved)

while at work on the Owner's job. He shall also be notified immediately of the occurrence of any potentially serious incident (no injury involved) or of any hazardous condition observed.

3.1.1 The contractor must thoroughly investigate, determine and report all details of an accident and cooperate with the Owner and Contractors' Safety Council inspection teams.

3.1.2 A written report must be submitted on every injury requiring medical treatment of any kind, to the Owner's Representative on the job, no later than 10:00 a.m. of the day following the injury. Also, any near-miss, potentially serious incident or hazardous condition that occurs, must be reported in the same manner, although no injury to personnel may be involved. Forms for these reports, "Notice of Contractor Accident and Property Loss", are available through the Owner's Representative. (See sample)

3.1.3 All fires must be reported, regardless of duration or extent.

3.2 Employees must report any injury to their immediate supervisor even though it may be considered slight.

3.2.1 The contractor shall make sure that all injured personnel report to a recognized medical facility. A First Aid

NOTICE OF CONTRACTOR ACCIDENT OR PROPERTY LOSS

This notice to be submitted by contractor to the Owner Representative as soon as possible, but not later than 10:00 a.m. the day after any injury requiring medical treatment of any kind, or for any potentially serious incident or hazardous condition occurring, although no injury was involved.

CONTRACTOR _____ SUB CONTRACTOR _____

P. O. No. _____ DATE _____ TIME _____ A.M. _____ P.M. LOCATION _____

NAME OF INJURED _____ AGE _____

CRAFT _____ CLOCK NUMBER _____

EXTENT OF INJURY _____

WHERE TREATED _____

IS THIS A DISABLING INJURY YES () NO () INDEFINITE ()

WHAT HAPPENED _____

CAUSE _____

CORRECTIVE ACTION TAKEN _____

SAFETY INVESTIGATION MADE BY _____

_____(Foreman)_____(Owner Representative)_____
DATE DATE

_____(General Foreman)_____(Owner Construction Sub.)_____
DATE DATE

_____(Prime Contractor Sub.)_____
DATE DATE

Station is available at Plant A and Industrial Medical Facilities and the Community Hospital at Plant B. The contractor is responsible for furnishing treatment reports if a medical facility other than the above is used.

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3.2.2 In the event of accidents, ambulance runs, etc., contractors must exert all possible effort to keep onlookers from the scene. The only personnel required in such areas are those directly engaged in assisting in the emergency.

3.3 Employees must not attempt to remove foreign material from the eyes, except by washing with water. If foreign material, either solid or liquid, gets in the eye, the eye must be washed immediately with potable running water, preferably at an eyewash station, and the washing continued uninterrupted for at least fifteen minutes. It is vital that the injured employee and others who are able to help him make sure that thorough and complete washing of the eye is accomplished. THE AMBULANCE MUST BE CALLED.

3.4 If chemicals come in contact with the body, the affected parts must be washed with running water for at least fifteen minutes. To make sure that adequate washing is accomplished, shoes and clothing covering affected parts must be removed. The Owner's Representative must be consulted before reuse of clothing and shoes that may have been contaminated.

4.0 INDIVIDUAL ACTION

4.1 Horseplay in any form is not allowed.

4.2 Running in the plant must be avoided except in case of an emergency.

4.3 Personnel must not climb through, under, over or between railroad cars of a train except in the performance of assigned duties necessitating such action.

4.4 Unless specifically authorized to do so by the Owner's Representative, contractor personnel must not make inoperative or operate safety devices such as relief valves, deluge valves, gate valves, electrical and mechanical interlocks, guards, electrical switches in an operating plant.

4.4.1 Any accidental interruption of lines or equipment in service or any irregularities observed must be reported to the Owner's Representative and/or the Owner's operating personnel immediately.

4.5 Unsafe shortcuts, such as walking pipe-lines, sliding down pipe or stanchions and cutting corners to save a few steps, must be avoided.

4.6 Tools, materials or equipment must not be intentionally dropped or thrown from one level to another unless adequate precautions have been taken to assure that no injury to persons or damage to equipment will occur.

4.7 Lifting of personnel by a crane is prohibited unless done by means of a bosun's chair and safety harness or by means of a crane basket and safety belt or harness.

4.8 Personnel must not stand, sit, walk, drop or jump on a transite roof. Where a permanent platform or walkway is not provided, a temporary walkway or spread footing shall be used to distribute the load over a large area of the transite.

4.8.1 In lieu of using a temporary walkway or spread footing, contractors installing transite roofs may hang safety nets under the erection area. Such nets must be of acid resistant material, and designed and installed for the specific purpose of catching personnel who might fall.

5.0 VEHICLES AND TRAFFIC

5.1 Personnel working on Owner's property will comply with all safety rules and signs regarding traffic and vehicles at all times.

5.2 Seat belts, as required by law in vehicles, shall be used whenever a vehicle is in motion.

5.3 The maximum speed limit is 30 miles per hour on open roads in the plant and 10 miles per hour within block limits, unless otherwise designated by signs.

5.4 When approaching a plant bus from either direction while it is stopped on a plant road to load or discharge passengers, vehicles must come to a complete stop. Provided that the way is clear, they may then proceed past the bus at no more than 10 miles per hour.

5.5 Smoking will not be permitted in vehicles in designated "NO SMOKING" areas.

5.6 Hauled material that overhangs the sides or ends of a truck must be red-flagged at the extent of the overhang. Loads must not be hauled from a single suspension cable that allows free swinging beyond the sides of the truck. Dragging or skidding material and objects along plant roadways is prohibited.

5.7 Fuel tanks on motorized equipment must not be filled while the engine is running or is hot, nor while welding or other hot work is being done nearby. Smoking will not be allowed in the immediate vicinity during the fueling operations.

5.8 Motorized equipment such as trucks, dozers, cranes, graders, etc., must not be left running and unattended.

5.9 Equipment such as welding machines, pumps, etc., shall not be transported with the engine running.

5.10 All equipment must be in safe mechanical working condition at all times. In addition to complying with state requirements as to brakes, lights, signals, horns, mufflers, etc., vehicles must be periodically inspected by a representative of the contractor. Necessary repairs and adjustments must be made prior to their use on Owner's property.

5.11 The use of flatbeds, stakebeds, etc., as transportation for personnel will not be permitted unless adequate safety provisions are made and the vehicle is adapted for that purpose. In any case, the number of personnel must not cause overcrowding.

5.12 Riding of "Cherry Pickers," yard cranes or winch trucks, is permitted only when adequate safety provisions such as seats, platforms, rails, etc., are provided for passengers.

5.13 The maximum number of people who may ride in the cab of a pickup is three. Personnel riding in the back must be seated on the floor of the bed, or on approved built-in seats.

5.14 Vehicles must yield to pedestrians crossing streets in marked pedestrian lanes.

5.15 Pedestrian paths and walkways must be used whenever provided. In their absence, personnel using streets and roadways must walk facing approaching traffic.

5.16 The following rules must be observed when moving cranes, cherry pickers, winch trucks and similar equipment having booms or extended loads in excess of 15 feet in front of or to the rear of the equipment.

5.16.1 A flagman must be provided.

5.16.2 At intersections, when the equipment is to proceed straight across a main

thoroughfare or turn either way, the operator must stop; the flagman must get off the equipment, clear all traffic, then flag the equipment through the intersection or around the corner.

5.16.3 Before entering any thoroughfare, street, road, etc., from a work area within a block, the flagman must clear the traffic and flag the equipment onto the road.

5.16.4 All booms extending more than 15 feet must be marked with high visibility material when moving on plant roads. Loads extending more than 3 feet in front of or behind a vehicle must be flagged. Traveling speeds must be safe and prudent, depending upon loads, traffic, road conditions, etc.

5.16.5 A flagman must be provided and swinging of loads must be controlled with a tag line when moving in a congested area or where load swinging would present a hazard to personnel or property.

5.16.6 Loads or vehicles that extend out of the normal road lanes require flagmen or escorts.

5.16.7 Contractors must check vertical clearances and bridge load limits on the route to be used prior to moving equipment or high loads.

5.17 Prior to moving extremely heavy loads,

contractors must determine from the Owner's Representative which roads are to be used, and when.

5.18 Motor vehicle accidents, including those involving personal cars on company property, must be reported to Industrial Security and the Owner's Representative immediately.

6.0 PROTECTIVE EQUIPMENT AND CLOTHING

6.1 The contractor and his employees shall recognize the importance of the use of special protective equipment and clothing whenever and wherever prescribed.

6.1.1 The contractor shall be responsible for knowing and enforcing special Owner area or job rules requiring special personnel protection.

6.1.2 Contractors shall provide their employees with the proper protective equipment required and shall enforce its use.

6.2 Approved safety glasses with approved side shields are a minimum requirement on all contractor jobs at all times and shall be properly fitted to the wearer.

6.2.1 Approved safety glasses with side shields must fulfill federal requirements (GGG-G-513) for drop-ball testing and safety code for polarized "Strain" pattern.

6.2.1.1 Prescription glasses with side shields are acceptable only if they meet the requirements of Paragraphs 6.2 and 6.2.1.

6.2.2 Employees wearing contact lenses must wear chemical goggles.

6.3 Chemical goggles, approved prior to their use, are required for working in or entering certain chemical areas which are posted with signs, or while doing chipping or power tool cleaning work on pressurized lines or equipment which contains hazardous chemicals.

6.3.1 All employees working in the vicinity of chemicals must know where the nearest safety shower and eye bathing facilities are located.

6.3.2 When chemical type goggles are in use, the headband must be around the back of the head, not around the safety hat.

6.4 Face shields, together with side shield safety glasses or chemical goggles, must be worn while grinding, chipping or buffing.

6.5 Approved plastic safety hats are required for all contractor work. The use of metal safety hats is prohibited.

6.5.1 Approved plastic safety hats must fulfill requirements in Federal Specifica-

tion GGG-H-142C. The major requirement in this specification says, "The specimen must withstand the drop of an 8 pound spherical weight, approximately 3.8 inches in diameter, from a distance of 5 feet, without breaking the hat, bottoming out or breaking suspension." Most skull caps, scalp guards, bump helmets, etc., will not meet this test. Safety hats shall not be drilled or punched for ventilation holes, or edges trimmed off hats.

6.6 When sandblasting or applying volatile or toxic material inside tanks, rooms or other inadequately ventilated areas, air hoods or equivalent equipment, supplied with filtered air, shall be worn.

6.6.1 The enclosed area must be sufficiently ventilated to prevent the build-up of an explosive mixture.

6.7 Safety belts or harnesses, with lifelines attached, are to be worn by employees when performing work in elevated positions where the use of scaffolds or ladders is impractical and where a slip might result in a serious fall.

6.8 Personnel must wear Owner approved life jackets or otherwise be protected by handrails or lifelines, when working over water wherein a drowning hazard exists.

6.9 Employees are expected to wear personal clothing that is safe and proper for their jobs.

Wearing of canvas shoes, sneakers or house-shoes, and working in an undershirt, shorts or stripped to the waist is prohibited. Loose sleeves, long watch chains or rings should not be worn where there is a potential hazard. The wearing of safety shoes is strongly recommended.

6.10 Fixed blade knives used as tools of the trade must be carried in sheaths while not in use.

7.0 FIRE PROTECTION

7.1 Accumulation of trash, oily rags, combustible material, or fire hazards of any nature will not be permitted.

7.2 The area around welding and cutting operations must be kept free of flammable material of all kinds (wood, paper, cardboard, flammable liquids, etc.

7.2.1 There must be a fire extinguisher, water hose, or other fire control equipment easily accessible for each welding, cutting, burning or other such operation.

7.2.1.1 It is the contractor's responsibility to obtain any required fire extinguishers through the Owner's Representative. It is also the contractor's responsibility to arrange, through the Owner's Representative,

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for the recharging and resealing of extinguishers immediately after each use.

7.2.1.2 When such work is being done in a grassy area where an adequate water hose is not available, mops and buckets of water shall be kept on hand for the control of possible grass fires.

7.2.2 Special care must be taken during overhead cutting and welding operations to safeguard personnel and prevent falling sparks from starting a fire. Warning signs must be posted at each level below the area of any overhead welding, burning or cutting operation. Warning signs are available through the Owner's Representative.

7.2.3 A Safe Work Permit must be obtained prior to cutting or welding along or above a railroad right-of-way. A blue flag must be placed on the track if sparks or slag could constitute a fire hazard to passing railroad cars. In the event it becomes necessary to remove the flag and move rail cars, the Safe Work Permit is cancelled and must be reissued before the work is resumed.

7.2.4 When rail cars that contain combustible or flammable material are within 50 feet of the work area, they must be moved prior to starting any hot work.

7.3 All tarpaulins shall be fire-retardant and identified as such by stenciling: "FR-treated (date)" with a minimum of 2-inch letters in diagonal corners. In lieu of this treatment, fire-proof blankets such as fiberglass or asbestos are acceptable.

7.3.1 Contractors must inspect and test all tarpaulins at least once each six months to be sure that they are still fire-retardant.

7.3.1.1 Tarpaulins passing the test must be re-stenciled to show the date of the test.

7.3.1.2 Tarpaulins failing the test must be removed from the Owner's property immediately. They may be returned only if re-treated, re-tested, approved and re-stenciled.

7.4 Fire protection must not be impaired by unauthorized use of, or interference with, fire protection equipment.

7.4.1 Fire hydrants, fire hose racks, extinguishers and other emergency equipment shall not be covered or blocked.

7.4.2 Access lanes for fire fighting equipment must not be blocked by unattended contractors' equipment after working hours. During working hours, contractors must be able and ready to clear access roads and fire lanes at any time.

7.4.3 Tie-ins with hose or piping shall not be made on any sprinkler system or monitor nozzle.

7.4.4 The hose on fire-hose racks is for emergency use only and shall not be used as service hose.

7.4.5 Temporary hose connections may be made to fire hydrants only if other water supply is not available, the tie-ins have been approved by the Owner's Fire Department through the Owner's Representative, and such connections are removed at the end of each work period (except in cases where a special waiver is granted by the Fire Department).

7.5 All heating units for offices, shops, work areas, change rooms, etc., must be in good working order and periodically inspected. Gas units must be provided with "flame-out" protective devices and electrical units must be grounded. Gas units shall not be connected by means of rubber hose. All heating units must be turned off at the end of each work day.

7.6 Flammable or explosive type material such as fuel, oil, cleaner, etc., must be properly contained, clearly identified, separately stored and kept clear of work areas. Appropriate warning signs must be provided in storage areas.

7.7 All containers used for transporting or transferring gasoline or fuel must be labeled by Underwriters' Laboratories or Factory Mutual Laboratories.

7.8 Fuel storage tanks, filler hoses and the dispensing vehicle or container must be properly grounded, and be equipped with contractor furnished fire extinguisher. Storage tanks must be identified with the contractor's name.

7.8.1 A quick closing shut-off valve is required on the dispensing end of fuel hoses.

7.8.2 Smoking, welding or any spark-or flame-producing operation in the immediate area must be stopped during refueling operations.

7.8.3 The Contractor shall provide and maintain "NO SMOKING" signs in fuel storage areas.

7.9 Welding rod cabinets presenting a fire or safety hazard will not be permitted. Cabinets of fireproof materials equipped with strip heaters are recommended. If light bulbs are used, they must be securely guarded with adequate spacing in relation to the cabinet and to stored material. Metal cabinets must be grounded in an approved manner.

7.10 Volatile materials must not be applied near an open flame or in inadequately venti-

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lated areas. If such material is to be applied in a vessel, or other confined area, only explosion-proof connections, lights or other equipment shall be used. The contractor must designate such areas as "NO SMOKING."

7.11 Heating equipment for freeze protection of concrete must be approved by the Owner's Representative prior to use.

7.12 Welding or cutting torches and hoses must not be left connected to cylinders when stored at the end of the work day. When work is shut down and equipment is unattended, close all valves at the gas and oxygen cylinders, bleed lines and check five minutes later for pressure build-up. If there is no build-up, bleed hoses at the torch, remove hoses from cylinders and store. No smoking will be permitted during this shutdown procedure.

7.13 Gas and oxygen cylinders must be handled with care, properly supported in an upright position away from any source of heat or flame and securely tied off. All cylinders not in use must have their caps in place.

7.13.1 Oxygen cylinders stored in buildings shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease) a minimum distance of 20 feet, or by a non-combustible barrier at least 5 feet high having a fire-resistance rating of at least one-half hour.

7.13.2 Oxygen cylinders stored outdoors must be separated from fuel-gas cylinders a minimum distance of 10 feet or by a fire-resistant barrier.

7.13.3 When gas and oxygen cylinders are lifted by hoisting equipment, a basket, cradle or similar handling device must be used. Cylinders must not be lifted by the valve protection caps.

7.13.4 When oxygen or gas cylinders are transported by any means over plant roads, valve protection caps must be in place.

7.14 All "NO SMOKING" restrictions in specified areas must be strictly observed. Smoking is not permitted in vehicles in designated "NO SMOKING" areas.

7.15 Compressed gases, including air, must not be used for cleaning of clothes, the body or work areas. Oxygen must not be used for pressure testing purposes.

7.16 Adequate ventilation must be provided when cleaning agents are used.

7.17 Contractors must not dump flammable or toxic materials into sanitary sewers or waste water system without prior clearance of the Owner's Representative.

8.0 MACHINERY, CRANES, TOOLS, AND EQUIPMENT

8.1 The safe design capacity of any tool or piece of equipment must not be exceeded. Tools or equipment must not be modified in any manner that reduces the original safety capacity.

8.2 All contractor owned, leased or rented equipment must be in safe mechanical working condition to render safe service at all times.

8.2.1 Defective tools and equipment must be removed from service immediately and, if repairable, must be properly repaired before reuse on Owner's job.

8.3 Equipment with exposed gears, belts, couplings, fans, etc., must be provided with proper guards.

8.3.1 Machinery, tools and equipment must not be operated without all guards and safety devices in place and functioning properly.

8.4 All cranes, including hydraulic cranes (cherry pickers, pole cats, bucket trucks, etc.) must be inspected by the contractor and approved by the Owner on a regular frequency of four months. Crane inspections must be submitted in writing to the Owner's Representative, using the Owner's "Hoisting Equipment Inspection Report" or "Hydraulic Crane

Inspection Report" form, whichever is applicable (see samples on following pages). Equipment must be shut down before repairs or adjustments are made. Each inspection report will be audited by the Owner and, if approved, a numbered and dated decal will be affixed in the cab of the crane. Except as noted in Paragraph 8.4.1, no crane without the proper decal affixed is to be used on the Owner's property.

8.4.1 The Owner's Representative shall visually check each crane prior to initial use on a job to assure himself that it is satisfactory for use on the job at hand. The Owner's Representative may give temporary permission to use the crane pending the completion of an inspection and audit, provided, however, that a critical lift (see Paragraph 8.4.3) is not involved and that the inspection/audit procedure is initiated immediately.

8.4.2 All "bucket trucks" or "pole cats" must be ground tested before lifting personnel. During use, a standby man must be ready to take over controls in case of an emergency.

8.4.3 The contractor has the complete responsibility for a safe operation when using hoisting equipment to make lifts. The contractor shall verify weights of loads to be lifted. No load shall be lifted which exceeds the Manufacturer's rated

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HOISTING EQUIPMENT INSPECTION REPORT (Use Hydraulic Crane Inspection Form for Hydraulic Cranes)

OWNER _____ DATE _____
EQUIPMENT NO. _____

MANUFACTURER/MODEL _____
MAXIMUM CAPACITY _____
SERIAL NO. _____
DATE OF MANUFACTURE _____
COUNTERWEIGHT FOR NORMAL USE _____
BOOM LENGTH FOR NORMAL USE _____
COUNTERWEIGHT FOR CAPACITY LIFT _____
BOOM LENGTH FOR CAPACITY LIFT _____
CAPACITY CHART POSTED IN CAB ☐ YES ☐ NO

	CONDITION
1. Identification and high visibility markings	_____
2. Hoists (winches)	_____
3. Boom (extension and blocks (straps))	_____
4. Traveling block (winch-gravit (straps))	_____
5. Cable drums (hoist and bucket)	_____
6. Hoist fast (hook on bracket)	_____
7. Chutes (hoist-gravit-gravit)	_____
8. Wire line condition of cable, age	_____
9. Main line condition of cable, age	_____
10. Boom line condition of cable, age	_____
11. Boom and jib structural condition of cable, age	_____
12. Main beam (structural members-ent)	_____
13. Jib (structural members-ent)	_____
14. Gantry (A-frame) (Pneumatic-ent)	_____
15. Swing base	_____
16. Hydraulic or air system	_____
17. Lifting system	_____
18. Painting	_____
19. Drive shafts (tension)	_____
20. Tires (air pressure-damage)	_____
21. Steering mechanism	_____
22. Counterweights (balance or not)	_____
23. Cab, platform, handrails, floor, gear, etc. (entire)	_____
24. Fire extinguisher	_____
25. Boom hook safety device	_____
26. Power lowering—wind line	_____
27. Power lowering—hoist line	_____
28. Boom hook arm	_____
29. Hoisting device	_____

OVERALL EVALUATION OF CONDITION
☐ Good, Safe ☐ Fair, Safe ☐ Unsafe

Inspector (Owner) _____
Audited by (Owner) _____
Tag No. _____ Date _____

HYDRAULIC CRANE INSPECTION REPORT

OWNER _____ DATE _____
EQUIPMENT NUMBER _____

MANUFACTURER/MODEL _____
SERIAL NUMBER _____
DATE OF MANUFACTURE _____
MAXIMUM CAPACITY _____
BOOM LENGTH AT MAXIMUM LIFT CAPACITY _____
CAPACITY CHART POSTED IN CAB ☐ YES ☐ NO

	CONDITION
1. Identification and high visibility markings	_____
2. Hoists (winches)	_____
3. Hoist block (winch-gravit (straps))	_____
4. Boom (Tie Shovel)	_____
5. Cable Drum (hoist and bucket)	_____
6. Hoist line condition of cable, age	_____
7. Main beam (structural members-ent)	_____
8. Boom extension (structural members-ent)	_____
9. Cable Guide	_____
10. Boom Hook Safety Device (hoist valve)	_____
11. Hydraulic System (hoist, pump, controls, reservoir)	_____
12. Hydraulic Outriggers	_____
13. Power Unit (instrumentation)	_____
14. Tires (air pressure-damage)	_____
15. Steering mechanism	_____
16. Cab, Platform, Handrails, Floor, Gear, etc. (entire)	_____
17. Lifting System	_____
18. Painting	_____
19. Fire Extinguisher	_____
20. Hoisting device	_____

OVERALL EVALUATION OF CONDITION:
☐ Good, Safe ☐ Fair, Safe ☐ Unsafe

Comments _____

Inspector (Owner) _____
Audited by (Owner) _____
Tag No. _____ Date _____

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CHECK LIST FOR CRITICAL LIFTS

DATE _____

1. ACC. No. / W.O. No. _____

2. JOB DESCRIPTION _____

3. LOCATION _____

4. OOW REPRESENTATIVE _____

5. PLANNING DATA:

A. 1. CONTRACTOR _____

2. SUPERINTENDENT _____

3. SUPERVISOR RESPONSIBLE FOR LIFT _____

B. DESCRIPTION OF ITEM TO BE RAISED _____

C. MAJOR HOISTING EQUIPMENT TO BE USED (MUST INCLUDE INSPECTION TAG NO. AND DATE. TAGS ARE VALID FOR FOUR MONTHS.)

1. _____

2. _____

3. _____

4. _____

D. EQUIPMENT AND LIFT RELATIONSHIP

1. OPERATING RADIUS _____

2. BOOM LENGTH _____

3. ALLOWABLE LOAD (FROM LOAD CHART) _____

4. RATIO OF LIFT TO ALLOWABLE LOAD _____

5. CLEARANCE BETWEEN BOOM AND LIFT _____

6. CLEARANCE TO SURROUNDING FACILITIES _____

E. SCHEDULE OF OPERATIONS (INCLUDE TIME FOR RIGGING AND EQUIPMENT INSPECTION).

6. BASIS FOR CRITICAL LIFT:

A. LOAD EXCEEDS 80% OF LOAD CHART FOR CRANE OR DERRICK _____

B. LOAD EXCEEDS 80% OF LOAD CHART, AND FAILURE WOULD ENDANGER EXISTING FACILITIES _____

C. TWO BOOMS ARE REQUIRED _____

D. POLES OR DERRICKS HAVE BEEN ERECTED FOR THIS SPECIFIC LIFT _____

7. HOW WEIGHT OF CRITICAL LIFT WAS OBTAINED:

A. CERTIFIED SCALE WEIGHT _____

B. CALCULATED INDEPENDENTLY BY MORE THAN ONE SOURCE.

1. SOURCE _____ WEIGHT _____

2. SOURCE _____ WEIGHT _____

C. IF LIFT IS AN EXISTING ITEM (BEING REMOVED OR DEMOLISHED), THE WEIGHT IS TO BE RECALCULATED, TAKING INTO ACCOUNT ALL MODIFICATIONS INCLUDING INTERNAL AS WELL AS AN ALLOWANCE FOR SCALE, SEDIMENT, SLUDGE, INSULATION, LIQUID, ETC.

1. SOURCE _____ WEIGHT _____

2. SOURCE _____ WEIGHT _____

8. CONDITION OF HOISTING EQUIPMENT AND RIGGING:

A. HAS EQUIPMENT BEEN REINSPECTED FOR THIS LIFT? _____

B. HAS ALL EQUIPMENT AND RIGGING BEEN INSPECTED AND FOUND IN ACCEPTABLE CONDITION FOR THIS LIFT? _____

9. GUY ANCHORS AND GUYS:

A. ADEQUACY OF FOUNDATION FOR FOOT BLOCKS _____

B. ADEQUACY, NUMBER, AND LOCATION OF GUYS AND ANCHORS _____

C. FOOT BLOCKS ARE TO BE ANCHORED _____

D. CONDITION OF ALL CABLE, INCLUDING SPLICES, CLAMPS, THIMBLES, AND OTHER HARDWARE _____

10. STABILITY OF GROUND AREA:

A. CHECK SOIL BEARING ALLOWABLE LOAD _____

B. WILL MATS BE REQUIRED? _____

C. ANY UNDERGROUND INSTALLATIONS NEEDING SPECIAL TREATMENT _____

11. OPERATORS:

WHAT IS OPERATOR'S EXPERIENCE ON THIS EQUIPMENT AND THIS TYPE OF LIFT? _____

12. REMARKS _____

Nothing in this statement and/or acceptance of the CHECK LIST is to be considered as relieving the Contractor of any responsibility for a safe operation.

Contractor _____

By: _____

Title: _____

RESUME OF ACTUAL SCHEDULE:

DATE OF LIFT _____

INSPECTIONS COMPLETED _____

LIFT STARTED _____

PERMANENT SUPPORTS COMPLETED _____

TOTAL TIME _____

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capacity of the crane. When one of the following conditions prevail, the contractor must, using the Owner's "Critical Lift Sheet" (see sample), submit a written outline of the safety planning for the lift to the Owner's Representative, prior to starting the lift.

- a. The load exceeds 80 percent of rated load chart for crane.
- b. The load exceeds 50 percent of rated load chart for crane, and possible failure would endanger existing facilities.
- c. Two cranes are required to make the lift.
- d. Poles or derricks have been erected for this specific lift.

8.4.4 If burning of lugs or other such flame producing operations may be required during crane hoisting operations, arrangements for proper Safe Work Permits must be made before the lifting or burning operation begins.

8.5 The following rules must be observed when operating a crane, cherry picker, winch truck or similar piece of equipment.

8.5.1 A flagman must be provided whenever equipment in operation partially blocks a plant road or whenever else operation of the equipment could present a hazard to personnel or property.

8.5.1.1 Personnel shall be kept out from under any load being lifted.

8.5.2 When mobile equipment (cranes, draglines, cherry pickers, winch trucks, etc.) is used near overhead power lines or D.C. bus bars, the following listed safe working distances shall be observed:

- a. Five feet minimum clearance—circuits up to 480 volts. (Telephone wires and telephone cables are not hazardous but must not be contacted or damaged.)
- b. Eight feet minimum clearance—480 volts to 2,400 volt circuits, open wire unprotected on insulators—D.C. power lines and bus bars—15,000 volts shielded or armored power cables on messenger cables in pole lines.
- c. Sixteen feet minimum clearance—15,000 volts and 132,000 volt bare (uninsulated) bus in 132 KV substations and conductors on 132 KV power lines. When it is necessary to work over or under a power line or D.C. bus or within the above listed minimum safe working distances, it shall be the contractor's responsibility to notify the Owner's Representative prior to performing any work. This is not intended to restrict electrical work performed by linemen.

8.6 All pressure vessels of construction equipment must be hydrostatically tested annually. Items in this category are those exceeding 6

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inches (inside diameter) and with internal or external operating pressure exceeding 15 psi, or those protected by a relief valve with a setting greater than 18 psig, or by a rupture disc whose bursting pressure is greater than 25 psig.

8.6.1 These tests must be performed during the month of January each year by the owner or renter of the equipment. Equipment with untested pressure vessels and arriving in the plant for the first time after the January test period must be visually inspected and approved by the Owner's Representative and must meet the above test requirements within 10 days. Such equipment must be retested the following January.

8.6.2 Relief valves must be removed and the vessels hydrostatically tested to one and one-half times the maximum allowable working pressure of the unit. A thorough visual external inspection must be made.

8.6.3 As a part of these test procedures, relief valves must be properly sized and set for the vessel involved and checked for proper operation, apart from the vessel test.

8.6.4 Metal identification tags must be attached to relief valves bearing pressure setting, date of test, name of company

conducting test and name of person conducting the test.

8.6.5 Contractors will furnish the Owner's Representative a test certificate for each piece of equipment. Each certificate must be signed by the test conductor and a representative of the company owning the equipment.

8.6.6 The Owner's Representative will forward each certificate to the E & CS Construction Department Central Office, B-2402, where an equipment number will be assigned and the certificate will be kept on file. The contractor will be informed of the assigned number by the Owner's Representative.

8.6.7 Contractors shall paint or stencil the assigned equipment number in plain view on the equipment. The numerals shall be painted or affixed on a colored background. They shall be approximately 3" high and of a color contrasting with the background color. The background color for the calendar year 1970 shall be yellow. The background color will be changed for each calendar year thereafter, and contractors will be notified in December as to the color for the following year.

8.7 Electrical tools and equipment operating at more than 32 volts must be properly grounded. Certain test equipment such as oscilloscopes, vacuum tube voltmeters and signal generators, as well as certain areas where exposed D.C. equipment is used, do not require grounding and proper operational procedures must be ascertained from the Owner's Representative in the above areas. Electrical office equipment and coffee pots shall be grounded.

8.8 Locking buttons on electrical tools must be removed or otherwise rendered inoperative.

8.9 Only 32 volt or less electrical service is to be used when working inside metallic vessels. Drop lights shall have protection guard over globe. Transformers must be kept outside vessels.

8.10 When arc welding is to be done, the grounding lead should, to minimize the possibility of intermediate arcing, be connected as close as practical to the work piece.

8.10.1 When arc welding is to be done in an area restricted by a Safe Work Permit, the grounding lead MUST be connected to the work piece within the limits specified in the permit.

8.10.2 All leads and lead connections

shall be in good condition and free of any exposed conductors.

8.11 Gloves must not be worn while using pedestal or bench mounted grinders, drills, saws or any tools where gloves are apt to become entangled.

8.12 Loose clothing must not be worn while working around machinery.

8.13 Personnel must not crank any machinery with their feet.

8.14 Hose connectors and adaptors must be of a standard manufacture and used only for the type of service intended.

8.14.1 In order to insure positive locking at all times, hose connectors must be in good condition and not abused. Sand-blast hose connections shall be the safety lock type which prevents accidental disengagement.

8.14.2 Spring-loaded snap-on "Cleco" quick hose connections must be reserved for use on air and cold (under 140° F.) water hoses only. A part of the "Cleco" connector must not be left connected to a process line or equipment.

8.14.3 "Boss-type" union connectors must be used on steam and hot (140° F and above) water hoses.

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8.14.4 Air pressure on pneumatic tools must be bled down before tools are disconnected from air supply.

8.14.5 Care must be exercised not to allow air hoses to come in contact with steam lines or hot equipment.

8.15 Powder-actuated fastening guns shall be used only in accordance with the following procedure.

8.15.1 Whenever it is planned to use such equipment on a job, the Contractor's Representative shall submit to the Owner's Representative:

- a. Written notice of intent to use such equipment.
- b. A written safe work procedure covering use of the equipment, and
- c. The qualifications of the men who will use the equipment.

8.15.2 The Owner's Representative shall, if satisfied with the submitted procedure and the qualifications, give the Contractor's Representative written permission to proceed.

8.15.2.1 Use of the equipment shall not be allowed until such written permission is in hand.

9.0 LADDERS AND SCAFFOLDS

9.1 All ladders must be in good condition and of the proper length for the job at hand.

9.1.1 Wooden ladders are not to be painted with anything other than clear paint or linseed oil. All metal parts must be hot dipped galvanized.

9.1.2 All straight ladders must be tied off or held and stepladders higher than ten feet must be tied off at the top or held at the bottom by another workman. Personnel must not stand on the top step of any stepladder.

9.1.3 When climbing a ladder, personnel must face the ladder and keep both hands free for climbing. Where practical, grasp ladder by side rails, rather than the rungs.

9.1.4 Set straight ladders so that the bottom is out from the vertical about one-fourth of the distance from the upper support to the bottom.

9.1.5 All straight ladders must be provided with non-skid adjustable feet.

9.1.6 The area around the bottom of all ladders must be free from slippery substance and tripping hazards.

9.1.7 All wooden ladders must be stored

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according to guidelines in ASA Code No. A14.1

9.1.8 The top sections of extension ladders are not to be used by themselves.

9.1.9 All portable metal ladders and platform ladders must conform to ASA Code No. A14.2.

9.1.10 All portable wooden ladders must conform to the requirement of ASA Code No. A14.1. Portable stepladders must be ASA type.

9.1.11 Ladders are not to be used as pencil or scaffold boards.

9.1.12 Unacceptable ladders shall be removed from the Owner's property immediately.

9.2 The use of No. 9 soft annealed wire is not recommended and its use should be minimized on scaffolds.

9.2.1 When the use of No. 9 soft annealed wire is absolutely necessary, a minimum of two separate strands must be used to tie scaffold handrails, braces, etc. The ties must be crossed to form a lock and prevent slipping in any direction.

9.2.2 Do not reuse No. 9 soft annealed wire for any purpose.

9.3 Makeshift scaffolds such as "Coke" boxes, crates and drums must not be used.

9.4 Wood-framed scaffolding, aluminum ladders, aluminum scaffolds and aluminum pencil boards are not permitted except in special cases as specified in job specifications or by prior written approval from the Owner's Representative.

9.5 The following rules apply to all patented metal scaffolds.

9.5.1 Scaffolds must be erected with proper fixtures made for each type of scaffolding. Scaffolds and associated equipment must not be modified in any manner that reduces the manufacturer's designed performance.

9.5.2 All scaffolds and appurtenances must be kept in good repair.

9.5.3 Equipment that is damaged or deteriorated to the extent that it is unsafe shall not be used. Such equipment shall be removed from the Owner's property.

9.5.4 Compensate for unevenness of ground by using adjusting screws in addition to proper blocking.

9.5.5 Do not force braces to fit. Adjust evenness of scaffold until the proper fit can be made with ease.

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9.5.6 Use ladders when climbing scaffold rather than the cross braces and handrails.

9.5.7 Horizontal diagonal bracing shall be used at bottom and intermediate levels of thirty feet to prevent racking of all scaffolds.

9.5.8 Planking overhang shall be a maximum of 4 inches on stackup scaffolds. 1 x 4-inch wood cleats shall be secured or fastened across top of planking at each end outside end frames. A minimum of 2 x 2-inch cleats shall be bolted underside each end of plank with 2 1/2 inch carriage bolts. Scaffold boards shall not rest upon steam lines or other hot equipment.

9.6 The following rules apply to rolling tower scaffolds:

9.6.1 The minimum base dimensions for towers shall be 5 x 7 feet.

9.6.2 Towers of a height greater than three times the minimum base dimension must be guyed or tied off while being erected, used or dismantled.

9.6.3 Caster brakes must be applied when not in motion.

9.6.4 Extreme care must be exercised while moving a rolling scaffold.

9.6.4.1 Towers must be free of men

material and equipment before being moved.

9.6.4.2 Surface area where tower is being moved shall be free of rubble or any material that may cause the tower to tip.

9.6.4.3 Do not attempt to move a rolling tower without sufficient help.

9.6.5 Do not extend adjusting screws beyond the limits specified by the equipment manufacturer.

9.6.6 The minimum size for casters shall be 6 inches. Scaffolds higher than 25 feet must be stabilized, either with outriggers or hand lines, while being moved.

9.6.7 Horizontal diagonal bracing is to be used at the bottom and at intermediate levels of 30 feet.

9.6.8 Do not use knee braces or cantilevered brackets on rolling towers.

9.7 The following rules apply to suspended scaffolds:

9.7.1 Chains or 1/4-inch (minimum) steel cable shall be used to support suspended scaffolds. All suspended scaffolds shall be anchored to prevent swinging. Chains so used shall be made of not less than 1/4-inch links and shall be inspected immediately

prior to each use. Chains shall be securely fastened by the use of double wrapped No. 9 wire through the links or fastened with a stove bolt.

***Safe Load Limits for Scaffold Chains**

1/4" proof coil loading chain, proof tested to 2350 lbs. Safe Load - - 1175 lbs.

5/16" proof coil loading chain, proof tested to 3500 lbs. Safe Load - - 1750 lbs.

9.7.2 The suspending support must be insulated when arc welding is to be performed from platform, thus avoiding accidental arcing and subsequent failure.

9.7.3 Block and falls, if required, shall be a minimum of two sheaves for 3/4-inch rope and the minimum size rope shall be 5/8-inch. Acid resistant rope shall be used in acid or caustic areas. Tail ropes shall be placed in an open container for protection while used in an acid area or above operating machinery, pumps, etc. All ropes and blocks must be inspected and tested prior to each use and taken down and stored inside at the end of each work day.

9.8 The following rules apply to all scaffolds:

9.8.1 Scaffolds and related material shall be carefully inspected at regular intervals and particularly just before using.

9.8.2 Scaffold boards shall be used exclusively for work platforms.

9.8.3 Provide sufficient sills or underpinning on all scaffolds to be erected on filled or otherwise soft ground. Scaffold boards shall not be used for this purpose.

9.8.4 All scaffolds must be plumb and level at all times.

9.8.5 All scaffolds shall be guyed or tied off at every 18 feet of elevation. Anchor running scaffolds to wall approximately every 28 feet of length. Use additional care when using pulley arms.

9.8.6 All work levels of a scaffold must, if practical, be fully planked. If, of necessity, a work platform is not completely planked, personnel working on that platform must use properly tied-off safety belts.

9.8.7 Handrailing and access ladders must be used on all scaffolds regardless of height. Scaffolds higher than 30 feet around columns, tanks, etc., must have access ladders constructed on the inside, unless a ladder cage is provided. Handrails must be at a height sufficient to provide maximum personnel safety.

9.8.8 Scaffolds must not be used as material hoist towers or for mounting

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derricks without first determining the loads and stresses involved.

9.8.9 Erect scaffold in such a manner that ladder is easily accessible and lined up from top to bottom.

9.8.10 Lumber used in the construction of platform shall be of good quality and reasonably straight grained. It shall be free from injurious ring shakes, checks, splits, cross grains, unsound knots, knots in groups, decay and growth characteristics which materially decrease the strength of the lumber. Planking shall not be painted all over, as this would conceal any defects. Scaffold boards shall be identified by painting each end. When wooden handrails are to be installed, nothing less than 2 x 4-inch (nominal) material shall be used for the purpose.

9.8.11 The normal size of planking shall be determined from Table 1. These values are for planks with the wide face up, with the loads concentrated at the center. Loads given in the table are net. Allowance has been made for the weight of the planking. If select structural coast-region Douglas Fir or merchantable structural square and sound southern pine is used, the loads may be increased 45 percent.

9.8.12 Planks used for platforms shall be

of uniform thickness, laid close together. These planks must be overlapped at the bearers. An overlap of at least two feet must be allowed with the bearing in the center of the overlap. When planks overhang a bearer more than one-tenth of the length of the span, the planks must be securely fastened to the bearer at the opposite end to prevent tipping.

9.8.13 All nails used in scaffold construction shall be driven full length. If double headed nails are used, they shall be driven to the first head only and may not be used on platforms or walkways. No nail smaller than 8d shall be used in this construction and enough nails must be driven to support the designed loads. The design must be such that no nail is subject to a direct pull.

9.8.14 Where beams are used in scaffolding, the schedule of loads shown in Table II, shall be followed. Loading on cantilever type beams used for tool and material hoists is shown in Table III. It should be noted that the loading at the center of bearing point is four times as great as the load being lifted and the bearing should be checked to ascertain if it will support the contemplated load. The inboard end of the beam has a force upward of twice the load and must be securely fastened with no nails in direct pull.

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9.8.15 Platforms shall be kept clear of slippery substances and tripping hazards.

9.8.16 Scaffolds shall be so erected that any heated pipelines or equipment will not come in contact with wind breaks or scaffold boards.

TABLE I
SAFE CENTER LOADS FOR SCAFFOLD
PLANK IN POUNDS

Span in Feet	Size of Plank			
	2 x 10 Dressed to 1 5/8 x 9-1/2	2 x 12 Dressed to 1 5/8 x 11-1/2	3 x 10 Dressed to 2 3/8 x 9-1/2	3 x 12 Dressed to 2 3/8 x 11-1/2
6	256	308	667	807
8	192	232	500	608
10	153	188	400	486
12	128	155	333	404
14	110	132	288	348
16		116	250	303

TABLE II
SAFE CENTER LOADS FOR SCAFFOLD
PLANK IN POUNDS

Nominal Timber Size	Length of Span in Feet									
	5	6	8	10	12	14	16	20	24	
2 x 4	440	290	210							
4 x 4	725	515	420	330	260	215				
2 x 6	780	850	470	360	290	240	190			
2 x 8	1400	1150	850	660	530	450	370	270	190	
2 x 10	2190	1820	1350	1050	860	710	600	450	320	
2 x 12	2800	2030	1850	1530	1250	1050	890	670	510	
3 x 8	2100	1730	1290	990	810	680	560	410	290	
3 x 10	3290	2750	2120	1580	1300	1070	900	670	480	
3 x 12	4525	3840	2970	2300	1880	1570	1340	1000	660	

TABLE III
SAFE LOADING FOR SIMPLE MATERIAL
HOIST ON CANTILEVER BEAM IN POUNDS

Beam Size	Length of Cantilever in Feet						
	2	3	4	5	6	7	8
4 x 4	220	180	105	80	65		
4 x 6	495	370	260	180	150	125	105
6 x 6	740	490	360	285	230	180	160
8 x 8	1325	875	650	515	420	350	300
8 x 6	1765	1165	865	685	560	470	405

Horizontal dimension from front bearing to rear bearing must be equal to or greater than cantilever projection "8" in table.

10.0 DANGER, WARNING AND CAUTION TAGS

10.1 Danger Tags (Red)

10.1.1 To insure that operating status of equipment is not changed while it is being used or worked on, Red Danger Tags must be attached to the controls.

10.1.1.1 No control such as a valve, switch, clutch, etc. is to be operated by anyone while a Red Danger Tag is attached.

10.1.1.2 Red Danger Tags must not be altered or used for more than one job.

10.1.1.3 If a control must be operated intermittently such as for testing equipment, the Red Danger Tag must be properly removed before

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each operation. The Red Danger Tag may be reused on the same job if the scope of the job has not changed.

10.1.1.4 Violation of Red Danger Tag rules will result in disciplinary action up to and including rejection from any work on Owner's property.

10.1.2 Attachment of Red Danger Tags to equipment controls does not mean that equipment has been cleared to work on. When work is to be done on tagged-out equipment, personnel responsible for the operation of the equipment are responsible for clearing the equipment and making it safe for others to work on.

10.1.3 Whenever the operation or use of any equipment may endanger anyone, a request must be made to supervision of the group which operates the equipment to clear and tag the equipment. "Clearing" means making the equipment inoperable and safe for others to work on. The authority to clear and tag equipment may be delegated by this supervision to any qualified personnel after supervision has assured themselves that the person delegated can properly clear the equipment for the particular job involved.

10.1.4 After the group which operates the equipment has cleared and tagged the equipment, each worker or group of workers who may be exposed to the

hazards must tag the equipment for their protection. When Red Danger Tags are attached to equipment by persons other than those responsible for its operation, prior approval from the person responsible shall be obtained.

10.1.5 As the individual jobs have been completed, each worker or group of workers must remove their tags immediately.

10.1.6 The group responsible for the equipment must place their tags first and remove their tags last.

10.1.7 Red Danger Tags may be removed only upon authorization of the person designated on the tag, except in the following specific instances. The supervisor of any person who fails to remove a Red Danger Tag when a job has been completed may authorize the removal of the tag by another person in his organization after he has determined to his complete satisfaction that the equipment can be operated in a safe manner. Authorization across line organizations is not permissible except for those cases where Section 10.1.5 ("As the individual jobs have been completed, each worker or group of workers must remove their tags immediately.") has been violated and no supervision in the violating organization is in the plant. In such cases, the Operating Department supervisors must contact

supervision in the violating organization to obtain authority to remove the tag. The Operating Department supervisor must first determine that the equipment can be operated in a safe manner and that all non-operating workers have left the immediate area. In the space on the tag entitled, "Removal will be ordered by _____," it is permissible to designate some classifications, such as foreman, electrician, pipefitter, etc., instead of a special individual's name.

10.1.8 At the discretion of the supervisor, locks may be used on valves and switches in addition to, but not in place of Red Danger Tags.

10.1.9 Tags removed must be filled out and turned in to the Owner's Representative.

10.2 Warning Tags (Green)

10.2.1 When it is necessary to convey instructions or information prior to operation of equipment controls, Green Warning Tags are to be attached to the controls.

10.2.2 Green Warning Tags should be removed when conditions set forth on the tag have been met.

10.3 Caution Tags (White)

10.3.1 White Caution Tags are affixed to mechanical or electrical equipment by the Owner's Representative to prevent in-service operation of such equipment by anyone until items on the tag have been completed.

10.3.2 The tag provides spaces for measuring, rotation, final alignment and lubrication of equipment. When appropriate action has been taken, then personnel performing the work signs and dates the tag.

10.3.3 When tagged equipment is released to the Owner, a representative of operations and the Owner's Representative sign the tag which is kept by the Owner's Representative until job completion.

11.0 SAFE WORK PERMITS

11.1 Safe Work Permits issued by the Owner to contractor personnel are required for certain hazardous locations and conditions. These permits are designed to provide a means of checking at the job site the safety of such jobs as, but not limited to, entering closed vessels; working on electrical gear; performing hot tap work; welding, cutting on, breaking into or repairing pipelines or vessels in operation or under pressure or that have contained hazardous materials. These permits also cover work involving the use of flame or spark producing equipment in hazardous areas, near an

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open ditch, or for work on machinery.

11.1.1 Safe Work Permits are specifically required for any excavation work done with machinery (gradalls, draglines, augers, pile drivers, ditching machines, etc.). These can be obtained only with the approval of the Owner's Representative and after he has completed a prescribed Safety Clearance for Machine Excavation.

11.1.1.1 "Excavation" is defined as the penetration, in any manner, of the ground.

11.2 Contractor supervision must be in close contact with the progress of work and must be in constant communication with the Owner's Representative for up to date status of operations. Further, contractor supervision must be certain that all personnel involved are informed as to specific procedures and changes in the situation.

11.3 Safe Work Permits are to be initially requested through the Owner's Representative and issued by the Owner's operating area or facility supervision involved on any job where the Safe Work Permit is applicable. More than one Safe Work Permit may be required on certain jobs which will be ascertained upon obtaining each Safe Work Permit.

11.3.1 Safe Work Permits will be issued only after a physical check of the job site by the person issuing the permit.

11.4 Personnel must give a careful and complete description of the work to be done to

the person issuing the Safe Work Permit.

11.4.1 Where a job presents a serious man hazard, it is mandatory that a written Safe Job Procedure accompany the request for the Safe Work Permit. If, on jobs of a repetitive nature, it is necessary to have a written procedure, one that is already written will do in lieu of writing one if the contractor says he can follow the procedure and do the job safely. New procedures are to be signed by the Manufacturing Representative, the Owner's Representative, and the Contractor's Representative. If previously approved procedure is to be used, it must be initialed and dated by the above-named representatives.

11.5 Directions and restrictions noted on Safe Work Permits must be carefully followed.

11.6 A Safe Work Permit must be revoked and reissued for a job if there is evidence that conditions have changed subsequent to the issuance of the original Safe Work Permit.

11.7 Permits issued for jobs that last longer than one day will normally be issued for that job each day. By mutual consent of the parties involved, permits for these jobs may be issued for longer or shorter periods of time.

11.8 Existing vessels to be entered must be made safe for personnel.

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11.8.1 The requirements set forth in the following sub-paragraphs must be accomplished by the Owner before entry of any personnel is permitted.

a. Vessels to be entered must be isolated by blinding or disconnecting from process and service systems. Double block and bleed may be permitted if the foregoing methods are impractical.

b. Hazardous materials contained in the vessels and related piping must be removed or reduced to a safe level by washing, steaming, or purging.

c. Tests must be made with an approved combustible gas indicator to detect the presence of any flammables.

d. Tests must be made with an approved oxygen indicator for excess or deficient oxygen content.

11.8.2 A Safe Work Permit must be obtained.

11.8.3 Rescue breathing apparatus, tested just prior to entry, must be on hand nearby on the outside of the vessel.

11.8.4 Whenever personnel are working inside a closed vessel (one entered through a manhole), an attendant must be stationed outside one entrance to warn of external danger or summon help if needed.

11.9 A Safe Work Permit shall be obtained before working on pipelines or other equipment which contain or have contained hazardous material.

11.9.1 The proper protective clothing and equipment (slicker suits, face shields, full-face gas masks, chemical goggles, rubber gloves, etc.), as specified in the Safe Work Permit, must be worn.

11.10 Prior to any welding or burning, either inside or outside, on an existing vessel, the vessel must be positively checked inside for flammable or explosive gases or liquids, and a Safe Work Permit must be obtained before heat is applied.

11.11 The contractor may request Safe Work Permits for his own protection. Safety checks by the Owner for dangerous gases or chemicals should be requested through the Owner's Representative, when there is any uncertainty.

11.12 All Safe Work Permits in the area affected are automatically cancelled when an emergency signal is sounded and must be reissued after the "All Clear" signal.

12.0 ELECTRICAL WORK

12.1 Work on energized electrical equipment shall be minimized and if such work is found to be necessary, it shall be given sufficient careful planning to protect personnel from electric shock and flash burns and all other foreseeable hazards.

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12.1.1 Electrical equipment of 460 volts (nominal) or more, or equipment of less than 460 volts that is protected by a fuse or circuit breaker of 100 amperes or more, shall not be worked hot unless and until the Owner's Representative has received a written Safe Job Procedure from the Contractor's Representative AND has obtained the written approval of the Major Production Manager(s) and the Major Service Group Manager(s) in whose area(s) of responsibility the work will be performed, and then it shall be done only by personnel specifically qualified for this type of work.

12.1.1.1 The following jobs are exempt from this "hot work" policy.

- a. Trouble shooting on control circuits of 460 volts or less which are isolated and protected by a fuse or breaker of 30 amps or less.
- b. Work on equipment with nominal voltage levels of 230 volts or less which is isolated and protected by a fuse or breaker of less than 100 amps.
- c. Checking of fuses.

The use of proper shock protection equipment, such as rubber gloves, fuse pullers, hot sticks and insulated tools, shall be required on any such work.

12.1.2 IF ELECTRICAL EQUIPMENT

OF ANY VOLTAGE CAN NOT BE DE-ENERGIZED, AND THE PROPOSED WORK ON IT CAN NOT BE SAFELY DONE HOT, THE WORK SHALL NOT BE DONE.

12.2 Procedures for Working on 115/230 Volt Equipment.

12.2.1 The Contractor's Representative shall request permission from the Owner's Representative to work on the equipment.

12.2.2 If it has been decided that the equipment is to be de-energized for the work, the Owner's Representative shall arrange with the Manufacturing Representative for the equipment to be de-energized.

12.2.2.1 The Manufacturing Representative, or his designee, shall de-energize the equipment, attach his Red Danger Tag to each disconnecting device involved, and then issue an Electrical Safe Work Permit to the Contractor's Representative.

12.2.2.2 The Contractor's Representative, or his designee shall, with a voltage indicating device, confirm that the equipment is de-energized and then attach his Red Danger Tag to each disconnecting device red-tagged by the Manufacturing Representative or his designee.

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12.2.3 If the equipment can not be de-energized and can safely be worked hot, the Contractor's Representative, or his designee, must obtain an area Safe Work Permit from the Manufacturing Representative, or his designee, before proceeding with the work. This permit shall be issued only upon presentation of a properly drawn up and approved Safe Job Procedure (See Paragraph 11.4.1).

12.2.3.1 Equipment, instruments, tools, barricades and protective clothing (See Paragraph 12.7) to be used shall be noted in the written Safe Job Procedure.

12.3 Procedures for Working on 460 Volt Equipment.

12.3.1 The Contractor's Representative shall request permission from the Owner's Representative to work on the equipment.

12.3.2 If it has been decided that the equipment is to be de-energized for the work, the Owner's Representative shall arrange with the Manufacturing Representative for the equipment to be de-energized.

12.3.2.1 The Manufacturing Representative, or his designee, shall de-energize the equipment, attach his Red Danger Tag to each disconnect-

ing device involved, and then issue an Electrical Safe Work Permit to the Contractor's Representative.

12.3.2.2 The Contractor's Representative, or his designee, shall, with a voltage indicating device, confirm that the equipment is de-energized and then attach his Red Danger Tag to each disconnecting device red-tagged by the Manufacturing Representative, or his designee.

12.3.2.3 When a visible check can not be made for verification of open disconnects or disconnected leads on the 460 volt supply source, grounds shall be applied to the system. When grounds are to be installed, this information shall be noted on associated Red Danger Tags. Upon completion of the job, the grounds shall be removed before the Red Tags are detached.

IF IN DOUBT, GROUND IT!

If grounds are needed but can not be installed, the work shall be performed as if the equipment is energized (See Paragraph 12.3.3).

12.3.3 If the equipment can not be de-energized and can safely be worked hot, the Contractor's Representative shall prepare a written Safe Job Procedure and submit it for approval by the Owner's

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Representative, the Manufacturing Representative, the Major Production Manager(s) AND the Major Service Group Manager(s) in whose area(s) of responsibility the work will be performed. Only upon presentation of a properly approved Safe Job Procedure shall the Manufacturing Representative, or his designee, then issue an area Safe Work Permit to the Contractor's Representative, or his designee.

12.3.3.1 Equipment, instruments, tools, barricades and protective clothing to be used shall be noted in the written Safe Job Procedure.

12.3.3.2 The Contractor's Representative must be present during the entire job, and if the geographical area of the work makes close observation by one man impossible, additional non-working supervisors must be assigned to assist him.

12.3.3.3 Immediately prior to commencing work, the Contractor's Representative and the Owner's Representative shall conduct a safety meeting to review the Safe Job Procedure with the personnel assigned to the job.

12.4 Procedures for Working on or in Close Proximity to 2400 Volt and Higher Voltage Equipment.

12.4.1 The Contractor's Representative shall request permission from the Owner's Representative to work on the equipment.

12.4.2 If it has been decided that the equipment is to be de-energized for the work, the Owner's Representative shall arrange with the Manufacturing Representative for the equipment to be de-energized. The following procedures shall then be followed.

12.4.2.1 Equipment under the control of the Utilities Department Power Dispatcher (Includes all Electrical Distribution facilities of 2400 volts or higher voltage).

12.4.2.1.1 The Manufacturing Representative, or his designee, shall obtain a Power Dispatcher's order to de-energize the equipment. He shall then proceed to carry out the order, attaching a Power Dispatcher's Red Danger Tag to each disconnecting device involved. This having been accomplished, the Owner's Representative shall obtain a clearance from the Power Dispatcher to proceed with the job. The Manufacturing Representative, acting for the Power Dispatcher, shall then issue an Electrical Safe Work Permit (ESWP) to the Con-

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tractor's Representative. The Clearance Number shall be noted on the ESWP and the ESWP Number shall be given to the Power Dispatcher by the Owner's Representative.

12.4.2.2 Equipment NOT Under the Control of the Utilities Department Power Dispatcher.

12.4.2.2.1 The Manufacturing Representative, or his designee, shall de-energize the equipment, attach his Red Danger Tag to each disconnecting device involved, and then issue an Electrical Safe Work Permit to the Contractor's Representative.

12.4.2.3 Following receipt of the Electrical Safe Work Permit, the Contractor's Representative, accompanied by the Owner's Representative, shall check the protection applied, attach his Red Danger Tag to each disconnecting device tagged by the Manufacturing Representative, and test each piece of equipment to be worked on with a voltage indicating device to prove that it is de-energized.

12.4.2.4 Except as noted below, grounds shall be applied in all cases.

12.4.2.5 Grounds may be omitted in the case of single-ended 2400 volt to 4160 volt circuits, such as motor circuits, where disconnecting devices can be visibly checked and locked out and attachment of grounds is so difficult as to be impractical. Omission of grounds must, however, be agreed to by the Manufacturing Representative, the Owner's Representative and the Contractor's Representative. In such a case, the equipment shall be considered "hot", and procedures for hot work shall be followed.

12.4.2.6 The location of grounds applied to 15 KV shielded power cable conductors is critical in many instances in relation to the maximum safety of workmen. Grounds shall be applied ONLY as specified by the Owner's Representative.

12.4.2.7 When grounds are to be applied, the Power Dispatcher shall be so notified and the fact noted on the Electrical Safe Work Permit and the Clearance. Upon completion of the job, the grounds shall be removed before the Red Tags are detached.

12.4.2.8 Red Danger Tags authorized by the Power Dispatcher shall be removed only with his permission.

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12.4.3 15 KV and higher voltage equipment shall not be worked hot.

12.4.4 If 2400 - 4160 equipment can not be de-energized and can safely be worked hot, the Contractor's Representative shall prepare a written Safe Job Procedure and submit it for approval by the Owner's Representative, the Manufacturing Representative, the Major Production Manager(s) AND the Major Service Group Manager(s) in whose area(s) of responsibility the work will be performed. Only upon presentation of a properly approved Safe Job Procedure shall the Manufacturing Representative, or his designee, then issue an area Safe Work Permit to the Contractor's Representative, or his designee.

12.4.4.1 Equipment, instruments, tools, barricades and protective clothing to be used shall be noted in the written Safe Job Procedure.

12.4.4.2 When work is to be performed on equipment under the control of the Utilities Department Power Dispatcher, the Owner's Representative must notify the Power Dispatcher just prior to commencing work. With the Power Dispatcher's permission, Yellow Work Tags shall be attached by the Manufacturing Representative, or his designee, and the Contractor's Representative to

any relayed or fused device that will open should a fault occur during the course of the job. The purpose of these tags is to prevent reclosure until the fault has been corrected and personnel moved out of danger.

12.4.4.3 The Contractor's Representative must be present during the entire job, and if the geographical area of the work makes close observation by one man impossible, additional non-working supervisors must be assigned to assist him.

12.4.4.4 Immediately prior to commencing work, the Contractor's Representative and the Owner's Representative shall conduct a safety meeting to review the Safe Job Procedure with the personnel assigned to the job.

12.4.4.5 Before work is commenced, ground fault indicators, if any, shall be checked and any existing fault corrected.

12.4.4.6 If the Power Dispatcher is involved, the Owner's Representative shall notify him of the completion of the job and obtain permission for the removal of his Yellow Work Tags.

12.5 On jobs involving work on energized

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electrical equipment, the contractor shall follow the approved Safe Job Procedure faithfully.

12.5.1 If, during the course of a job, any minor deviation from the approved Safe Job Procedure should be deemed necessary or advisable, the Contractor's Representative shall obtain the written approval of the Owner's Representative and the Manufacturing Representative before proceeding. Should the proposed deviation be significant, however, the written approval of all signers of the original Safe Job Procedure must be obtained before proceeding.

12.6 Voltage indicating devices used to confirm the de-energizing of circuits or equipment shall be tested and proven operable immediately prior to and after use.

12.7 Yellow barricade tape or other approved methods of barricading shall be used to protect personnel from open energized electrical equipment of 50 volts or more.

12.8 Protective Clothing

12.8.1 A fire-resistant plastic face shield with hood and flash protective clothing, consisting of 10 oz. "Nomex" jackets and pants or full-length coat, must be worn as outer garments under certain conditions, as follows:

a. When working on any energized 230 volt equipment or circuit that is protected at more than 100 amps.

b. When working on any energized 460 volt equipment or circuit that is protected at more than 30 amps.

c. When working on or within reach of any energized 2400 volt or higher equipment or circuit that is not electrically shielded or mechanically protected.

12.8.1.1 Linemen may be exempted from wearing a face shield and hood and flash protective clothing if they are not handling energized facilities in a confined location. This exemption must be stated in, and approved as part of, the written Safe Job Procedure.

12.8.2 Rubber gloves shall be worn whenever installing or removing grounds as specified in Paragraphs 12.3.2.3 and 12.4.2.4.

12.9 With the exception of the 138 KV Substations, smoking shall not be permitted in Power Distribution substations.

13.0 EXCAVATIONS, FLOOR OPENINGS, BARRICADES

13.1 Where a safety hazard would be created for the personnel involved, and/or others,

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excavations such as ditches, trenches, or bell holes should be sloped sufficiently to prevent cave-ins or slides. If sloping is impractical, shoring must be used in cases wherever the vertical dimension exceeds four feet.

13.1.1 Personnel removing shoring after completion of work must not be in the bottom of the excavation. Shoring must be removed in such a manner to prevent cave-in on personnel.

13.2 Contractors must provide adequate barricades, covers, handrails, signals, flagmen, or other appropriate warning devices to protect personnel near any hazardous operation or excavation. Floor openings, open trenches, excavations, etc., shall be covered when handrails or barricades do not provide adequate protection to personnel.

13.2.1 Contractors must notify the Owner's Representative of necessary obstructions on road shoulders on the day such obstructions occur.

13.2.2 Contractors must obtain approval from the Owner's Representative at least one day prior to cutting roads or otherwise obstructing traffic on plant roads.

13.2.3 All barricades must be nonored at all times.

13.2.4 When the necessity for barricades

no longer exists, they shall be removed immediately.

13.3 Grade lines, ropes, chains, and other tripping hazards must be sufficiently marked to be clearly visible day or night.

13.4 No obstruction of any kind, whether permanent or temporary, is permitted within 8'9" horizontally from the centerline of any railroad track and within 22'6" vertically from the top of the rail.

13.5 In locations where strictly temporary loading or unloading operations are to be undertaken, blue flags and portable derails available through the Owner's Representative, must be used to prevent over-running of the work by a train. Blue lights, also available through the Owner's Representative, must be attached to blue flags at night. Placement of blue flags and portable derails must have prior clearance with the Owner's Representative, who will in turn obtain clearance from the Railroad Department.

13.5.1 Blue flags/blue lights must be placed on the tracks so they will be in unobstructed view of the train crew and they must be placed a minimum of two car lengths (100 feet) in front of the area they are intended to protect. Exceptions to the minimum distance may be made by the Owner's Representative where existing installations do not allow sufficient space.

13.5.2 Blue flags and portable deraills must be removed immediately when the hazard for which they were installed no longer exists.

13.6 Specific authorization from the Owner's Representative as well as the proper placing of blue flags, blue lights and portable deraills is required prior to boring under or excavating adjacent to railroad tracks when passage of a train would create a hazard for personnel or equipment.

14.0 RADIATION

14.1 All state and/or federal laws governing use, storage or handling of a radiation source must be complied with.

14.2 A minimum of two qualified people are required for the performance of any radiographic work.

14.3 In locations where a radiation source is used or stored, regulations require that it be marked with a "Radiation Material" sign. This sign is for the purpose of informing anyone in the area that such material is present, and not that a safety hazard due to radiation exists.

14.3.1 Only authorized personnel may enter an area marked by "Radiation Area" sign.

14.3.2 All areas where a radiation hazard

exists must be roped off all the way around the area and marked conspicuously by standard signs at a safe distance from the source of radiation. These signs bear the radiation symbol of magenta (or purple) on a yellow background with the words "Caution—Radiation Area."

14.3.3 "Radiation Area" signs must be removed when a radiation hazard no longer exists in the affected area.

14.3.4 Equipment containing a source of radiation must not be handled, uncrated or installed without prior clearance with the Owner's Representative.

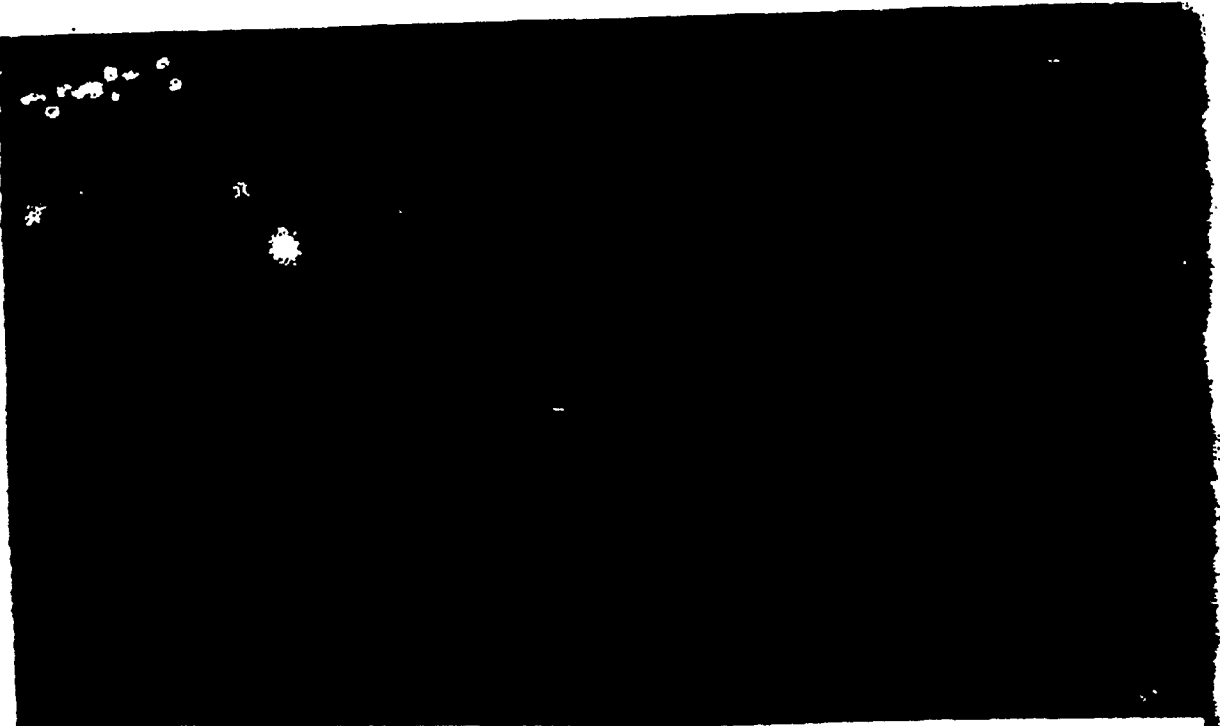
15.0 DEMOLITION

15.1 Due to the inherent hazards in demolition work, special care must be devoted to safe procedures, scope understanding and communications concerning the safe clearance of work.

15.2 Responsibility for field supervision of demolition work must be delegated only to those whose experience qualifies them to make the necessary judgments and decisions that are required to assure the safest possible prosecution of the job.

15.3 The contractor shall make certain that all lines, services and equipment have been cleaned or purged and properly cleared for safe removal. All lines (including water and

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steam) are to be considered "hot" until positive safe clearance has been obtained.

15.4 Special care shall be exercised to locate and mark old underground or otherwise hidden lines, cables and sewers using the best available information and Owner's assistance.

15.5 The pre-job safety meeting with the contractor, as covered in Section 1 of this manual, shall devote special attention to pre-planning the safety aspects of demolition jobs.

15.5.1 Steps of dismantling and loads to be handled shall be reviewed with the Owner's Representative prior to starting work.

15.5.2 Temporary provisions must be made where safety showers, eye wash baths and fire extinguishers are being moved in the work area.

15.5.3 Special attention shall be given to the marking of hazards and the barricading of hazardous areas for the protection of all personnel, including those not directly involved in the demolition work.



THE DOW CHEMICAL COMPANY

Midland, Michigan

D O W C O N F I D E N T I A L

June 24, 1970

TO WHOM IT MAY CONCERN:

It was my privilege to attend an intensive course on asbestos at Mount Sinai Medical School in New York last week. In the accompanying report, a brief attempt has been made to summarize this learning experience.

I have innumerable references available, including 115 35-mm slides, of all aspects of the course and would be pleased to discuss any aspect in detail with you or a group of your choice. Lists of the slides and references are attached.

I have purposely kept my summary short, but can enlarge on any particular area if you are interested.

Charles G. Kramer, M.D.

Charles G. Kramer, M.D.
Corporate Medical Department

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ASBESTOS AND HEALTH

Asbestos is an extremely useful mineral in our society--having more than 3,000 different applications.

Early in this century, a scarring disease of the lungs called "Asbestosis" was discovered. Control standards were established and, to my knowledge, no case of "classical" advanced asbestosis has occurred at our Company. This disease brought early death, usually in less than 20 years after first exposure.

Though there is no reason to believe we have ever exceeded the time-weighted average recommended for control of asbestos-containing dusts, it has now become apparent that these people exposed to the lower levels will develop various other forms of "asbestos disease" after a lapse period of 20 to 30 years. These diseases consist of

- (1) thickening of the pleura or lining of the lungs,
- (2) cancer of the lung,
- (3) cancer of the gastrointestinal tract, and,
- (4) malignant mesotheliomas--a deadly cancer of the lining of the lung or abdomen which is extremely rare except following asbestos exposure.

Studies by our Medical Department indicate that, though we thought our employees were exposed only to safe levels, the changing opinion of what constitutes a safe level has left us with a significant number of individuals who are potential victims of asbestos disease. We should therefore

- (1) institute procedures to minimize future exposure,
- (2) institute medical surveillance of the individuals at risk, and,
- (3) institute a campaign among the previously exposed group to discontinue smoking, which habit vastly enhances the chances of developing cancer of the lung.

Some Divisions have ongoing control programs of excellent quality and I have no doubt their people will gladly share their experience with anyone who has not yet established control.

Continued public information on this topic could eventually result in another case of environmental hysteria--we hope if such occurs we can say everything that can be done has been done. Let us be sure that, in addition to controlling our plant environment, we also insure that we are adding no asbestos dust to the community environment.

Corporate Medical Department
July 17, 1970

CONFIDENTIAL

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7-27-70
J. A. Banta

INDUSTRIAL HYGIENE SURVEY OF THE USE OF ASBESTOS IN THE TEXAS DIVISION

USERS AND LOCATIONS BEING SURVEYED

1. CHLORINE PLANTS, CELL REPAIR

a. DIAPHRAGM DRAWING

b. DRY PULPING

c. DISPOSAL METHODS OF PULP, ROPE, PAPER

2. CELL MANUFACTURING, A-1000

3. RAIL CAR UNLOADING AND STORAGE, A-427

4. INSULATORS

a. REMOVING DRY, OLD INSULATION

b. MIXING MATERIALS AND CUTTING PRE-FORMED NEW MATERIALS

5. CARPENTERS - TRANSITE

ASBESTOS

- THE CONTENT OF ASBESTOS USED IN THE TEXAS DIVISION IS PRIMARILY CHRYSOTILE ($3\text{MgO} \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$) WITH A RELATIVELY CONSTANT Mg CONTENT OF ABOUT 25%.
- 90% OF ASBESTOS USED IN THE U.S. IS CHRYSOTILE.
- IT IS THOUGHT BY MANY RESEARCHERS THAT THE ROLE OF ASBESTOS FIBER IS PRIMARILY THAT OF A CARRIER OF CARCINOGENIC METALS (AND OTHER CARCINOGENIC SUBSTANCES) TO RESPONSIVE TISSUE SITES.

DUST SAMPLING TECHNIQUE

- MEMBRANE FILTER IN HOLDER CONNECTED TO MINIATURE VACUUM PUMP WORN BY THE WORKER

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- ANALYZED BY LIGHT MICROSCOPY FOR ACTUAL FIBER COUNT AND
SIZE RANGE.

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RESULTS OF AIR SAMPLING FOR ASBESTOS TO DATE (CHLOR-ALKALI
PLANTS)

<u>DESCRIPTION OF SAMPLES</u>	<u>CONCENTRATION FIBERS/C.C.</u>
A. BREATHING ZONE OF OPERATOR DUMPING ASBESTOS FOR DRAWING PROCESS	
CELL MANUFACTURING	1.04
CHLORINE 5	1.59
B. BREATHING ZONE OF OPERATOR DURING DRAWING OPERATION	
CELL MANUFACTURING	0.025
CHLORINE 5	0.019
C. BREATHING ZONE OF OPERATOR DURING COMPLETE DRAWING CYCLE	
CHLORINE 3 CELL MANUFACTURING	0.23
CHLORINE 5	0.15

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DESCRIPTION OF SAMPLES	CONCENTRATION FIBERS/C.C.
D. GENERAL AREA , 10-15 FT. FROM SLURRY TANK	
CELL MANUFACTURING	0.14
CHLORINE 5	0.012
E. GENERAL AREA , ~ 50 FT. FROM SLURRY TANK	
CELL MANUFACTURING	0.024
CHLORINE 3.	0.027
CHLORINE 5.	0.008
F. BREATHING ZONE OF OPERATOR DRY PULPING CELLS	
CHLORINE 3.	0.04
CHLORINE 5.	< 0.004

THRESHOLD LIMIT VALUE (1970 PROPOSED) 5

— PRELIMINARY INDICATIONS ARE, THEREFORE, THAT WE ARE NOT
 "OVER EXPOSING" OUR PEOPLE TO ASBESTOS IN THE AREAS
 THUS FAR SURVEYED.



THE DOW CHEMICAL COMPANY

MIDLAND DIVISION
July 30, 1970

Confidential

Harold Bosscher, Manager
Midland Division
47 Building

SUMMARY ON ASBESTOS IN THE MIDLAND DIVISION

Since the recognition of health hazards associated with the use of asbestos, the following steps have been taken.

Environmental Health conducted a study of pipe coverers on the job and determined the exposure to dusts from insulating materials in use. By determining how long and how often the various activities were performed a time-weighted exposure was established. From this information, the minimal respiratory protection was established for each type of insulating material and each activity in the pipe coverers job.

During August, 1969 the results of this study were presented to the pipe coverers, maintenance supervisors and production representatives. Additionally, the Medical Department explained the health hazards involved and the effects of smoking as a habit which enhances the chances of developing cancer of the lung. The maintenance group explained what would be required for respiratory protection and when it was to be worn. The use of fiberglass as a replacement for aircell was discussed.

Since August, 1969, the use of aircell has been discontinued and replaced with fiberglass (100°F - 350°F). Careytemp 1500 has been introduced as the replacement for calcium silicate type insulations up to 1500°F. Purchasing will not buy an insulation containing asbestos without notifying the Maintenance Technology Center and insuring that there is no other material that will do the job. Careytemp is more difficult to work with and install than some of the calcium silicate insulations. Because of this, there is probably a 5 to 10% extra cost in using Careytemp. As the coverers become more experienced with Careytemp, this should drop. Work is underway with the manufacturer to improve the product.

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Present technology does not give us a substitute for asbestos at high temperatures (4150C°F.). Ceramic foam may offer a possibility for high temperature use. Insulating cements are also a problem area. Until substitutes can be developed, careful handling procedures must be followed during the mixing.

The introduction of additional asbestos containing insulation into the Division has been vastly reduced. In the coming years, the prime source of asbestos exposure will be the removal, transportation and disposal of old asbestos insulation. Procedures for handling and sending old insulation to disposal must be developed.

The other major use of asbestos is in the chlorine cell maintenance area in the manufacture of diaphragms for chlorine cells. The asbestos is received in 50 lb bags and dumped into a mix tank. About 150 lbs is required for a diaphragm for the present cells and 450 - 500 lbs will be required per diaphragm in the new plant. The new plant will use about 50,000 lbs/yr of asbestos for this purpose.

The operation has been studied by Environmental Health and the proper respiratory equipment has been specified for the mixing operation. In the old cell maintenance area only full bags of asbestos are handled and use of partial bags is avoided which reduces exposure. The mixing is an intermittent operation which also reduces personnel exposure. The new plant will have a complete ventilation system above the mix tank which will go to a filter unit and then to a scrubber or bag filter.

In the cell buildings asbestos is handled in small amounts by the operators. It is dumped directly into the cell to plug holes in the diaphragm. This operation requires respiratory protection. For the long term solution, a new material of construction for diaphragms is being considered but a likely successor has not yet been found.

In the cell maintenance area as the old diaphragms are washed with high pressure water, 70% of the asbestos is recovered on a set of vibrating screens and is sent to land fill. The remainder is recovered at the treatment plant on the centrifuges.

Environmental Health is making a complete inventory of uses of asbestos and recommended disposal techniques. The Maintenance Technology Center will work with Waste Disposal and Environmental Health to develop procedures for handling and disposal of covering.

W. A. Snodgrass

W. A. Snodgrass
Maintenance Technology Center
834 Building

rwh

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100-100-100 THE DOW CHEMICAL COMPANY
DOW CONFIDENTIAL

TEXAS DIVISION
FREEPORT TEXAS 77541

September 11, 1970

B. J. Kinsel
B-108

cc: O. A. Easton

ASBESTOS INSULATION - STATUS REPORT

As of the date of this report, the Insulator Shop has discontinued the installation of most asbestos-bearing pipe insulation. In cases where the service requirements are greater than 1500°F., we are still installing Kaylo 20, a calcium silicate, asbestos reinforced material. This use is limited, mostly, to tube-turns on LHF cracking furnaces. This work only comprises about 2% of the jobs we currently install. This is expected to continue until an adequate high temperature substitute is found.

All of the Kaylo, a calcium silicate asbestos-filled insulation for temperatures to 1200°F., has been removed from the shelves in the shops and has been returned to locations as directed by Stores. The field stocks are being shipped to Stores as they are located. It is felt that approximately 80% of these field stocks have been removed to date. We are still in the process of locating and eliminating these small amounts of material.

Engineering standards of E & CS and Texas Division are in the process of being revised. It is felt that finalization of these standards will take about eight weeks longer. Contractors are still being allowed to install Kaylo and Kaylo 20 on new construction although most of the new installations are in Carey-temp, a non-asbestos material.

Technical Development is working in the area of finding substitutes for materials which contain asbestos such as transite, haveg, etc.

It is felt at this time that existing safety rules regarding the use of respirators for "hazardous dusts" are adequate to require the use of respirators by all personnel when dismantling the existing insulation materials. Subsequent to additional talks with the Safety Department, we expect to formally communicate with all supervisors involved. The Functional Superintendents have already talked with the Zone Superintendents regarding the use of respirators, when handling these products.

We had some minor difficulties with Purchasing's getting us into the Carey-temp business, but these were ironed out quickly. I feel that we are now "over the hump" as far as the change over occurs. There are a great many loose ends which still need to be gathered up. I will keep you informed as we change specifications, types of materials, handling procedures, etc.

Jack Crouch
F. B. Crouch

/wb

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ASBESTOS USAGE - STATE OF MAINTENANCE DEPARTMENT AT PRESENT

Briefly, we feel that the highest exposure rates are experienced by the Insulator Group which handles the material on a day-in and day-out basis, both maintenance and construction. The next highest group would be the Brickmasons who apply the loose asbestos fill used in the mag pot program. Next in the exposure-time-weighted factor would be the persons who occasionally fabricate asbestos-bearing materials such as transite, haveg, and the like. The last on the exposure list would be those persons who occasionally perform demolition of asbestos-bearing insulation within the plants such as removal to facilitate repairs, etc., and handling loose material torn off existing lines prior to sending to the dump grounds.

Presently, we have discontinued all purchasing of asbestos-bearing insulating pipe covering with exception of certain selected sizes of Kaylo 20, a high temperature pipe covering material, used for temperatures from 1200°F to 2200°F. Only use we are aware of for this material is certain light hydrocarbon plant furnaces tube-turn bends.

We have made a concerted effort to eliminate the small stocks of asbestos pipe covering which are scattered throughout the division. I believe we have accomplished this goal to the tune of about 95% complete. We have also returned all asbestos pipe covering from our supplier (Gulf Supply) back to the manufacturer.

Presently, we believe that only about 2% of the insulators' work within the division is made up of asbestos pipe covering. (\$4,000 to \$5,000 to eliminate all existing stocks.)

Insulating materials we are using to replace asbestos are:

1. Fiberglass - both in "snap-on" and loose blankets, ambient to 350°F.
2. Foamglass - 450° to 800°F - also used where temperatures cycle excessively and for Dowtherm service. 15% more expensive than asbestos.

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3. Careytemp 1500 - ambient to 1500°F - expanded perlite - fiberglass reinforced. Some problems associated with application but best available at present. Same cost as asbestos.

Several other areas we are working on:

1. Have problems with loose fill insulation used when setting mag pots. This generates a terrific amount of dust when asbestos shorts are used. We have found that "Super 48" by "48 Insulations, Inc." mineral wool makes less dust than asbestos shorts and contains only about 10% asbestos. The texture is slightly damp or moist feeling, thus cutting down on the dust problem. When our brickmasons are using this material, they have been wearing respirators. We have been assured by the manufacturers of "Super 48" that by October 16 they will be producing an asbestos-free insulation in bags marked as such. The composition of this material is a mineral wool made from copper slag.
2. Fabricating of asbestos-reinforced plastics such as transite, haveg, micarta, where dusts become a problem in operations such as sawing and grinding. We have no problem with insulators wearing respirators when this work is going on. Saws have been developed with vacuum systems to reduce amount of dust, but we still wear respirators as we still get quite a bit of residual dust.
3. Our foremen have been notified that respirators are to be worn by the employees when significant amounts of insulation are to be removed when demolition occurs. We have not yet made it a firm rule to wear respirators in any situation where dusts of asbestos occur, but I believe this will be only a short time before we do. Due to gathering evidence

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of existing hazards.

The last principal area I want to cover is that of new construction.

We are currently in the process of changing the Texas Division standards which will require the elimination of Kaylo (asbestos-type pipe covering) from the list of approved material. The Construction Department is continuing with all new construction in asbestos in which the material is on the job site, but any other new work will have the Careytemp 1500 or expanded pearlite installed in lieu of asbestos. This change took place about the 5th of October.

This is a brief summary of where we stand in the Maintenance program of elimination of asbestos exposure hazards.

F. B. Crouch

/bs

October 13, 1970.

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ASBESTOS USE - STATUS OF IN TEXAS DIVISION

We recently ran a survey of the use of asbestos in the Division with the object of answering 3 questions - 1) Where is asbestos used 2) What protective gear is being used and 3) What have people been told about asbestos.

Where is asbestos used? In addition to the use of asbestos containing materials/^{for insulation purposes}~~that have been used~~ throughout the Division, asbestos is used in our chlorine areas for cell diaphragms in cell manufacturing. and repair for facilities and in all chlorine plants for pulping cells. Asbestos is also used in the Mag Cell areas for insulation in pot settings and in numerous other ways for the sealing of leaks in the cells and vent systems.

In addition to the use of new asbestos, we also have the problem of tearing out of insulation throughout the plant as well as the disposing of used asbestos in the chlorine and magnesium areas.

There is also in use materials of construction such as transite and haveg that are asbestos containing materials.

What protective gear is being used?

In most of the areas where asbestos is being used, either installed or disposed, we now have some form of protective gear in use. Our insulators have been wearing respirators for sometime. Cell Manufacturing folks have had a good protective program for about the last 1½ to 2 years. Recently the Mag folks started using more pro-

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protective gear. I would say that the insulator and Cell Manufacturing and repair people have a good program with good supervisory control. With some of the other crafts who occasionally remove and dispose asbestos materials, the use of protective gear is variable, probably relative to the degree of exposure. Contractors in the Division presently do not wear much in the way of protective gear.

What have people been told?

Asbestos information which our folks have received varies widely. Some have been told little, if anything -- others that asbestos is hazardous to the lungs -- and others that it causes lung problems including cancer. Probably the best informed are those who have been under the periodic examination program where the doctors have apparently discussed asbestos candidly. Contractors probably have been told little about the hazards of asbestos.

Now, I'll turn this over to Jack Crouch who will discuss the effort by the Maintenance folks in substituting some different materials for asbestos containing materials.

RCW/ks
10/14/70
S & LP

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ASBESTOS RECOMMENDATIONS

1. Develop a Dust-Asbestos informational type program for division employees and contractors. (Similar to other hazardous material programs which have been developed.)
2. Develop and audit safe work procedures for minimizing the generation of asbestos dust. Procedure must include protective gear as a final precaution.
3. Continue to pursue the replacement of asbestos with reasonable economic substitutes. (Recognize that asbestos is probably irreplaceable in certain applications.)
4. Develop procedures for accounting for asbestos used and in monitoring asbestos exposures.
5. Continue periodic physical program on division employees who have reasonable exposure to asbestos.

D. J. Kilian, M. D.
F. B. Crouch
R. C. Walker

RCW/ks
10/15/70
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ASBESTOS USAGE IN THE TEXAS DIVISION

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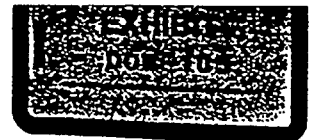
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ASBESTOS USAGE IN THE TEXAS DIVISION

WHERE IS IT BEING USED	WHO IS USING IT	HOW USED	PROTECTIVE EQUIPMENT	HOW LONG HAS WORKING BEEN
Low Carpenter Shop - Plant Side	Insulators, yard, laborers, boilermakers, pipefitters, etc.	Mix & apply, remove the old.	Dust respirators by Insulators for about 2 years. Usually nothing	Insulators - can cause lung problems & cancer - by 8 p.m. & 2 p.m. 24.475-- nothing.
Plant Side by Contractors	Insulators, laborers, carpenters, fitters, masons, boilermakers.	Application, destruction, mix with Epoxy, cut siding, remove material, stress relieving.	None	Nothing

FORMS OF ASBESTOS				
Refract Shields	Used in Chlorine Cell cathode drawing and dry pulping, Mag Cell insulation filler, filler for Epoxies, etc. Many forms.			
Refract Block (KATO-20 etc.)	High temperature (2200°F) insulation by Owens-Corning. Now used only for greater than 1900°F service pipe insulation. Cutting must be done!			
Refract	Cut in shop and on the job. Siding.			
Refract	Asbestos filled Phenolic Resin. Do much grinding. Are able to replace much if not all with Derakane.			
Refract	Used as gasketing, etc.			
Refract	For handling hot materials.			
Refract	As filler and by itself.			

JCS/vts
10/12/10



THE DOW CHEMICAL COMPANY

TEXAS DIVISION
FRIEPORT TEXAS 77541

October 27, 1970

O. L. Dickson
O. N. Freeman
J. H. Moore
R. L. Silverthorne

cc: J. A. Barton
R. E. Flake, M. D.
B. S. Horvath

DUST - ASEESTOS SAMPLING

I have asked Jack Barton to set up to run Dust-Asbestos Sampling training program. I would like each of you to go through this training. It is the intent that you become qualified to make dust-asbestos surveys. Jack thinks that it will take about 6 half days to do this. Training will be Monday, Wednesday, and Friday afternoons, starting at 12:30 Friday, October 30, 1970, in Jack Barton's office.

I consider this to be high priority and hope you do not miss any of the training sessions.

R. C. Walker

R. C. Walker
Safety and Loss Prevention

ks
attachment

ST0014361

DUST SURVEY (ASBESTOS) PERSONNEL TRAINING OUTLINE

1. Develop Background
 - A. Research the Literature - Tox.
 - B. Talk with Dr. Flake - His viewpoint and Dow workers clinical evidence.
 - C. Research sample and analysis techniques.
2. Set Up Equipment In Lab - Dry Run
3. Set Up Survey at Cell Manufacturing, etc. and Get Samples
4. Have Samples Analyzed - U.S.P.H.S. Method
5. Evaluate Data and Write Technical Report

JAB/ks
10/27/70
S & LP

ST0014362

W/ THE ASBESTOS SHORTS (K) I WOULD GIVE
OUR EPOXY MIXTURES SOME BODY BUT SINCERELY/
Maintenance Supervision DONT THINK IT WOULD BE A HAZARD.

DUST RESPIRATOR USAGE

MARSHALL

The following safety rule will be placed in effect with
Maintenance Department employees on November 2, 1970.

All Maintenance Department employees sub-
ject to hazardous dusts such as silica,
asbestos, etc., must wear an approved
dust respirator. Areas where sandblast-
ing and demolition of existing insulation
for the purposes of salvage and/or repair
would be included in this rule.

The two respirators which have been approved by the Safety
Department are: (1) MSA Dustfoe 77, Dow Stock No. 15-26005,
Cartridge No. 15-23775, and (2) Wilson Dust Respirator, Dow
Stock No. 15-25460, Cartridge No. 15-23790.

You should see that your people are notified and equipped
for this prior to the effective date.

Jack Crouch
F. B. Crouch

/bs

All Contractors
E & CS Construction Department Personnel - Freeport

DUST RESPIRATORS

The following safety rule will go into effect on November 9, 1970:

All contractor employees subject to hazardous dusts such as silica,
asbestos, etc., must wear an approved dust respirator.

Areas where sandblasting, demolition, etc., of such materials are
involved are included in this rule.

Two respirators which have been approved for this service are:

1. Dustfoe 77, MSA No. 96000, Cartridge MSA No. 96077
2. Wilson Dust Respirator (Mask) No. 600A, Cartridge Wilson
No. R-501.

You should see that your people are notified and equipped with the
approved respirator prior to the effective date.

M. E. Bergen
M. E. Bergen

ST0614904

ST0614904A



THE DOW CHEMICAL COMPANY

TEXAS DIVISION
FREEMONT, TEXAS 77541

November 6, 1970

G. B. Harding, Jr.
Magnesium I
A-650

#13

cc: R. C. Walker, B-101

ENVIRONMENTAL CONDITIONS AND PROTECTIVE EQUIPMENT SPECIALIST TEAM
NOVEMBER INSPECTION OF MAGNESIUM I

Aside from the obvious problems of heat and gas exposure against which you seem to be waging a continuing battle the Specialist Team feels you may be overlooking two problems.

1. Asbestos exposure: occurs with mixing of dry asbestos; replacing and breaking up asbestos panels and tearing asbestos sheeting. We recommend
 - A) An intensive educational program informing the men of risk of the danger of lung cancer with asbestos exposure combined with cigarette smoking.
 - B) Strict enforcement of adequate protection when exposed to asbestos dust:
 - 1) Acme-Duo Seal with clip on dust filter or
 - 2) Welsh twin cartridge respirator with clip on dust filter (either of which will be effective against asbestos dust and chlorine).
2. Noise exposure: appears to be a problem
 - A) Chain hanging - air driven tools
 - B) Air driven chipper - cleaning cells
 - C) Metal transfer crew - motor noise. We recommend
 - 1) Noise level measurements in above areas by the Industrial Hygiene group.
 - 2) Auditory ear plugs in those areas where acceptable noise level is exceeded.

For the
R. E. Flake, M.D.
(For the Specialist Team)

910654087



THE DOW CHEMICAL COMPANY

Dust, Hazardous

HOUSTON DOW CENTER
Texas Division
November 10, 1970

H. L. Mathews - Angleton
D. M. Turner - Freeport - A-1201
J. E. Arbour - Houston
J. P. Murray - Bay City
W. G. Specht - Bay City
J. C. Brownfield - Houston
T. C. Mandrell - Houston
W. R. Hale - Freeport-B-101

HAZARDOUS DUST

You are aware that effective November 2, 1970 all employees subject to hazardous dust, such as silica, asbestos, etc., must wear approved dust respirators. Mr. Bergen has issued the same safety rule for all contractors and E&CS Construction Department personnel.

You are advised to instruct your personnel of this rule which also applies without exception to our people and our contractors.

R. R. Swanke

R. R. Swanke
APC Chairman

10

NOV 12 1970

T. C. MANDRELL

NOV 12 1970

ST0614903

H A N D B O O K
F O R
H A N D L I N G
A S B E S T O S M A T E R I A L

THE DOW CHEMICAL COMPANY
TEXAS DIVISION

Maintenance Department
Supporting Services

March, 1971

ST0540027

SAFE WORK PROCEDURE

Subject: Insulation Removal

Minimum Safety Equipment Requirements

1. Hard Hat must be worn.
2. Side Shield Goggles must be worn.
3. Approved "Nose and Mouth" Dust Respirator must be worn at all times.
4. A Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.
5. All other safety equipment which is required by job location must be used. When in doubt, read Area Safe Work Procedure.

Special Hazards:

1. Do not breathe asbestos dust.
2. Asbestos dust falling or blown on other employees and scattering throughout the area must be eliminated as far as possible.
3. Keep all personnel not directly involved in the insulation removal operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
4. Consider the use of water to wet down the insulation before and during removal.
5. Safe handling of all debris before loading at the job and unloading at the burial site is to be considered and planned for prior to the initiation of the job. The Yard Department is to be notified for disposal, informed of the hazards, and should handle material while still in a damp condition.

ST0540037

USE OF HANDBOOK
FOR
HANDLING ASBESTOS MATERIALS

The Safe Work Procedures outlined in this handbook are minimum requirements for working with asbestos containing materials.

In some cases, job conditions may dictate more stringent requirements. These could include completely wetting down the area with water when removing old insulation, or completely isolating the work area tarpaulins, etc.

These procedures are to be used in conjunction with Plant Safety Rules, Maintenance Standard Safe Work Procedures for the Area, and Safety Standards.

ST0540031

HANDBOOK FOR HANDLING ASBESTOS MATERIALS

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ST0540028

PURPOSE AND DESCRIPTION

The purpose of this handbook is to outline the safe handling procedures of various asbestos materials used in the Texas Division. The intent is to minimize future exposure of employees to asbestos dust in any form through the proper use of safe work procedures.

Asbestos is widely used as structural wall board, insulation, and roofing material. Asbestos fibers are used as a mechanical reinforcing matrix in insulation, roofing paper, certain piping systems, etc.

When working with materials which contain asbestos fiber, care must be taken to eliminate as much loose dust as possible. Wetting, isolating the work area, or other suitable procedures to eliminate the dust hazard is absolutely necessary.

Should a hazard exist and these procedures are not sufficient, contact the superintendent of the Plant A or B Functional groups.

Exceptions to these procedures can be obtained only by the above responsible superintendent.

ST0540029

SAFETY

Materials described herein are furnished in blocks (or lags) shapes, curved segments, pre-formed pipe and fitting covers, flat and corrugated sheets and the asbestos as loose material.

When handled, formed, cut, sawed, or mixed into mortars, a fine dust will be loosed in the air which may be breathed into the human respiratory system.

The health of those who breathe asbestos dust may be seriously effected. Results can be similiar to those caused by the more commonly known materials such as silica and coal dust. This phenomena has been observed for many centuries. Current medical discoveries show that handling of asbestos by a confirmed cigarette smoker is especially hazardous in the area of potentially serious lung disorders. It is recommended that those persons handling asbestos not smoke cigarettes in any quantity.

The intent of THE DOW CHEMICAL COMPANY is to minimize the exposure of their employees to these hazardous dusts. In order to accomplish this, substitutes will be used wherever possible. Respiratory protection, dust collectors, blowers, etc., will be mandatory where asbestos containing materials must be handled.

The two respirators which have been approved by the Safety Department are: (1) MSA Dustfoe 77, Dow Stock No. 15-26005, Cartridge No. 15-23775, and (2) Wilson Dust Respirator, Dow Stock No. 15-25460, Cartridge No. 15-23790.

ST 0540030

SAFE WORK PROCEDURE

Subject: Fabrication of Asbestos Materials

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times.
3. There shall be a Dust Collecting System on Power Equipment adequate to remove large amounts of dust generated.
4. A Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Hazards:

1. Do not breathe asbestos dust.
2. Do not operate equipment if provision cannot be made to eliminate dust in a safe manner.
3. Normal precautions must be taken for working with power equipment. (See specific Safe Work Procedure for Operating Power Driven Tools if in doubt.)
4. When cleaning out the vacuum system of the machines, a respirator must be worn. Wet down dust prior to handling, if at all possible. Dispose of asbestos dust while in a wet condition. The Yard Department must be notified under these circumstances and disposal by landfill should be accomplished while material is damp.
5. Good housekeeping in the shop area is to be practiced. Asbestos dust must be vacuumed throughout the shop area if and when such conditions exist.

ST0540032

SAFE WORK PROCEDURE
Fabrication of Asbestos Materials
Page 2

Special Hazards Cont'd.

6. People in area other than worker when exposed to asbestos dust are required to observe all minimum safety requirements.

ST0540033

SAFE WORK PROCEDURE

Subject: Mixing Cement Containing Asbestos

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times.
3. A Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Hazards:

1. Do not breathe asbestos dust.
2. When mixing whole sacks, do not open sacks and dump into open mixing tray. Moisten asbestos by adding water through a small hole in sack until danger of dust is eliminated. Then the material can be removed if necessary to complete mixing operation to desired consistency.
3. Slipping or falling is a hazard to be considered when working around wet asbestos mud.
4. Back strains from handling containers of mixed mud are also a hazard. A means of handling this mixture may need to be provided, depending on the circumstances.
5. Keep all personnel not directly involved in the mixing operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.

ST0540034

SAFE WORK PROCEDURE

Subject: Handling and Storing Asbestos Materials

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times.
3. A Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Hazards:

1. Do not breathe asbestos dust.
2. Handle materials in such a manner as to minimize exposure to dust.
3. Areas used to store asbestos containing materials should be marked "Asbestos Material". Follow Safety Check List procedure when handling.
4. Destroy boxes that have contained asbestos materials as soon as boxes are empty.
5. Good housekeeping of shop areas is to be practiced. Clean up all loose dust on floor, machines, shelves, etc., by vacuuming. Wet down and dispose of dust while damp. Notify the Yard Department to dispose by landfill while material is still damp.

ST0540035

SAFE WORK PROCEDURE

Subject: Sawing and Cutting by Hand

Minimum Safety Equipment Requirements:

1. Hard Hat must be worn.
2. Side Shield Goggles must be worn.
3. Approved "Nose and Mouth" Dust Respirator must be worn at all times.
4. A Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.
5. All other safety equipment which is required by job location must be used. When in doubt, read Area Safe Work Procedures.

Special Hazards:

1. Do not breathe asbestos dust.
2. Wear the "Nose and Mouth" Dust Respirator when removing asbestos material from package, installing, or cutting.
3. All people in the area other than those doing the work which are exposed to asbestos dust are required to observe minimum safety requirements.
4. Special precautions shall be taken when using "Skil-Saw" for sawing asbestos materials to eliminate dust hazards and protect all people in the area.

ST0540036

PRE-JOB CHECK LIST
FOR
HANDLING ASBESTOS MATERIALS

Job Description: _____

Location: _____ Maximum Service Temperature: _____

(Note: When under 1500° F., use non-asbestos material.)

	<u>YES</u>	<u>NO</u>
1. Area safe work procedure read and understood.	☐	☐
2. Safety Standard No. _____ apply?	☐	☐
3. Safe work permit required?	☐	☐
4. Handbook for Handling Asbestos Materials used?	☐	☐
5. Electrical clearance?	☐	☐
6. Red tags necessary?	☐	☐
7. Safe scaffolds in place?	☐	☐
8. Type of material to be removed known?	☐	☐
9. Disposal of used materials required?	☐	☐
10. Stencil on job denoting material used?	☐	☐
11. Signs up warning other personnel?	☐	☐
12. Has disposal of all debris been arranged?	☐	☐
13. Is water needed for controlling dust?	☐	☐
14. Have all involved personnel been instructed?	☐	☐
15. *Safety Equipment required on job:		

Chemical Goggles	Scott Air Pack	Explosimeter
Face Shield	Rubber Gloves	Air Mover
Acid Hood	Rubber Boots	Exhaust Fan
Dust Respirator	Slicker Coat	32 Volt Transformer
Gas Respirator	Slicker Pants	Other:
Air Mask	Safety Belt	

*Cross out items not applicable.

Approvals:

Shop Superintendent _____

Operations Superintendent _____

Foreman _____

Date: _____

THRESHOLD LIMIT VALUE

We are required to keep asbestos dust in the air within certain limits. These Threshold Limit Values are $2\frac{1}{2}$ fibers per cubic centimeter. In order to assure compliance with these limits, the Environmental Health Group will make random samples. When field testing is necessary, call Environmental Health at 238-2121.

In order to keep asbestos dust concentration within the proper limits, any dusty conditions connected with the handling of asbestos materials must be kept to an absolute minimum. This must be done as outlined in the previous Safe Work Procedures by wetting down the area, pre-soaking the material, or vacuuming the material as it is cut. Each individual job should be planned with this uppermost in mind.

ST0540039

250 mm. x 3 in.
1/2" syth. case

H A N D B O O K
F O R
H A N D L I N G
A S B E S T O S M A T E R I A L

ST0002863

THE DOW CHEMICAL COMPANY
TEXAS DIVISION

Maintenance Department
Supporting Services

July 1972 Rev.

HANDBOOK FOR HANDLING ASBESTOS MATERIALS

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ST0002864

PURPOSE

The purpose of this handbook is to define safe handling procedures for asbestos materials used in the Texas Division. The intent is to control the exposure of employees to asbestos dust through the proper use of safe work procedures and by the substitution of non-asbestos containing materials.

Asbestos is widely used as structural wall board, insulation, and roofing material. Asbestos fibers are used as a mechanical reinforcing matrix in insulation, roofing paper, certain piping systems, etc. However, Dow Engineering Specifications were revised to exclude asbestos-containing insulation prior to installation of Federal regulations controlling the use and handling of asbestos. Eventually, the use of asbestos will be eliminated as the ultimate solution to the problem.

The OSHA standards which became effective July 7, 1972, define the precautions required for asbestos handling and the allowable safe working limits.

Should a hazard exist, and these procedures appear insufficient, contact the superintendent of the Plant A or B Functional groups for exceptions or variations.

These procedures will be reissued prior to 7 December 72 to incorporate revisions dictated by results obtained from the Division Monitoring Program.

ST0002865

SAFETY

The health of those who breathe asbestos dust may be seriously affected. Results can be similar but more serious than those caused by the more commonly known materials such as silica and coal dust. This phenomena has been observed for many centuries. Current medical discoveries show that handling of asbestos by a confirmed cigarette smoker is especially hazardous in the area of potentially serious lung disorders. It is recommended that those persons handling asbestos not smoke cigarettes in any quantity.

When working with materials which contain asbestos fiber, care must be taken to eliminate as much loose dust as possible. Wetting, isolating the work area, or other suitable procedures to eliminate the dust hazard are absolutely necessary. The main problem areas will be in removal of old, deteriorated insulation and the sawing of Transite.

Respiratory protection, dust collectors, blowers, etc., will be mandatory where asbestos-containing materials must be handled.

The two "nose and mouth" dust respirators which have been approved by the Safety Department are: (1) MSA Dustfoe 77, Dow Stock No. 15-26005, Cartridge No. 15-23775, and (2) Wilson Dust Respirator, Dow Stock No. 15-25460, Cartridge No. 15-23790. *3-M. mask #8610 #8730 #8710*

Disposal of asbestos will be in polyethylene bags, Dow Stock No. 15-05080 for large bag and 15-04170 through 15-04185 for small bags.

As required, special protective clothing such as coveralls, head covering and gloves will be provided. Such requirements will be determined by the Division Monitoring Program.

Two lockers will be provided, so separated or isolated as to prevent contamination of the employee's street clothes from his work clothes.

Asbestos-contaminated clothing shall be placed in labeled, polyethylene bags for shipment to the laundry.

ST0002866

USE OF HANDBOOK
FOR
HANDLING ASBESTOS MATERIALS

The Safe Work Procedures outlined in this handbook are minimum requirements for working with asbestos containing materials.

In some cases, job conditions may dictate more stringent requirements. These could include completely wetting down the area with water when removing old insulation, or completely isolating the work area with tarpaulins, etc. Specific requirements for each job will be detailed on the "Insulators Safety Check List."

Because Dow's Engineering Specifications have been revised to exclude use of asbestos-containing insulation, most of the Safe Work Procedures in this section of the Manual will seldom be referred to for new installations.

These procedures are to be used in conjunction with Plant Safety Rules, Maintenance Standard Safe Work Procedures for the Area, and Safety Standards.

ST0002867

SAFE WORK PROCEDURE

Subject: Shop Fabrication With Asbestos Materials

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
3. There shall be a Dust Collecting System on Power Equipment adequate to remove large amounts of dust generated.
4. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Precautions:

1. Do not breathe asbestos dust.
2. Do not operate equipment if provision cannot be made to eliminate dust in a safe manner.
3. Normal precautions must be taken for working with power equipment. (See specific Safe Work Procedure for Operating Power Driven Tools if in doubt).
4. When cleaning out the vacuum system of the machines, a respirator must be worn. Wet down dust prior to handling. Place the wet material in polyethylene bags, seal, label and notify Yard Department that asbestos waste is ready for proper disposal at landfill.
5. Good housekeeping in the shop area is to be practiced. Asbestos dust must be vacuumed throughout the shop area if and when such conditions exist.
6. Keep all personnel not directly involved in the fabrication operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.

ST0002868

SAFE WORK PROCEDURE (

Subject: Mixing Material Which Contains Asbestos

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
3. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Precautions:

1. Do not breathe asbestos dust.
2. When mixing whole sacks, do not open sacks and dump into open mixing tray. Moisten asbestos by adding water through a small hole in sack until danger of dust is eliminated. Then the material can be removed if necessary to complete mixing operation to desired consistency.
3. Slipping or falling is a hazard to be considered when working around wet asbestos mud.
4. Back strains from handling containers of mixed mud are also a hazard. A means of handling this mixture may need to be provided, depending on the circumstances.
5. Keep all personnel not directly involved in the mixing operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
6. All contaminated bags, boxes, waste, etc., shall be wetted, placed in labeled polyethylene bags and sent to landfill.

ST0002869

SAFE WORK PROCEDURE

Subject: Handling and Storing Asbestos Materials

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
3. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Precautions:

1. Do not breathe asbestos dust.
2. Handle materials in such a manner as to minimize exposure to dust. Moisten material with water spray before removing from container if material will not be damaged.
3. Areas used to store asbestos containing materials should be marked "Asbestos Material".
4. Cartons, boxes, etc., that have contained asbestos materials should be wetted, broken and placed in labeled polyethylene bags for disposal.
5. Good housekeeping of shop areas is to be practiced. Clean up all loose dust on floor, machines, shelves, etc., by vacuuming. Wet down, place in labeled polyethylene bags and dispose of dust while damp. Notify the ~~Yard Department~~ to dispose by landfill while material is still damp.

waste disposal 2417

ST0002870

SAFE WORK PROCEDURE

Subject: Sawing and Cutting by Hand

Minimum Safety Equipment Requirements:

1. Hard Hat must be worn.
2. Side Shield Goggles must be worn.
3. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
4. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.
Notify Environmental Health Services (1281) before removal.
5. All other safety equipment which is required by job location must be used. (Read Area Safe Work Procedures.)

Special Precautions:

1. Do not breathe asbestos dust.
2. Wear the "Nose and Mouth" Dust Respirator when removing asbestos material from package, installing, or cutting.
3. Keep all personnel not directly involved in the operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
4. Special precautions shall be taken when using "Skil-Saw" for sawing asbestos materials. To eliminate dust hazards and protect all people in the area, an air operated saw shall be used and the material shall be flooded with water.
5. If water will damage the material, a hand saw shall be used and sawdust collected with a portable vacuum whenever possible. If site work prohibits use of a vacuum pick-up, cuts should be made directly over a collection box or polyethylene bag.
6. All contaminated bags, boxes, waste, etc. shall be wetted, placed in labeled polyethylene bags and sent to landfill.

ST0002871

SAFE WORK PROCEDURE

Subject: Insulation Removal

Minimum Safety Equipment Requirements:

1. Hard Hat must be worn.
2. Side Shield Goggles must be worn.
3. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
4. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.
Notify Environmental Health Services (1281) before removal
5. All other safety equipment which is required by job location must be used. (Read Area Safe Work Procedure.)

Special Precautions:

1. Do not breathe asbestos dust.
2. Hazards from asbestos dust that falls, blows or may be scattered throughout the area must be eliminated.
3. Keep all personnel not directly involved in the insulation removal operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
4. Use water to wet down the insulation before and during removal.
5. Seal all material in labeled polyethylene bags as removed. ~~The Yard Department~~ is to be notified for disposal at landfill.

waste disposal (2471)

ST0002872

JOB DESCRIPTION: _____ DATE _____

LOCATION _____

AREA		YES	NO
1.	Safe Work Permit Received	☐	☐
2.	Area Safe Work Procedure Known	☐	☐
3.	Nearest Phone _____		
4.	Nearest Eyebath and Safety Shower _____		
5.	Job Site in Safe Condition	☐	☐
6.	Is Pipe or Equipment Safe to Work On?	☐	☐
7.	Are Corrosive Chemicals Involved?	☐	☐
a.	Can lines or equipment be drained?	☐	☐
	Is Adjacent Piping and Equipment Safe	☐	☐
9.	Red Tags Needed?	☐	☐
10.	Burn Hazards Present?	☐	☐
11.	Craftsmen Lined Up With Check List?	☐	☐

Special Hazards _____

Special Safety Precautions _____

Checked and Approved By:	DATE:
Supt. _____	
Foreman _____	
Crew leader _____	
Craftsman _____	

II. ASBESTOS WORK

	YES
1. Handbook for Handling Asbestos Materials Used?	☐
2. Signs and/or Barricades Up to Warn Others ?	☐
3. Has Disposal of Debris Been Arranged ?	☐
4. Is Water Needed to Control Dust ?	☐
5. Stencil on Job to Denote Materials Used ?	☐
6. Have all Involved Personnel Been Informed ?	☐

III. Special Safety Equipment Require

☐	Coveralls
☐	Chemical Goggles
☐	Face Shield
☐	Acid Hood
☐	Air Mask
☐	Dust Respirator
☐	Rubber Gloves
☐	Rubber Boots
☐	Slicker Coat
☐	Slicker Pants
☐	Safety Belt
☐	Hearing Protection
☐	Other: Specify _____

ST0002873

IV. Personnel on Job (Name)	Exposure Time-Hr
1. _____	
2. _____	
3. _____	
4. _____	
5. _____	
6. _____	

THRESHOLD LIMIT VALUE

No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air. The eight hour time-weighted average shall not exceed five (5) fibers per cubic centimeter.*
2

In order to assure compliance with these limits, the Environmental Health Group will make random samples. When special field testing is desired, call Environmental Health at 238-2121.
1281

In order to keep asbestos dust concentration within the proper limits, any dusty conditions connected with the handling of asbestos materials must be kept to an absolute minimum. This must be done as outlined in the previous Safe Work Procedures by wetting down the area, pre-soaking the material, or vacuuming the material as it is cut. Each individual job should be planned with this uppermost in mind.

* Effective 1 July 1976, this limit is reduced from five (5) to two (2) fibers per cubic centimeter.

ST0002874

Latest word on asbestos won't be the last

Scientific evidence against asbestos continues to accumulate, and OSHA's much-delayed exposure standard goes on bringing criticism from all concerned parties. Meanwhile, millions of workers remain exposed to asbestos dust in plants throughout the world.

□ Bad news about asbestos continues to make headlines. In September, for instance, Joseph A. Califano, Secretary of Health, Education, and Welfare (HEW), drew attention to an alarming statistic in a new study by the National Cancer Institute (NCI) and the National Institute of Environmental Health Sciences (NIEHS): An astonishing 17% of all cancer deaths in the U.S. over the next few decades will be linked to some previous exposure to asbestos.

Speaking at the AFL-CIO National Conference on Occupational Safety and Health, Califano said that the NCI/NIEHS report definitely rejects the conventional estimate that 1 to 5% of all U.S. cancer incidence is related to occupational exposure to carcinogenic agents. Estimates of 20% to as high as 38% are not unreasonable, he added.

EXPOSURE THAT KILLS—The joint

study estimates that between 8 and 11 million U.S. workers have been exposed to asbestos since the beginning of World War II. Of these, about 4 million have been "heavily exposed,"—i.e., worked directly with the material most of the time—and 4 to 7 million have received "peripheral" exposure—e.g., of the sort that a maintenance worker would get in a plant where asbestos was being installed.

The NCI/NIEHS report assumes that 20 to 25% of those in the first group will die of lung cancer, 7 to 10% of pleural or peritoneal mesothelioma (a particularly lethal cancer), and 8 to 9% of gastrointestinal cancer. Assuming that the risk to the second group is 25% that of the first one, the report concludes that a total of 2.15 million workers will die over the next 30 to 35 years, or about 67,000 per year. This

represents a whopping 17% of all cancers detected annually in the U.S.

The joint study's figures on exposure for workers are taken from HEW estimates (the department believes that 1.5 to 2.5 million U.S. workers are still being exposed to asbestos), while the fatality percentages are borrowed directly from a World Health Organization (WHO) position paper issued in early 1977. This link with the WHO document is confirmed by Joseph Wagoner, special assistant for carcinogenesis with the Occupational Safety and Health Administration (OSHA), who was a member of the group of health experts that authored the WHO study.

Meanwhile, a spokesman for NCI/NIEHS says that the joint report is basically an update of epidemiological data on asbestos, in the light of new information uncovered in the past year.

Whatever its origin, the NCI/NIEHS work is attracting its share of criticism by way of an attack on Califano's recent statement. Some claim that the HEW secretary is unnecessarily alarming the public. Asbestos no longer causes widespread sickness because working conditions have changed, they say.

Dr. Irving J. Selikoff, a well-known authority on asbestos, and director of Mt. Sinai Medical Center's Environmental Health Laboratory (New York City), notes that "Califano's remarks are projections based on limited data, and probably represent an upper limit." But he warns that even if Califano's figures are off by a factor of two, the problem is enormous.

However, a spokesman for the American Cancer Soc. (ACS), New York City, feels that the NCI/NIEHS report does overstate the problem.

INDUSTRY RESPONSE—The Asbestos Information Assn. (AIA), Arlington, Va., an organization of asbestos processors, says that the NCI/NIEHS data are being analyzed by the group's scientific advisors, and that a statement will be issued when the study is complete. Meanwhile, an AIA press release calls the report "simply another extrapolation in statistical terms from the same data which have been available to the international scientific community for some time."

Another AIA press release, issued in response to a Califano statement (made in April) regarding a large



Fiberglass insulation, an alternative to asbestos, is considered safer

ST0002875

U.S. firms still use it, despite its checkered career

The term "asbestos" comprises a group of impure magnesium silicate minerals—e.g., chrysotile, amosite—that occur in fibrous form. Reports of the toxic properties of asbestos date back to the 1920s in the U.S. However, it wasn't until the war broke out, when millions of workers were employed in shipyards insulating warships, that mass exposure to asbestos dust occurred in this country.

The material enjoyed wide popularity as an insulator in plants and buildings until 1970, when, in response to mounting evidence of its toxic properties, manufacturers stopped producing insulation made of loosely bound asbestos fiber.

The Asbestos Information Assn. says that the 3,000 asbestos products made today in the U.S. contain chemically and physically bound fibers that do not flake off. Current end-use breakdown: asbestos cement products (pipe, sheets), 22.4%; roofing products, 34.9%; asbestos paper, 4.3%; flooring products, 15.6%; packing and gaskets, 2.8%; thermal and electrical insulation, 1.2%; friction products (brake linings), 8.8%; coatings and compounds, 2.7%; plastics, 3.0%; textiles, 1.0%; and miscellaneous, 3.3%.

outbreak of asbestos-related diseases among World War II shipyard workers, explains that such a heavy exposure to asbestos existed before medical information revealed the dangers involved. Since then, millions of dollars have been spent in dust-control equipment by miners, millers, processors and manufacturers of asbestos.

In addition, note other asbestos-industry spokesmen, the type of products made in the past—e.g., asbestos thermal insulation—are no longer produced. They were phased out in the early 1970s, when the inherent hazards became apparent (see box).

Nevertheless, asbestos is still used as an insulator or fire retardant in more than 3,000 products ranging from water pipes to brake linings. And an estimated 500 million tons of the material are still around in plants and

linings throughout the U.S., according to Roy Steinfurth, administrator of the insulation health-hazards programs for the International Assn. of Heat and Frost Insulators and Asbestos Workers (Washington). Workers still exposed to asbestos are not adequately protected, charges Selikoff.

CIGARETTE LINK—Industry spokesmen also point out that exposure to asbestos alone may not be enough to cause lung cancer—the disease most commonly associated with the breathing of asbestos fibers—and that the connection between exposure and cigarette smoking has not been stressed enough. Says John A. McKinney, president of Johns-Manville Corp. (a

leading maker of asbestos products): "Clinical evidence shows that lung cancer in asbestos workers is virtually limited to those who smoke cigarettes, and that for practical purposes, lung cancer as an asbestos-related disease would not be a problem were it not for cigarette smokers."

AIA is currently on a vigorous campaign to persuade industry workers to stop smoking.

"There is no doubt that exposure and cigarette smoking have a synergistic effect," says an ACS spokesman, "but since so many workers included in past studies were smokers or ex-smokers, it's difficult to assess the risk to non-smokers."

The synergism is acknowledged in the WHO document. "Both cigarette smoking and exposure to asbestos independently cause lung cancer. However, when present together, they act in a multiplicative fashion." The NCI/NIH study agrees, and admits that it would be an error to attempt to blame each type of cancer mentioned in the report on an exclusive cause.

A NEW STANDARD?—The current flareup of the asbestos controversy is of more than marginal interest to OSHA, which has been trying to modify present rules governing exposure to the material (the agency is studying the NCI/NIH report).

For more than three years, OSHA has been pushing a proposal to reduce the permissible level of airborne fibers in the workplace from a present value of 2 fibers/cm³ to 0.5 fiber/cm³ on an

8-h, time-weighted basis, with a 15-min ceiling of 5 fibers/cm³. All limits apply only to fibers longer than 5 µm. (NIOSH, which serves in an advisory capacity, has recommended a limit of 0.1 fiber/cm³.)

OSHA is currently evaluating the economic impact of the proposed standard, which is bound to affect both processing and use of the material.

Predictably, industry response to the idea has not been favorable. AIA calls the 0.5-fiber/cm³ limit "not technically feasible," and recommends instead the adoption of 2 fibers/cm³ as a permanent standard—one that can be realized at a reasonable cost for dust control.

On the other side of the spectrum, Roy Steinfurth, the asbestos workers' spokesman, feels that the only acceptable level is no asbestos exposure at all. The union official says that, even if the exposure level is reduced to 0.5 fiber/cm³, a worker would breathe in 4 million fibers in an 8-h workday. He estimates that as many as 50% of the members of his organization will eventually die of asbestos-related diseases.

In Europe, there is also a move to cut down on the exposure level, which has been 2 fibers/cm³ in the past few years. Italy, which lacks asbestos deposits, is attempting to phase out the material completely. Sweden moved to a 1-fiber/cm³ standard a year ago, and U.K. authorities are clamoring for a reduction of the present limit.

Critics who complain that the OSHA proposal does not go far enough in protecting workers also question why the standard should apply only to fibers longer than 5 µm. Both Selikoff and Wagoner, for example, believe that the smaller fibers are even more active in producing lung tumors. And, according to Selikoff, "For each fiber longer than 5 µm, there may be as many as 100 shorter ones."

OSHA's Health Standards Project Officer William Warren says that the 5-µm length was the most practical alternative because detection equipment does not pick up anything smaller. Warren notes that available monitoring units detect only "from a few percent to 50%" of the actual number of fibers in a sample.

INSULATION DANGER—Spot checks with a number of U.S. insulation manufacturers turned up no one still making the asbestos-containing version. However, there are still tons of it

ST0002876

installed in chemical plants all over the world. Since the asbestos is loosely bound, the cutting, handling and tearing down of such insulation poses a health hazard.

"If the insulation is intact, there's no problem," says an engineer with Britain's ICI, Ltd., "Whenever maintenance requires stripping down and removal, we replace with a substitute material." He adds that the firm does not specify asbestos for any new plants.

"We stopped using asbestos for insulation about seven or eight years ago," claims the safety manager of a U.S. refinery. "Although it is cheaper and easier to apply, the health risks persuaded us to switch to fiberglass and calcium carbide." He further notes that although some asbestos is still used, it is of the bonded type, which does not present a potential dust hazard.

The indirect risks of asbestos insulation were highlighted in a recent study of maintenance workers at American Cyanamid's facility in Bound Brook, N.J. The survey, commissioned by the

International Chemical Workers Union (ICWU), Washington, and carried out by the Mt. Sinai Medical Center, identifies the risks faced by maintenance workers (other than insulation installers) when working in the vicinity of an insulation job.

According to Larry Ahern, director of health and safety for ICWU, the results show that 44% of all workers, regardless of job function, had some form of asbestos-related lung abnormality. One group of workers exposed for less than one month experienced a significant increase in the incidence of lung disease.

Worse, the researchers discovered that many of the workers' relatives, who had not been in direct contact with the material, were affected. "About 123 wives were sick," says Steinfurth.

HOW ABOUT SUBSTITUTES?—Such popular asbestos replacements as fiberglass, mineral wool and calcium silicate may have health hazards of their own, but these have yet to be identified.

In a criteria document issued in

April 1977, NIOSH said: "Fibrous glass seems to be considerably less hazardous than asbestos . . . and, until more information is available, the recommended standard can also be applied to other manmade mineral fibers." The NIOSH paper suggests a standard of 3 fibers/cm³ for fibers of less than 3.5-μm dia. Larger fibers are not thought to be respirable.

Ralph Zumwalde, an industrial hygienist at NIOSH, points out that most of the exposure to fiberglass involves fibers with diameters greater than 3.5 μm, even though some special products contain thinner ones.

"Fiberglass is an irritant, and can cause skin irritation or upper respiratory irritation," says Dr. Donald J. Billmaier, assistant medical director of Owens-Corning Fiberglas Corp. (Toledo, Ohio, "but our studies show that there are no chronic adverse health effects from using the material."

Calcium silicate is classified as nuisance dust, not a fiber. The OSHA standard is 15 particles/cm³ for the respirable fraction.

Vincent Cavasano

Gulf Coast buildup may ease olefin glut

□ A more hopeful outlook for ethylene derivatives is triggering major expansions in the Gulf Coast area, and these may help alleviate, at least locally, the ethylene surplus that is predicted through the early 1980s (*Chem. Eng.*, Mar. 27, p. 80).

Consider, for example, the current buildup at the Raporte, Tex., complex of the USI Div. of National Distillers and Chemical Corp. The company, which last year increased its high-density polyethylene (HDPE) capacity to 500 million lb/yr, boosted its low-density polyethylene (LDPE) capacity by 200 million lb/yr this spring. Another ethylene-consuming addition is under way—USI will complete early next year a vinyl acetate monomer expansion. This will raise monomer capacity from 375 million lb/yr to 600 million lb/yr. The three expan-

sions will consume a total of just under 500 million lb/yr of ethylene.

Shell has marked the tenth anniversary of its complex at Geismar, La., by inaugurating ethylene oxide and ethylene glycol trains, now about 60% completed. About a year ago, the company began work to increase oxide production from 300 to 700 million lb/yr, and glycol output from 150 to 350 million lb/yr. "This expansion will be ready for startup in early 1979," says plant manager Fred Foster. The ethylene oxide boost will require 340 million lb/yr of ethylene raw material.

Shell will also add flexibility to the Gulf Coast ethylene distribution system with a new 254-mi ethylene pipeline that will run from Mont Belvieu (just east of Houston) to Napoleonville, La., near Shell's petrochemical

plant at Norco. The company is building a 1.5-billion-lb/yr ethylene plant there, which is expected to go onstream in 1981. Says A. R. Flora, Shell's olefins business manager, "The pipeline will help to eliminate spot shortages in Texas and Louisiana complexes, which are the heart of the petrochemical industry."

USI executives now speak more optimistically about the future of downstream products, and predict a better supply/demand balance. According to George Kappas, vice-president of National Petrochemicals Corp. (jointly owned by National Distillers and Owens-Illinois), "HDPE is currently moving away from oversupply."

"At present," says Kappas, "there is a slight surplus of HDPE. However, producers are not building up year-end inventories, and demand is growing steadily. Consequently, in 1980 and 1981, supply and demand will be somewhat tighter than they are today." Kappas notes that domestic need for the resin has grown at an average annual rate of more than 11% since 1971. LDPE will be in balance by 1980, according to USI estimates.

ST0002878

GUIDELINES FOR HANDLING OF SILICA DUST

INTRODUCTION

These guidelines are provided to further alert our customers to the potentially harmful health effects and the increase of risk of serious disease caused by the inhalation of silica dust. The developing medical and scientific evidence strongly suggests that as the amount and/or duration of silica dust inhalation increases, the risk of serious and possibly fatal respiratory and other diseases also increases. Even a minimal inhalation of silica dust may pose a health hazard. While C-E is not in a position to agree or disagree with all the various scientific and medical studies, C-E does believe that various precautions could minimize whatever risk is associated with silica dust inhalation. These guidelines also provide information which may assist you in implementing, monitoring and evaluating your own industrial hygiene and dust control programs to minimize potentially harmful personnel exposures. While C-E cannot assure that these procedures will eliminate risk, they should tend to reduce the risk.

CLASSIFICATION OF SILICA DUST

Free silica is uncombined silicon dioxide (SiO_2). Silicates contain silicon and oxygen combined with other elements in a more complex molecule. With the exception of asbestos and some talcs, silicate dusts should not ordinarily cause disabling lung conditions such as is produced by free silica.

It is uncombined or free silica that is most important in industrial dust exposure. So that an exposure can be properly evaluated, the percentage of uncombined silica must be determined by petrographic analysis, preferably by x-ray diffraction or infra-red techniques.

HARMFUL EFFECTS OF DUST

It has been generally stated that the size of the offending dust particles is of extreme importance in determining the concentration of particles that may be suspended in the air. The size of particles also determines the depth to which these particles penetrate into the lung along with the quantity that may become deposited and retained.

The particulates less than 10 microns in size are potentially the most harmful. Generally, when airborne particles are substantially larger than 10 microns in diameter, they are not of great concern because they are unable to penetrate into the lung where they could be damaging. Instead, they are removed, and collected, by the nasal passages or upper respiratory system.

Also, it has been generally stated that the duration of dust inhalation is of extreme importance. Persons who for many years have continuously inhaled free silica dust have a great likelihood of contracting a silica related or caused disease. Those who only intermittently inhale the dust have less risk of injury. In addition, those persons who smoke will increase the risk which otherwise exists.

INSTALLATION AND TEAR-OUT

It is important to be aware that exposure to silica dust can occur during installation of products that contain free silica as well as during tear-out and repair of facilities where products containing free silica have previously been installed.

Protective measures should be taken during both installation and tear-out and repair operations.

SILICOSIS

Inhalation of progressively excessive amounts of silica dust can produce rapidly-developing (acute) or chronic silicosis — a disabling lung disease. Typically, the lung tissue reacts to the presence of silica particles by forming fibrous matter around the particle. Evidence suggests that particles below one micron (one-millionth of a meter) in size may be the most dangerous since they may penetrate deeper into the lungs in high concentrations. In rapidly-developing silicosis, symptoms appear 8 to 18 months after the first exposure. Chronic silicosis, the type usually encountered in industry, generally is produced 5-20 years after the chronic silica inhalation.

Silicosis is generally classified in three separate stages by medical authorities.

The first stage of the disease produces no disability. The affected man can carry on his work as well as ever. Frequently, the individual is not aware that anything is wrong, and the disease is revealed only by opaque nodular shadows on a chest x-ray coupled with a known exposure to crystalline free silica.

In the second stage, respiration may be affected in some persons but not in all by any means. Labored breathing, on heavy exertion usually is noted first, and a dry cough also may be present.

The third stage can develop after the second stage even though the individual has been removed from exposure to silica dust. However, the progress of the disease will be slower without continued dust exposure. Breathing may become severely labored. The worker is far below normal physically and is susceptible to respiratory diseases. Chest x-ray may show an enlarged heart as a result of the body's attempts to overcome the resistance of restricted blood vessels in the lungs. Pulmonary tuberculosis and emphysema are frequent complications.

In addition to causing silicosis, the inhalation of silica dust can otherwise weaken the lungs and their natural cleansing process. As a result, the inhalation of silica dust may be a contribution factor leading to other respiratory diseases. Medical and scientific analysis is continuing, and the total effect of silica inhalation is not known. What is known strongly indicates that silica inhalation is hazardous to health.

THRESHOLD LIMIT VALUE (TLV)

TLV's or Threshold Limit Values of mineral dusts are time weighted average concentrations considered permissible for exposures of eight hours per day, five days per week that are published by the American Conference of Governmental Industrial Hygienists (ACGIH) and have been promulgated as standards of OSHA.

These values have been obtained from the experience of many groups in industry and from laboratory studies on animals. They are reviewed annually and changed as necessary on the basis of experience. Copies of TLV's may be obtained by writing to:

American Conference of Industrial Governmental Hygienists
U.S. Public Health Service
P.O. Box 1937
Cincinnati, OH 45201

For maximum safety, C-E does not recommend the inhalation of any silica dust.

MEDICAL REQUIREMENTS

An effective medical control program for exposed personnel will help prevent occupational diseases. Such a program can also serve as a check on engineering controls because symptoms of exposure in a group of workers could indicate inadequate controls.

Examinations should be performed by, or under the supervision of a licensed physician and should be given to all personnel prior to their assignments to areas in which airborne concentrations of dust may exceed the permissible exposure limits.

These examinations should include as a minimum the following:

1. Medical and occupational history
2. Chest x-ray
3. Pulmonary function studies
4. Physical including body weight, height and age

INDUSTRIAL HYGIENE MEASUREMENTS

Personnel dust exposures should be evaluated by dust measurements and a step-by-step analysis should be made to determine the conditions under which personnel are exposed to silica material. A standard procedure using personal sampling pumps should be employed in silica dust sampling. Sampling Data Sheet #S315 found in the "NIOSH" Manual of Sampling Data Sheets" may be used to sample respirable silica dust.

ABATEMENT OF PERSONNEL EXPOSURES

VENTILATION

The primary means of controlling airborne dust is through use of proper ventilation. For detailed information refer to the ACGIH publication, "Industrial Ventilation, a Manual of Recommended Practices".

PROTECTIVE EQUIPMENT

Respiratory protection should be used by personnel working in dust environments where the ventilation system is inadequate or non-operational. A combination of both proper ventilation and respiratory protection would tend to eliminate most risks.

For details on use of respirators refer to the ANSI standard, Z88.2-1969 "Practices for Respiratory Protection".

ST0002879

ASBESTOS WORK
INSULATOR CHECK LIST

JOB DESCRIPTION: _____

LOCATION: _____

I. AREA	YES	NO
1. Safe Work Permit Received	☐	☐
2. Area Safe Work Procedure Known	☐	☐
3. Nearest Phone _____		
4. Nearest Eyebath and Safety Shower _____		
5. Job Site in Safe Condition	☐	☐
6. Is Pipe or Equipment Safe to Work On?	☐	☐
7. Are Corrosive Chemicals Involved?	☐	☐
a. Can lines or equipment be drained?	☐	☐
8. Is Adjacent Piping and Equipment Safe?	☐	☐
9. Red Tags Needed?	☐	☐
10. Burn Hazard Present?	☐	☐
11. Craftsmen Lined Up With Check List?	☐	☐

SPECIAL HAZARDS _____

SPECIAL SAFETY PRECAUTIONS _____

ISSUED BY:	Date:
Supt. _____	_____
Foreman _____	_____
Crewleader _____	_____
Craftsman _____	_____

II. ASBESTOS WORK	YES	NO
1. Handbook for Handling Asbestos Materials Used	☐	☐
2. Type of Material to be Removed Known	☐	☐
3. Signs and/or Barricades Up to Warn Others	☐	☐
4. Has Disposal of Debris Been Arranged	☐	☐
5. Is Water Needed to Control Dust	☐	☐
6. Stencil on Job to Denote Materials Used	☐	☐
7. Have All Involved Personnel Been Informed	☐	☐
8. Other _____		

Special Safety Equipment

1. Chemical Goggles	ST00002880
2. Face Shield	
3. Acid Hood	
4. Air Mask	
5. Dust Respirator	
6. Rubber Gloves	
7. Rubber Boots	
8. Slicker Coat	
9. Slicker Pants	
10. Safety Belt	
11. Hearing Protection	
12. Other. Specify _____	

DESCRIPTION: _____

CAUTION

I. AREA

- | | YES | NO |
|--|--------------------------|--------------------------|
| 1. Safe Work Permit Received | ☐ | ☐ |
| 2. Area Safe Work Procedure Known | ☐ | ☐ |
| 3. Nearest Phone _____ | | |
| 4. Nearest Eyebath and Safety Shower _____ | | |
| 5. Job Site in Safe Condition | ☐ | ☐ |
| 6. Is Pipe or Equipment Safe to Work On? | ☐ | ☐ |
| 7. Are Corrosive Chemicals Involved? | ☐ | ☐ |
| 8. Can lines or equipment be drained? | ☐ | ☐ |
| 9. Is Adjacent Piping and Equipment Safe | ☐ | ☐ |
| 10. Red Tags Needed? | ☐ | ☐ |
| 11. Burn Hazards Present? | ☐ | ☐ |
| 12. Craftsmen Lined Up With Check List? | ☐ | ☐ |

Special Hazards _____

Special Safety Precautions _____

Issued By _____ Date _____

apt. _____

Foreman _____

Swelcader _____

Craftsman _____

II. ASBESTOS WORK

- | | YES |
|--|--------------------------|
| 1. Handbook for Handling Asbestos Materials Used | ☐ |
| 2. Type of Material to Be Removed Known | ☐ |
| 3. Signs and/or Barricades Up to Warn Others | ☐ |
| 4. Has Disposal of Debris Been Arranged | ☐ |
| 5. Is Water Needed to Control Dust | ☐ |
| 6. Stencil on Job to Denote Materials Used | ☐ |
| 7. Have All Involved Personnel Been Informed | ☐ |
| 8. Other _____ | |

Special Safety Equipment

1. Chemical Goggles
2. Face Shield
3. Acid Hood
4. Air Mask
5. Dust Respirator
6. Rubber Gloves
7. Rubber Boots
8. Slicker Coat
9. Slicker Pants
10. Safety Belt
11. Hearing Protection
12. Other. Specify _____

ST6002881

PIPE COVERER'S HANDBOOK

AND

FIELD NOTES

DEVELOPED

BY

ROY J. ANDERSON

FUNCTIONAL POLYMERS MAINTENANCE

ST0000707

REVIEWED

BY

PIPING TECHNOLOGY SUB-CENTER

MAINTENANCE TECHNOLOGY CENTER

CHAIRMAN - T. MADDEN

PRINTED AND DISTRIBUTED

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1971

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ST0000710

INTRODUCTION

While the principal use of this handbook will be as a source of reference information, a section has been added which covers a number of subjects related to the covering trade. For example, due to the fact that asbestos is known to be a health hazard, this subject is discussed by a member of the Dow Medical Staff. In this way, we hope you will understand why Dow has chosen to do away with asbestos containing insulating materials whenever possible.

Other subjects, such as heat transfer and "k" factors, are explained so that you may have a better basic understanding of terms and nomenclature. Older craftsmen will at some time have used most of the materials and methods listed in the book. There are some new techniques and materials listed, however, and these should be used to good advantage. Pre-cut head blocks and vinyl-acrylic mastics are good examples.

A large number of the sketches and tables have been taken from the Dow Engineering Practices. The help and cooperation of the Engineering Technical Specialists group has been greatly appreciated. A special "Thank You" is also due to the many other people who have helped with the compilation of this handbook.

Roy Anderson
July, 1971

HEALTH AND SAFETY

Only in recent years have we become fully aware of the health hazards involved in working with asbestos-containing materials. In 1969 the Environmental Research Laboratory made a thorough study of air borne dust with relation to our coverers. As a result of this study and with strong support from the Medical Department, a program was initiated whereby we would (1) reduce drastically the purchase of all asbestos-containing insulating materials, and (2) wear approved respiratory protection when working with asbestos. Since then the purchase of asbestos-containing materials has been reduced to almost zero, and our Medical Department has instituted a very rigorous program of surveillance. See Medical Information on page 3.

In general, our dust problem can be divided into two categories, namely asbestos dust and nuisance dust. We have thousands of feet of lines still covered with asbestos insulation. These lines are continually being uncovered and recovered. It is mandatory that respiratory protection be worn when these operations are taking place. Whenever possible the materials should be wetted down to reduce the dust. Nuisance dusts, while not as potentially dangerous as asbestos, can still be a very real source of irritation and respiratory protection is highly recommended. Rarely is a demolition job accomplished without a lot of dust. Wear your respirator.

Good housekeeping is essential in reducing the dust level in a working area. Always pick up torn off insulation and deposit in a dumpster promptly. Do not cut insulation or mix up cement in a confined area and wear clean, loose-fitting clothing.

^{Three} Two types of U. S. Bureau of Mines approved respirators are carried in stock. They are Dustfoe #66 and #67, and Sure-Guard #R2090. These pieces of equipment, properly fitted and kept in good condition, will afford

and 3M ~~Respirator~~
MODEL 8710

ST0000712

page 2

adequate protection. It is very important that the outer edges of the face piece form a perfect seal with the face. This should be checked frequently.

Coverers are frequently called upon to work on hot vessels and lines and to remove insulation that has been saturated with chemicals. This calls for alertness and caution. In other respects the safety habits of coverers should be no different than any other maintenance personnel. Remember, "~~Safety must be a first consideration and basic responsibility of every Midland Division employee.~~"

safety is a personal thing, "Life is Precious"

MEDICAL INFORMATION

The Medical Department is concerned about the hazards of excessive asbestos exposure not only because of the possibility of developing asbestosis, a permanent scarring condition of the lungs, but also because of the increased risk of developing lung cancer. We know that cigarette smoking along with exposure to asbestos dusts increases the risk of developing lung cancer about 80 times. Therefore, it is against your best general interest to smoke from a health standpoint--more so, if you are a pipe coverer.

Always wear the proper protective equipment when working with asbestos containing insulation materials.

The Medical Department maintains surveillance of all pipe coverers through periodic chest x-rays, measurements of breathing ability and health screening examinations. After an initial series of chest x-rays are taken, if you are under 40 years of age or have been pipe covering less than 10 years, follow up x-rays will be taken every year. If you are over 40 years of age or have been pipe covering more than 10 years, follow up chest x-rays will be taken every 6 months.

In recent years we have markedly reduced the use of asbestos in the Midland Plant. Our long range plans call for complete elimination of asbestos; however, until this is possible through the substitution of other materials, you are urged to use extreme caution when working with asbestos containing insulation.

Should you have any question relating to your health in regard to the handling of these materials, please contact the Medical Department at 6-2243.

GENERAL THEORY AND PRACTICE

Heat Transfer

The function of thermal insulation is to retard heat flow. We can best accomplish this by knowing how heat is transferred. Heat has two methods of transfer, namely, conduction and radiation. Convection, in the strict sense of the word, is not a method of heat transfer even though it is commonly used as such. Definitions are as follows:

Conduction is energy (heat) transferred from one body to another through actual physical contact. Example: heat traveling through a metal wire.

Radiation is energy (heat) transmitted through space from a hotter to a colder body. Example: the sun's heat on the earth.

Convection is the movement of a mass (air) from one location to another. Example: the movement of air from one part of a room to another.

One of the important measurements of an insulation's value is its thermal conductivity or "k" factor. This is defined as the amount of heat in Btu which will travel through a square foot of insulation one inch thick in one hour. The lower the "k" factor the better the insulation. Another way of saying the same thing would be to state that a good insulating material is a poor heat conductor. One of the big reasons for this is that insulating materials contain a large number of air spaces, and dry, immobile air is a very poor conductor.

The loss of heat due to radiation is countered by the use of reflective insulation. The use of aluminum foil over a steam traced line is a good example of this type of insulation. Reflective insulation is often used as a part of building construction. More recently we have seen "space age" reflective blankets and the gear worn by our astronauts.

Next, let us consider convection. Convection of air or heat energy within or around an insulation mass reduces its effectiveness. This is why an insulation made up of many tiny air cells is better than one containing larger air spaces. Convection currents, as we can call them, are set in motion by temperature differences. For example, we know that warm air moves upward.

In moving through an insulating material, heat will use all three modes of transfer. It is impossible to determine exactly the effect from each method. Therefore, the total amount is stated to be by conduction. Figure 1-1 illustrates how heat energy moves through an insulation mass.

As a basis for comparison the following table shows the thermal conductivity (k factor) for a number of insulating materials.

Thermal Conductivity (k factor) Table

Material	k factor at temperatures indicated				
	100°F.	200°F.	300°F.	500°F.	1000°F.
Polyurethane	.16				
Styrofoam	.27				
Fiberglas	.27	.29	.36		
Kaylo	.34	.36	.42	.50	
Careytemp	.32	.37	.42	.51	.83
Unibestos	.32	.36	.42	.50	.75
Foamglas	.42	.48	.56	.73	

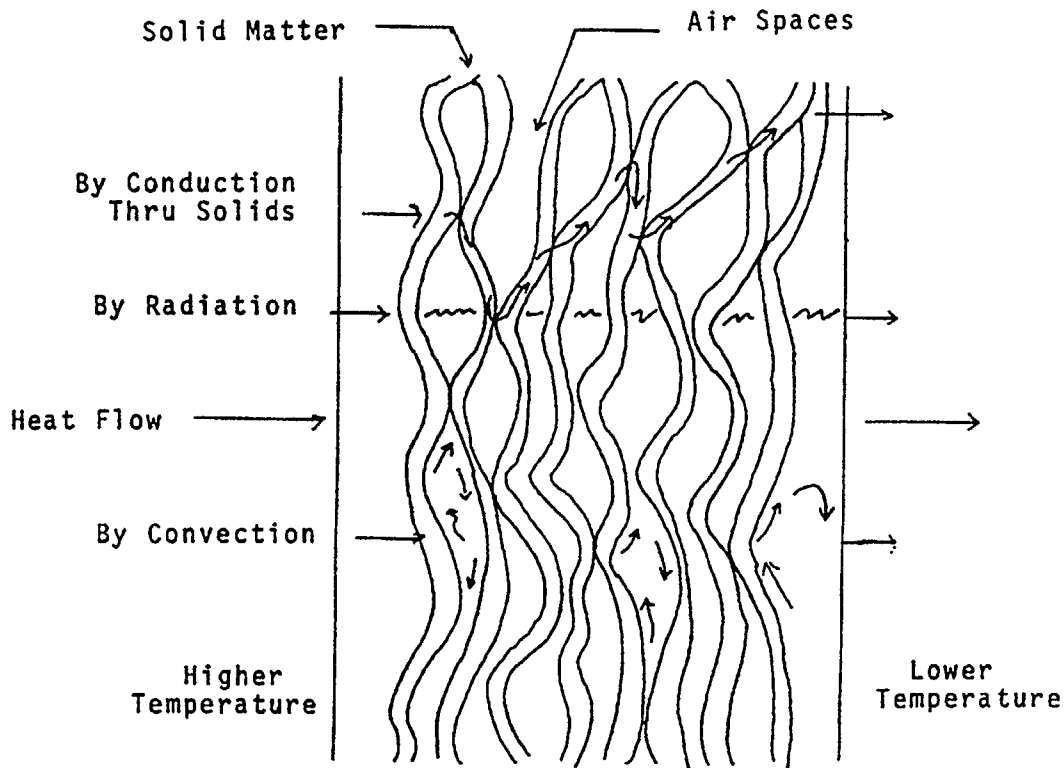


ILLUSTRATION OF HEAT TRANSFER
THROUGH MASS INSULATION

Figure 1-1

Insulation Usage

Insulation is used in our plant for several reasons. It may be used to conserve heat, control process temperatures, reduce noise levels, or serve as personnel protection. In the case of heat conservation, we make every effort to use insulation in thicknesses that will give a return in steam savings greater than the insulation cost. Depending upon the cost of installed insulation and the cost of steam, a definite thickness of insulation provides the lowest total cost.

Using bulk insulation to dampen noise is a separate field completely foreign to heat conservation. For this reason, the type and kind used on any particular job should be done only upon the recommendation of a specialist in that field.

Personnel protection generally refers to an installation of minimum thickness insulation where we are primarily concerned with keeping people from touching hot pipes or equipment. A good example would be on condensate run down lines. There is another area where we must be concerned with personnel protection and that is in the kind of jacketing used on fairly high surface temperatures. A metal jacket, because of its high thermal conductivity, is much more apt to cause a burn than asbestos paper even though they both have been used at the same temperature.

Weather and Vapor Barriers

The insulating material itself is only a part of the total system. Weather and vapor barriers also play a very important role. Weather barriers and covers are materials which will resist the elements and stand a certain amount of physical abuse. Thermal insulation depends upon finely divided air spaces to retard the flow of heat. When insulation becomes wet, all or part of the spaces become saturated with water. The transmission of heat through water is 27 times greater than through air. Besides lowering the effectiveness of the insulation, an additional heat loss occurs in drying out wet insulation.

Vapor barriers are materials which resist the passage of moisture in the vapor state. They are especially important on systems operating below normal (ambient) temperatures where the vapor pressure is lower than that on the outside. Under these conditions, vapor tends to force itself into the insulation. Then, as it encounters lower temperatures, it will reach the dew point and form water or frost as the case may be. Various types of resins have been formulated for use as vapor barriers. Some of these are Vinyl Chlorides, Hypolon, Monolar, and Acrylics.

AUTO-IGNITION

1.0 Description of Auto-Ignition

All combustible materials in the presence of air will ignite by themselves when heated above a temperature known as the auto-ignition temperature. This temperature as measured in standard tests is included in most tables of the fire and explosion properties of combustible. The "standard" auto-ignition temperatures for combustibles commonly handled in Dow plants range from about 500 to 1200°F. It should be obvious that as the temperature for handling a combustible fluid exceeds its auto-ignition temperature, the design and operational requirements for acceptable fire and explosion prevention and control become more stringent.

2.0 Lowering of Auto-Ignition Temperatures by Insulations

2.1 Certain insulations can drastically lower the auto-ignition temperatures of combustible fluids from the values given in fire property tables. For example, Dowtherm[®] A which has leaked or spilled into calcium silicate insulation has auto-ignited at temperatures of about 500°F although the "standard" value for Dowtherm A is 1150°F. Stearic acid, which has a standard auto-ignition temperature of 743°F, has auto-ignited at about 400°F when absorbed in calcium silicate insulation.

2.2 The exact mechanism for the lowering of auto-ignition temperatures by certain insulations is not known. Retention by the insulation of heat from oxidation of the combustible fluid is probably an important factor. Typically, the insulation will be smoking, and when uncovered, will be found to be glowing. Occasionally, the combustible vapors will burst into flame when the insulation is uncovered.

3.0 Conditions Under Which the Auto-Ignition Temperature is Lowered

3.1 Auto-ignition temperature lowering by insulation has been observed in the plant and (or) the laboratory with chlorophenotole, styrene (monomer or polymer), Dowtherm A, heat transfer oils, several lub oils, lanol, Acrowax, paraffin wax, stearic acid, polyglycols, VCN and ethylene oxide. It probably can occur with any combustible fluid.

3.2 It has occurred when a liquid combustible has been absorbed into the insulation as a result of a leak or a spill. Absorption and wicking into the insulation appears necessary for the phenomenon. Significant auto-ignition temperature lowering has been observed with calcium silicate, magnesia, and asbestos-type insulations and with mineral wool cement. The effect has not been observed in either laboratory tests or in the field with glass foam and Dow ceramic foam insulations.

3.2 (Cont'd.)

These insulations are closed cell and almost completely non-absorptive. Glass fiber insulation has not shown the effect in laboratory tests nor in the plant, but is not suitable for use at temperatures where auto-ignition has been a problem. "Kaylo", "Unibestos" and "Thermbestos" can cause marked lowering of auto-ignition temperatures. As manufactured "Careytemp 1500" has only a slight tendency to lower autoignition temperatures and is much less absorptive and shows much less wicking action than "Kaylo". However, it contains temporary binders which degrade rapidly, often with evolution of much smoke, at temperatures above 400° F. After decomposition of these binders, its absorption, wicking and autoignition behavior approaches that of "Kaylo".

- 3.3 The principle points of trouble have been around leaky valve packing glands, thermocouple connections, equipment flanges and places where insulation contacts horizontal flat surfaces such as floor plates. Leakage collects on the flat surface and is absorbed into the insulation by wicking action.

4.0 Corrective Measures

- 4.1 Use an insulation that has little or no tendency to lower auto-ignition temperatures.

4.1.1 Where the operating temperature, proximity to potential leak sources and consequences of an auto-ignition are critical, "Foamglas" is the recommended insulation. (Note: Dow ceramic foam is similar to "Foamglas" in respect to auto-ignition effect and compressive strength, has a higher effective service temperature, but is not yet available in quantity.)

- 4.2 Auto-Ignition can be eliminated in thermal insulation if means are used to prevent oils or organic fluids from being absorbed into the insulation. These corrective steps should be considered for new construction as well as for correcting existing conditions. They may be used separately or in combination to suit each specific case.

4.2.1 Eliminate the source of leakage. This may mean repacking valve stems, replacing leaky gaskets, seal welding screwed joints, etc.

- 4.2.2 Omit the insulation 6 or 8 inches each side of the leak. If necessary, provide personnel protection by means of a guard or expanded metal grille. Finish edges of insulation thus exposed with a beveled fillet of B & W K-20 cement. Due consideration should be given to increase heat loss and possible thermal shock (on outdoor installations) in using this method.
- 4.2.3 Install all valves, for the particular service, with stems in horizontal position so that any leaks will drip away from the insulation.
- 4.2.4 Provide sheet metal trough to carry leakage away from insulation below.
- 4.2.5 Cover insulation, in area of potential leak, with a hydraulic setting, oil resistant cement such as Babcock and Wilcox K-20 cement.
- 4.2.6 Consider use of an all metallic reflective type insulation.
- 4.2.7 Provide for adequate inspection and repair of equipment and piping systems to prevent leaks. Remove or replace insulation found to be oil soaked.
- 4.2.8 Note: See special application (Auto-Ignition) of aluminum foil on vertical vessels 43" O.D. and larger. See M8-515.

STRESS CORROSION CRACKING OF 300 SERIES STAINLESS STEEL

1.0 All 300 Series Stainless Steels are subject to stress corrosion cracking caused by Chloride attack under suitable conditions of moisture, temperature and metal stress. The 400 Series Stainless Steels are immune from this phenomenon.

1.1 The main source of Chlorides is from industrial or marine atmospheres which induce chloride contamination of the metal surface.

1.2 All commercially available inorganic insulation contains sufficient leachable chlorides in trace quantities to cause cracking.

Some Chemical Plant atmospheres are heavily chloride-contaminated. Chlorides from external sources often enter the system through condensation, rainfall, leaky valves, packing glands, etc., wetting the insulation by penetration through breaks or cracks in the insulation, and concentrating to a level where external stress corrosion takes place.

1.3 Provide and install expansion joints as required in insulation and weatherproofing which will prevent moisture from getting into the Insulation causing stress corrosion.

1.4 The most effective preventative would be to take great care to see that the insulation, piping and equipment is dry at the time of application and kept dry. Weatherproof as follows: Vapor seal mastic, weatherproof felt or metal jacket. See M8-481 and M8-555. Chloride leaching cannot take place without moisture. Failures of 300 Series Stainless Steels are most common at 150°F thru 400°F.

1.5 Purchase only inhibited insulations (1) Calcium Silicate, Thermasil - Baldwin Ehret Hill; (2) Kaylo and Fiberglas - Owens-Corning; (3) Sodium Silicate; Unibestos-Pittsburgh Corning Corporation.

1.6 As an additional precaution in case moisture does get through the insulation, or where the stainless steel piping and equipment has become contaminated or was subject to a Chloride atmosphere in storage or erection, clean and coat before insulating.

1.7 Cleaning

- a. Wash with condensate and a non-chloride detergent. Condensate shall be tested for chloride count.
- b. Steam clean.
- c. S.S.P.C. No. 6 Commercial Blast Cleaning.

1.8 Apply coatings IMMEDIATELY after cleaning.

a. Silicone coating - for temperature up thru 1000°F maximum, 800°F continuous.

1. Dampney Company
Thur-Ma-Lox #70
Doylestown, Pennsylvania

b. Silicone Coating - for temperature up to 1400°F maximum.

Thur-Ma-Lox #240.

2.0 IMPORTANT:

2.1 DO NOT USE:

a. CHLORINATED ORGANIC COATINGS.

b. CHLORIDE CONTAMINATED TESTING PROCEDURES.

c. WET MIXES OF INSULATING CEMENTS AGAINST THE STAINLESS STEEL SURFACES.

2.2 DO NOT HANDLE WITH SWEATY HANDS OR DIRTY GLOVES, AFTER CLEANING.

INSULATION REQUIREMENTS

The temperature of pipe or equipment on which insulation is installed is one of the prime considerations in the selection of an insulating material. Each type of insulation has a maximum and minimum service temperature; therefore, the proper type should be selected for the temperature service involved. See Table 2-1. No attempt has been made to go into detail on the Table itself and the materials listed are not all inclusive.

There are specific applications where the material listed for a certain temperature will not work nearly as well as another. Detailed information on each material listed in the Table can be found in the "Materials" section. Details for the use of the materials can be found under either the "Piping Applications" or "Equipment Applications" sections.

The next requisite is the form of insulation to be used. Some of the forms and their applications are listed below:

1. Rigid insulation for structural strength. Pipes, vessels, and uniformly shaped equipment subjected to mechanical abuse.
2. Semi-rigid or flexible insulation for use when external support is available and where shapes and contours make rigid insulation difficult and uneconomical to use.
3. Blanket insulation for ducts and when expansion and compression are necessary. Blankets are frequently used between vessel walls and rigid insulation to provide a thermal and mechanical cushion.

4. Sprayed urethane foams for large surfaces subjected to only moderate temperatures.
5. Poured or loose insulation for filling cavities or tight enclosures.

The right thickness of the proper insulating material is probably the next most important criterion. See Tables 2-3 thru 2-11 for thicknesses.

Finally, the proper application of the right weather and/or vapor barrier is extremely important. Insulation systems must be kept dry. On below ambient temperature applications a vapor barrier is also necessary. Details on insulating cements, jacketing and mastics can be found in the "Materials" section.

INSULATION SELECTION CHART

Temp. °F.	Service	Pipe		Equipment	
		Standard	Alternate	Standard	Alternate
1200°	Hot	Careytemp		Careytemp blocks Insulating Cement	Mineral Wool blocks/metal mesh blankets
550°	400# Steam	Careytemp	Foamglas	<i>Careytemp</i> Fiberglas metal mesh blankets 250° to 1000°F. 48" dia. up	Above 250°F. & 48" dia. up Foamglas
240°	10# Steam	Fiberglas, also on steam traced lines	Careytemp	Insulating Cement on 18" or smaller heads	Careytemp
150°	Personnel protection	Fiberglas	Careytemp	Fiberglas blanket	Careytemp
75°	Condensa- tion control	Fiberglas	Ethafoam Armaflex Dow "FX"	Fiberglas Sprayed Cork	Ethafoam
35°	Chilled water	Styrofoam FB	Foamglas	Styrofoam FB or FR	Urethane
-100°	Brines Refriger- ants	Styrofoam FB	Urethane	Styrofoam FB or FR	Urethane

Table 2 - 1

CAREYTEMP 1500 THICKNESS TABLE
5 YR. DEPRECIATION (MINIMUM THICKNESS)*

Indoor - Ambient air at 80°F.

METAL WALL OPERATING TEMP °F	PIPE (IPS) OR DIAM. OF ROUND EQUIPMENT												OVER 18 4 FLAT
	1-3 4	1-1 1/4	1 1/2	2	2 1/2	3	4	6	8	10-12	14-16	18	
150-300	1	1	1	1	1	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
301-400	1	1	1	1	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
401-500	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2 1/2	2 1/2	2 1/2
501-600	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2 1/2	2 1/2	2 1/2	3	3	3
601-700	1 1/2	1 1/2	1 1/2	2	2	2	2 1/2	2 1/2	3	3	3	3	3
701-800	2	2	2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3	3
801-900	2	2	2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3	3
901-1000	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3 1/2	3 1/2	3 1/2
1001-1100	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3 1/2	3 1/2	4	4	4
1101-1200	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3 1/2	3 1/2	3 1/2	4	4	4

**

For outdoor use add 100°F. to operating temperature

* Included in this class are installations subject to change in 5 years or less, such as:

1. Piping and equipment in pilot or semi-plants.
2. Pipe lines heated by steam or water tracer lines.
3. Insulation required for safety or protection of personnel to insure outer surface temperatures of not over 150°F.
4. Temporary facilities, experimental set ups.

** For pipe lines 2" and above, at design temperature above 600°F, apply insulation in double-layer construction with staggered joints. For additional data see manufacturer's latest bulletins.

CAREYTEMP 1500 THICKNESS TABLE
10 YR. DEPRECIATION (SHORT TERM) *

INDOOR Ambient air at 80°F

METAL WALL OPERATING TEMP °F	PIPE (IPS) OR DIAM. OF ROUND EQUIPMENT												OVER 18 ↓ FLAT
	1/2-3/4	1-1 1/4	1 1/2	2	2 1/2	3	4	6	8	10-12	14-16	18	
150-300	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2	2	2
301-400	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2	2	2	2
401-500	1 1/2	1 1/2	1 1/2	2	2	2	2	2 1/2	2 1/2	2 1/2	3	3	3
501-600	1 1/2	1 1/2	1 1/2	2	2	2 1/2	2 1/2	3	3	3	3	3	3
601-700	2	2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3	3
701-800	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3	3 1/2	3 1/2	3 1/2
801-900	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	3 1/2	4	4	4
901-1000	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	4	4	4	4	4
1001-1100	3	3	3	3	3 1/2	3 1/2	3 1/2	4	4	4	4 1/2	4 1/2	4 1/2
1101-1200	3	3	3	3	3 1/2	3 1/2	4	4	4 1/2	4 1/2	5	5	5

**

For Outdoor Use Add 100°F to Operating Temperature

* Included in this class are installations that are subject to change in approximately 10 years such as:

1. Process equipment and piping.
 2. Branch lines or connecting lines to operating equipment.
- ** For pipe lines 2" and above, at design temperature above 600°F, apply insulation in double-layer construction with staggered joints. For additional data see manufacturer's latest bulletins.

CAREYTEMP 1500 THICKNESS TABLE
20 YR. DEPRECIATION (LONG TERM) *

INDOOR Ambient air at 80°F

METAL WALL OPERATING TEMP °F	PIPE (IPS) OR DIAM. OF ROUND EQUIPMENT												OVER 18 ↓ FLAT
	1/2-3/4	1-1 1/4	1 1/2	2	2 1/2	3	4	6	8	10-12	14-16	18	
150-300	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2	2	2	2
301-400	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2 1/2	2 1/2	2 1/2	2 1/2
401-500	1 1/2	1 1/2	1 1/2	2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3
501-600	1 1/2	2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3
601-700	2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3	3	3 1/2	3 1/2	3 1/2	3 1/2
701-800	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	3 1/2	4	4	4
801-900	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	3 1/2	4	4	4
901-1000	2 1/2	2 1/2	2 1/2	2 1/2	3	3 1/2	3 1/2	4	4	4	4 1/2	4 1/2	4 1/2
1001-1100	3	3	3	3 1/2	3 1/2	4	4	4 1/2	4 1/2	4 1/2	5	5	5
1101-1200	3	3	3	3 1/2	3 1/2	4	4	4 1/2	4 1/2	4 1/2	5 1/2	5 1/2	5 1/2

**

For Outdoor Use Add 100°F to Operating Temperature

* Included in this class are permanent installations such as:

1. Steam distribution mains.
2. Main steam lines and principle equipment in Power Houses, Boiler Rooms, Pump Houses, and Process Plants.
3. Permanent pipe lines in Process Plants, Laboratories, and Shops.
4. Permanent refrigeration and air conditioning systems.

** For pipe lines 2" and above, at design temperature above 600°F, apply insulation in double-layer construction with staggered joints.
For additional data see manufacturer's latest bulletins.

FIBERGLAS INSULATION THICKNESS TABLE
5 YR. DEPRECIATION

INDOOR - AMBIENT AIR AT 80°F

TEMP °F	PIPE (IRS) ROUND EQUIPMENT									
	1/2-3/4	1-1 1/4	1 1/2	2	2 1/2	3	4	6	8	10-14
100-200	3/4	3/4	3/4	3/4	3/4	3/4	3/4	1	1	1
201-300	1	1	1	1	1	1	1	1 1/2	1 1/2	1 1/2
301-400	1	1	1	1	1	1	1	1 1/2	1 1/2	1 1/2
401-450	1	1	1	1	1	1	1	1 1/2	1 1/2	1 1/2

FOR OUTDOOR USE ADD 100°F TO OPERATING TEMPERATURE

INCLUDED IN THIS CLASS ARE:

1. PILOT PLANTS
2. PERSONNEL PROTECTION
3. SHORT-LIFE INSTALLATIONS
4. TEMPORARY LINES

FIBERGLAS INSULATION THICKNESS TABLE
10 YR. DEPRECIATION

INDOOR - AMBIENT AIR AT 80°F

PIPE (IPS) ROUND EQUIPMENT												
TEMP °F	1/2-3/4	1-1 1/4	1 1/2	2	2 1/2	3	4	6	8	10-12	14-16	18
100-200	3/4	3/4	3/4	1	1	1	1	1	1	1	1 1/2	1 1/2
201-300	1	1	1	1	1	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
301-400	1	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2
401-450	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2

FOR OUTDOOR USE ADD 100 °F TO OPERATING TEMPERATURE

FOR OUTDOOR USE ADD 100°F TO OPERATING TEMPERATURE

- INCLUDED IN THIS CLASS ARE:
- (1) TRACED PROCESS LINES (150 PSIG MAX. DOWNTHERM, STEAM, OR HOT WATER).
 - (2) HOT AND COLD WATER LINES 50°F AND UP.
 - (3) LOW PRESSURE HEATING STEAM

FIBERGLAS INSULATION THICKNESS TABLE
20 YR. DEPRECIATION

INDOOR - AMBIENT AIR AT 80°F

PIPE (I.P.S.)-ROUND EQUIPMENT											
TEMP °F	1/2-3/4	1-1 1/4	1 1/2	2	2 1/2	3	4	6	8	10-12	14-18
100-200	1	1	1	1	1	1	1	1	1	1 1/2	1 1/2
201-300	1	1	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2
301-400	1	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2
401-450	1	1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2	2 1/2

FOR OUTDOOR USE ADD 100°F TO OPERATING TEMPERATURE

INCLUDED IN THIS CLASS ARE:

- (1) CONDENSATE LINES
- (2) STEAM DISTRIBUTION LINES (150# STEAM)
- (3) PERMANENT BUILDING SUPPLY LINES - 10 PSIG & 150 PSIG

SI0000733
CELLULAR GLASS THICKNESS TABLES
RECOMMENDED THICKNESS IN INCHES

page 23

Ambient Air at 90°F

30 % Relative Humidity

Pipe Size (NPS)	PIPE SURFACE TEMPERATURE (°F.)								
	45	30	15	0	-25	-50	-100	-200	-300
1/2	1.0	1.0	1.5	2.0	2.0	2.5	3.0	4.0	4.5
1	1.0	1.0	2.0	2.0	2.5	3.0	3.5	4.5	5.0
1 1/2	1.0	1.5	2.0	2.5	3.0	3.0	4.0	5.0	5.5
2	1.0	1.5	2.0	2.5	3.0	3.0	4.0	5.0	6.0
4	1.0	1.5	2.5	2.5	3.0	3.5	4.5	5.5	6.5
6	1.0	1.5	2.5	2.5	3.0	3.5	4.5	6.0	7.0
8	1.5	2.0	2.5	2.5	3.0	4.0	5.0	6.0	7.5
10	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.5	8.0
14	1.5	2.0	2.5	3.0	3.5	4.5	5.5	7.0	8.5
18	1.5	2.0	3.0	3.0	3.5	4.5	5.5	7.5	9.0
24	1.5	2.0	3.0	3.0	3.5	5.0	6.0	8.0	9.5
30	1.5	2.0	3.0	3.0	4.0	5.0	6.0	8.0	10.0

Vessel Dia. Feet	VESSEL SURFACE TEMPERATURE (°F.)								
	45	30	15	0	-25	-50	-100	-200	-300
3	1.5	2.0	3.0	3.5	4.0	5.0	6.0	8.5	10.5
6	1.5	2.5	3.0	3.5	4.5	5.0	6.5	9.0	11.0
10	1.5	2.5	3.0	3.5	4.5	5.5	6.5	9.5	11.5
Flat	1.5	2.5	3.0	3.5	4.5	5.5	7.0	10.0	12.0

Pipe or Vessel Size	PIPE SURFACE TEMPERATURE (°F.)					
	To 300°	301-400°	401°-500°	501°-600°	601°-700°	701-800
1 1/2" or less	1.0	1.0	1.5	2.0	2.0	2.5
2" thru 3 1/2"	1.0	1.5	1.5	2.0	2.5	3.0
4" thru 6"	1.0	1.5	2.0	2.5	3.0	3.0
8 thru 10"	1.5	2.0	2.5	3.0	3.0	3.5
12 thru 30"	1.5	2.0	2.5	3.0	3.5	4.0
36 to 48"	1.5	2.0	2.5	3.0	3.5	4.0
48 to flat	2.0	2.0	2.5	3.0	3.5	4.0

Table 2-8

. ST0000734

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MISCELLANEOUS INSULATION THICKNESS TABLES

EQUIPMENT INSULATION - INDOOR. (ADD 1/2 INCH FOR OUTDOOR)

TEMP. DEGREE F.	FIBERGLAS BLANKET	MINERAL WOOL BLANKET	MINERAL WOOL BLOCK	MINERAL WOOL CEMENT		
100 - 200	1	1	1	1		
201 - 300	1	1	1 1/2	1 1/2		
301 - 400	1	1 1/2	1 1/2	2		
401 - 500	1 1/2	1 1/2	2	2 1/2		
501 - 600	2	2	2 1/2	3		
601 - 700	2 1/2	2	3	3 1/2		
701 - 800	3 1/2	2 1/2	3 1/2	4		
801 - 900	4 1/2	2 1/2	3 1/2	4		
901 - 1000	5 1/2	3	4	4 1/2		
1001 - 1100		3	4	4 1/2		
1101 - 1200		3 1/2	4 1/2	5		
1201 - 1300			4 1/2	5		
1301 - 1500			5	5 1/2		
1501 - 1600			5 1/2	6		
1601 - 1800				6 1/2		

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STYROFOAM THICKNESS TABLES
FOR PIPE & VESSEL INSULATION

RECOMMENDED THICKNESS IN INCHES
USING STYROFOAM FB BRAND

Ambient Air at 90°F

85% Relative Humidity

Pipe Surface Temperature

PIPE SIZE (IPS)	45	30	15	0	-25	-50	-75	-100	-150	-200	-250	-300
1/2	1.0	1.5	1.5	1.5	2.0	2.0	2.5	2.5	3.0	3.5	3.5	4.0
3/4	1.0	1.5	1.5	1.5	2.0	2.5	2.5	3.0	3.0	3.5	3.5	4.0
1	1.0	1.5	1.5	2.0	2.0	2.5	2.5	3.0	3.5	3.5	4.0	4.0
1-1/4	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.5	4.0	4.0	4.5
1-1/2	1.0	1.5	1.5	2.0	2.5	2.5	3.0	3.0	3.5	4.0	4.0	4.5
2	1.0	1.5	2.0	2.0	2.5	2.5	3.0	3.5	3.5	4.0	4.5	4.5
2-1/2	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.5	4.0	4.5	4.5	5.0
3	1.5	1.5	2.0	2.0	2.5	3.0	3.5	3.5	4.0	4.5	5.0	5.0
4	1.5	1.5	2.0	2.0	2.5	3.0	3.5	3.5	4.5	4.5	5.0	5.5
6	1.5	2.0	2.0	2.5	3.0	3.5	3.5	4.0	4.5	5.0	5.5	6.0
8	1.5	2.0	2.0	2.5	3.0	3.5	4.0	4.0	5.0	5.5	6.0	6.0
10	1.5	2.0	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
14	1.5	2.0	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	6.5	7.0
18	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.5	5.5	6.0	6.5	7.0
24	1.5	2.0	2.5	2.5	3.5	4.0	4.5	5.0	5.5	6.0	7.0	7.5
30	1.5	2.0	2.5	2.5	3.5	4.0	4.5	5.0	6.0	6.5	7.0	7.5

RECOMMENDED THICKNESS IN INCHES
USING STYROFOAM FR BRAND

Ambient Air at 90°F

85% Relative Humidity

Vessel Surface Temperature (°F)

VESSEL DIA. (FEET)	45	30	15	0	-25	-50	-75	-100	-150	-200	-250	-300
3	1.5	2.0	2.0	2.5	3.0	3.5	4.0	4.5	5.5	6.0	6.5	7.0
6	1.5	2.0	2.5	2.5	3.5	4.0	4.5	5.0	5.5	6.5	7.0	7.5
10	1.5	2.0	2.5	2.5	3.5	4.0	4.5	5.0	6.0	6.5	7.0	7.5
20	1.5	2.0	2.5	2.5	3.5	4.0	4.5	5.0	6.0	6.5	7.5	8.0
Flat	1.5	2.0	2.5	2.5	3.5	4.0	4.5	5.0	6.0	7.0	7.5	8.0

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THURANE THICKNESS TABLES
FOR PIPE & VESSEL INSULATION

RECOMMENDED THICKNESS IN INCHES
USING THURANE BRAND

Ambient Air at 90°F

85% Relative Humidity

PIPE SIZE (NPS)	Pipe Surface Temperature (°F)											
	45	30	15	0	-25	-50	-75	-100	-150	-200	-250	-300
1/2	1.0	1.0	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.0
3/4	1.0	1.0	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.0
1	1.0	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
1-1/4	1.0	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
1-1/2	1.0	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.5	3.5	3.5
2	1.0	1.0	1.0	1.5	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0
2-1/2	1.0	1.0	1.0	1.5	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.0
3	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.5	3.5	4.0	4.0
4	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.5	4.0	4.0	4.5
6	1.0	1.0	1.5	1.5	2.0	2.5	2.5	3.0	4.0	4.0	4.5	4.5
8	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.0	4.0	4.5	4.5	5.0
10	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.0
14	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.5	4.5	5.0	5.5
18	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.5	5.0	5.5	5.5
24	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.5	5.0	5.5	5.5
30	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.5	5.0	5.5	6.0

RECOMMENDED THICKNESS IN INCHES
USING THURANE BRAND

Ambient Air at 90°F

85% Relative Humidity

VESSEL DIA. (FEET)	VESSEL SURFACE TEMPERATURE (°F)											
	45	30	15	0	-25	-50	-75	-100	-150	-200	-250	-300
3	1.0	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.5	5.5	6.0	6.0
6	1.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	5.5	6.0	6.5
10	1.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	5.5	6.5	6.5
20	1.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	6.5	6.5
Flat	1.0	1.5	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	6.5	7.0

CAREYTEMP 1500*

1.0 Manufactured by Philip Carey Corp.

2.0 Physical Properties

Temperature Limits	Maximum 1200°F. Continuous 1500°F. Cyclic 1500°F.
Density (dry)	11-13 lbs./cu.ft.
Compressive Strength	5% deformation 100 psi.
Linear Shrinkage (percent)	
1200°F. for 24 hours	.60
1500°F. for 24 hours	1.20
Water Absorption (percent)	
By Volume @ 90% relative humidity 4 weeks	1.30
By Volume, Immersed 24 hours	2.70
Acid Resistance (after 24 hour immersion)	
25% Sulfuric or Hydrochloric Acid	No Effect
Thermal Conductivity (Expressed as BTU/hr. sq.ft. °F./1" thickness)	
300°F. Mean	.42
500°F. Mean	.51
700°F. Mean	.64
Made with expanded Perlite. Asbestos content 0.	

3.0 Standard Sizes

Copper tubing - 3/4" O.D. through 3-1/8" O.D., half sections.
 Iron Pipe - 1/4" through 24" IPS, half sections.
 Thickness - 1" through 3", single layer.
 Segmental - 12-3/4" wide curved sections through 60" O.D.
 Block Insulation:
 Standard widths - 6", 12" and 24"
 Standard lengths - 18" and 36"
 Standard thickness - 1" through 6", in 1/2" increments

4.0 Available Shapes

Block
 Pipe
 Premolded Elbows
 Prejacketed (with Aluminum) pipe insulation
 Traced pipe insulation

5.0 Application

5.1 Pipe Insulation - See page 68

5.2 Block and Segment Insulation - See page 108.

6.0 Reference pages

17 Recommended Thickness for Careytemp 1500
 105 Wall and Floor Sleeve Sizes
 106 Weight of Pipe Insulations

* See next page

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CAREYTEMP 1500

- * The first time Careytemp 1500 insulation is brought up to operating temperatures, some discoloration of the insulation occurs at the hot surface, with the possible accompaniment of a one time emission of slight organic odor and smoke. This is caused by the baking out of phenolic resin and starch binders that give the insulation added strength during the molding operation and in its subsequent transfer to the oven to initiate the drying and curing process. The inorganic component of the binder system (bentonite clay) then takes over as the drying and curing proceeds, and becomes the primary binder of the product in its final finished form and provides the required strength to the product under full service conditions.

FLEXIBLE TUBING INSULATION

1.0 Uses

For preventing condensation, sweating and drip on cold and chilled water pipes, tubing and equipment in air conditioning, cooling and refrigeration systems. Also suited for dual-temperature and heated fluid lines at temperatures up to 220°F.

2.0 Description

Flexible, expanded cellular synthetic elastomer with stabilizing compounds added. Tubular and sheet form for thermal insulation and condensation control.

Flexible, strong and tough at all working temperatures - may be installed by slipping over pipe ends. Self-extinguishing resistant to ozone, mildew, oils and solvents.

3.0 Acceptable Manufacturer

3.1 Baldwin-Ehret-Hill - "Monoflex"

3.2 Johns Manville Co. - "Aerotype"

3.3 Armstrong Cork Co. - "Armaflex"

3.4 Owens Corning - "O-C Flexible Tubing"

4.0 Available Sizes

4.1 Tubing - to fit standard sizes up to and including 3 inch, in wall thickness 3/8", 1/2", 3/4". 6 ft. lengths in all thicknesses.

4.2 Sheets - Width and Length: 24" x 60", 48" x 60"
Thicknesses: 1/8" thru 1", by 1/8" increments

5.0 Technical Data: Thermal Conductivity K at 75°F = 0.28

Temperature Range	-20 to 220°F
Density, Average	6.5 lb/cu. ft.
Tensile Strength	80 lb./sq. in.
Water Vapor Permeability	0.12 perm-in.
Self-extinguishing	by ASTM D 1692
Standard Sizes	

6.0 Recommended Thicknesses:

Conditions	Sizes	50°F	Line Temperatures	
			32°F	0°F
Normal (85°F & 70% R.H.)	3/8" O.D. 3" IPS	3/8" Nominal	1/2" Nominal	3/4" Nominal
	3" 4" IPS	1/2" Nominal	1/2" Nominal	3/4" Sheet
	Over 4" & Flat	3/8" Sheet	5/8" Sheet	1" Sheet

7.0 Application

- 7.1 On pipes or tubing install by one of the following methods.
 - 7.11 Slipping over the ends of pipes.
 - 7.12 Slitting tubing and applying it on connected piping.
 - 7.13 Applying sheet material around pipes and fittings, holding it in place with adhesive and tapes.
- 7.2 In all applications, abutting cut surfaces of butted and longitudinal joints shall be brush-coated with adhesive before joining.
- 7.3 Fittings, valves, etc. shall have fabricated covers cut from specified thickness tubing or sheet and applied with adhesives.

8.0 Finishing

- 8.1 The surface may be coated with a vinyl lacquer which will flex after drying.
- 8.2 For use outdoors, weatherproof jackets of asphalt coated roofing, aluminum or galvanized sheet metal can be used.

MINERAL WOOL METAL MESH BLANKETS

- 1.0. Product: SPUN WOOL BLANKET INSULATION (METAL MESH)
- 2.0. Description: Spun Mineral Wool enclosed between facings of flexible, metal fabrics, held together by metal tie wires.

Standard Types of Facings are:*

1. 1-inch wire mesh both sides
2. 1-inch wire mesh and stucco lath
- 2A. 1-inch wire mesh and expanded metal lath
- 2B. 1-inch wire mesh 3/8" ribbed lath (rib turned in)
3. Stucco lath both sides
- 3A. Expanded metal lath both sides
- 3B. Stucco lath one side, expanded metal lath other side
4. Stucco lath and 3/8" ribbed lath (rib turned in)
- 4A. Stucco lath and 3/8" ribbed lath (rib turned out)
5. Stucco lath and 3/4" ribbed lath (rib turned in)
- 5A. Stucco lath and 3/4" ribbed lath (rib turned out)
6. 3/8" ribbed lath both sides
7. No. 12 mesh fly screen both sides
8. 3/8" ribbed lath (rib turned in) and 3/4" ribbed lath (rib turned out)

- 3.0. Manufacturers: (See latest bulletins)

B-E-H	OCF	JM	Eagle	48
Metal-mesh Blanket #1 thru #4A	Metal-mesh Blanket O, R, H, L	Banroc Blanket #102 thru #142A	Mineral Wool Blanket #200 thru #208	Metal-mesh Blanket #4800 thru #4806

- 4.0. Uses: For heated surfaces up to 1200F, in power plants, refineries and chemical plants. Used on tanks, towers, vessels, fan housings, turbines, ovens, breechings, boilers, etc.
- 5.0. Features: Light-weight, made of Spun Mineral Wool. Factory-made to insure consistent quality. Stable, resistant to vibration. Flexible, easily applied to any regular-curved, or flat surface.

- 6.0. Technical Data: Temperature Limit, maximum 1200 F
(With monel wire mesh, up to 1500 F) (MAX)
LIMIT USAGE TO 1400 F
- | | | | |
|-------|-------------|---|----------------------------|
| Sizes | Length | - | 48, 96 inches |
| | Width | - | 24 inches |
| | Thicknesses | - | 1 to 8" by 1/2" increments |

Density:

1400° BLANKET: Density: 10 lbs./cu. ft. Temperature limit: 1400° F.
 1200° BLANKET: Density: 8 lbs./cu. ft. Temperature limit: 1200° F.
 1000° BLANKET: Density: 6 lbs./cu. ft. Temperature limit: 1000° F.

SPECIFICATIONS: Federal: HH-I-558a, Form C, Class 10 and 11

A.S.T.M.: C-592, Class I and II

RECOMMENDED THICKNESSES *

	HOT FACE	THICKNESS	HEAT LOSS	COLD FACE
1400° BLANKET	700°F	2"	95 Btu	130°F
	1000°F	4"	87 Btu	127°F
	1200°F	5½"	91 Btu	129°F
	1400°F	7½"	93 Btu	130°F
1200° BLANKET	500°F	1½"	77 Btu	122°F
	800°F	3"	83 Btu	125°F
	1000°F	4"	92 Btu	130°F
	1200°F	6"	91 Btu	129°F
1000° BLANKET	300°F	1"	52 Btu	110°F
	500°F	1½"	80 Btu	124°F
	800°F	3"	90 Btu	128°F
	1000°F	5"	87 Btu	127°F

*80°F ambient still air.

Thermal Conductivity

BTU in./hr. sq. ft. deg. F.

Mean Temperature	200	300	400	500	600	700
	.28	.37	.43	.49	.56	.63

7.0. Application

Secure mineral wool metal mesh blankets with No. 16 ga. monel wire or stainless steel bands to support rings, fasten edges of mesh together with clinch staples or 16 ga. monel wire. See M8A-203 Pg. 5.

Finish

Indoor use - Apply hydraulic setting insulating cement 3/8" minimum thickness. See M8A-203 Pg. 1.

Flashing - Seal around projecting nozzles, supports, etc. with flashing mastic and glass fabric.

Outdoor Use - Over a cement finish apply two 1/8" layers of asphalt mastic with glass fabric between layers. See M8-561 or M8A-203 Pg. 2.

Alternate - Cover with protective jacketing. See M8-560 and 563.

FIBERGLAS METAL MESH BLANKETS

- 1.0 Fiberglas Metal Mesh Blanket insulation consists of a thickness of fibrous glass wool faced on one or both sides with wire mesh or expanded metal rib lath.

For uses on Dow equipment specify type 900 with HL facing (hexagonal mesh inside, expanded metal lath outside.)

- 2.0 TEMPERATURE RANGE:

Type 900 to 1000°F Type 600 to 400°F

- 3.0 Expansion joints at 15' intervals should be provided where temperatures in excess of 600°F. are encountered. Use manufacturer's recommendations.

- 4.0 SIZE DATA:

Thickness: 1" to 6" by ½" increments

Width: 12" to 24"

Length: 24" to 96"

Standard sizes are 24" x 96". Other sizes are made to order.

- 5.0 APPLICATION

Page 24 Recommended Thickness for Fiberglas Blanket Insulation

Page 119 Application of Blanket Insulation on Horizontal Vessels 48" O.D. and larger

Page 121 Application of Blanket Insulation on Vertical Vessels 48" O.D. and larger

NOTE: Expansion Joints for Blanket Insulation may be necessary for some installations. Obtain manufacturer's recommendations.

GLASS FIBER PIPE INSULATION

1.0 Material: Fiberglas Heavy Density Section Pipe Insulation is a molded pipe covering composed of Fiberglas wool resin bonded and formed in two half cylinders up to 12" IPS.

2.0 Temperature: -120°F. to 450°F.

3.0 Properties: Density: 7 lbs./cu. ft. (nom.)

Thermal Conductivity:

Mean Temp. °F.	BTU/sq. ft. hr. °F. /in.
50	.23
100	.25
200	.30
300	.36
350	.38

4.0 Sizes: Available in 3 ft. long sections to fit all sizes of pipe and tubing from 1/2" IPS to 33".

Thicknesses available in 1/2" increments.

5.0 Jackets: Available with a number of factory applied jackets including FRJ (Fire Retardant Jacket) with self sealing lap. This cover provides a vapor seal for use on cold water lines and is sufficient for temporary or indoor service. The self sealing lap will not stick in cold weather and should be stapled. All outdoor lines should be further protected by a suitable weather barrier.

The insulation is available with a 4 oz. canvas jacket only on special order (requisition) except in 12 inch size which comes with canvas cover only.

6.0 Finish:

6.1 Indoors

6.1.1 Concealed areas where insulation does not have to be protected from physical abuse, no finish is required. It may be finished with 4 oz. canvas (muslin).

6.1.2 Exposed areas where insulation is subject to washdowns, leaks, and other physical abuse, use outdoor finish as below.

6.2 Outdoors - Use weatherproof finish.

- 7.0 Manufacturers: Johns-Manville
Owens-Corning - Fiberglas Heavy Density Sectional
Pipe Insulation
Pittsburgh Plate Glass
Gustin-Bacon
- 8.0 Dow Uses:
- 8.1 Traced lines (150 psig max. steam or hot water). See thickness charts.
- 8.2 Hot and cold water lines 50°F. and up, low pressure heating steam, condensate lines and personnel protection. See thickness charts.
- 8.3 Pilot plants, short-life installations and temporary lines. See thickness charts.
- 9.0 Application: For pipe, valves and fittings.
- 10.0 Weather proofing - moisture proofing - Glass Fibre insulation has the ability to hold moisture against the pipe or vessel wall which will corrode the pipe or vessel. It does not absorb moisture but will hold moisture. Care must be taken to assure complete water proofing. Insulation must be clean and dry when applied. Pipe lines or vessels should be warm and dry when insulation is installed. A weather proof jacket should be applied over insulation immediately to insure insulation from getting wet.

NOTE: The owners of this insulation system should be informed of the above characteristic of Glass Fibre Insulation. (This is more or less a characteristic of all insulation; particularly when the temperatures are low.)

All breaks in the water proof jacket must be repaired immediately to avoid the absorption of water in the insulation.

FOAMGLAS INSULATION

1.0 Manufactured by Pittsburgh Corning

2.0 Physical Properties

Temperature Limits	-300°F to +800
Absorption of Moisture	0.2% by Volume
Acid Resistance	Impervious to common acids and acid fumes
Capillarity	0
Coefficient of Expansion	0.0000046/°F
Combustibility	Will not burn
Composition	Closed glass cells completely inorganic
Compressive Strength	100 Lb. per sq. in.
Density	9 lb./cu. ft.
Thermal Conductivity @	
50°F = 0.38 BTU/Hr. sq. ft. °F./in.	
75°F = 0.42 BTU/Hr. sq. ft. °F./in.	

3.0 Non-Absorbent cellular construction.

4.0 Shapes available:

Curved Sidewall Segments (Tanks)
Shaped Head Segments (Tanks)
Valve and Fittings Covers
Pipe Insulation

5.0 Pipe Sizes Available:

Nom. ½" IPS through 36" IPS
1" through 4" thicknesses (single layer)

(Can also be furnished for double layer installation)

CERAMIC FOAM

1.0 Manufactured by The Dow Chemical Company

2.0 Physical Properties:

~~CANCEL~~

Absorption of Moisture, (% by Vol.)	.5
Acid Resistance	Excellent
Capillarity	None
Chemical Resistance	Excellent
Combustibility	Will Not Burn
Composition	Inorganic
Compressive Strength, Avg. Ult. (PSI)	60
Density, Average (PCF)	8
Flexural Strength, Avg. Ult. (PSI)	60
Linear Coefficient of Thermal Expansion, ($^{\circ}$ F) (75° F- 400° F)	2.9×10^{-6}
(75° F- 1200° F)	3.3×10^{-6}
Maximum Service Temperature ($^{\circ}$ F)	1,200
Odor	None
Shear Strength, Avg. Ult. (PSI)	20
Specific Gravity	0.128
Specific Heat (BTU/lb.)	0.175
Tensile Strength, Avg. Ult. (PSI)	35
Thermal Conductivity (BTU-in./hr.-ft. 2 $^{\circ}$ F)	
Avg. @ 40° F Mean Temp.	0.38
Avg. @ 75° F Mean Temp.	0.40
Thermal Shock Resistance	Excellent
WVTR (PERM-inches)	0.00

3.0 Ceramic foam is a totally inorganic, rigid, closed cell vitreous material containing no fillers or binders. It is odorless and chemically inert, it is non-combustible resistant to solvent attack. It has no food value and will neither attract nor support animal or plant life. Concentrations of dust during fabrication and installing are within acceptable levels for nuisance dust.

4.0 Fabrication - Ceramic Foam has a high strength to weight ratio. Combined with excellent abrasion and impact resistance, material can be fabricated into shapes with commercially available saws, routers. For details of pre-cut vessel head blocks, see M8A-121.

5.0 Shapes Available:

Board Stock - 2, 3, 4 & 6 Tk. x 24" width x 36" long.

Billets - 4" width 24 x 36"
 6" width 24 x 36"
 8-3/4 width 17 1/2 x 36"
 8-3/4 width 48 x 36"

LOW TEMPERATURE PIPE AND VESSEL INSULATION

1.0 Material

- 1.1 Styrofoam[®] - extruded polystyrene foam plastic
 - 1.1.1 Styrofoam[®] FB brand plastic foam is supplied in billet form to fabricators for production of precision pipe covering.
 - 1.1.2 Styrofoam[®] brand plastic foam boards: FR, SM, and HD-FR (PZ 1623)
 - 1.1.2.1 Styrofoam[®] FR boards are cut board stock used for insulating side walls of tanks.
 - 1.1.2.2 Styrofoam[®] SM boards are skinned (molded) boards used for coating roofs and domes of tanks. It is stiffer than Styrofoam[®] FR and harder to manipulate. It can be used for insulating the side walls of large tanks.
 - 1.1.2.3 Styrofoam[®] HD-FR (PZ 1623) boards are designed for tank floor insulation. It has a high load bearing capacity.
- 1.2 Thurane[®] brand plastic foam is a polyurethane plastic foam.
 - 1.2.1 Thurane[®] billets are supplied to fabricators for production of precision pipe covering.
 - 1.2.2 Thurane[®] boards are used for tank insulation.

2.0 Temperature Range

- 2.1.1 Styrofoam[®] -297°F to +165°F.
- 2.1.2 Thurane[®] -297°F to 250°F.

3.0 PROPERTIES

		STYROFOAM			
	ASEM TEST	FF BRAND ELASTIC FOAM	FR BRAND PLASTIC FOAM	SM BRAND PLASTIC FOAM	THURAND BRAND PLASTIC FOAM
3.1 Physical Properties					
Density (lb./cu.ft.)	-	1.8	1.8	2.2	2.0
Compressive Strength Avg. (psi at 5% deflection or yield)	D1621-64	25.0	30.0	30.0 ²	25.0
3.2 Water Resistance Properties					
Water Absorption, % by Vol	C-272-53	0.50	<0.10	<0.10	<0.1
Water Vapor Transmission (perm-inch)	C355-64	1.0	1.0	0.6	1.0
Capillarity	-	None	None	None	None
3.3 Thermal Properties					
Burning Characteristics	D1692-67	SE	SE	SE	SE
Flame Penetration	Bureau of Mines	*	*	*	*
Linear Coefficient of Thermal expansion (in/in [°] F) -260 [°] F to +70 [°] F	D696-44	2.6x10 ⁻⁵	2.6x10 ⁻⁵	2.6x10 ⁻⁵	2.3x10
Thermal Conductivity BTU/hr-sq ft [°] F/in mean temp of 40 [°] F	C177-63	0.28	0.23	0.185	0.15 M
Maximum Operating Temp. (for continuous use), [°] F	-	165	165	165	250

¹at yield²at 0.1 inch deformation

*Little or no resistance to flame penetration

3.4 Other Properties[®]3.4.1 Styrofoam[®]

- 3.4.1.1 Protects low temperature pipes and tanks from condensation and water collection on the surface, a major factor in corrosion of the metal.
- 3.4.1.2 Excellent resistance to water absorption and to moisture vapor transmission.
- 3.4.1.3 Flame retardant
- 3.4.1.4 Blue color
- 3.4.1.5 Non-dusting - does not cause irritation to body during handling and fabrication.

3.2.2 **Thurane[®]**

3.2.2.1 Lowest thermal conductivity of all commercial plastic foam insulations.

3.2.2.2 High resistance to water absorption.

3.2.2.3 Fire retardant

3.2.2.4 Excellent resistance to solvents and chemicals.

4.0 **Sizes**

4.1 **Styrofoam[®] and Thurane[®] pipe insulation -**
Available in Nominal Pipe Sizes 1/2" through 30" in thickness 1/2" through 4" in 1/2" increments.

4.2 **Styrofoam[®] Boards**

	THICKNESS, INCHES	WIDTH, INCHES	LENGTH, FEET
STYROFOAM FR BRAND PLASTIC FOAM BOARDS	1, 1½	16	9
	2, 3, 4	16	4½, 9
	1, 1½, 2, 3, 4	24	8
STYROFOAM SM BRAND PLASTIC FOAM BOARDS	¾, 1, 1½, 1½, 2	24	8

4.3 **Thurane[®] brand plastic foam boards**

THICKNESS, INCHES	WIDTH, INCHES	LENGTH, FEET
¾, 1, 1½, 2, 3, 4, 5, 6	16, 24, 48	4, 8, 9

5.0 Finishes

5.1 Weatherable coatings or coverings are required on outdoor insulated equipment.

5.1.1 Mastic coating systems or a metal jacket may be used.

5.1.2 White or aluminum colored finishes are recommended over systems exposed to sunlight.

5.1.3 A protective covering should be provided over the insulation where mechanical damage is likely.

5.1.4 Thurane[®] brand plastic foam insulation requires a vapor barrier coating on all equipment operating below ambient.

5.1.5 Styrofoam[®] brand plastic foam installed on dual temperature equipment requires a vapor barrier.

5.1.6 Solvent based mastics or coatings should not be applied directly to Styrofoam[®]. A base mastic of a type compatible with Styrofoam[®] should be applied with no pinholes, and allowed to cure properly, before applying the solvent base coating.

5.1.7 Black colored mastics or coatings should not be applied over Styrofoam[®].

5.1.8 Almost all solvent adhesives and coatings, including polyester resin coatings, can be applied directly to Thurane[®].

5.1.9 Sunlight or even artificial light with a significant ultraviolet spectrum will gradually deteriorate the surface of Thurane[®]. Any finish or coating will afford an adequate shield to ultraviolet.

5.1.10 Nearly all adhesives and coatings are compatible with Thurane[®] due to its good general solvent resistance.

6.0 Economic Thickness Charts

6.1 Styrofoam[®] See page 25

6.2 Thurane[®] See page 26

EXPANDED POLYETHYLENE INSULATION, ETHAFOAM®

- 1.0 This material is a white, multicellular expanded polyethylene, closed cell, flexible foam. Its suggested use as insulation is primarily in the low temperature field. It is flexible and can be bent around small vessels. Its advantages lie in its resistance to decomposition and low installation cost due to flexibility.
- 2.0 Physical Properties: K Factor- .37 BTU/Hr./Sq. Ft.
°F/Inch, for all shapes.
- Density- 1.9-2.6 Lb./Cu. Ft. for
planks and 1.9-4.0 Lb./Cu.
Ft. for Sheet and Tube.
- Water Absorption .5 Lb./Sq. Ft. of
Surface Area, maximum.
- Water Vapor Transmission - 1.0 Perm-
inch
- Compressive Stress at 25% Deflection-
Continuous - 160°F.
Intermittent - 190°F.

3.0 Sizes:

The following sizes are available in nine foot lengths. For proper application thicknesses, consult Styrofoam thickness tables with consideration for slightly higher K factor.

Thickness	Tolerance	Width	Tolerance
1 1/4"	1/8"	14"	1/2"
1 3/4"	1/4"	16"	1/2"
1 7/8"	1/4"	24"	1/2"
2 1/2"	1/4"	12"	1/2"

The material is also available in 1/2", 3/4", 1", 2", 3", 4", and 6" rounds, and in a range of tubing sizes from 3/16" to 1 3/8" with 1/4" or 1/2" nominal wall thicknesses.

4.0 Availability:

Dow Chem. Co.
600 Northland Towers
15565 Northland Drive Southfield
Detroit, Michigan 48235
Phone Number
Area Code 313
444-1000

FOAMED-IN-PLACE POLYURETHANE INSULATION

1.0 Types of Foam

- 1.1 "MONO-FOAM," from Baldwin-Ehret-Hill, Federal Spec. HH-I-00530 (GSA-FSS), Blocks and Boards also.
 - 1.1.1 (Standard) Type I, Class 2.
 - 1.1.2 (Non-Burning) Type III, Class 2; by ASTM D-1692.
- 1.2 "EXPANDOFAM," from Armstrong Cork Co.
 - 1.2.1 System RI09/R222H is standard.
 - 1.2.2 System RI10/R223H is fire retardant "Non-Burning," by ASTM test method D-1692.
- 1.3 "VULTAFOAM," from General Latex & Chemical Company.
Non-Burning Fire Retardant Type, 16F-1202.
- 1.4 "MINIT FOAM," from Kerr Chemical, Inc., for elbows, fittings, small jobs, etc., in aerosol cans.
- 1.5 "INSTA-FOAM FROTH PAK," Urethane foam in aerosol cans, from Insta-Foam Products, Inc.
 - 1.5.1 A partially used can may be stored and later used to do other jobs.
 - 1.5.2 Nozzle Selection - shipped with two dispensing nozzles.
 - 1.5.2.1 Fan spray (slotted) nozzle for coating surfaces.
 - 1.5.2.2 Round opening nozzle for filling and caulking holes.

2.0 General Characteristics

- 2.1 Will adhere to most clean and dry surfaces except polyethylene, wax, and teflon.
- 2.2 Low thermal conductivity.
- 2.3 Low Moisture - vapor permeability.
- 2.4 Easy to install.
- 2.5 Unaffected by fungus or mildew.
- 2.6 Long term performance.
- 2.7 Dimensionally stable.
- 2.8 Density - Free rise open box or form pour - 2 to 3 lbs. Densities increase when foam is poured into a more restricted space.
- 2.9 Closed Cells - (By volume) when properly foamed should be 80% to 95%. Cell walls 2 to 2.5% - Open cells 2.5 to 10%.
- 2.10 Temperature Range - Varies - Check Mfg. literature
 - 200°F. to + 140°F.
 - 300°F. to + 250°F.

2.11 Time

Hand mixing 15 to 30 seconds
 When air temperature and all component parts are at
 70°F.
 Rise time 3 to 4 min.
 Tack free time 3 to 4 min.
 Curing time 1 day

3.0 Care in Handling, Mixing, Foaming.

Do not inhale the Toluene diisocyanate vapors. Avoid prolonged contact with the eyes and skin. With reasonable care components are safe to work with in a well ventilated room or in outdoor locations. Handling, mixing and pouring of the foamed-in-place insulation shall be in accordance with the foam manufacturer's printed instructions.

4.0 Application.

All valves, fittings, flanges and other complex shapes shall be tested prior to application of insulation and shall be free of defects, dirt and foreign matter, and shall be thoroughly dry. A form shall be purchased or made to contain the foam while being formed. This form may be a pre-cast aluminum ell or tee or tuf-jac to serve as a permanent protection or a temporary removable form. The thickness of the foamed-in-place insulation shall be the same as the adjacent insulation.

When using a removable form, lubricate the inner surface of your form material with a parting agent to prevent sticking.

5.0 Finishes.

Weatherable coatings are required on outdoor installations. White is the preferred color for coatings that will be exposed to sunlight. Protect with a white Polyethylene film or light gray P.V.C. film. Sunlight will degrade the surface of the cellular structure.

Protect the surface of the foamed-in-place insulation in the same manner as the adjacent insulation.

Alternate finish - Apply 2 coats of Benjamin Foster 60 - 20 white safety monolar mastic reinforced with a layer of glass cloth.

Alternate - 4010 mastic or "Thermotex" may be used over foam underground or where not exposed to the sunlight.

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6.0 Weatherproofing

Mastic, See M8-261

7.0 Metal Jacketing

Steel vinyl coated, see M8-263

Aluminum, see M8-264

INSULATION SUNDRIES

1.0 The following materials are required in the application of piping and equipment insulations. Most of them are carried in Dow Stock and stock code numbers are listed accordingly. Other items which are not in Dow Stock must be purchased as required.

INSULATING CEMENTS

- | | |
|---|---|
| 1. B-E-H No. 1 Plus Cement
Dow Stock Code No. 200270 | A mineral wool, bentonite clay, and asbestos fiber cement for use up to 2100°F. Supplied by Baldwin-Ehret-Hill Co., in 50 pound bags. Coverage 25 sq. ft. at 1" thick per bag ASTM-195. |
| OR | |
| Super "66" Cement | A mineral wool cement for use up to 1800°F. Supplied by Eagle Picher Co., in 50 pound bags. Coverage 25 sq. ft. at 1" thick per bag. |
| OR | |
| MW No. 50 Cement | A mineral wool cement for use up to 1600°F. Supplied by Philip Carey Mfg. Co., in 50 lb. bags. Coverage 20 sq. ft. at 1" thick, per bag. |

INSULATING FINISHING CEMENTS (Also known as "Blue Mud")

- | | |
|--|--|
| 2. No. 303 Cement (or 7M) Dow
Stock Code No. 200271 | An asbestos base finishing cement for use up to 1000°F. Supplied by Philip Carey Co., in 100 lb. bags. Coverage 19 sq. ft. at 1" thick per bag. Also known as 7M Cement. |
| OR | |
| No. 152 Cement | An asbestos base finishing cement for use up to 1000°F. Supplied by Armstrong Cork Co. in 100 lb. bags. Coverage 19 sq. ft. at 1" thick per bag. |
| OR | |
| No. 352 Cement | An asbestos base finishing cement for use up to 1000°F. Supplied by Johns-Manville in 100 lb. bags. Coverage 19 sq. ft. at 1" thick per bag. |
| OR | |
| MW-One Cement | A mineral wool base finishing cement for use up to 1000°F. Supplied by Philip Carey Co. in 50 lb. bags. Coverage 20 sq. ft. at 1" thick per bag. |

HYDRAULIC SETTING INSULATING CEMENT

3. Superpowerhouse Cement
Dow Stock Code 200264

OR

E.P. One-Cote Cement

A hydraulic setting mineral wool cement for one-coat finishing on equipment and large pipes. Supplied by Baldwin-Ehret-Hill Co., in 50 lb. bags. Coverage 55 sq. ft. at 1/2" thick per 100 lbs.

Same as above. Supplied by Eagle-Picher Co., in 50 lb. bags. Coverage 75 sq. ft. at 1/2" thick per 100 lbs.

ASPHALT MASTIC EMULSION

4. Thermotex
Dow Stock Code No. 200263

OR

Insulkote

OR

90-07 H.I. Mastic

For weatherproof finish supplied by Philip Carey Co., in 50, 100, 300 and 500 lb. containers. Weight 10 lbs. per gallon. Coverage 55 sq. ft. at 1/4" thick wet per 100 lbs.

Johns-Manville in 50, 150 and 500 lb. containers. Weight 10 lbs. per gallon. Coverage 55 sq. ft. at 1/4" thick wet per 100 lbs.

Benjamin Foster in 1, 5 and 55 gallon containers.

ALTERNATE: Fire Resisting Mastic, used at 794 Bldg.
Insul-Caustic No. 551 (gray) vinyl-acrylic, 15 sq. ft.
per gal. at 1/8" thick wet film, 10.3 lbs. per gal.

ADHESIVE CEMENTS

5. No. 340 Cement
Dow Stock Code No. 200260

For cementing joints in Styrofoam and cork. Supplied by Armstrong Cork Co., in 1 and 5 gallon cans. Weight 12 1/2 lbs. per gallon. Coverage 30 sq. ft. per gallon, trowel application.

6. Plastic Elastigum
Dow Stock Code No. 300114

For applying hair felt and sealing laps of Weatherproof Felt. Supplied by Barrett in 10, 50 and 500 lb. containers. Weight 10 lbs. per gallon. Coverage 100 sq. ft. at 1/16" per 35 to 40 lbs.

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7. No. 81-71 Adhesive
Dow Stock Code No. 200224
- For cementing glass fiber insulation on air ducts. Supplied by Benjamin Foster Co. (Ductfas) in 1 and 5 gallon cans. Coverage 150-200 sq. ft. per gallon. Drying time 10 - 15 min. Flammable solvent.
8. Flashing Insulmastic
No. 4010 Vaporseal Mastic
Dow Stock Code No. 200247
- Used with glass fabric to seal Weather-proof mastic around nozzles and brackets. Supplied by Pittsburgh Coke and Chemical Co. in 1 and 5 gallon pails and 55 gallon drums. Coverage 10 sq. ft. at 1/8" dry thickness per gallon. Flammable solvent.
- OR
- Flashing Compound No. 9510
- Benjamin Foster Co.
9. No. 5D-40 Adhesive
Dow Stock Code No. 200261
- Used in spraying cork on indoor piping and equipment. Supplied by Schermerhorn Paint Prod. Co., (Navy Cuticle) in 5 gallon pails. Coverage 10 sq. ft. per gallon for 1/2" thick cork. Water soluble.
10. Sodium Silicate
Dow Stock Code No. 300203
- Used with Asbestos Cement to adhere insulation to metal surfaces. Use 40 Baume type. Supplied in 50 gallon drums.
11. Careytemp Fibrous Adhesive
- An asbestos fiber and silicate of soda fibrous plastic cement for use up to 800°F. Supplied by Philip Carey Co. in one and five gallon pails and 55 gallon barrels. One gallon covers 25 - 30 sq. ft. at 1/8" thickness.
12. Pittsburgh-Corning's
Pittseal 111
- Used for bedding cellular insulations and as a sealer in expansion joints. It cushions insulations against abrasion and seals joints against vapor leaks which might cause condensation and freezing. Aluminum in color. Temperature range of -100°F. to +300°F. Supplied by Foamglas distributors in one and five gallon containers. One gallon covers 26 sq. ft. at 1/16" thickness or 13 sq. ft. at 1/8" thickness.

FASTENING MATERIALS

13. Staples, Copper Clad
Flat, 12 Ga.

For fastening pipe covering.
Supplied in 100 lb. boxes.
(Jennison Hardware Co.)

Dow Stock Code No.
200257

Size 3/4" x 1/2", 350 pcs. per lb.

Dow Stock Code No.
200258

Size 1" x 3/4", 185 pcs. per lb.

Dow Stock Code No.
200259

Size 1 1/2" x 1", 140 pcs. per lb.

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14. Banding, Stainless Steel
Dow Stock Code No. 200131
For fastening insulation. Size 5/8" x .015" Type "304" thick in 200 ft. rolls. Supplied by A. J. Gerrard & Company; for seals, see Item 14.
15. Seals, Stainless Steel
Dow Stock Code No. 200132
For use with stainless steel banding. Supplied by A. J. Gerrard & Company. No. 1523, closed type, SS, 5/8" x 7/8".
16. Wire, Copper
Dow Stock Code No. 775187
For fastening insulation. No. 12 Gauge, Soft. Furnished in 25 pound spools.
17. Wire, Monel
Dow Stock Code No. 048116
Order soft annealed, supplied in rolls. Dia. .064" No. 16 Ga.
18. Screws, Sheet Metal
Dow Stock Code No. 577203
For fastening 26 Ga. galvanized steel sheets. Use Size No. 7 (.151" Dia.) x 1/2", RH, Pan Head self tapping cadmium plated sheet metal screws Parker-Kalon or approved equal. Supplied in 1 gross boxes. Use 7/64" drill.
19. Wire Netting, Hex Mesh
Dow Stock Code No. 200254
For reinforcing insulating cements and asphalt mastics. Order 20 ga., 1" hex mesh, "galvanized after weaving." Furnished 48" wide in 150 ft. rolls. Also known as Poultry Netting.
20. Tape, Filament
Dow Stock Code No. 200313
For fastening sectional Styro-foam pipe insulation. No. 880 "Filament Tape" 3/4" wide, supplied by Minnesota Mining & Mfg. Co. in 60 yard rolls.
21. Tape, Pressure Sensitive
Dow Stock Code No. 200223
For sealing joints in glass fiber duct insulation. 2" wide supplied by Permacel Tape Company in 60 yard rolls.
22. "Zeston" Z-Tape
10 mil polyvinyl chloride film bonded with a specially formulated adhesive that can be applied indoors or out at temperatures as low as 20°F. to make a strong, permanent bond joint. Effective in stalled temp. range of -40°F. to 175°F. Available in widths 1 1/2" & 3" standard lengths, 100'

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23. Skewers, Wood

Dow Stock Code No. 200311

Dow Stock Code No. 200312

For fastening layers of Styrofoam. Supplied by Armstrong Cork Company (also from butcher supply companies)
1-1/64" Dia. x 4 1/2", Wt. 5 pounds per M.
1/2" Dia. x 5 1/2", Wt. 6.5 pounds per M.
1/2" Dia. x 7", Wt. 10 pounds per M.

24. Paste, Cold Water

Dow Stock Code No. 200262

For Pasting Osnaburg Rag over insulation. Also called "Dry Paste". Supplied by Jennison Hardware Co., in 100 and 5 lb. bags.

JACKETING

25. Weatherproof Felt Firetard Jacket

Dow Stock Code No. 200266

For weather protection of insulation. Supplied by Johnsmenville in 55 pound rolls, 32" wide x 40 ft. long. Coverage 100 sq. ft. per roll. Order whiteside out, rolls in one piece, felts only. Also known as "Black and White" felt. Outside use.

OR

Weatherproof Felt Fireclad Jacket

For weather protection of insulation. Supplied by Philip Cary Mfg. Co., in 50 pound rolls 38" wide. Coverage 108 sq. ft. per roll. Order whiteside out, rolls in one piece, felts only. Also known as "Black and White" felt. Outside use.

26. Osnaburg Rag

Dow Stock Code No. 770129

For covering insulation. Order Furnished in bolts or rolls 40" wide, in varying lengths, as required. Inside use only.

27. Glass Membrane Fabric

Dow Stock Code No. 200246

For reinforcing asphalt mastic weatherproofing. Open weave, 36" wide x 50 yard rolls. Supplied by Twinsburg-Miller Corp. (Glasfab) Inside or outside use.

OR

An open mesh glass fabric, (wrap 100 lb., Fill 75 lb.), supplied in 50 yd. rolls in widths of 6", 18", 36" and 45"; Insul-Mastic Corp. of America. Inside or outside use.

28. 10 oz. Fiberglas Cloth Volan
"A" Treated Style 7500 Supplied
by Cadillac Plastic
For use with Epoxies on equipment.
To produce a hard finish over in-
sulation. Glass cloth with a
plain weave. 50" in width x 125
yd. roll, 16 x 14 thread average
thickness 13 mils break strength
450 x 410 mfg. for marine and
tooling field. Inside or outside
use.
29. 6 oz. Plastic Sheet
Dow Stock Code No. 200015
"FILON" No. 950 clear, flat plastic
sheet, size: 3' x 10' x .045"
thick. (Approx. \$.60 per sq. ft.).
Used to replace galvanized sheet
metal on columns, towers, tanks,
in highly corrosive areas. Inside
or outside use.
30. Dynel Modacrylic Fabric
A porous woven reinforcing fabric
used as an overlay for reinforced
plastics to give a tough, abrasion
resistant, chemical resistant,
durable surface. Supplied by
Union Carbide Corporation. Inside
or outside use.
31. P.V.C. Pre-Molded One Piece Pipe
Fitting
"Zeston" molded pre-cut P.V.C.
fitting that snaps quickly into
place over pre-cut insulation and
is held firmly in position by two
simple metal bands. Available in
90°, 45°, tees, valves, reducers,
end caps, hub joints and long
radius elbows in most commonly
used sizes from Zeston, Inc. Inside
or outside use. (See Design Aid
M8-427)
32. P.V.C. Piping Jacket
"Zeston" P.V.C. jacketing is
supplied in 600 sq. ft. rolls
that can easily be cut to size
and stapled or tacked to the in-
sulation material with "Zeston's"
tack fasteners and heat sealed.
Alternate fastening method - use
Zeston Z-Tape available from Zeston,
Inc. Inside or outside use.

33. Tuf-Jac^(R) Coated Steel
Jacketing. Insul-Coustic
Division, Birma Products
Corp.
Class 561 Code 200151
Or

Steel Jac Coated Steel
Jacketing. Childers Products
Company, Division of Smith
Products, Inc.
34. I-C Stainless Steel
Jacketing

Mild steel with electrogalvanized
baked on organosol protective coating.
Melts at 2400° F. Available in 36"
wide by 50' and up rolls with smooth
or corrugated finish for piping and
equipment and deep corrugated sheets
1½" x 2½" pitch, deep corrugated
along length of sheet to 12' lengths
with smooth or cross-crimped finish
for vertical tanks and vessels.
For details see page 58.

301 or 302 alloy stainless steel.
316 alloy available as special item
only. Melts at 2400° F. Supplied by
Insul-Coustic Division, Birma Products
Corporation. Available in 36" wide
by 50' and up rolls with 2-B smooth
or corrugated finish for piping and
equipment and deep corrugated sheets
1½" x 2½" pitch, deep corrugated
along length of sheet to 12' lengths
with smooth or cross-crimped finish
for vertical tanks and vessels.

MISCELLANEOUS

35. Cork, Granulated
Dow Stock Code No. 200272
36. Styrofoam, Granulated
37. Tape, Asbestos Listing Dow
Stock Code No. 020101

For filling voids in cork insulations.
and for spraying on pipes and equip-
ment. Size 8 - 14 mesh. Supplied by
Armstrong Cork Company, in 7 cu. ft.
bags weighing approximately 35 lbs.

Manufactured by Dow and available
on order at 542 Bldg. Order
Grind "A" type. Furnished in 10
cu. ft. boxes containing 15 - 18 lbs.

For wrapping exposed copper tubing.
Size .025" x 1" wide, woven white
asbestos. Johns-Manville #2025.

38. Gilso Gard[®] or Gilso Therm[®]
Dow Stock Code No. 200166
For insulating pipes buried directly in ground. Supplied by American Gilsonite Company, in 100 lb. bags containing approximately 2½ cu. ft. Gilso Gard[®] Temp. Range 35-300°F. Gilso-Therm[®] Temp. Range 100-460°F.
39. Heat Conducting Cement
For improving performance of steam tracing. "Zeston", "Thermon", or approved equal. Coverage - .33 lbs. per linear foot of 1/2" tracer tube. Supplied in 1 and 5 gallon pails. Weight 14 pounds per gallon.
40. VI-AC 551 Mastic
A poly vinyl acetate mastic for use up to 180°F. Supplied by Insul-Coustic Division, Birma Products Corporation. One gallon covers 12 - 15 sq. ft. at 1/8" thickness.
41. 5/8" Braided Asbestos Tubing
Dow Stock Code No. 200117
Used to slip over 1/2" and 3/8" copper tube tracer along process lines to keep lines from touching each other. Also where tracer is used along instrument lines to stop hot spots, etc.
42. Armstrong "Armaflex" Pipe Insulation
A flexible foamed plastic insulation to be slipped over pipes and tubing to prevent condensation on liquid cooling and heating lines, chilled water, and other cold lines. Available in 6 foot lengths in 3/8" wall thickness for all pipes and tubing through 1-3/8" O.D., and 1/2" wall thickness for pipes and tubing through 3-1/8" O.D. Temperature Range: 1/2" wall thickness - 32°F.-200°F. 3/8" wall thickness - 50°F. - 200°F.
43. Dow "FX" Tubing
A low-density polyethylene foam which remains soft and flexible up to 150°F. used for insulating chilled water and refrigeration equipment lines to prevent surface condensation. It may be slipped over pipes or tubes with bends up to 45°. Available in 6 ft. lengths in 3/8" or 1/2" wall thickness for 3/8" I.D. through 2-5/8" I.D. pipe sizes; and 3/4" wall thickness for 3/8" I.D. through 1-3/8" I.D. pipe sizes.

STAPLE JACKET FASTENING PROCEDURE

1.0 Scope

- 1.1 An effective way of fastening asbestos paper to insulation is to use a staple gun and monel staples.

2.0 Staple Guns Available

2.1 Hand Stapler

- 2.1.1 Recommended for use on small jobs or in areas where an electric or pneumatic stapler cannot be used.
- 2.1.2 Bostitch Model T-580-C2 with Standard Spring.
- 2.1.3 Use 1/2" leg length Monel Outward Clinch Staples .050" wide x .019" thick.

2.2 Pneumatic Stapler

- 2.2.1 Requires an 80 psi air supply to operate.
- 2.2.2 Bostitch Model SBMK
- 2.2.3 Use 1/2" leg length Monel Outward Clinch Staples .040" wide x .023" thick.

2.3 Electric Stapler

- 2.3.1 Duo Fast Model No. EW-5018-OC Tacker.
- 2.3.2 Use 9/16" leg length Monel Outward Clinch Staples No. 5018C, .050" wide x .019" thick.

3.0 Application

- 3.1 The staples should be applied every two inches.
- 3.2 This same procedure is recommended for use on the self sealing lap of Fiberglas insulation in extremely cold weather.

PRE-CUT WEATHERPROOF FELT WITH SELF SEALING LAP

1.0 Scope

Pre-cut and pre-rolled sections of jacketing paper for pipe insulation are available. These sections are very advantageous for new construction jobs and offer an appreciable savings in application time.

2.0 Material

- 2.1 The jacketing is asphalt saturated inorganic felt with a white flame-proof laminate, approximately .030" thick, and reinforced with glass fiber strands spaced on $\frac{1}{2}$ " centers laid circumferentially.
- 2.2 The inner face of the lap has a sealer of synthetic adhesive, $1\frac{1}{2}$ " wide, .002" thick, with a treated paper release tape.
- 2.3 The outer face of the lap edge is printed with a pattern indicating the proper spacing location of the attaching staples. (See M8A-408).

3.0 Sizes Available

- 3.1 The jacket is preformed to fit various pipe sizes with $\frac{3}{4}$ ", 1", $1\frac{1}{2}$ ", 2", $2\frac{1}{2}$ " and 3" thicknesses of pipe insulation.

4.0 Ordering Information

- 4.1 These pre-cut and pre-rolled sections of jacketing paper are available from Industrial Insulation, Inc., Bay City, Michigan.
- 4.2 In ordering this paper specify the following:
 - 4.2.1 Pipe size.
 - 4.2.2 Thickness of insulation.
 - 4.2.3 Length of pipe line.

SELECTION OF METAL JACKETING

- 1.0 In order to design an optimum jacketing system, the various metals currently used must be discussed.

1.1 Stainless Steel:
(T301 or T302 & T304 & T316)

1.11 Advantages are:

- 1.111 High corrosion resistance
- 1.112 High melting point (2800°F)
- 1.113 Low maintenance cost
- 1.114 Low heat emissivity

1.12 Limitations are High Cost.

1.2 Vinyl coated Electro-Galvanized,
"Tuf-Jac" or "Steel-Jac."

1.21 Advantages are:

- 1.211 No glare
- 1.212 Good fire retardence
- 1.213 Good mechanical strength

1.22 Limitations are that organic coating will char at incendiary conditions, but will not support combustion.

1.3 Epoxy or Acrylic coated Aluminum.

1.31 Advantages are:

- 1.311 Choice of colors
- 1.312 Intermediate corrosion resistance

1.32 Limitations are:

- 1.321 Organic coating will support combustion
- 1.322 Tendency to discolor

1.4 Aluminum (.016" Ga.) with moisture barrier.

1.41 Advantages are:

- 1.411 Low material cost
- 1.412 Installation ease

1.42 Limitations are:

- 1.421 Low melting point
- 1.422 Limited use in chemical atmosphere

SELECTION OF PROTECTIVE STEEL JACKETING

1.0 Available in a variety of forms as follows:

- 1.1 In rolls.....for field application - in either smooth or "Super Strength" corrugation...comes in sizes of 36 inches in width and 50, 75 or 100 feet in length.
- 1.2 In pre-cut and pre-rolled.....metal clad with a deep Pittsburgh longitudinal joint and matching butt joint sealer strip. It is accurately cut and rolled to fit pipe insulation sizes up to 24 inches IPS x 3 inches thick insulation.
- 1.3 In panels.....deep corrugated ($1\frac{1}{4}$ and $2\frac{1}{2}$ inch pitch) available in 33 inch widths and 6, 8, 10 and 12 feet lengths - ideal for tank insulation and building panel work.

2.0 Advantages are:

Maximum impact resistance, good weather durability, and it has a polyethylene galvanic barrier heat-seal laminated to under side. Multi-stage protective finish, toughness of steel, fire resistivity, and low cost are others.

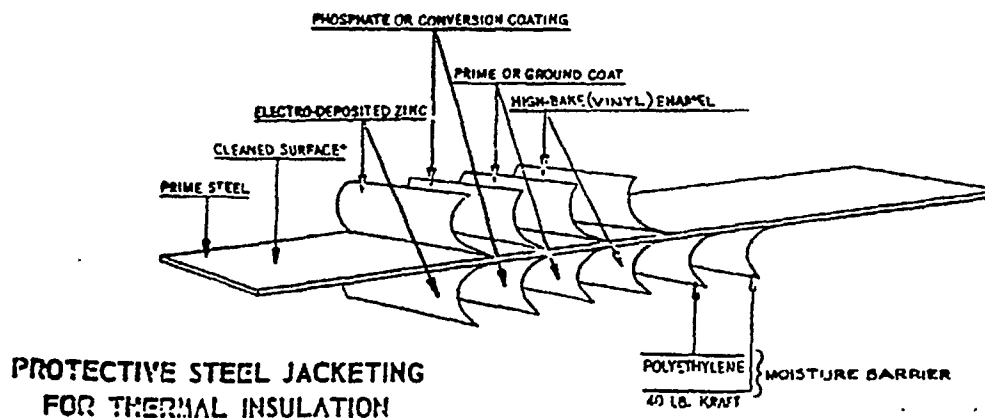
3.0 Workability factors are:

Easily worked with conventional hand tools and applied similar to other types of insulation jackets.

4.0 Metal finish contains:

Electrogalvanized, chemically treated, and resistant enamels.

5.0 Color is gray with special colors available.



6.0 Thickness of metal is 0.010 inches.

7.0 Acceptable makes are Smith Products, Incorporated "Steel-Jac," and Insul-Mastic Corporation "Tuf-Jac."

8.0 Application

8.1 Lap all joints one corrugation when installing ($1\frac{1}{2}$ " and $2\frac{1}{2}$ " pitch) panels.

8.2 Lap 2" on all joints when installing the smooth or low corrugation material.

8.3 Secure in place using a No. 7 x $\frac{1}{2}$ " long pan head cadmium-plated, self-tapping sheet metal screw on 4" centers.

ALUMINUM JACKETING FOR THERMAL INSULATION

1.0 Available in a variety of forms.

1.1 Roll Jacketing

Alloys - type 3003 (3s)
type 5005 (5s) with H-14 temper

1.2 Moisture Barriers

30-90-30 Duplex laminated moisture barrier.
It is a uniform film of oxidized asphalt laminated
between two 100% Virgin Kraft sheets. Softening
point of asphalt 180 to 200°F, flash point of 550°F.

1.3 Poly Kraft

Polyethylene coated kraft paper.
One layer of 50 lb. paper coated on one side with 1
mill polyethylene film. The kraft paper is attached
to the underside of aluminum using an adhesive across
full width of the jacketing. Softening point of
polyethylene coat 300° to 320°F, flash point of 500°F.

1.4 Thickness

.010 recommended corrugated for use on pipe lines up
to 24" O.D.

.016 recommended corrugated for use on pipe lines,
tower vessels and tanks up to 15' in dia.

1.5 Roll Sizes

.010 or .016" Tk x 36" x 100 ft. = 300 sq. ft. roll
.010 or .016" Tk x 48" x 100 ft. = 400 sq. ft. roll

1.6 Corrugated Sheets

Thickness .016", .019", .020", and .024"
Corrugations 1½" and 2½"
Widths 33" and 44" x 6, 8, 10, and 12' long
For insulating towers, vessels, and tanks 16 ft. in
dia. or more.

2.0 Application of Aluminum Sheet on Vessels

2.1 Apply - 0.016 thick type 5005 H-14 cross crimped aluminum jacketing with integral poly kraft (polyethylene - kraft paper) moisture barrier.

- 2.2 Install the aluminum sheets so they will shed water. Secure the aluminum sheets with aluminum screws or pop rivets spaced on maximum 6" centers for vertical seams and 9" centers for horizontal seams.
 - 2.3 Install 3/4" wide by 0.020" thick aluminum bands on 24" centers over the aluminum jackets. To prevent the bands from slipping, attach same to the aluminum jackets with 3 aluminum clips, screws, or pop rivets per band, spaced 120° apart.
 - 2.4 Flashing - Seal around projecting nozzles, supports, etc. for weatherproof finish.
 - 2.5 On vertical vessels place aluminum "Z" clips on the upper perimeter of each sheet of aluminum. Space clips on maximum 24" centers.
 - 2.6 The aluminum jackets must not be installed in contact with steel.
 - 2.7 Over calcium silicate or other alkaline insulation, it is imperative that any damaged moisture barrier on the aluminum jacket is patched before being applied. Do not allow the bare aluminum to contact calcium silicate or other alkaline insulation.
- 3.0 Aluminum has a limited use in some chemical atmospheres.
- 3.1 It requires protection from most acids and alkalis. Aluminum is now available pre-coated in colors with vinyls, epoxies and phenolics when color is desired or when the environment demands it.
 - 3.2 Check location and ambient conditions with the Materials Engineering Department before specifying aluminum.
- 4.0 Acceptable makes
- 4.1 Childers Manufacturing Co., Houston 8, Texas
 - 4.2 Al-Cor-Jac Insul-Cooustic Corporation

SELECTION OF MASTIC JACKETING

1.0 TYPES:

1.1 Asphaltic Type

A weather-barrier type mastic for troweling. Applies easily. For use as a finish over insulating cements. Flashing mastic used to seal nozzles and brackets.

1.1.1 Breathing Type

Thermotex - B	Philip Carey Company
Dow Stock Code No. 200263	
Insulkote ET	Johns-Manville
90-07 H.I.Mastic	Benjamin Foster

1.1.2 Sealing Type

Flashing Insulmastic	Pittsburgh Coke
No. 4010	and Chemical Company

1.2 Polymeric Type

Vinyl and Acrylic type latexes. A semi-vapor barrier mastic for trowel or spray. Easily applied, provides excellent mechanical and weather resistance.

Benjamin Foster GPM [®] 35-00	Benjamin Foster
Vimasco WC-1	Vimasco
Insul-Coustic VI-AC 551	Birma Products Corp.
Vi-Cryl CP-10 and CP-11	Childers Products Company.

1.3 Elastomeric Type

A vapor-barrier type mastic. Provides excellent mechanical and weather resistance. Can be used as an overcoat with GPM[®] 35-00.

Benjamin Foster Monolar	Benjamin Foster
60-36.	
Benjamin Foster Mastic	Benjamin Foster
60-30	
Benjamin Foster Mastic	Benjamin Foster
60-35	
D.C.Silicone Rubber Dispersion	Dow Corning

- 2.0 Before application, the insulator must acquaint himself with the product being handled, such as:
 - 2.1 See Manufacturer's Specifications for handling:
Trowel, spray or brush grade - summer or winter grade.
 - 2.2 Classification: as to fire, flame spread and flash point, temperature limits, safety.
 - 2.3 Type of Volatile: Water or solvent.
 - 2.4 Material Preparation.
 - 2.5 Limitation of Materials.
- 3.0 CAUTION: These coatings shall not be applied to surfaces containing frost or moisture, oil, grease, chemicals, wet cement or scale. Any of these will interfere with adhesion.
- 5.0 Application of Weatherproofing:
 - 5.1 Apply 1/8 inch minimum thickness of mastic; while wet, imbed a glass or Dynel membrane into the mastic to insure complete and uniform contact. Smooth out all wrinkles and follow with a 1/8 inch final layer of asphalt mastic.
 - 5.2 Alternate: When tanks, vessels or heat exchangers are subject to expansion and contraction, apply one inch hexagonal wire mesh laced on smooth and tight. Then apply two 1/8 inch layers of mastic troweled to a smooth finish.
 - 5.3 Flash all nozzles, brackets, lugs or any projection through the insulation at flanges, platforms, etc. See page 151.

APPLICATION OF EPOXY COATING

1.0 Scope

- 1.1 This practice shall serve as a guide only as each specific job must be altered to suit field conditions.
- 1.2 For additional information on the use of Epoxies and Derakanes (Vinyl Ester Resins), call Materials Engineering, Coatings Section.
- 1.3 Multiple layer laminate - On a firm substrate such as Foamglas and other block, a two layer laminate should be adequate. In traffic areas or where hard finish is subject to abuse, an added layer may be necessary.

2.0 Insulation

- 2.1 Application of insulation and filler material shall be as previously specified with all joints pointed up, all voids filled, and covered with a coat of cement in preparation for the resin finish.

3.0 Epoxy Coating Materials

- 3.1 Glass cloth specifications: 10 oz. fiber-glass cloth No. 7500 Volan treated 16 x 14 thread, 13 mil thickness, plain weave, 50 in. wide x 125 yds. in roll. Supplied by Cadillac Plastic.
- 3.2 Dow Epoxy D.E.R. 331 resin in stock at Materials Center in gallons.
- 3.3 DETA Hardner in stock at Solvent Stock.
- 3.4 Use 10 to 11 parts by weight of DETA per 100 parts of DER 331.

4.0 Application of Epoxy and Glass Cloth for Hard Finish

- 4.1 Wet the cemented surface with Dow Epoxy. Stretch on the first layer of glass cloth and roll it on to saturate the back side of the cloth. Extend glass cloth and epoxy up 3" around all nozzles and allow 6" lap over body jacket to protect against chemical spills. Overlap glass cloth 3 to 4" and stagger all joints.
- 4.2 Apply resin to top side of the cloth, work into thoroughly saturate the cloth, work out all bubbles. If white spots appear, it is lack of saturation. Allow time for curing at a minimum temperature of 60°F.

4.3 As soon as the first layer is firm enough to work on, apply the second layer of cloth in the same manner. Too long a time interval between layers will result in poor adhesion.

4.4 After the laminate system has hardened, hand sand (using a sanding block) remove irregularities, rough spots and frayed edges of the cloth.

4.5 Apply a finish coat of Epoxy.

5.0 Curing Time

5.1 The resin system must have adequate curing temperature at 60°F for several days. If temperatures are lower than 60°F, provide closures and/or other facilities for curing. Curing time is less at higher temperatures.

Dimension Standards : Insulated NPS Pipe

In the development of the insulation industry the major manufacturers produced pipe insulation to their own specifications. This, of course, resulted in a hodge podge of pipe sizes. There was a definite need for a standardization of sizes as well as a need to have the outside diameter of each piece of insulation equal to the outside diameter of standard nominal pipe sizes (NPS). In this way, multiple layered insulation could be fitted by using the appropriate next larger pipe size. This system has been adopted by the major producers of pipe insulation and is known as ASTM Standard C-521. The dimensions for both NPS pipe and tubes are shown in the following tables.

NPS		NOMINAL INSULATION THICKNESS															
NOM	O.D.	½"		1"		1½"		2"		2½"		3"		3½"		4"	
		THK.	O.D.	THK.	O.D.	THK.	O.D.	THK.	O.D.	THK.	O.D.	THK.	O.D.	THK.	O.D.	THK.	O.D.
½	.84	.53	1.90	1.02	2.88	1.58	4.00	2.08	5.00	2.89	6.62	3.39	7.62	3.89	8.62	4.39	9.62
¾	1.05	.66	2.38	.91	2.88	1.48	4.00	1.98	5.00	2.79	6.62	3.29	7.62	3.79	8.62	4.29	9.62
1	1.32	.53	2.38	1.09	3.50	1.59	4.50	2.12	5.56	2.65	6.62	3.15	7.62	3.65	8.62	4.15	9.62
1¼	1.66	.61	2.88	.92	3.50	1.67	5.00	1.95	5.56	2.48	6.62	2.98	7.62	3.48	8.62	3.98	9.62
1½	1.90	.49	2.88	1.05	4.00	1.53	5.00	2.36	6.62	2.86	7.62	3.36	8.62	3.86	9.62	4.48	10.75
2	2.38	.56	3.50	1.06	4.50	1.59	5.56	2.12	6.62	2.62	7.62	3.12	8.62	3.62	9.62	4.18	10.75
2½	2.88	.56	4.00	1.06	5.00	1.87	6.62	2.37	7.62	2.87	8.62	3.37	9.62	3.94	10.75	4.44	11.75
3	3.50	.50	4.50	1.03	5.56	1.56	6.62	2.06	7.62	2.56	8.62	3.06	9.62	3.62	10.75	4.12	11.75
3½	4.00	.50	5.00	1.31	6.62	1.81	7.62	2.31	8.62	2.81	9.62	3.37	10.75	3.88	11.75	4.38	12.75
4	4.50	.53	5.56	1.06	6.62	1.56	7.62	2.06	8.62	2.55	9.62	3.12	10.75	3.62	11.75	4.12	12.75
5	5.56	.53	6.62	1.03	7.62	1.53	8.62	2.03	9.62	2.59	10.75	3.10	11.75	3.59	12.75	4.22	14.00
6	6.62	.50	7.62	1.00	8.62	1.50	9.62	2.06	10.75	2.56	11.75	3.06	12.75	3.68	14.00	4.18	15.00
8	8.62	.50	9.62	1.06	10.75	1.56	11.75	2.06	12.75	2.68	14.00	3.18	15.00	3.68	16.00	4.18	17.00
10	10.75	.50	11.75	1.00	12.75	1.63	14.00	2.13	15.00	2.63	16.00	3.13	17.00	3.63	18.00	4.13	19.00
12	12.75	.63	14.00	1.13	15.00	1.63	16.00	2.13	17.00	2.63	18.00	3.13	19.00	3.63	20.00	4.13	21.00
14	14.00	.50	15.00	1.00	16.00	1.50	17.00	2.00	18.00	2.50	19.00	3.00	20.00	3.50	21.00	4.00	22.00
16	16.00	.50	17.00	1.00	18.00	1.50	19.00	2.00	20.00	2.50	21.00	3.00	22.00	3.50	23.00	4.00	24.00
18	18.00	.50	19.00	1.00	20.00	1.50	21.00	2.00	22.00	2.50	23.00	3.00	24.00	3.50	25.00	4.00	26.00
20	20.00	.50	21.00	1.00	22.00	1.50	23.00	2.00	24.00	2.50	25.00	3.00	26.00	3.50	27.00	4.00	28.00
22	22.00	.50	23.00	1.00	24.00	1.50	25.00	2.00	26.00	2.50	27.00	3.00	28.00	3.50	29.00	4.00	30.00
24	24.00	.50	25.00	1.00	26.00	1.50	27.00	2.00	28.00	2.50	29.00	3.00	30.00	3.50	31.00	4.00	32.00
26	26.00	.50	27.00	1.00	28.00	1.50	29.00	2.00	30.00	2.50	31.00	3.00	32.00	3.50	33.00	4.00	34.00
28	28.00	.50	29.00	1.00	30.00	1.50	31.00	2.00	32.00	2.50	33.00	3.00	34.00	3.50	35.00	4.00	36.00
30	30.00	.50	31.00	1.00	32.00	1.50	33.00	2.00	34.00	2.50	35.00	3.00	36.00	3.50	37.00	4.00	38.00

NOM—Nominal Diameter
 O.D.—Actual Outside Diameter (inches)
 THK.—Actual Thickness of Insulation (inches)

This table is used to convert the nominal insulation thickness to the proper dimension standards for insulated NPS Pipe. For 2 inch NPS pipe with 3 inches of insulation a single layer 3.12 inches with an O.D. of 8.63 inches would be used. The two layer design would require one 1.59 inch thickness with O.D. of 5.66 inches and one 1.53 inch thick covering with an O.D. of 8.63 inches. The second layer actually has an I.D. corresponding to the O.D. of 5-inch NPS pipe and could be used as covering for that size. The actual thickness of the two layer design would be 3.12 inches.

Table 4 - 1

[ST0000777

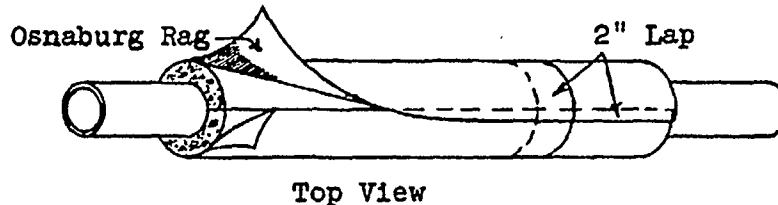
page 67

PIPE AND TUBE INSULATION DIMENSIONSBASIC OUTSIDE DIAMETERS FOR TUBE INSULATION
ASTM Recommended Practice

Tube Size	O.D.	Nominal Thickness of Insulation							
		1/2	1	1½	2	2½	3	3½	4
1/4	0.250	1.315	2.875	3.500	4.500	5.625	6.625	7.625	8.625
3/8	0.375	1.660	2.875	3.500	4.500	5.625	6.625	7.625	8.625
1/2	0.500	1.660	2.875	3.500	4.500	5.625	6.625	7.625	8.625
1/2	0.625	1.660	2.875	3.500	4.500	5.625	6.625	7.625	8.625
3/4	0.750	1.900	2.875	4.000	5.000	5.625	7.625	8.625	9.625
3/4	0.875	1.900	3.500	4.000	5.000	6.625	7.625	8.625	9.625
1	1.000	2.375	3.500	4.000	5.000	6.625	7.625	8.625	9.625
1	1.125	2.375	3.500	4.000	5.000	6.625	7.625	8.625	9.625
1½	1.250	2.375	3.500	4.500	5.563	6.625	7.625	8.625	9.625
1½	1.500	2.875	4.000	4.500	5.563	6.625	7.625	8.625	9.625
1½	1.625	2.875	4.000	4.500	5.563	6.625	7.625	8.625	9.625
2	2.000	3.500	4.000	5.000	6.625	7.625	8.625	9.625	10.750
2	2.125	3.500	4.500	5.563	6.625	7.625	8.625	9.625	10.750
2½	2.500	3.500	4.500	5.563	6.625	7.625	8.625	9.625	10.750
2½	2.625	4.000	5.000	5.563	6.625	7.625	8.625	9.625	10.750
3	3.000	4.000	5.000	6.625	7.625	8.625	9.625	10.750	11.750
3	3.125	4.500	5.563	6.625	7.625	8.625	9.625	10.750	11.750
3 5/8	3.625	5.000	6.625	7.625	8.625	9.625	10.750	11.750	12.750
4	4.000	5.000	6.625	7.625	8.625	9.625	10.750	11.750	12.750
4	4.125	5.563	6.625	7.625	8.625	9.625	10.750	11.750	12.750
5	5.000	6.625	7.625	8.625	9.625	10.750	11.750	12.750	14.000
5	5.125	6.625	7.625	8.625	9.625	10.750	11.750	12.750	14.000
5	6.000	7.625	8.625	9.625	10.750	11.750	12.750	14.000	15.000
5	6.125	7.625	8.625	9.625	10.750	11.750	12.750	14.000	15.000
3	8.000			11.750	12.750	14.000	15.000	16.000	17.000
3	8.125			11.750	12.750	14.000	15.000	16.000	17.000
10	10.000			12.750	14.000	15.000	16.000	17.000	18.000
10	10.125			14.000	14.000	15.000	16.000	17.000	18.000
12	12.000			15.000	16.000	17.000	18.000	19.000	20.000
14	14.333			18.000	19.000	20.000	21.000	23.000	23.000
16	16.333			20.000	21.000	22.000	23.000	24.000	25.000
18	18.333			22.000	23.000	24.000	25.000	26.000	27.000
20	20.333			24.000	25.000	26.000	27.000	28.000	29.000
24	24.333			28.000	29.000	30.000	31.000	32.000	33.000

Table 4 - 2

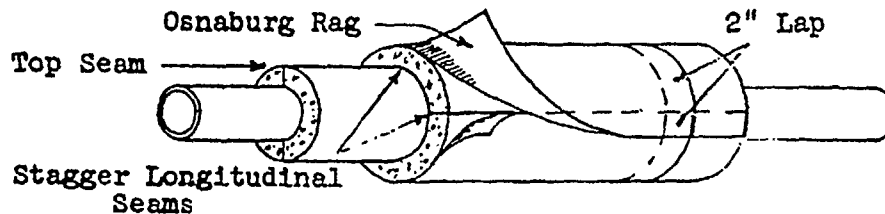
APPLYING SINGLE LAYER RIGID PIPE INSULATION



APPLICATION PROCEDURE

- 1.0 O. D. Insulation sizes up to 12" Use a lagging adhesive to fasten on the canvas jacket. Glass fiber adhesive tape may be used on cellular glass. Any voids shall be pointed up with insulating cement.
- 2.0 O. D. Insulation sizes over 12" Fasten the sections with stainless steel banding (5/8" x .015). Spacing of bands shall be approximately 12" apart with no band more than 4" from an end joint. Any voids shall be pointed up with insulating cement.
- 3.0 Indoor Finish On sizes under 12" O. D. cover with Osnaburg Rag using a lagging adhesive. O. D. insulation sizes over 12" shall always be finished with a weatherproof cover.
- 4.0 Weatherproof Finish Apply weatherproof felt as shown on page 102 or an equivalent metal finish as shown on page 103.
- 5.0 Fittings Use premolded elbows covered with canvas or as shown on pages 74 and 76.

APPLYING DOUBLE LAYER RIGID PIPE INSULATION



APPLICATION PROCEDURE

- 1.0 O. D. Insulation sizes up to 12" Remove canvas from inner layer with joints and seams staggered. Use a lagging adhesive to fasten on the outer canvas jacket. Glass fiber adhesive tape may be used on cellular glass. Any voids shall be pointed up with insulating cement.
- 2.0 O. D. Insulation sizes over 12" Fasten the outer layer with stainless steel bands (5/8" x .015). Spacing of bands shall be approximately 12" apart with no band more than 4" from an end joint. Any voids shall be pointed up with insulating cement.
- 3.0 Indoor Finish On sizes under 12" O. D. cover with Osnaburg Rag using a lagging adhesive. O. D. insulation sizes over 12 inches shall always be finished with a weatherproof cover.
- 4.0 Weatherproof Cover Apply Weatherproof Felt as shown on page 102 or an equivalent metal finish as shown on page 103.
- 5.0 Fittings Use premolded fittings or fabricate as shown on pages 77 and 80.

INSULATION ON PIPE BENDS,
WELD ELLS, 4" AND LARGER,
AND MITER ELBOWS

1.0 APPLICATION PROCEDURE

1.1 PIPE BENDS ALL SIZES:

Insulate bend with short mitered pieces of pipe insulation, same type as on adjacent pipe. Make pieces short enough to provide good continuous fit between pipe and insulation. Fasten pieces with copper clad wire or stainless steel bands.

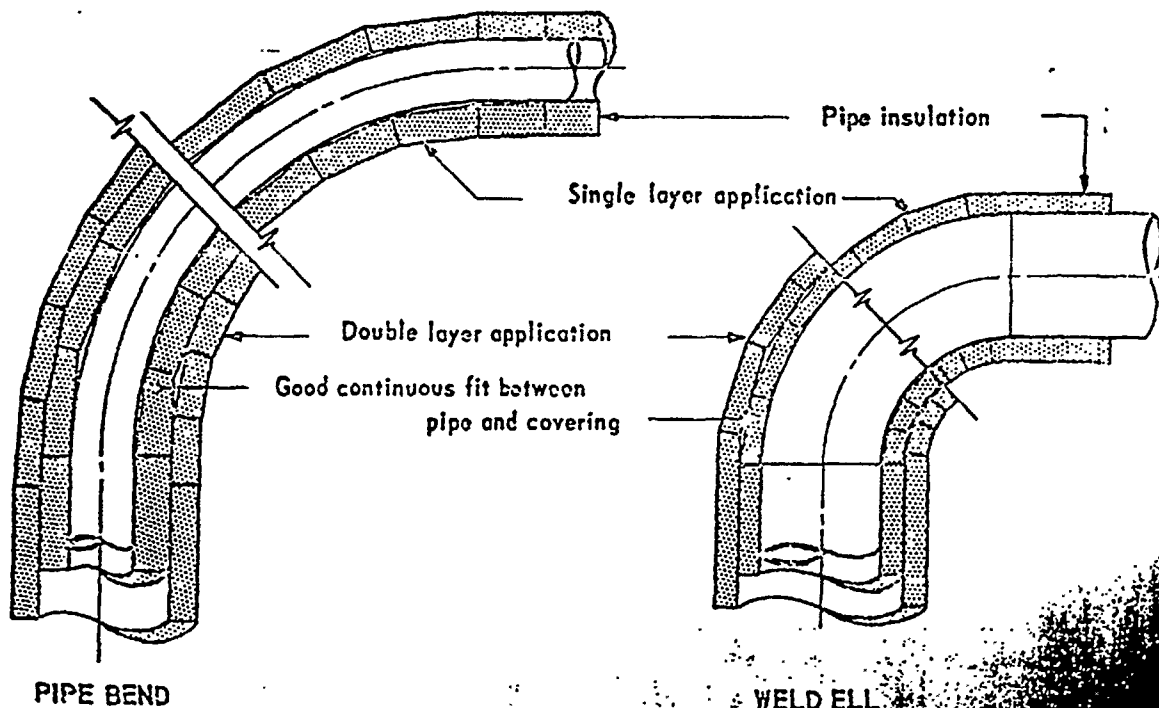
1.2 WELD ELLS 4" & LARGER:

Insulate elbow with pipe insulation, same type as on adjacent pipe. Fasten with copper clad wire or stainless steel bands.

2.0 INDOOR FINISH

2.1 BOTH TYPES:

Apply complete smooth coat hydraulic setting cement, 1/4" thick, working well into all seams and joints. Cover with Osnaburg Rag using a lagging adhesive.



3.0 WEATHERPROOF FINISH:

3.1 PIPE BENDS:

Point all joints with hydraulic setting cement. Cover with strips of weatherproof felt cut to fit. Fasten with copper clad wire or staples as shown on page 55.

3.2 WELD ELLS:

Point all seams with hydraulic setting cement. Cover completely with 1/8" coat of asphalt mastic and while wet embed glass membrane fabric. Finish with 1/8" coat of asphalt mastic.

4.0 INDOOR FINISH - ALL SIZES - MITER ELBOWS:

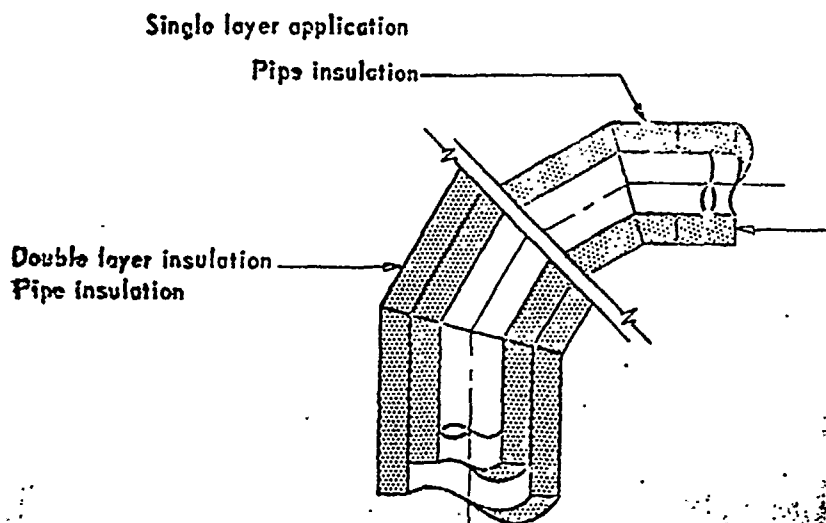
Insulate elbow with mitered pieces of pipe insulation, same type as on adjacent pipe. Fasten with 16 gauge copper clad wire or stainless steel bands.

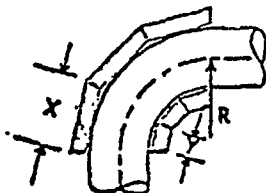
Apply complete smooth coat of hydraulic setting cement 1/4" thick, working well into all seams and joints. Cover with Osnaburg Rag, using a lagging adhesive.

5.0 WEATHERPROOF FINISH - MITER ELBOWS:

6" and Smaller: Point all seams with hydraulic setting cement. Cover completely with 1/4" asphalt mastic.

8" and Larger: Point all seams with hydraulic setting cement. Apply 1/8" coat of emulsion type asphalt mastic and while wet, embed glass membrane fabric. Finish with 1/8" complete coat of asphalt mastic.





MITERED SEGMENT DIMENSIONS

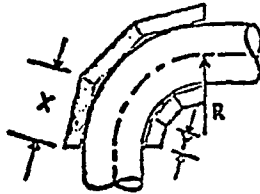
Short Radius Ells

R=D

N=No. of Segments

	THICKNESS OF INSULATION																				
PIPE SIZE	1"			1½"			2"			2½"			3"			3½"			4"		
	X	N	Y	X	N	Y	X	N	Y	X	N	Y	X	N	Y	X	N	Y	X	N	Y
3																					
3½																					
4	4½	3	¾	4½	3	¾															
4½	3¾	4	¾	3¾	4	¾															
5	3¾	4	¾	3¾	4	¾															
6	2¾	6	¾	2¾	6	¾	3¾	6	¾												
7	3¾	6	¾	2¾	6	¾	3¾	6	¾	3¾	6	¾									
8	3¾	6	¾	3¾	6	¾	3¾	6	¾	4	6	½	4½	6	¾						
9	3¾	8	¾	3¾	8	¾	3¾	8	¾	3¾	8	¾	4½	6	½	4½	6	¾			
10	3¾	8	¾	3¾	8	¾	3¾	8	¾	3¾	8	¾	3¾	8	¾	3¾	8	¾	3¾	8	¾
11	3¾	8	¾	3¾	8	¾	3¾	8	¾	4	8	¾	4½	8	½	4½	8	¾	4½	8	¾
12	3¾	8	1½	4	8	1	4½	8	¾	4½	8	¾	4½	8	¾	4½	8	¾	4½	8	½
14	4½	8	1½	4½	8	1½	4½	8	1	4½	8	¾	4½	8	¾	4½	8	¾	4½	8	¾
15	4½	8	1½	4½	8	1½	4½	8	1½	4½	8	1	5½	8	¾	5½	8	¾	5½	8	¾
16	4½	8	1½	5	8	1½	5½	8	1½	5½	8	1½	5½	8	¾	5½	8	¾	5½	8	¾
17	5½	8	1½	5½	8	1½	5½	8	1½	5½	8	1½	5½	8	1	5½	8	¾	5½	8	¾
18	5½	8	1½	5½	8	1½	5½	8	1½	5½	8	1½	6	8	1½	6½	8	1½	6½	8	1
19	5½	8	1½	5½	8	1½	6	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½
20	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½
21	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	6½	8	1½	7	8	1½
22	6½	8	1½	6½	8	1½	6½	8	1½	7	8	1½	7½	8	1½	7½	8	1½	7½	8	1½
23	7	8	2½	7½	8	2	7½	8	1½	7½	8	1½	7½	8	1½	7½	8	1½	7½	8	1½
24	7½	8	2½	7½	8	2½	7½	8	2	7½	8	1½	7½	8	1½	7½	8	1½	7½	8	1½

Table 4 - 3



MITERED SEGMENT DIMENSIONS

Five Diameter Bends

R=5D

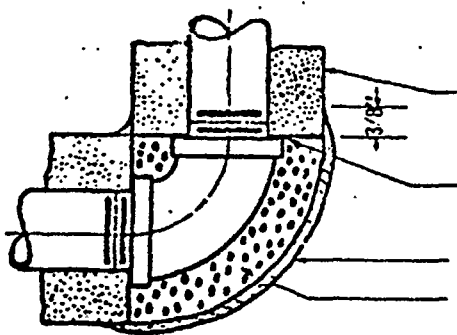
N=No. of Segments

THICKNESS OF INSULATION																					
PIPE SIZE	1"			1½"			2"			2½"			3"			3½"			4"		
	X	N	Y	X	N	Y	X	N	Y	X	N	Y	X	N	Y	X	N	Y	X	N	Y
3	2½	12	2	2¾	12	1¾	2½	12	1¾	2¾	12	1¾	3	12	1¾	3½	12	1¾	3¾	12	1¾
3½	3½	12	2½	3¾	12	2¾	3¾	12	2¾	3¾	12	2¾	3¾	12	2¾	3¾	12	1¾	3¾	12	1¾
4	3½	12	2½	3¾	12	2¾	3¾	12	2¾	3¾	12	2¾	3¾	12	2¾	3¾	12	2¾	3¾	12	2¾
4½	3½	12	2½	3¾	12	2¾	4	12	2¾	4½	12	2¾	4½	12	2¾	4½	12	2¾	4½	12	2¾
5	4½	12	3¾	4¾	12	3¾	4¾	12	3¾	4¾	12	3¾	4½	12	3	4¾	12	2¾	4¾	12	2¾
6	5½	12	3¾	5¾	12	3¾	5¾	12	3¾	5¾	12	3¾	5¾	12	3¾	5¾	12	3¾	5¾	12	3¾
	5¾	12	4½	5¾	12	4¾	5¾	12	4¾	6	12	4¾	6¾	12	4¾	6¾	12	4¾	6¾	12	4¾
8	6¾	12	5¾	6¾	12	5¾	6¾	12	5	6¾	12	4¾	6¾	12	4¾	6¾	12	4¾	6¾	12	4¾
9	7¾	12	5¾	7¾	12	5¾	7¾	12	5¾	7¾	12	5¾	7½	12	5½	7¾	12	5¾	7¾	12	5¾
10	8¾	12	6¾	8¾	12	6¾	8¾	12	6¾	8¾	12	6¾	8¾	12	6¾	8¾	12	6¾	8¾	12	6
11	8¾	15	5¾	6¾	15	5¾	7	15	5¾	7¾	15	5¾	7½	15	5½	7¾	15	5¾	7¾	15	5¾
12	7¾	15	5¾	7¾	15	5¾	7½	15	5¾	7¾	15	5¾	7¾	15	5¾	7¾	15	5¾	7¾	15	5¾
14	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾
15	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾	8¾	15	6¾	9	15	6¾	9	15	6¾	9	15	6¾
16	9¾	15	7¾	9¾	15	7¾	9¾	15	7¾	9¾	15	7¾	9½	15	7¾	9½	15	7¾	9½	15	7¾
17	9¾	15	7¾	9¾	15	7¾	10	15	7¾	10¾	15	7¾	10½	15	7¾	10½	15	7¾	10½	15	7¾
18	8¾	18	6¾	8¾	18	6¾	8¾	18	6¾	8½	18	6¾	8¾	18	6¾	8¾	18	6¾	8¾	18	6¾
19	8¾	18	7¾	8¾	18	7	8¾	18	6¾	8¾	18	6¾	9	18	6¾	9	18	6¾	9	18	6¾
20	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾
21	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾	9¾	18	7¾
22	10¾	18	8¾	10¾	18	8¾	10¾	18	8	10¾	18	7¾	10¾	18	7¾	10¾	18	7¾	10¾	18	7¾
	10¾	18	8¾	10¾	18	8½	10¾	18	8¾	10¾	18	8¾	10¾	18	6¾	10¾	18	8¾	10¾	18	8¾
24	9¾	22	7¾	9¾	22	7¾	9¾	22	7¾	9¾	22	7¾	9¾	22	7¾	9¾	22	7¾	9¾	22	7¾

INSULATING SCREWED AND WELDED VALVES AND FITTINGS

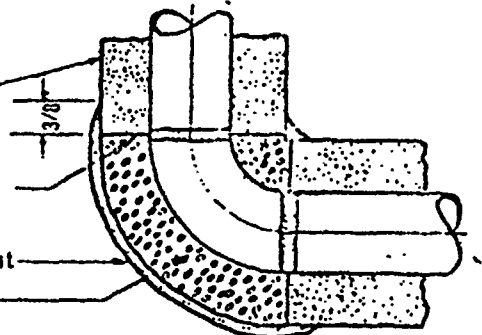
1.0 APPLICATION PROCEDURE

- 1.1 Butt the insulation tight to fitting or valve. Spot mineral wool cement to fitting or valve as shown above applying approximately same thickness as adjoining pipe insulation.
- 1.2 Indoor Finish - Overlay mineral wool cement with thin smooth layer of Hydraulic Setting cement extending it $\frac{3}{8}$ " over covering so as to make a tight joint. Cover with Osnaburg Rag using a lagging adhesive.

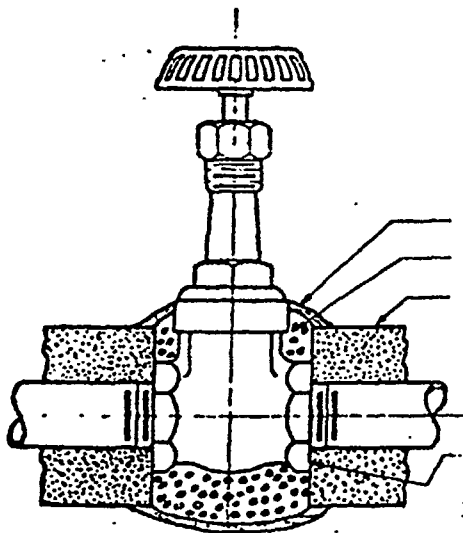


SCREWED ELBOWS
(Screwed Tees are similar)

Pipe Insulation
Single or Double
Layer
Butt Insulation tight
against fitting
Hydraulic Setting cement
Mineral wool Cement



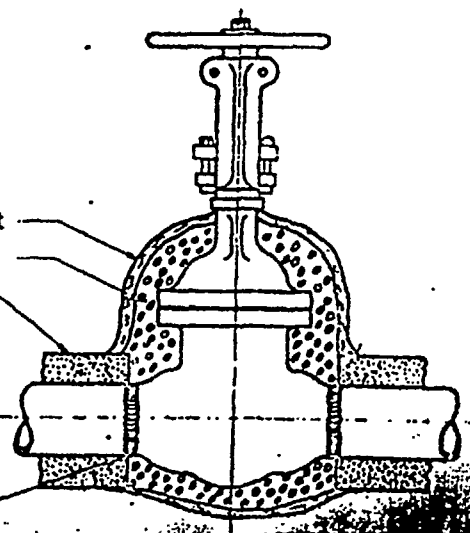
WELDING ELLS up to 4"
(For 4" and larger -See page 70)



SCREWED VALVES thru 2"
Single or Double Layer

Hydraulic Setting cement
Mineral wool Cement
Pipe Insulation

Butt Insulation
tight against
valve



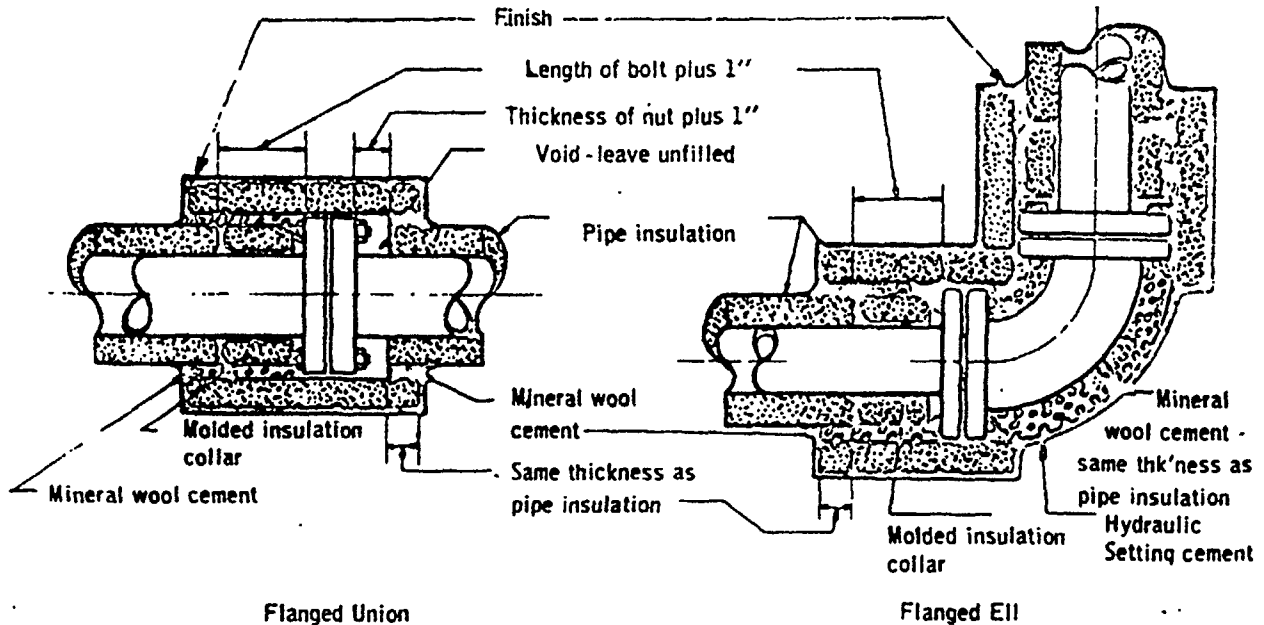
WELD END VALVES
Single Layer
Double Layer

- 1.3 Weatherproof Finish - Sizes 2" and smaller - Apply $\frac{1}{4}$ " emulsion type asphalt mastic directly to mineral-wool cement. Sizes $2\frac{1}{2}$ " and larger - Cover mineral wool cement with thin smooth layer of Hydraulic Setting cement then apply asphalt mastic $\frac{1}{4}$ " thick.

*For Weld-end valves 4" and larger see page 85.

Note: Screwed unions usually are not insulated.

INSULATING FLANGED ELLS AND UNIONS, 1 LAYER



APPLICATION PROCEDURE

Sizes 6\" &
Smaller

Block across flanges as shown above using same type of sectional insulation and thickness as on adjacent pipe. Fasten with 11 ga. Monel wire.

Sizes 9\" &
Larger

Follow same procedure using block type insulation. Fasten with 5/8\" stainless steel bands.

Cover bodies of flanged ells with mineral wool cement building up to same thickness as adjacent pipe insulation.

For bolt removal clearance, position pipe covering away from flanges the length of bolt plus 1\" on the bolt side, and nut thickness plus 1\" on nut side. (This does not apply to nut side of flanged ells) The void on the bolt side shall be filled with a collar made of the same pipe insulation plus mineral wool cement as shown in sketch.

Indoor Finish*

Sizes 6\" &
Smaller

Overlay with smooth thin coat Hydraulic Setting cement.
Cover with Osnaburg Rag using cold water paste.

Sizes 8\" &
Larger

Cover with 1/4\" Hydraulic Setting cement.

Weatherproof
Finish

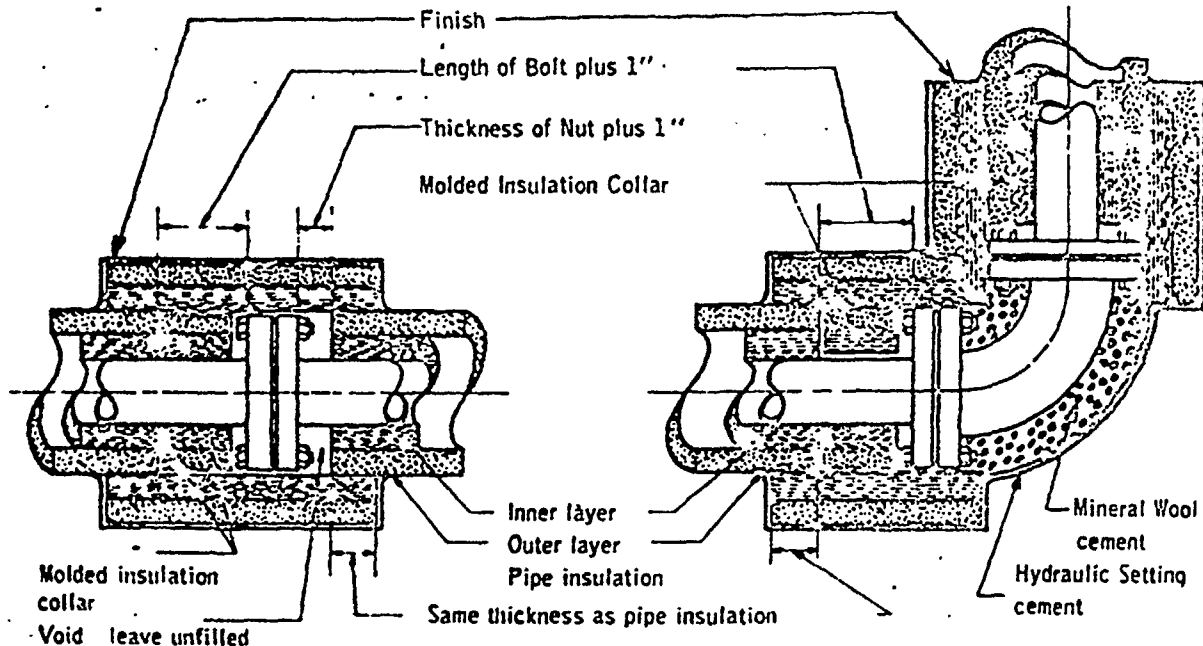
Sizes 6\" &
Smaller

Cover completely with 1/4\" asphalt mastic.

Sizes 8\" &
Larger

Cover completely with two 1/8\" layers of asphalt mastic with glass membrane fabric between.

INSULATING FLANGED ELLS AND UNIONS, 2 LAYERS



APPLICATION PROCEDURE

Sizes 6" &
Smaller

Block across flanges as shown using same type insulation and thickness as on adjacent pipe. Use sectional type for inner layer and block type for outer. Fasten with 16 ga. copper clad wire.

Sizes 8" &
Larger

Follow same procedure as above, using block type insulation. Fasten inner layer with wire or 5/8" stainless steel bands. Fasten outer layer with 5/8" stainless steel bands.

Cover flanged ell bodies with mineral wool cement, building up to same thickness as adjacent pipe covering.

To provide bolt removal clearance, position pipe insulation away from flanges the length of the bolt plus 1" on the bolt side, and the nut thickness plus 1" on the nut side. (This does not apply to nut side of flanged ells.) The void on the bolt side shall be filled with a collar made of the same pipe insulation. See sketch.

Indoor Finish

Sizes 6" &
Smaller

Overlay with smooth thin coat Hydraulic setting cement.
Cover with Osnaburg Rag using cold water paste.

Sizes 8" &
Larger

Cover with 1/4" Hydraulic setting finish cement.

1 ST0000788

page 78

Weatherproof
Finish

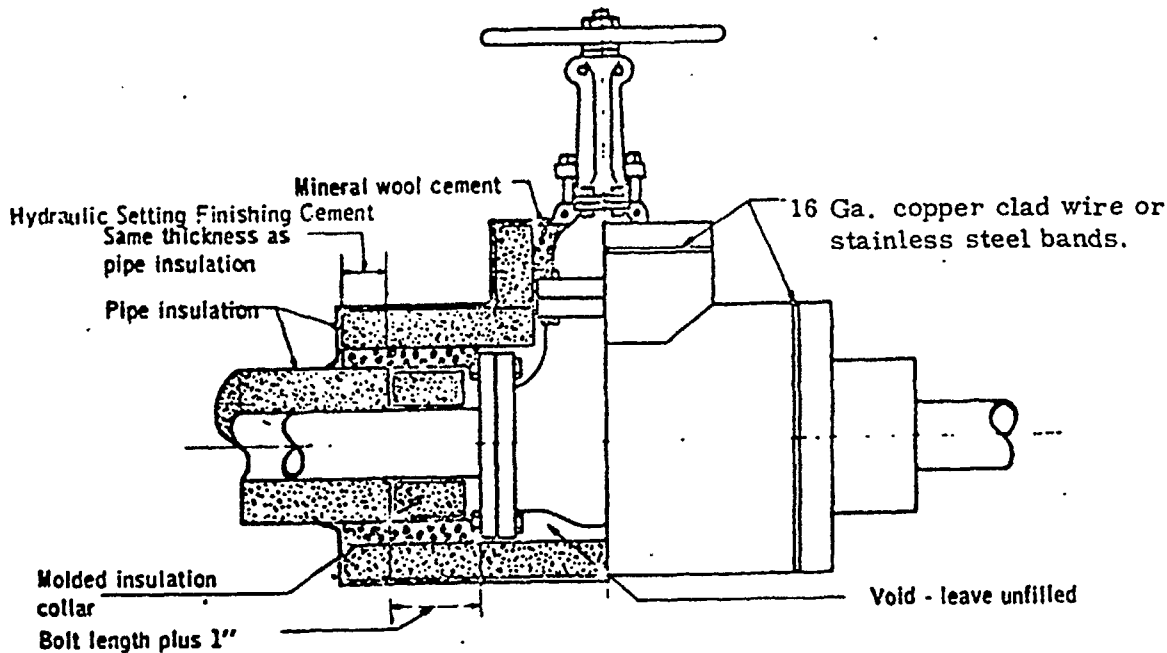
Sizes 6" &
Smaller

Cover completely with $\frac{1}{4}$ " emulsion type asphalt mastic.

Sizes 8" &
Larger

Cover completely with two $\frac{1}{8}$ " layers of asphalt mastic
with glass membrane fabric between.

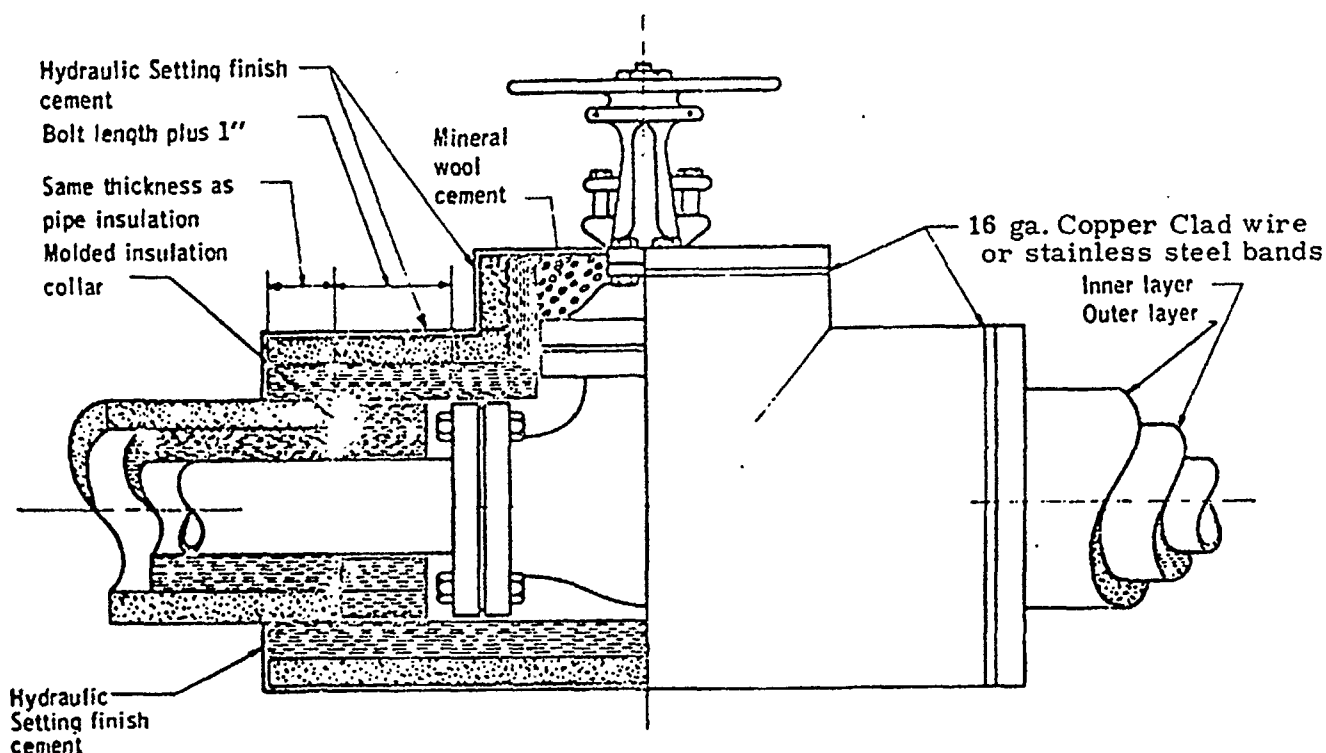
INSULATING FLANGED VALVES, 1 LAYER



APPLICATION PROCEDURE

Sizes 6" & Smaller	Cover body as shown above using the same type of insulation as on adjacent pipe. Fasten with 16 ga. copper clad wire.	
Sizes 8" & Larger	Cover body using block type insulation of same material as on adjacent pipe. Fasten with 5/8" steel bands.	
	For bolt removal clearance, position pipe covering away from flange the length of bolt plus 1" on bolt side. Fill void on bolt side with collar made of same insulation plus mineral wool cement as shown above.	
Bonnets	Insulate all bonnets at temperature 350°F. and above. Use block type insulation and mineral wool cement on sizes 4" and larger. Fasten with 16 ga. copper clad wire or 5/8" x .015 stainless steel bands. On sizes less than 4", use only mineral wool cement applying same thickness as pipe insulation and overlaying it with smooth thin layer of Hydraulic setting cement.	
Indoor Finish	Sizes 6" & Smaller	Overlay with thin smooth coat of Hydraulic setting cement and cover with Osnaburg Rag using cold water paste.
	Sizes 8" & Larger	Cover with 1/4" Hydraulic setting finish cement.
Weatherproof Finish	Sizes 4" & Smaller	Cover completely with 1/4" emulsion type asphalt mastic.
	Sizes 6" & Larger	Cover completely with asphalt mastic with glass membrane fabric between 1/8" layers of asphalt mastic or cover with fitted pieces of weatherproof felt and wire in place with copper clad wire or stainless steel bands, properly sealed with emulsion type mastic.

INSULATING FLANGED VALVES, 2 LAYERS

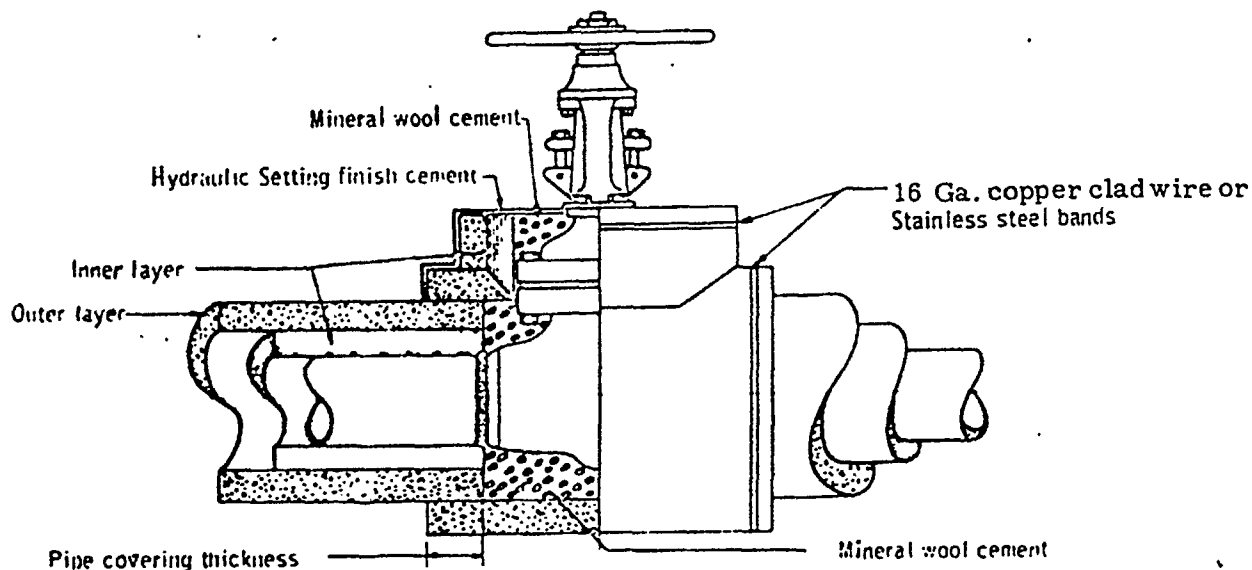


APPLICATION PROCEDURE

- | | |
|---------------------|--|
| Sizes 6" & Smaller | Block across flanges as shown above using same type insulation & thickness as on adjacent pipe. Fasten each layer with 16 ga. copper clad wire. |
| Sizes 8" & Larger | Follow same procedure using block type insulation. Fasten inner layer with 16 ga. copper clad wire or 5/8" stainless steel bands. Fasten outer layer with 5/8" x .015 stainless steel bands. |
| Bonnets | Insulate all bonnets. On valves 4" and smaller, use mineral wool cement building up to same thickness as pipe covering. On valves 6" and larger, use block type insulation as shown, fastening with prescribed wire or bands. Fill bonnet void with mineral wool cement. |
| Indoor Finish | <p>Sizes 6" & Smaller Overlay with thin smooth coat of Hydraulic setting finishing cement. Cover with Osnaburg Rag using cold water paste.</p> <p>Sizes 8" & Larger Cover bodies completely with 1/4" Hydraulic setting finish cement.</p> |
| Weatherproof Finish | <p>Sizes 4" & Smaller Cover completely with 1/4" asphalt mastic.</p> <p>Sizes 6" & Larger Cover completely with two 1/8" layers of asphalt mastic with glass membrane fabric between, or cover with fitted pieces of weatherproof felt and wire in place with copper clad wire or stainless steel bands, properly flashed with emulsion type mastic.</p> |

INSULATING WELD END VALVES

2½ & LARGER, 2 LAYERS



APPLICATION PROCEDURE

Sizes 2½"
thru 4"

Cover valve body with mineral wool cement building up to same thickness as adjacent pipe insulation.

Block across valve body as shown using same type insulation and thickness as outer layer. Extend it over pipe covering same distance as covering thickness. Fasten with 16 ga. copper clad wire.

Block across bonnet flanges as shown using double layer same as on adjacent pipe. Fasten with 16 ga. copper clad wire. Fill bonnet void with mineral wool cement.

Sizes 6" &
Larger

Follow same procedure as above using block type insulation. Fasten inner layer with 16 ga. copper clad or 5/8" stainless steel bands. Fasten outer layer with 5/8" stainless steel bands.

Indoor Finish

Sizes 2½"
thru 6"

General procedure. Cover body completely with ¼" thick Hydraulic setting finishing cement, and cover with Osnaburg Rag using cold water paste. Alternate: If a smooth finish is required, overlay the Hydraulic setting cement with thin smooth coat of asbestos cement. Cover with Osnaburg Rag using cold water paste.

Sizes 8" &
Larger

Cover body completely with ¼" Hydraulic setting finish cement.

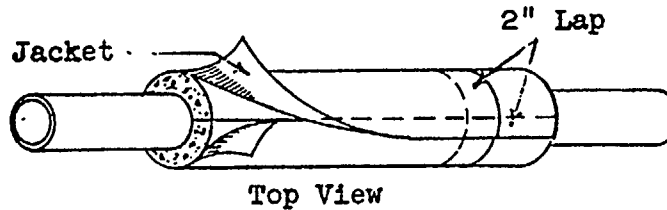
Weatherproof
Finish

Sizes 4" &
Smaller

Cover completely with ¼" asphalt mastic.

Sizes 6" & Larger Cover completely with two 1/8" layers of asphalt mastic with glass membrane fabric between, or cover with fitted pieces of Weatherproof felt and wire in place with copper clad wire or stainless steel bands, properly flashed with emulsion type mastic.

APPLYING GLASS FIBER PIPE INSULATION



APPLICATION PROCEDURE

- 1.0 Indoor:
 - 1.1 On sizes below 12 inch, with canvas jacket use a lagging adhesive to fasten on the insulation. On sizes above 12 inch insulation O. D., wire on the Fiber-glas with 16 gauge copper clad wire and band the jacket with stainless steel bands (5/8" x .015). Spacing of bands shall be approximately 12" apart with no band more than 4" from an end joint.
 - 1.2 With factory applied jackets such as FRJ the self sealing lap is sufficient to hold on the insulation. Staples should be used in cold weather to reinforce the self seal lap. Butt joint strips must be used with this system.
- 2.0 Weatherproof Cover
 - Apply Weatherproof Felt as shown on page 102 or an equivalent metal finish as shown on page 103.
- 3.0 Fittings
 - 3.1 Canvas finished lines: Finish as on page 74.
 - 3.2 Factory applied jacket: Finish fittings 2" and smaller as on page 74, 2½" and larger as on page 76.
 - 3.3 Weatherproof lines
 - a. Above 50°F. pipe temperature insulate as on page 74.
 - b. Below 50°F. pipe temperature miter covering at fittings, use larger sizes if necessary, cover insulation with two 1/8" layers of vapor barrier mastic with glass membrane fabric between.

TRACED SYSTEMS

Steam and Dowtherm® Tracing

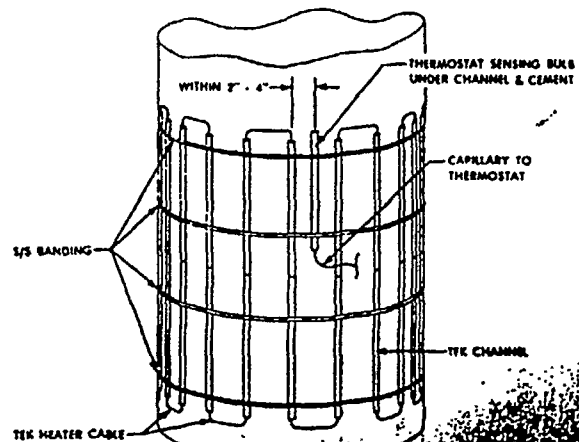
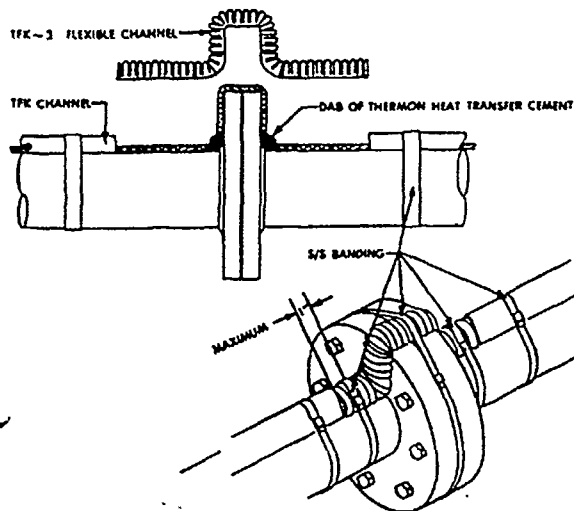
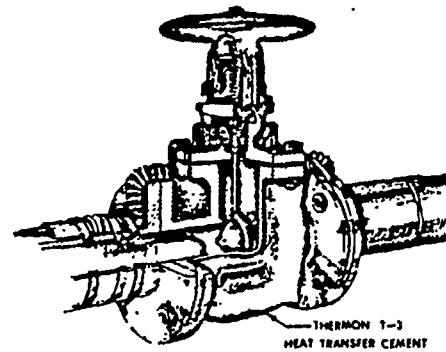
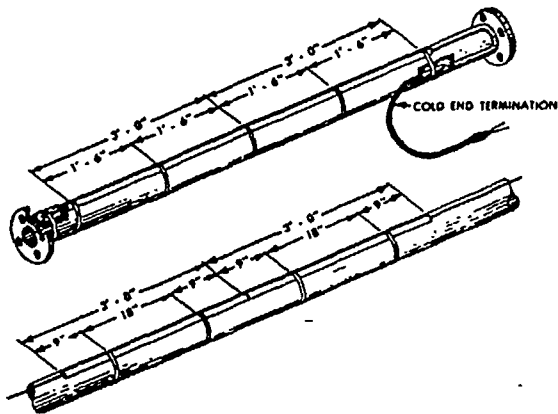
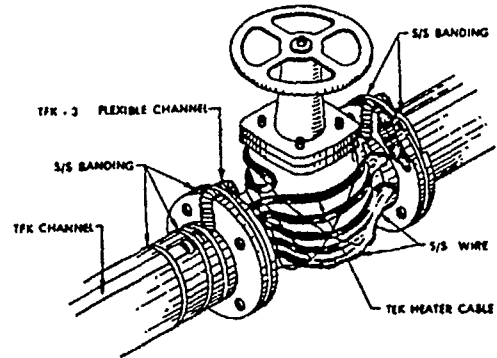
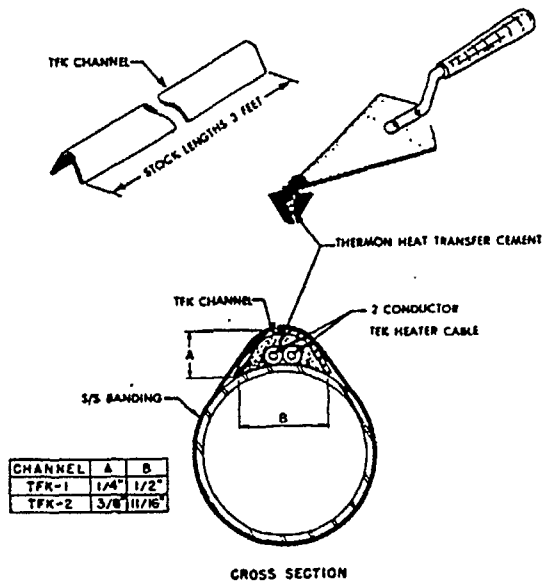
The installation of tracers on process lines, in addition to conduction, uses the principle of air convection in heating the annulus space between the pipe and the inside of the insulation. This system is sufficiently effective to be used where it is only necessary to maintain the pipe temperature at a considerable lower temperature than the steam inside the tracer. The use of spacers or asbestos sock is necessary when the temperature of the tracer line might cause degradation of either the process material or the pipe liner. In either case it is important to choose an insulation size large enough to fit loosely over both tracer and pipe line. Fiberglas will be used in most cases over traced lines. For the proper thickness see page 20. Application procedures for both insulation and weather proof jacketing can be found on page 83 and page 102.

Heat Transfer Cement

When it is important to extract the maximum amount of heat from a tracer, heat transfer cements are employed. Two systems are used. One is by trowelling into position, completely covering the tracer and bonding it to the pipe. The cement should completely cover the tracer and extend out at the base on each side a distance equal to the diameter of the tracer. This much coverage is necessary to insure that the mechanical strength of the cement is sufficient to withstand the force exerted by the expansion of the tracer tubing. The other system is to install water-mix heat transfer cement with metal channels. These channels may be factory filled or they may be filled at the time of application. The filled channels are pressed over the tracer and secured in place by stainless steel bands.

This latter method is used with electrical tracing and special care must be exercised to insure that there are no voids. Should parts of electric tracers not be thermally connected with heat transfer cement these spots cannot transfer the heat generated to the process pipe. In turn this will cause a temperature rise at this spot resulting in a burn-out. A special flexible cover should be used where a flange or elbow occurs in the line. Proper use of the channels is shown in the sketches on page 86. Amounts of cement needed to cover tracers are shown in the table on page 87. Because of their large outside area as compared to pipe, valves require additional tracer length and very careful installation of the heat transfer cement.

All surfaces, on which heat transfer cement is to be applied, must be cleaned to the bare metal. All rust, dirt and oil should be removed. The entire surface of valves, pumps and other pieces of equipment must be thoroughly cleaned. It is imperative that a good bond be formed between the metal and the cement. Without this bond considerable heat transfer efficiency is lost.



CEMENT COVERAGE
PER SINGLE PARALLEL TRACER
WATER-MIXED HEAT TRANSFER CEMENT

<u>TRACER SIZE</u>	<u>TROWELLED ON PROCESS LINE SIZE</u>	<u>FEET OF TRACER PER GALLON</u>
1/4 OD	1/2" through Flat	50
3/16 OD	1/2" through Flat	49
3/8 OD	1/2" through 1-1/4"	45
	1-1/2" through Flat	48
1/2 OD	1/2" through 1-1/4"	30
	1-1/2" through Flat	33
5/8 OD	1/2" through 1-1/4"	23
	1-1/2" through Flat	28

IN METAL CHANNELS

3/8 OD	1/2" through 2"	37 to 41
	2-1/2" through Flat	34 to 37
1/2 OD	1-1/2" through 2"	43 to 47
	2-1/2" through Flat	40 to 43
5/8 OD	1-1/2" through 2"	44 to 48
	2-1/2" through 2-1/2"	39 to 32
3/4 OD	4" through Flat	28 to 30

TABLE 4 - 5

EXPANSION JOINTS

High Temperature Piping

Rigid insulation applied to high temperature piping may be single or double layer, depending upon the service conditions and temperature. When there are long runs of piping, and where the piping is large, the problem of expansion occurs again. To make the problem more troublesome, most high temperature insulations shrink as they are subjected to higher temperatures.

The circumferential expansion of pipe within the covering does not present a problem as the covering is manufactured with an inside diameter greater than the O.D. of the pipe. High temperature pipe covering should not fit snugly on the pipe at atmospheric temperature, but should have sufficient clearance to allow for expansion of the pipe. Properly installed, the insulation should be free to slip on the pipe without binding, even after the line is in service.

Single layer pipe insulation should be installed with staggered joints, and multiple layer insulation should be installed with staggered broken joints. This secured cylinder of insulation should be free to slip as the pipe expands and insulation itself shrinks. Of course, this requires that, at the correct distances, one insulation cylinder be separated from the adjacent cylinder by an expansion joint. This is to prevent the frictional pull exerted by expansion of the pipe from pulling the insulation assembly apart. This can be accomplished by an expansion joint, or by using a flanged insulation cover as an expansion joint.

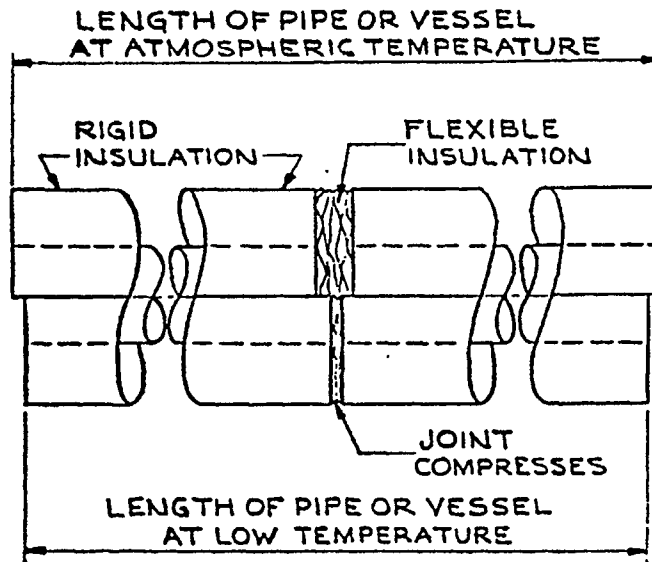
Not every straight run of pipe needs an expansion joint. The need must be determined by the length of the pipe, its temperature, metal of pipe and shrinkage of the insulation.

A typical expansion joint, and an expansion joint using a flanged insulation cover are shown on page 76.

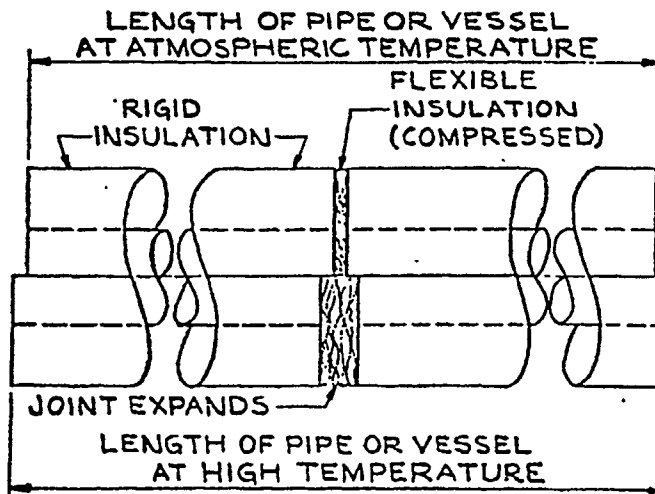
For differential expansion between foamglas and metal piping, see page 91 .

For differential expansion between Dow ceramic foam and metal piping, see page 92

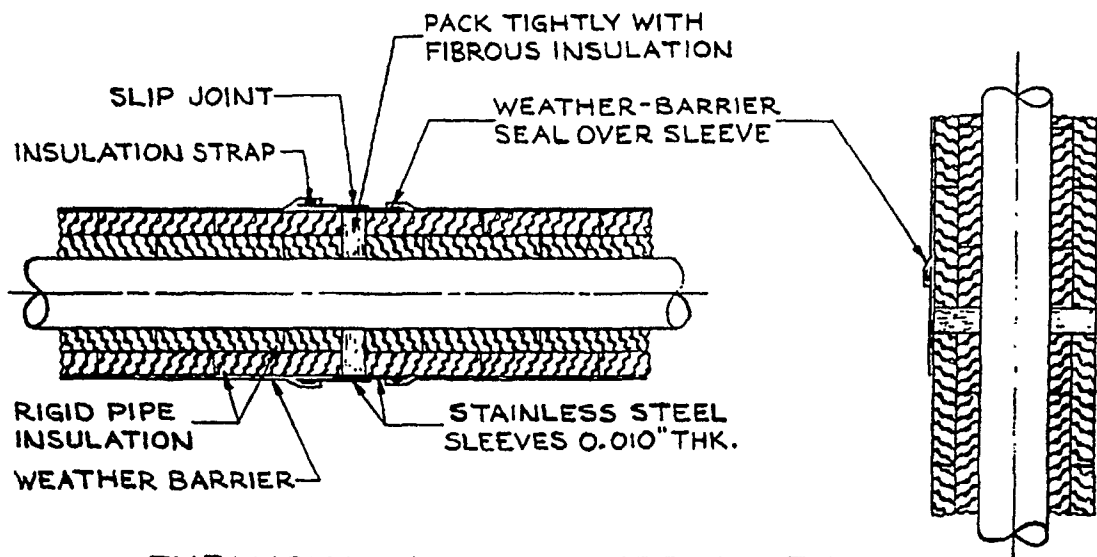
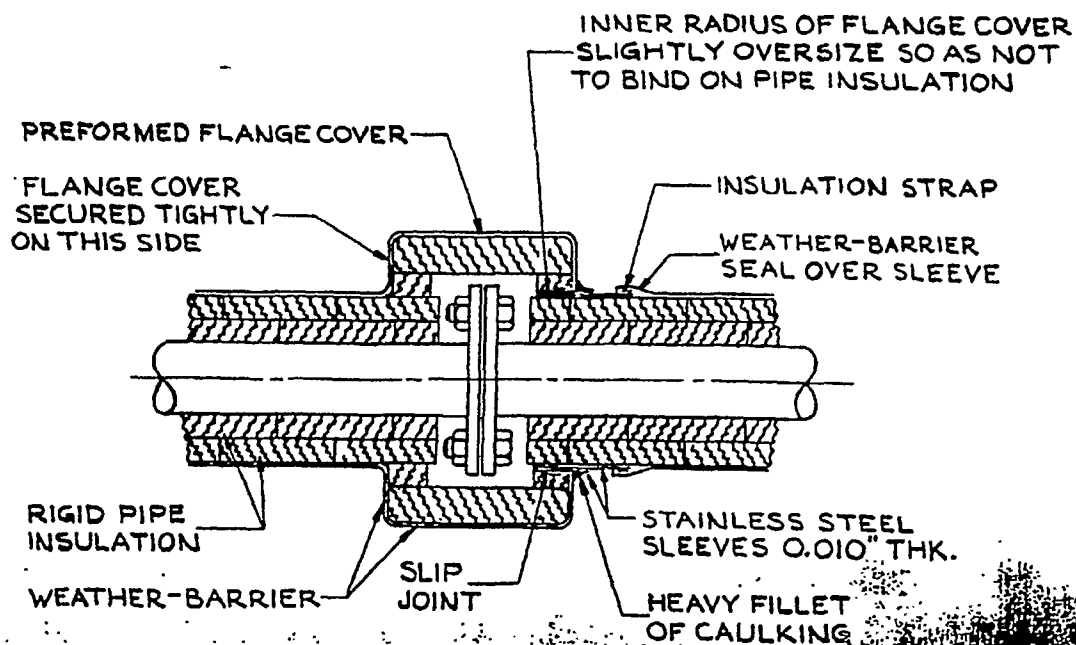
TYPICAL JOINTS



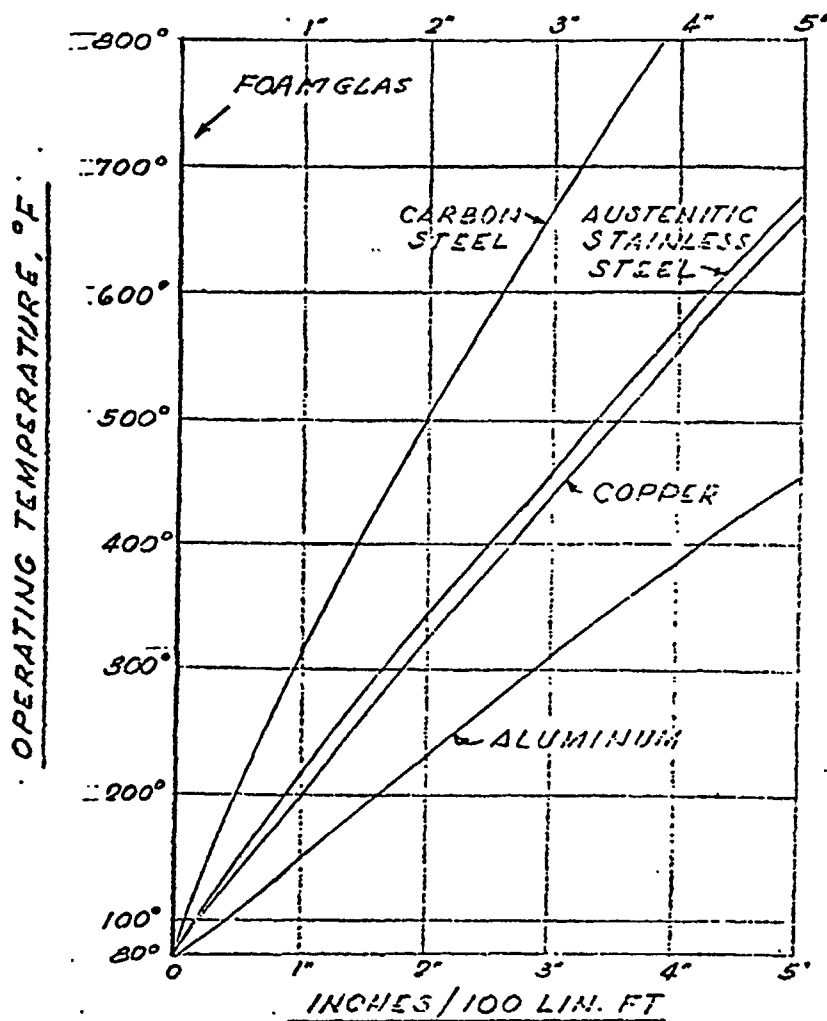
CONTRACTION JOINT FOR LOW TEMPERATURE



EXPANSION JOINT FOR HIGH TEMPERATURE

TYPICAL EXPANSION JOINTSEXPANSION JOINTS IN STRAIGHT PIPESEXPANSION JOINT AT FLANGE

DIFFERENTIAL EXPANSION
BETWEEN FOAMGLAS AND METAL PIPING



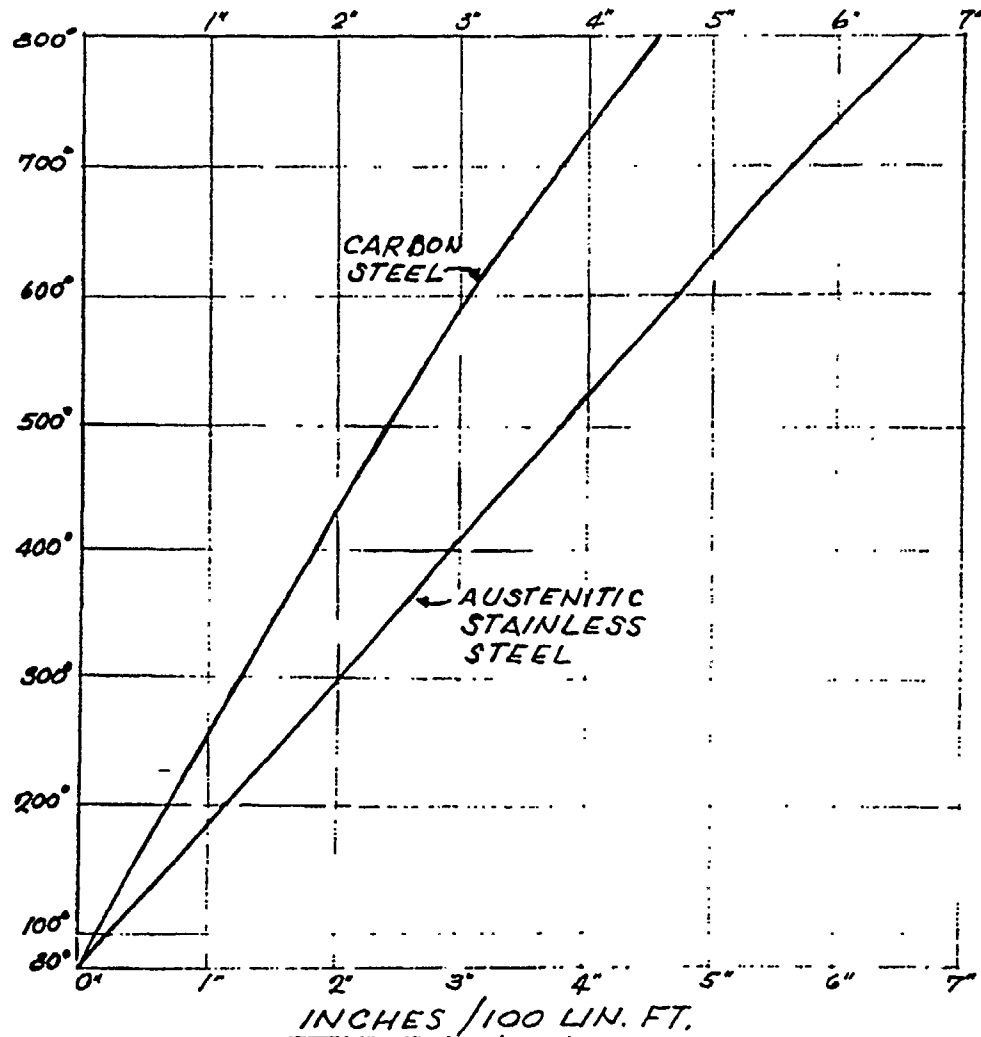
NOTE:

THERMAL EXPANSION OF PIPE CALCULATED FROM 80°F TO OPERATING TEMPERATURE.

FOAMGLAS EXPANSION CALCULATED FROM 80°F TO MEAN TEMPERATURE OF INSULATION.

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DIFFERENTIAL EXPANSION BETWEEN
DOW CERAMIC FOAM AND METAL PIPING.

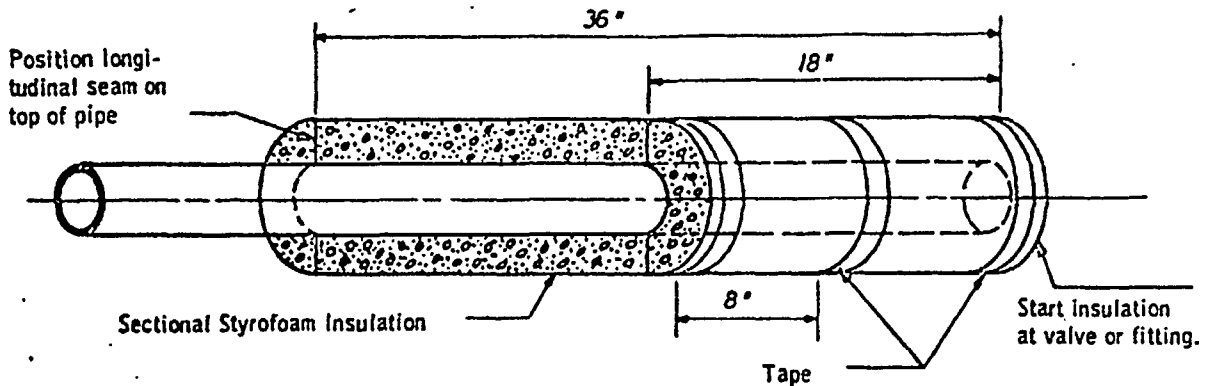


NOTE:

THERMAL EXPANSION OF PIPE CALCULATED
FROM 80° TO OPERATING TEMPERATURE.

DOW CERAMIC FOAM EXPANSION CALCULATED
FROM 80° F TO MEAN TEMPERATURE OF INSULATION.

APPLYING STYROFOAM[®] ON PIPE

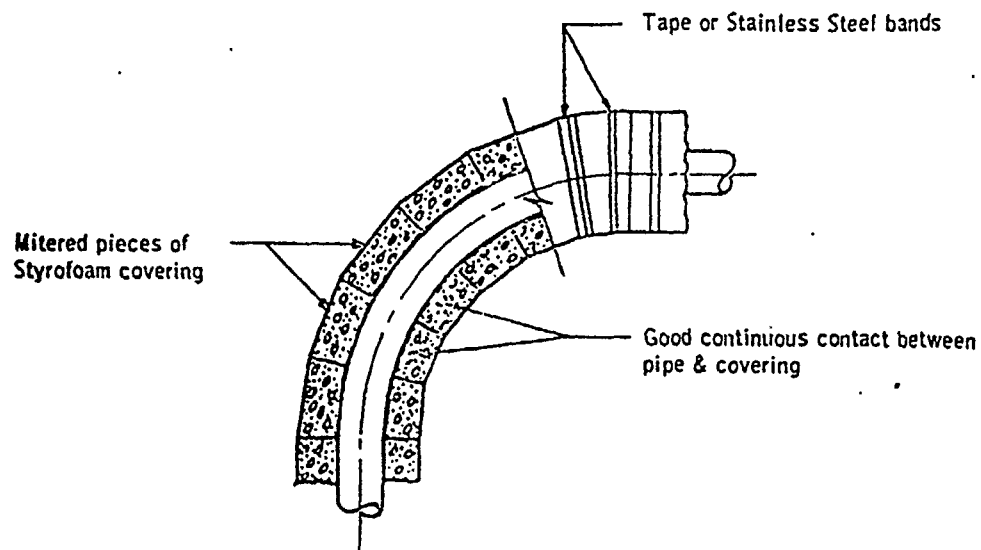


APPLICATION PROCEDURE

All Styrofoam joints shall be made absolutely tight.

- | | | |
|-----|---------------------|---|
| 1.0 | Sectional Form | Position half sections on pipe so that all end joints are staggered approximately 18" apart and the longitudinal joints are on top and bottom of pipe. Coat faces of all joints with waterproof adhesive cement, coating only one face of adjoining surfaces. Do not cement Styrofoam to pipe. Fasten half sections together with 3/4" Filament tape, wrapping tape twice around covering. Place tape each side of all end joints. Space intermediate tape about 8" apart. All tape shall be straight and tightly wrapped. |
| 2.0 | Segmental Form | Position segmental blocks so that end joints are staggered relative to each other. Start with 18" and 36" pieces placed alternately around pipe. Cement all joints following same procedure given for sectional form. Fasten segments together using 5/8" x .015" Stainless Steel bands. Position one band each side of all end joints and space intermediate bands 6" apart. |
| 3.0 | Indoor Finish | <div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>Sectional Form</p> <p>Segmental Form</p> </div> <div style="width: 65%;"> <ol style="list-style-type: none"> 1. Paint as per Dow Painting Spec., or 2. Cover with 26 Ga. galv. sheet metal where physical protection is required. (when specified) <p style="text-align: right; margin-right: 20px;">on page 102</p> <ol style="list-style-type: none"> 1. Cover with Weatherproof Felt following procedure but, instead of staples, fasten with No. 16 Ga. wire loops, spaced on 4" centers. or 2. Cover with 26 Ga. galv. sheet Metal, (when specified) 3. Cover with 1/4" Hydraulic Setting finish cement. (when specified) </div> </div> |
| 4.0 | Weatherproof Finish | <div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>Both Forms</p> </div> <div style="width: 65%;"> <p>Cover with Weatherproof Felt, same as above. In corrosive areas, all laps shall be glued and sealed with waterproof lap cement.</p> </div> </div> |

APPLYING STYROFOAM® ON ELBOWS



APPLICATION PROCEDURE

Cover bend with short mitered pieces of Styrofoam. Cut pieces short enough at correct miter to give good continuous contact between pipe and Styrofoam. Work from each end of bend making last piece a full tight fit.

Use waterproof adhesive cement on all joints coating one face only of adjoining surfaces. Do not cement Styrofoam to pipe. Fasten pieces separately with 3/4" Filament tape wrapping around twice on each loop. All joints shall be made absolutely tight. Pipe bend applications shall not be allowed to stand unfinished.

Indoor Finish

Paint as per Dow Painting Specifications

Weatherproof
Finish

1. Cover with Weatherproof Felt following procedure on p 102 but, instead of staples, fasten with No.16 Ga. wire using as many loops as required to give snug fit. In corrosive areas glue all laps with waterproof lap cement, or
2. Cover completely with two 1/8" layers of asphalt mastic with glass membrane between. (When specified)

APPLYING STYROFOAM[®] ON ELLS AND TEES

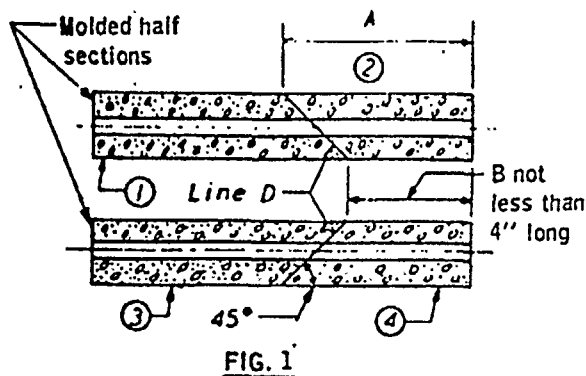


FIG. 1

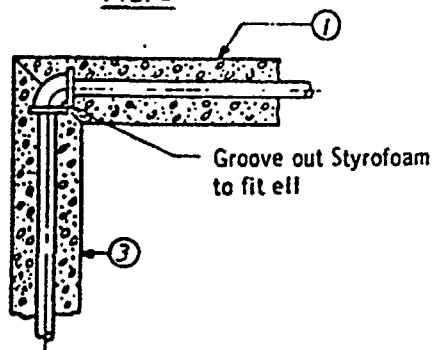


FIG. 2

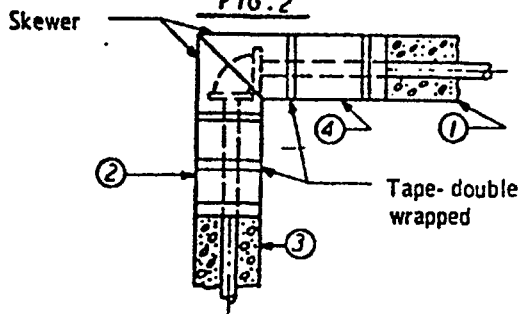
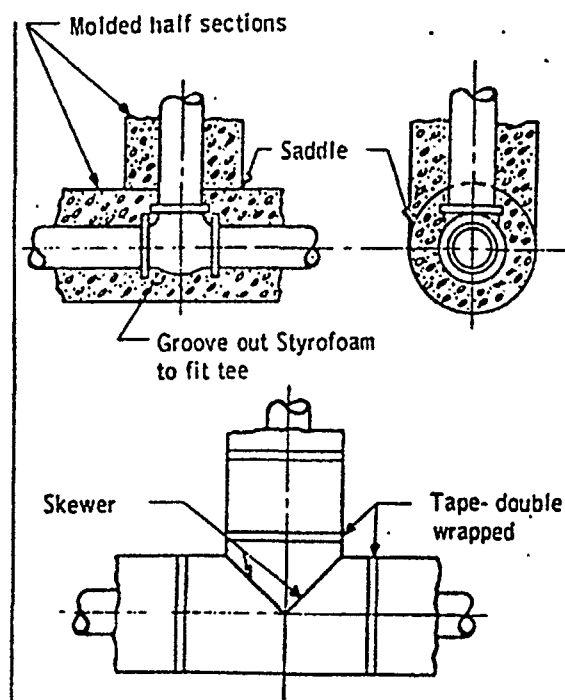


FIG. 3

SCREWED ELL



SCREWED TEE

Groove out two half sections of Styrofoam covering to snugly fit tee. Cut and form two additional half sections to form branch saddle as shown in sketch. Cement joints as specified below. Band together as shown with Stainless Steel Bands.

Screwed
Ell

Lay out dimensions A and B on both half sections so that Line D is at 45°. Groove out Styrofoam to snugly fit ell. To correctly assemble, butt the cut ends of pieces 1 and 3 together on one side of ell. (Fig. 2), and pieces 2 and 4 on opposite side, (Fig. 3). Cement joints as specified below. Tape together as shown in Fig. 3.

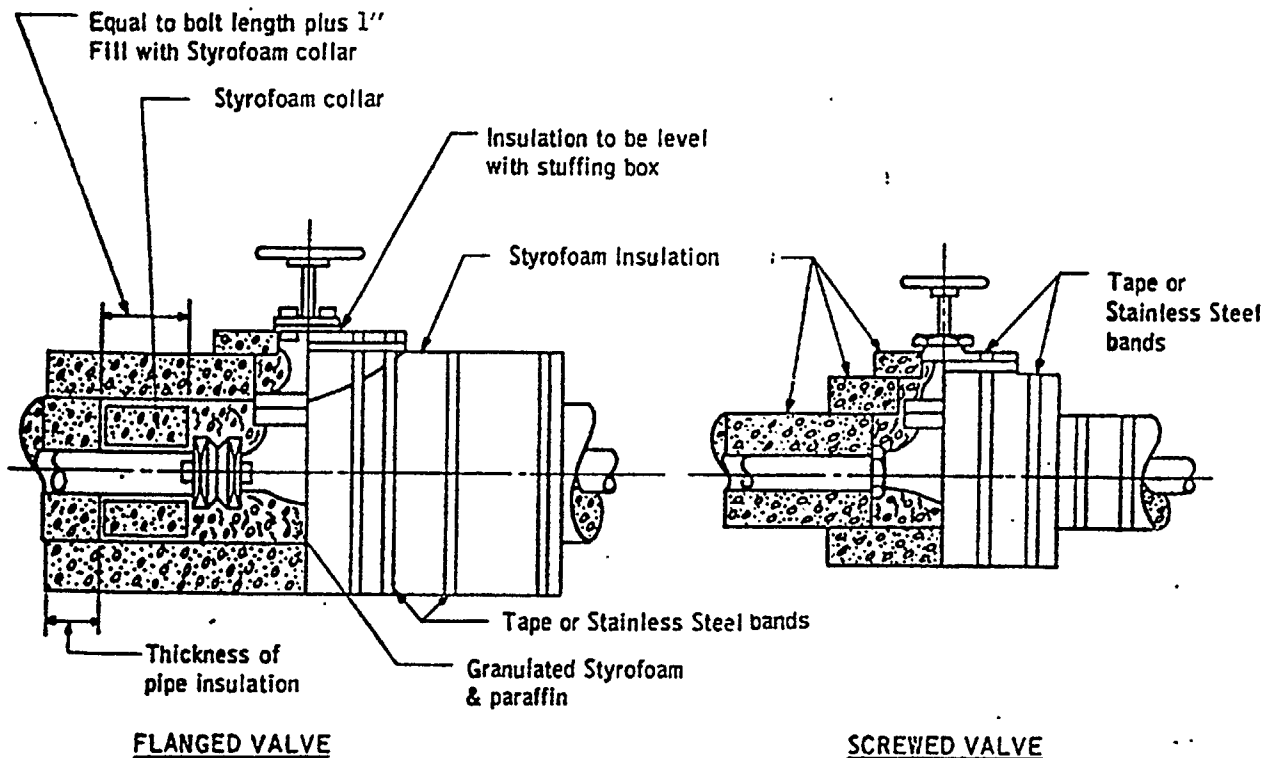
General

Cement all joints with waterproof adhesive cement, coating only one face of adjoining surfaces. Do not cement Styrofoam to fitting. Butt the joints tightly together. Fasten with 3/4" Filament tape wrapped tightly around and using two loops, or fasten with 5/8" x .015" Stainless Steel bands. All loops and bands shall be drawn straight and tight. All joints shall be made absolutely tight.

Indoor and
Weatherproof
Finish

Completely cover with two 1/8" layers of asphalt mastic with membrane fabric between. Alternate, if specified: Cover with 26 ga. Galv. Sheet Metal.

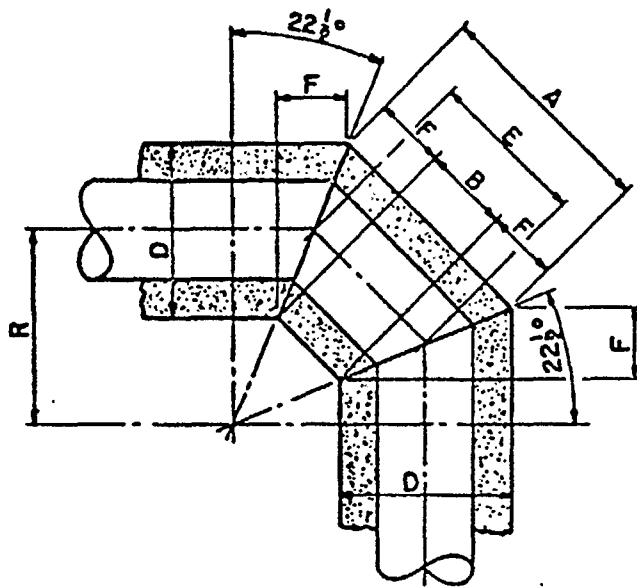
APPLYING STYROFOAM ON VALVES



APPLICATION PROCEDURE

Field Fabrication

- | | |
|---|---|
| Valve Body | Cover body by blocking across pipe covering as shown in sketch using same Styrofoam thickness as on adjacent pipe. Use sectional or segmental block form depending on O.D. of adjacent covering. Fill in bolt removal area with Styrofoam collar to fit. See above. |
| Valve Bonnet | Insulate bonnet to a point level with stuffing box using sectional or segmental form of required thickness. Leave stuffing box free and accessible for adjustment and packing. |
| Voids | Voids shall be completely filled with a mixture of granulated Styrofoam, Type Grind A, and melted paraffin. |
| General | Cement all joints with waterproof adhesive cement, coating only one face of adjoining surfaces. Fasten sectional covering with 3/4" Filament tape wrapped around twice on each loop. Fasten segmental blocks with 5/8" x .015" Stainless Steel bands. All loops and bands shall be drawn straight and tight. All joints shall be made absolutely tight. |
| Indoor and
Weatherproof
Finish | Cover completely with two 1/8" layers of asphalt mastic with glass membrane fabric between. |

STYROFOAM[®] CUTTING DIMENSIONS, MITER BENDS

$$B = (2R - D) \tan 22\frac{1}{2}^\circ$$

$$A = B \frac{(2R + D)}{(2R - D)}$$

$$E = 2R \tan 22\frac{1}{2}^\circ$$

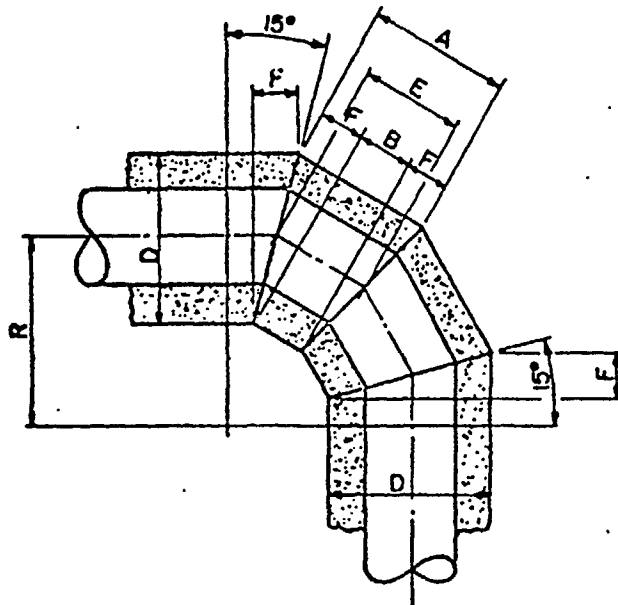
$$D = \text{O.D. OF COVERING}$$

$$F = \frac{(A - B)}{2}$$

All dimensions are in inches

LIGHT DUTY PIPE SIZE	STANDARD DUTY PIPE SIZE	HEAVY DUTY PIPE SIZE	D O.D. of COVERING	R	A	B	E	F
3			6.75	7 ³ / ₈	9 ³ / ₃₂	3 ⁵ / ₈	6 ⁷ / ₃₂	2 ²⁷ / ₃₂
	3		8.87	7 ³ / ₈	10 ¹ / ₃₂	2 ³ / ₈	6 ⁷ / ₃₂	3 ¹¹ / ₃₂
		3	9.62	7 ³ / ₈	10 ³ / ₈	2 ⁷ / ₃₂	6 ⁷ / ₃₂	3 ³¹ / ₃₂
4			7.87	9	10 ⁵ / ₈	4 ² / ₃₂	7 ⁷ / ₃₂	3 ⁷ / ₃₂
	4		9.62	9	11 ⁷ / ₃₂	3 ¹³ / ₃₂	7 ⁷ / ₃₂	4
		4	11.12	9	12 ¹ / ₃₂	2 ²⁷ / ₃₂	7 ⁷ / ₃₂	4 ⁵ / ₈
6			10.25	11 ¹ / ₂	13 ³ / ₈	5 ⁵ / ₃₂	9 ¹ / ₂	4 ¹ / ₂
	6		12.19	11 ¹ / ₂	14 ⁹ / ₃₂	4 ¹ / ₂	9 ¹ / ₂	5 ¹ / ₃₂
		6	14.62	11 ¹ / ₂	15 ⁹ / ₃₂	3 ¹³ / ₃₂	9 ¹ / ₂	6 ¹ / ₃₂
8			12.19	14	16 ⁵ / ₈	6 ⁵ / ₃₂	11 ⁵ / ₈	5 ¹ / ₃₂
	8		14.62	14	17 ⁵ / ₈	5 ¹⁷ / ₃₂	11 ⁵ / ₈	6 ¹ / ₃₂
		8	16.25	14	18 ¹ / ₄	4 ⁷ / ₈	11 ⁵ / ₈	6 ¹¹ / ₃₂
10			14.62	16 ¹ / ₂	19 ¹¹ / ₃₂	7 ⁵ / ₈	13 ⁵ / ₈	6 ¹ / ₃₂
	10		17.37	16 ¹ / ₂	20 ⁷ / ₈	6 ¹³ / ₃₂	13 ⁵ / ₈	7 ⁷ / ₃₂
		10	19.12	16 ¹ / ₂	21 ¹ / ₂	5 ³ / ₄	13 ⁵ / ₈	7 ⁷ / ₈
12			16.25	19	22 ⁷ / ₃₂	9	15 ³ / ₄	6 ²³ / ₃₂
	12		19.12	19	23 ⁵ / ₈	7 ¹³ / ₃₂	15 ³ / ₄	7 ²³ / ₃₂
		12	21.00	19	24 ⁷ / ₃₂	7 ¹³ / ₃₂	15 ³ / ₄	7 ²³ / ₃₂

Table 4 -6



$$B = (2R - D) \tan 15^\circ$$

$$A = B \frac{(2R + D)}{(2R - D)}$$

$$E = 2R \tan 15^\circ$$

$$D = \text{O.D. OF COVERING}$$

$$F = \frac{(A - B)}{2}$$

All dimensions are in inches

LIGHT DUTY PIPE SIZE	STANDARD DUTY PIPE SIZE	HEAVY DUTY PIPE SIZE	D O.D. of COVERING	R	A	B	E	F
3			6.75	7 ³ / ₈	5 ³¹ / ₃₂	2 ¹¹ / ₃₂	4 ⁵ / ₃₂	1 ¹³ / ₁₆
	3		8.87	7 ³ / ₈	6 ²⁷ / ₃₂	1 ²⁵ / ₃₂	4 ⁵ / ₃₂	2 ³ / ₈
		3	9.62	7 ³ / ₈	6 ³ / ₈	1 ¹⁹ / ₃₂	4 ⁵ / ₃₂	2 ¹⁹ / ₃₂
4			7.87	9	6 ¹³ / ₁₆	2 ²³ / ₃₂	4 ¹³ / ₁₆	2 ¹ / ₈
	4		9.62	9	7 ¹³ / ₃₂	2 ¹ / ₈	4 ¹³ / ₁₆	2 ¹⁹ / ₃₂
		4	11.12	9	7 ¹³ / ₁₆	1 ²⁷ / ₃₂	4 ¹³ / ₁₆	2 ³¹ / ₃₂
6			10.25	11 ¹ / ₂	8 ²⁹ / ₃₂	3 ¹⁹ / ₃₂	6 ⁵ / ₃₂	2 ³ / ₈
	6		12.19	11 ¹ / ₂	9 ⁷ / ₁₆	2 ²⁹ / ₃₂	6 ⁵ / ₃₂	3 ⁹ / ₃₂
		6	14.62	11 ¹ / ₂	10 ³ / ₁₆	2 ¹ / ₈	6 ⁵ / ₃₂	3 ²⁹ / ₃₂
8			12.19	14	10 ³ / ₈	4 ¹ / ₈	7 ¹ / ₂	3 ¹ / ₈
	8		14.62	14	11 ¹³ / ₃₂	3 ¹⁹ / ₃₂	7 ¹ / ₂	3 ²⁹ / ₃₂
		8	16.25	14	11 ⁷ / ₈	3 ⁵ / ₃₂	7 ¹ / ₂	4 ¹¹ / ₃₂
10			14.62	16 ¹ / ₂	12 ²⁵ / ₃₂	4 ¹⁵ / ₁₆	8 ²⁷ / ₃₂	3 ²⁹ / ₃₂
	10		17.37	16 ¹ / ₂	13 ¹ / ₂	4 ³ / ₁₆	8 ²⁷ / ₃₂	4 ²¹ / ₃₂
		10	19.12	16 ¹ / ₂	13 ³¹ / ₃₂	3 ²⁷ / ₃₂	8 ²⁷ / ₃₂	5 ¹ / ₈
12			16.25	19	14 ¹⁷ / ₃₂	5 ²⁷ / ₃₂	10 ³ / ₁₆	4 ¹¹ / ₃₂
	12		19.12	19	15 ⁵ / ₁₆	5 ¹ / ₁₆	10 ³ / ₁₆	5 ¹ / ₈
		12	21.00	19	15 ¹³ / ₁₆	4 ⁹ / ₁₆	10 ³ / ₁₆	5 ³ / ₈

Table 4 - 7

FOAMGLAS INSULATION
(PIPING INSTALLATION)

1.0 Fastenings

Stainless Steel Strapping or Bands

Fiberglas Filament Tape

Nylon Bands

DO NOT USE WIRE OR STAPLES

2.0 Finish

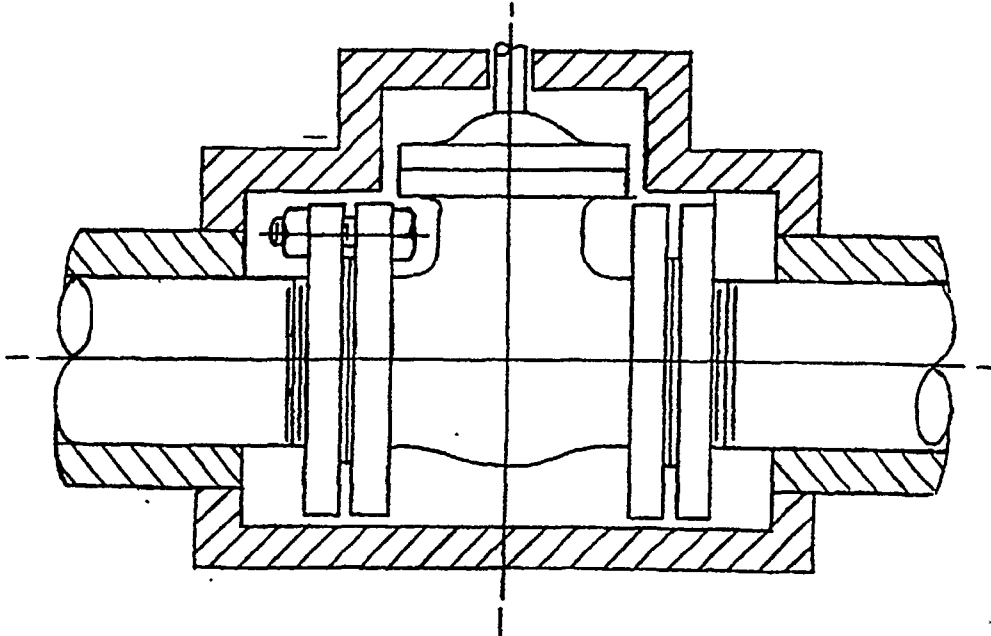
Mastic

Black and White Armored Felt

Tufjac

3.0 Application on Fittings (Valves, Flanges, etc.)

3.1 Avoid use of small mitered pieces, instead purchase
factory prefabricated fitting covers.



Foamglas Insulation (Cont'd.)

3.0 (Cont'd.)

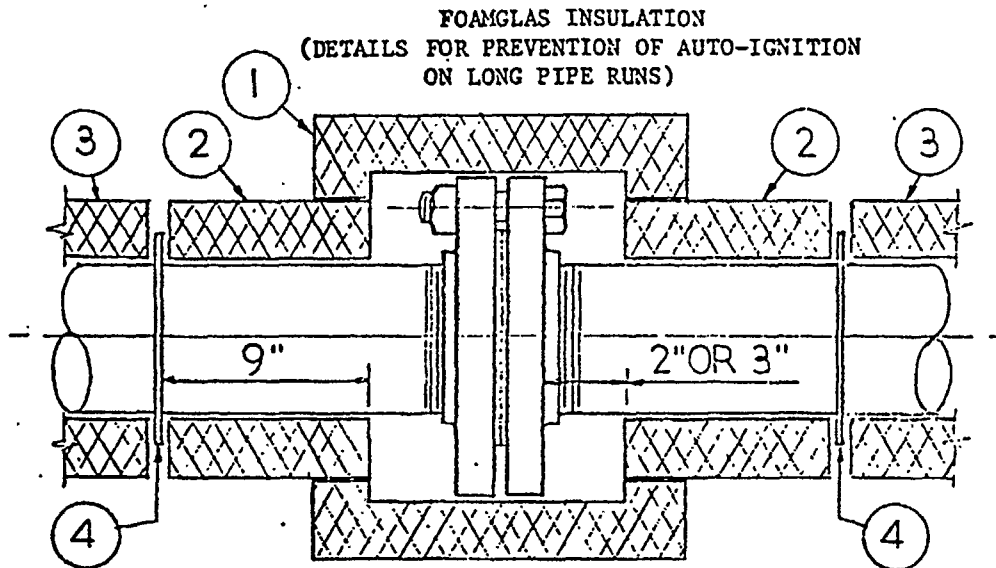
3.2 Specify if fitting covers are to be removable.

(Removable covers can show cost savings after repeated removals for maintenance in that they are reusable)

4.0 Special Applications

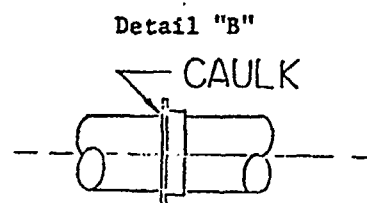
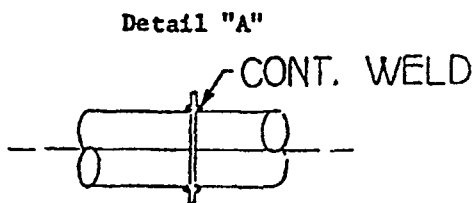
4.1 Steam traced pipe lines.

4.2 For prevention of auto-ignition, see page 101
This detail is for long uninterrupted (by fittings)
runs where material cost savings from using a less expensive
insulation can be recognized.



1. Foamglas removable flange or fitting cover (See PG.99)
2. Foamglas pipe insulation
3. Calcium Silicate (or other insulation)
4. Stop ring, designed to stop the flow of any leakage to the Calcium Silicate insulation. Ring should be approximately 1/2 of the insulation thickness above the pipe.

STOP RING DETAILS

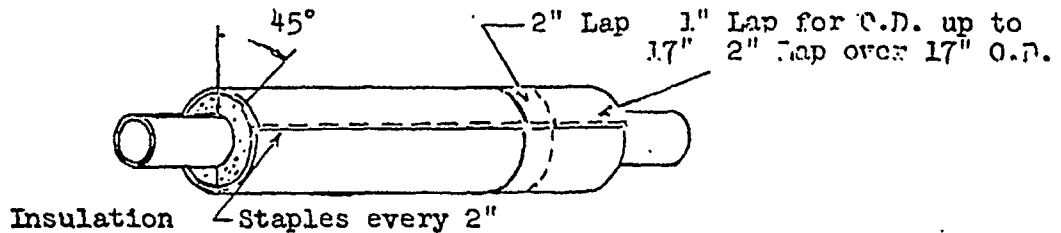


Detail "A" Ring - 16 ga. steel plate, continuous weld.

Detail "B" Ring - Sheet metal split ring banded in place with stainless steel band. Caulk with Dow Corning high temperature (Black) Sealant RTV-732.

Detail "B" is primarily for use in no welding areas.

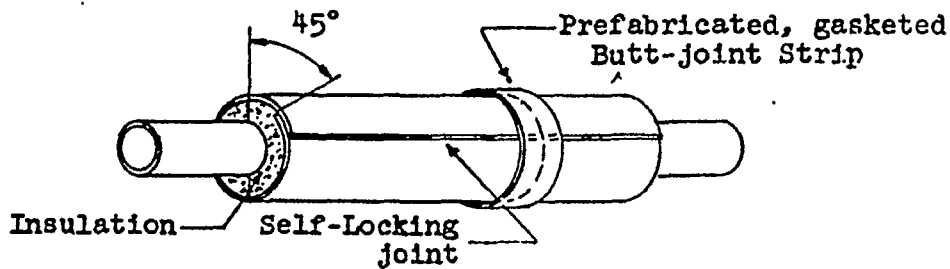
WEATHERPROOF FELT JACKET



APPLICATION PROCEDURE

- 1.0 O. D. Insulation Sizes up to 24" Pull weatherproof felt up tight against insulation, white side out. Lap the felt as shown so that the joint will shed water. Conceal longitudinal laps as much as possible. Entire length of lap shall be stapled approximately every 2 inches using either a hand or power stapler and $\frac{1}{2}$ inch Outward Clinch Monel staples. See page 55.
- 2.0 O. D. Insulation Sizes over 24" In addition to the monel staples stainless steel bands ($\frac{5}{8}$ " x .015) shall be used. Spacing of bands shall be approximately 12" apart with no band more than 4" from an end joint.
- 3.0 Fittings
Pipe bends: Finish as on page 71.
Flanges: Cover with weatherproof felt and staples. Sizes over 12" O. D. insulation size shall be banded with stainless steel bands ($\frac{5}{8}$ " x .015) or wired with 16 ga. Copper Clad wire in addition to stapling.
Valves: Large valves may be finished with weatherproof felt in the same manner as with flanges. All end joints shall be filled with an emulsion type mastic.
- 4.0 Pre-Cut Felt Pre-cut and prerolled weatherproof felt with a self sealing lap is available in various sizes. See page 56.

METAL JACKETS



APPLICATION PROCEDURE

- 1.0 Types
 - 1.1 Pre-cut and pre-rolled with locking (Pittsburgh) joint and matching butt joint sealer strips.
 - 1.2 Rolls 36" wide by 100 feet. Cut rolled and applied in the field.
- 2.0 Fasteners

Locking joint type should be fastened at each butt joint with plated sheet metal screws through the sealer strip. Plain roll type should be lapped 1" on the lateral seam and 2" at the butt joint so they will shed water. Plated metal screws or pop rivets spaced on 9" centers are used to secure the jacketing. Flashing mastic should be used around projecting nozzles and supports to provide a weatherproof finish.
- 3.0 Fittings

Flanges and valves may be covered with metal in much the same manner as with weatherproof felt. All end joints should be covered with an emulsion type mastic.

WEATHERPROOF FELT OR SHEET
METAL COVERING CHART

WIDTH OF WEATHERPROOF FELT OR SHEET METAL REQ'D										NO. ROLLS WEATHERPROOF FELT REQ'D PER 100 LINEAR FT. PIPE									
Pipe Size Inch	INSULATION THICKNESS INCHES									Pipe Size Inch	INSULATION THICKNESS INCHES								
	$\frac{1}{4}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	Std.	Std.		$\frac{1}{4}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	Std.	Std.
$\frac{1}{4}$	8	10	13	16	20	24	29	9	16	$\frac{1}{4}$	0.7	0.9	1.2	1.4	1.8	2.1	2.6	0.0	1.4
$\frac{1}{2}$	9	11	14	17	21	24	31	10	15	$\frac{1}{2}$	0.8	1.0	1.2	1.5	1.9	2.1	2.0	1.0	1.4
1	10	12	15	19	22	25	31	11	10	1	0.9	1.1	1.3	1.7	2.0	2.2	2.0	1.0	1.6
$1\frac{1}{4}$	11	13	16	20	23	26	33	12	19	$1\frac{1}{4}$	1.0	1.2	1.4	1.8	2.1	2.3	2.9	1.1	1.7
$1\frac{1}{2}$	12	13	18	21	24	27	33	13	20	$1\frac{1}{2}$	1.1	1.2	1.6	1.9	2.1	2.4	2.9	1.2	1.8
2	13	15	19	22	25	29	35	15	24	2	1.2	1.3	1.7	2.0	2.2	2.5	3.1	1.3	2.1
$2\frac{1}{2}$	15	16	21	24	27	30	35	17	25	$2\frac{1}{2}$	1.3	1.4	1.9	2.1	2.4	2.7	3.2	1.5	2.2
3	18	19	22	25	29	32	37	19	29	3	1.6	1.7	2.0	2.3	2.6	2.9	3.4	1.7	2.6
4	21	22	25	29	32	35	41	23	30	4	1.9	2.0	2.0	2.6	2.8	3.1	3.7	2.0	2.7
5	24	25	29	32	35	37	45	27	34	5	2.1	2.3	2.6	2.8	3.1	3.4	4.0	2.4	3.0
6	28	29	32	35	39	42	49	30	37	6	2.5	2.6	2.8	3.2	3.5	3.8	4.3	2.7	3.3
8	34	35	39	42	45	48	54	37	45	8	3.0	3.2	3.5	3.7	4.0	4.3	4.8	3.3	4.0
10	41	42	45	48	52	55	61	44	52	10	3.6	3.7	4.0	4.3	4.6	4.9	5.4	3.9	4.6
12	47	48	52	55	59	61	67	52	61	12	4.2	4.3	4.6	4.9	5.2	5.4	6.0	4.6	5.4
14	51	52	56	59	62	65	71	55	65	14	4.5	4.6	5.0	5.2	5.5	5.8	6.3	5.0	5.8
16	57	59	62	65	69	71	78	62	72	16	5.1	5.2	5.5	5.8	6.0	6.3	6.9	5.5	6.4
18	63	65	69	71	74	78	84	68	78	18	5.6	5.6	6.0	6.3	6.6	6.8	7.5	6.0	6.9
20	70	71	74	78	81	84	90	74	84	20	6.2	6.3	6.6	6.9	7.2	7.5	8.0	6.6	7.5
22	77	78	81	84	87	90	95	81	90	22	6.8	6.9	7.2	7.5	7.7	8.0	8.5	7.2	8.0
24	82	84	87	90	93	95	103	87	95	24	7.3	7.5	7.7	8.0	8.3	8.5	9.2	7.7	8.5
26	89	90	93	96	99	103	109	93	103	26	7.9	8.0	8.3	8.5	8.8	9.2	9.7	8.3	9.2
28	94	95	100	103	105	109	115	100	109	28	8.4	8.5	8.9	9.2	9.4	9.7	10.2	8.9	9.7
30	101	103	105	107	112	115	122	105	115	30	9.0	9.2	9.4	9.7	10.0	10.2	10.9	9.4	10.2

NOTE:

Based on 1" longitudinal lap for
Insulated O.D.'s 17" & smaller &
2" lap for larger than 17". All
end laps shall be 2".

NOTE:

Based on 108 sq. ft. rolls.

WALL AND FLOOR SLEEVE SIZES

PIPE SIZE INCHES	THICKNESS OF COVERING - INCHES												STYROFOAM OR CORK		
	HOT INSULATIONS												LIGHT DUTY	STD DUTY	HEAVY DUTY
	STD.	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6			
1/2"	4	4	6	6	8	10	10	12	12	14	14	16	6	6	8
3/4"	4	4	6	6	8	10	10	12	12	14	14	16	6	6	8
1"	6	6	6	8	8	10	12	13	14	15	16	17	6	8	10
1 1/4"	6	6	8	8	10	10	12	13	14	15	16	17	8	8	10
1 1/2"	6	6	8	8	10	10	12	13	14	15	16	17	8	10	10
2"	6	6	8	8	10	10	12	13	14	15	16	17	8	10	12
2 1/2"	8	8	8	10	10	12	13	14	15	16	17	18	8	10	12
3"	8	8	8	10	12	12	14	15	16	17	18	19	10	12	13
4"	10	10	10	12	12	14	15	16	17	18	19	20	10	12	14
5"	10	10	10	12	12	15	16	17	18	19	20	21	12	14	16
6"	12	10	12	13	14	16	17	18	19	20	21	22	13	15	18
8"	14	13	14	15	16	18	19	20	21	22	23	24	15	17	19
10"	16	15	17	18	19	20	21	22	23	24	25	26	17	19	22
12"	19	17	19	20	21	22	23	24	25	26	27	28	19	22	24
14"	20	18	20	21	22	23	24	25	27	28	29	30			
16"	22	21	22	23	24	25	26	27	29	30	31	32			
18"	24	23	24	25	26	27	28	29	31	32	33	34			
20"	26	25	26	27	28	29	30	31	33	34	35	36			
22"	28	27	28	29	30	31	32	33	35	36	37	38			
24"	30	29	30	31	32	33	34	35	37	38	39	40			
26"	33	31	33	34	35	36	37	38	39	40	41	42			
28"	35	33	35	36	37	38	39	40	41	42	43	44			
30"	37	35	37	38	39	40	41	42	43	44	45	46			

NOTE:

SIZES 12" AND SMALLER ARE SCHEDULE 40 STEEL PIPE.
SIZES 13" /O AND LARGER TO BE MADE FROM 1/4" MILD STEEL PLATE.

**WEIGHT OF PIPE INSULATIONS
FOR PIPE SIZES 12" OR LESS**

WEIGHT OF PIPE INSULATIONS - LBS. PER LINEAR FOOT																	
MATERIAL	THICKNESS INCHES	PIPE SIZE - INCHES															
		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	
TEMPER	1 1/2"	1.8	1.7	2.4	2.6	2.9	3.2	3.6	4.1	4.5	4.9	5.3	6.6	8.2	9.9	10.7	
	2"	3.3	3.4	3.6	3.9	4.2	4.5	5.3	5.9	6.6	7.2	8.4	9.4	10.6	14.2	16.2	
	37 D	0.6	0.7	0.8	0.9	1.0	1.4	1.6	1.9	2.1	2.5	3.0	3.5	3.9	5.9	8.3	
	1 1/2"	1.4	1.5	1.7	1.8	2.0	2.3	2.6	3.0	3.3	3.5	4.2	4.8	6.0	7.3	8.3	
SUPER	2"	2.3	2.4	2.6	2.9	3.1	3.4	3.9	4.3	4.7	5.1	5.9	6.8	8.4	10.1	11.7	
	2 1/2"	3.3	3.5	3.8	4.1	4.3	4.8	5.3	5.9	6.4	6.9	7.6	9.0	11.0	13.1	15.1	
	3"	4.4	4.6	5.1	5.5	5.8	6.3	6.5	7.7	8.3	8.8	10.9	11.4	13.3	16.3	18.7	
	4"	7.6	7.9	8.4	8.9	9.3	10.0	10.8	11.8	12.9	13.4	15.0	16.8	19.9	23.3	26.5	
UNIBESTOS	1"	0.4	0.4	0.6	0.6	0.8	0.8	1.0	1.2	1.3	1.4	1.6	1.8				
	1 1/2"	0.8	0.8	1.2	1.2	1.3	1.5	1.7	1.8	2.0	2.3	2.6	2.8	3.7	4.7	5.4	
	2"	1.4	1.5	1.8	2.0	2.0	2.3	2.5	2.8	3.0	3.2	3.7	4.2	5.2	6.4	7.3	
	2 1/2"	1.8	2.1	2.5	2.5	2.5	3.2	3.3	3.7	4.0	4.3	4.8	5.6	7.2	8.3	9.4	
CAREY TEMP.	3"	2.6	2.6	3.4	3.7	3.8	4.1	4.3	4.8	5.0	5.7	6.3	7.0	8.9	10.0	11.7	
	3 1/2"						5.0	5.5	5.9	6.4	6.8	7.7	8.6	10.5	12.3	14.1	
	4"						6.3	6.8	7.3	7.8	8.3	9.4	10.4	12.5	14.6	16.6	
	4 1/2"						7.6	8.2	8.9	9.4	9.9	11.1	12.3	14.6	17.0	19.3	
X	5"						9.1	9.7	10.4	11.0	11.7	13.0	14.3	16.9	19.5	22.1	
	5 1/2"						10.7	11.4	12.1	12.9	13.6	15.0	16.4	19.3	22.2	25.0	
	6"						12.5	13.2	14.0	14.8	15.6	17.2	18.7	21.8	25.0	28.1	
	LIGHT DUTY	0.5	0.7	0.8	0.9	0.9	1.0	1.1	1.4	1.7	1.8	2.0	2.5	3.0	3.9	3.3	
STYROFOAM	STD. DUTY	0.8	1.0	1.1	1.1	1.9	1.8	2.2	2.6	3.0	2.8	3.5	4.0	5.2	5.0	6.3	
	HEAVY DUTY	1.6	1.6	2.4	2.3	2.3	2.8	2.7	3.1	4.0	3.9	5.2	6.2	6.6	7.7	8.7	
	LIGHT DUTY	1.3	1.6	1.9	2.1	2.2	2.5	2.6	3.4	2.8	4.4	5.0	6.2	7.6	9.6	8.3	
	STD. DUTY	2.0	2.4	2.8	3.8	4.5	4.7	5.4	6.5	7.4	7.1	8.8	9.9	13.0	14.0	15.8	
CORK	HEAVY DUTY	4.0	3.9	5.1	5.8	5.7	7.0	6.8	7.7	10.1	9.7	13.0	15.4	16.6	19.2	21.7	
	ANTI-SWEAT	1.7	1.7	2.0	2.1	2.3	2.6	3.2	3.6	4.1	4.5	5.3	5.7	6.7	9.0	10.0	

* Single layer construction

** To obtain weight of Standard Unibestos, multiply weight of Super Unibestos by Factor 0.83

X Figures given are for conventional filter-moulded type. For precision moulded type, multiply by Factor 0.70

ST0000817

page 107

WEIGHT OF PIPE INSULATIONS
FOR PIPE SIZES 14" OR GREATER

WEIGHT OF PIPE INSULATIONS - POUNDS PER LINEAR FOOT

MATERIAL	THICKNESS INCHES	PIPE SIZE - INCHES								
		14	16	18	20	22	24	26	28	30
CAREYTEMP 1500	1½	6.0	6.8	7.6	8.4	9.2	10.0	10.7	11.5	12.3
	2	8.3	9.4	10.4	11.4	12.5	13.5	14.6	15.6	16.6
	2½	10.7	12.0	13.3	14.6	15.9	17.2	18.5	19.8	21.1
	3	13.3	14.8	16.4	18.0	19.5	21.1	22.6	24.2	25.7
	3½	15.9	17.7	19.6	21.4	23.2	25.0	26.8	28.7	30.5
	4	18.7	20.8	22.9	25.0	27.1	29.1	31.2	33.3	35.4
	4½	21.6	24.0	26.3	28.7	31.0	33.3	35.7	38.0	40.4
	5	24.7	27.3	29.9	32.5	35.1	37.7	40.3	42.9	45.5
	5½	27.9	30.7	33.6	36.5	39.3	42.2	45.0	47.9	50.8
	6	31.2	34.3	37.4	40.5	43.6	46.8	49.9	53.0	56.1

Table 4 - 11

CAREYTEMP 1500
APPLICATION OF BLOCK & SEGMENT INSULATION

Sidewall surfaces over 24" diameter up to and including 60" diameter shall normally be insulated with CAREYTEMP 1500 curved segments. See table on page 109. Surfaces over 60" diameter shall be insulated with Careytemp 1500 flat blocks. This material shall be securely fastened with 16 gauge monel or copperweld wire or .015" x 5/8" stainless steel bands on 12" to 18" centers using staggered joint construction.

All voids and joints shall be pointed up with Insulating Cement. Then apply wire mesh over the insulated surface. Finally, apply a 3/8" to 1/2" coat of Insulating Cement over the wire mesh. If Careytemp Cement is used, it shall be applied in two coats with the second layer troweled smooth.

Indoor work shall have a final 6 or 8 oz. canvas (muslin) jacket neatly pasted in place over the insulated surfaces.

Outdoor application shall be weatherproofed by either applying a 1/4" (1/8" dry) thickness of emulsion type mastic reinforced with 1" wire mesh, or a suitable jacket.

It is recommended for large vessels such as towers, tanks, stills, etc., that angle iron supports be installed on 12 ft. centers. (See page 147) On large vessels, vertical angle iron members should be installed to hold a 30 ft. maximum length of the securing wire or band. Horizontal vessels over 6 feet in diameter should have two steel angles welded to the vessel shell approximately 30 degrees below the horizontal center line. The depth of these supports should be held to 1/2" less than the insulation thickness.

Vessel heads can be covered by one of several methods. Dished heads 18" and smaller, and equipment of irregular shape, may be insulated with mineral wool cement up to the required thickness. Larger heads can be covered with flat blocks in the conventional manner.

The use of square double curved beveled blocks is one of the new developments and should be taken advantage of whenever possible. A grinding technique has been developed whereby square blocks of Careytemp, Foamglas, Styrofoam or Urethane foam insulation can be cut with a curved surface to fit any desired head radius. See figure on page 110. These curved blocks will give an effective insulation job without the need to fill a large number of voids. In most cases the radius of a bumped head will equal the diameter of the tank.

The blocks must be ordered from our DVS vendor, thus a lead time must be allowed. When ordering blocks the following information is necessary:

- a. Square feet of surface
- b. Required thickness
- c. Radius of the curved head

CAREYTEMP 1500
CURVED BLOCK CHART

Vessel Diameter	Width of Block	No. of Blocks	Pipe Size of Curved Block
14"	6"	10	16"
16"	6"	11	16"
18"	6"	12	16"
20"	6"	13	26"
22"	6"	14	26"
24"	6"	15	26"
26"	12"	8	26"
28"	12"	8½	26"
30"	12"	9	32"
32"	12"	9½	32"
34"	12"	10	32"
36"	12"	10½	32"
38"	12"	11½	42"
40"	12"	12	42"
42"	12"	12½	42"
44"	12"	13	42"
46"	12"	13	42"

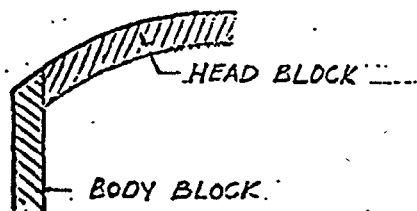
1. Cut bevels so opening, if any, will be on outside and can be filled in with cement.
2. Available thickness - 1½" & 2"
3. All blocks are 36" long.
4. Specify total number of blocks, thickness (1½" or 2"), width of each block (6" or 12"), and pipe size of block required.
5. For diameters over 46", use 6" wide x 36" long flat blocks.

Table 5-1

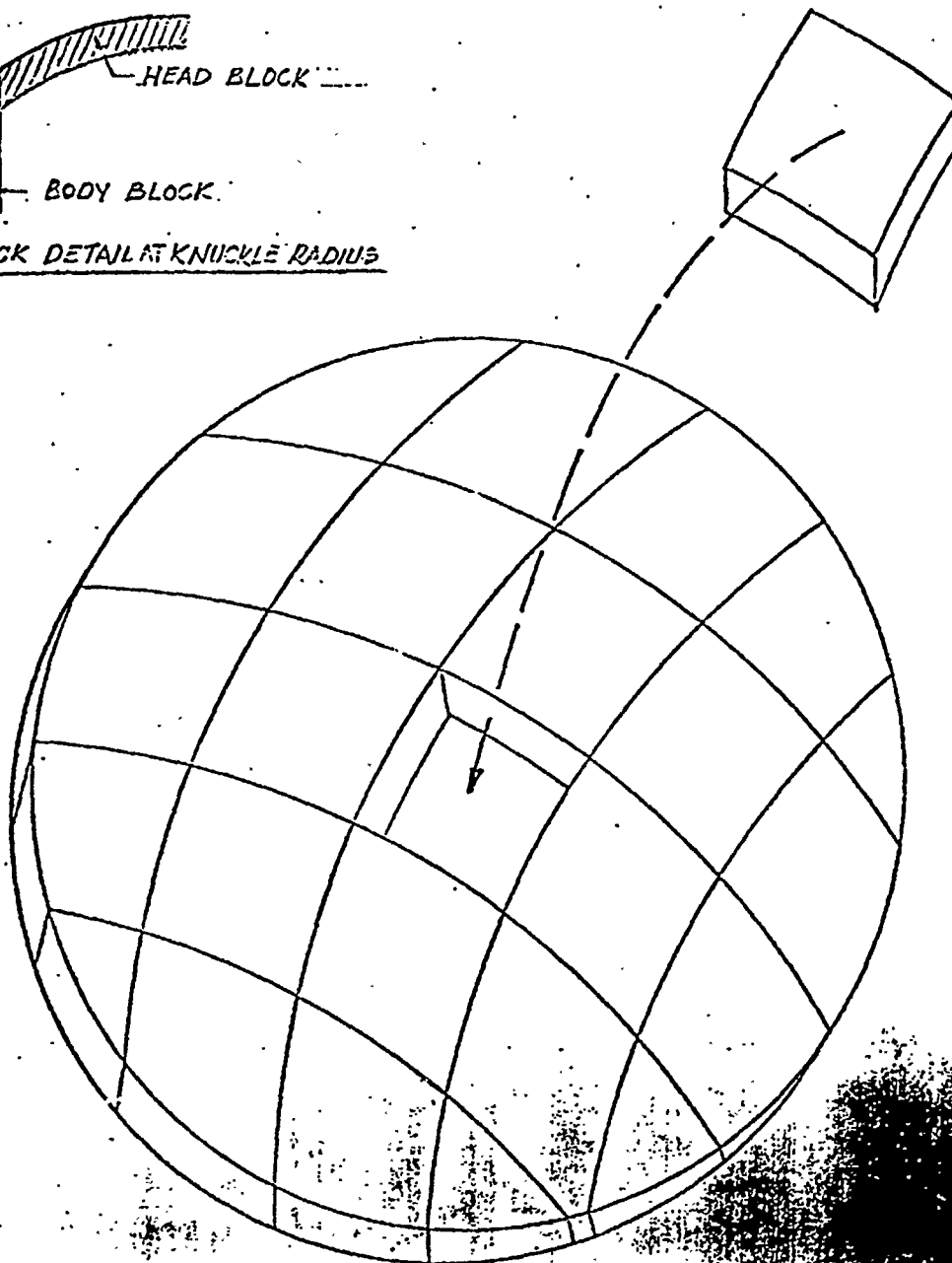
PRE-CUT VESSEL HEAD BLOCK

APPLICATION

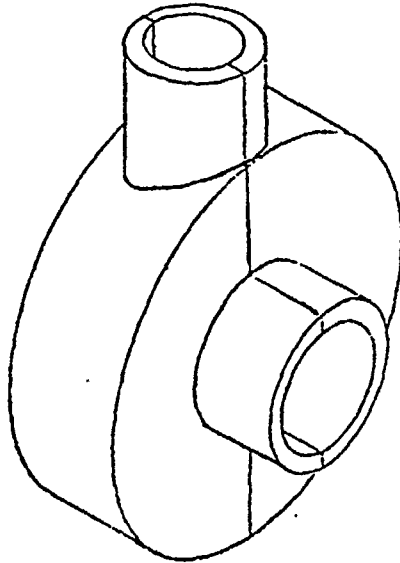
Pre-cut curved beveled blocks are installed similar to floor tile. Starting at the center blocks are laid in a straight line in one direction. Install a second row 90° from the first row. The space between the rows is then installed starting at the apex. Cut the head blocks to fit inside the body block and bevel as shown. Blocks may be cut from Careytemp, Cellular Glass Foam, Styrofoam or Polyurethane Foam.



BLOCK DETAIL AT KNUCKLE RADIUS



PREFORMED PUMP COVERS



1.0 Scope

Two piece prefabricated pump covers are available for standard size Goulds and Durco pumps. Covers for other makes of centrifugal pumps can be fabricated from a drawing or pattern. These covers can offer appreciable savings in applications where the cover must be removed at frequent intervals.

The covers are designed to be fastened together with stainless steel bands and have adequate room inside to handle tracing.

2.0 Material

The covers can be fabricated from any rigid type of insulation such as Careytemp, Foamglas, Styrofoam or Polyurethane. Thicknesses are optional from 3/4 inch to 2 inches. Outside finishes are available in any of the standard mastics such as Thermotex, Vinylacrylic, Hypalon or Epoxy.

3.0 Sizes available

Patterns have been made up for Goulds and Durco pumps in impeller sizes 6, 8, 10 and 13 inches. Inlet and discharge pipe sizes should be specified.

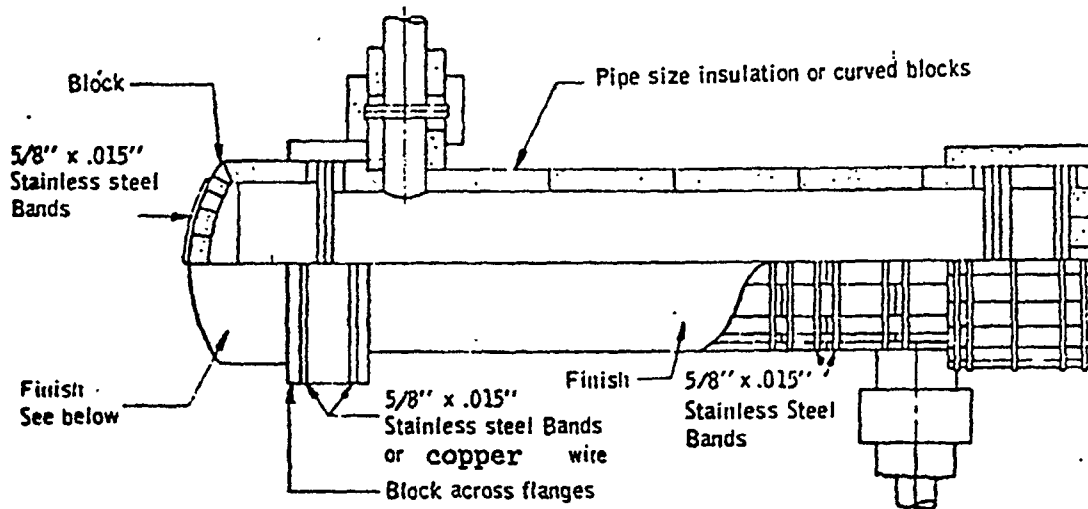
4.0 Ordering Information

The covers should be ordered by requisition from Industrial Insulation, Inc., Bay City, Michigan.

Specify as follows:

1. - Pump size
2. - Inlet and discharge pipe size
3. - Material required
4. - Thickness required
5. - Finish desired

VESSEL INSULATION, 46" O.D. AND SMALLER

APPLICATION

- .0 HEADS Use block insulation, fasten with 5/8" x .015" stainless steel bands or copper wire. Point up and fill voids with hydraulic setting cement. For alternate on small dished heads 18" O.D. and less, mineral wool cement may be used.
- .0 BODY Up to 14" O.D. - Use pipe size insulation.
14" to 46" O.D. - Use curved block insulation. See pg. 109. Fasten with metal bands. Point up and fill voids with insulating cement.
- .0 INDOOR FINISH Heads - Cover with insulating finishing cement 3/8" minimum thickness.

Body - Cover with Protective Jacketing.

Alternate, when specified:

Finish with insulating finishing cement same as for heads.

.0 WEATHERPROOF FINISH

- 4.1 Heads - Apply two 1/8" layers of asphalt mastic emulsion or other suitable mastics with glass membrane fabric between layers.

Flashing - Seal around projecting nozzles, supports, etc., with Vaporseal mastic and glass membrane fabric. See page 151.

- 4.2 Body - Same as for heads.

4.3 - Alternate finishes for body, when specified:

A. Protective Jacketing - See page 57

Flashing - Seal around projecting nozzles, supports, etc., with Vaporseal mastic reinforced with glass membrane fabric.

B. Weatherproof felt; lap 2" minimum and fasten with staples on 2" centers, or use stainless steel bands.

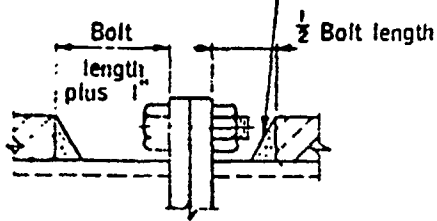
Flashing - Seal around projecting nozzles, supports, etc., with vaporseal mastic reinforced with glass membrane fabric. See pg. 151.

For alternate method with flanges not insulated, see page 115.

5.0 Method for Insulating Heat Exchangers with Flanges Left Bare.

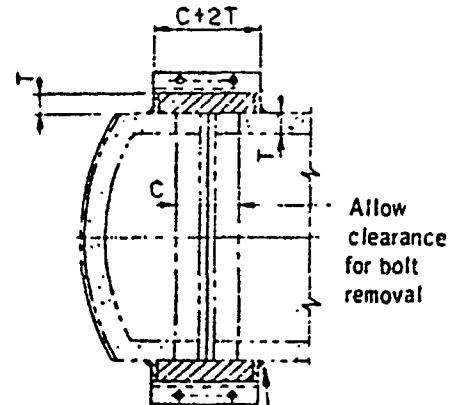
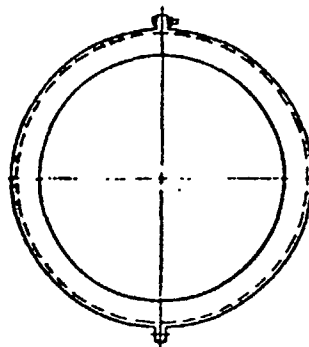
Use Mineral Wool Cement.
If outdoors, weatherproof
with vaporseal mastic and
glass membrane fabric
See page 151

Blanket insulation cut to fit
and pressed into guard halves
or block insulation cemented
into guard with mineral wool
cement.



DETAIL A

Bevel Detail at Flanges

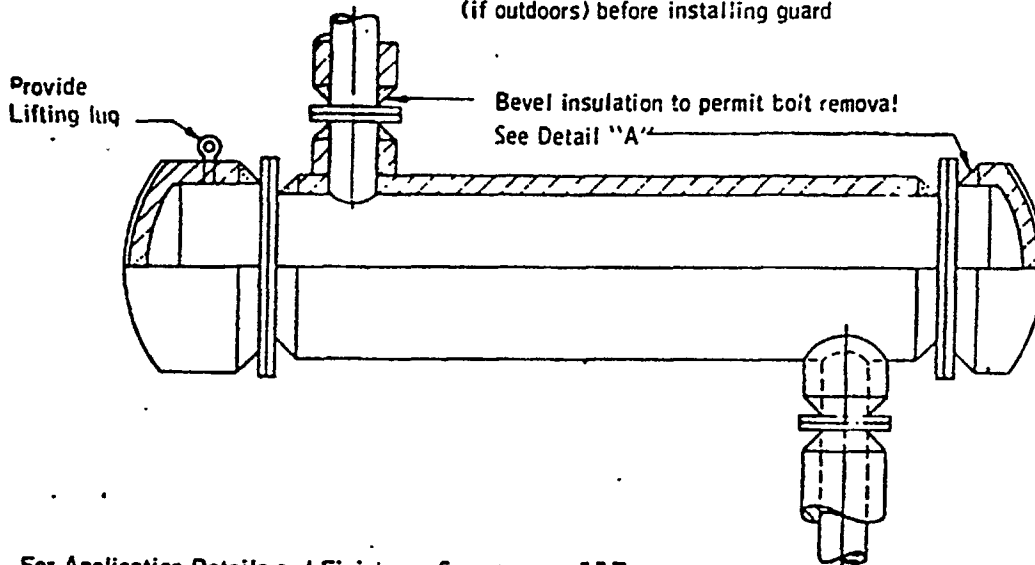


DETAIL B

Insulated Split Guard for Flange Joints
Make from No. 22 Ga. Galv. Steel with corners
locked and soldered outside.

Note: Apply weatherproof finish to body
(if outdoors) before installing guard

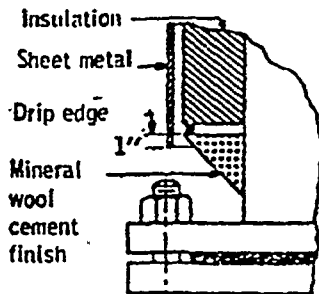
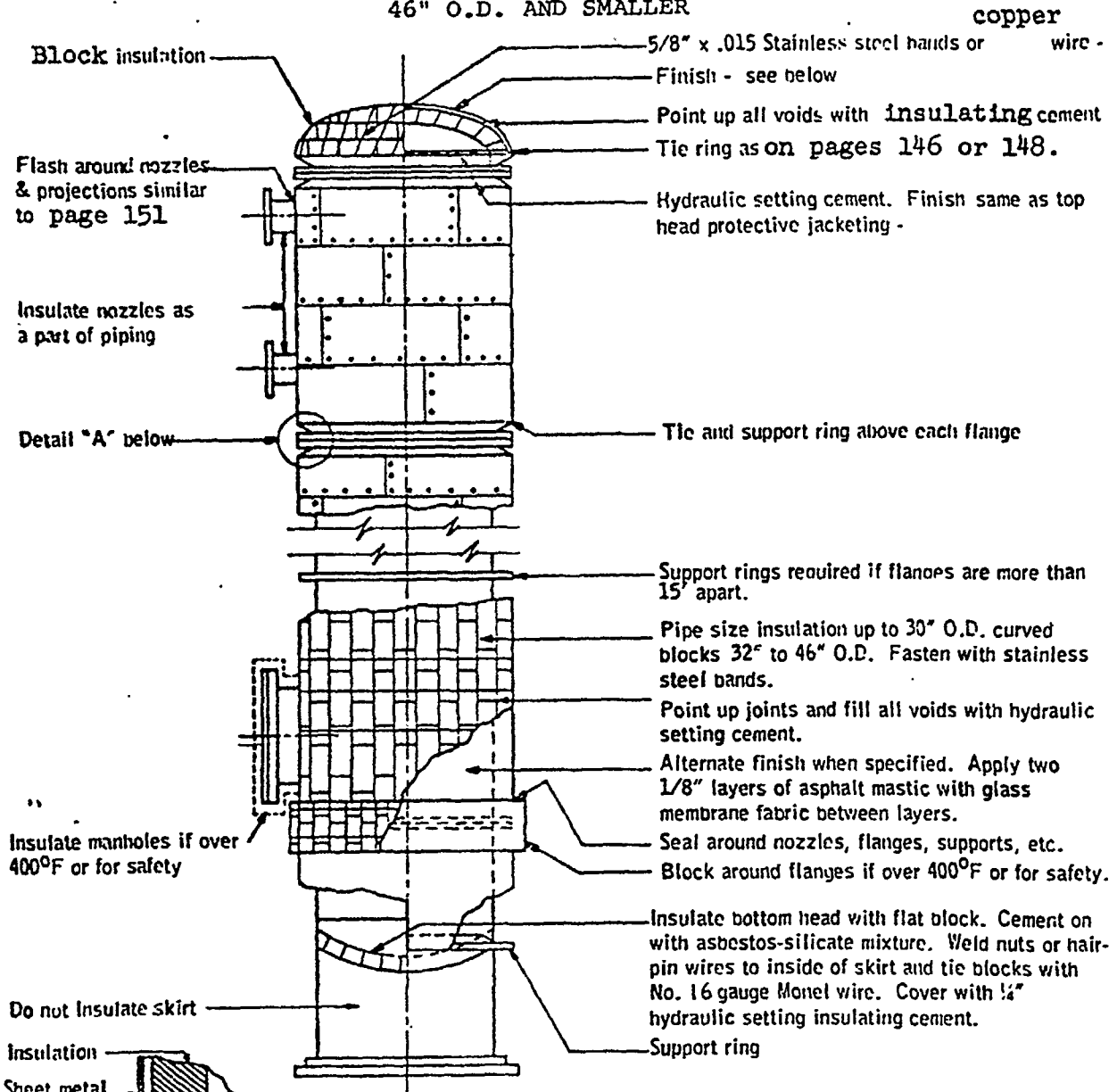
Seal with
Mineral Wool
Cement and
Vapor Seal
Mastic if
outdoors.



For Application Details and Finish - See page 113.

Note: This method may be used for low temperature heated equipment or for vessels which require frequent opening for cleaning and/or repairs. If personnel protection is required, use Insulated split guard

BLOCK INSULATION ON COLUMNS,
46" O.D. AND SMALLER



DETAIL "A"

FINISH ON TOP HEAD

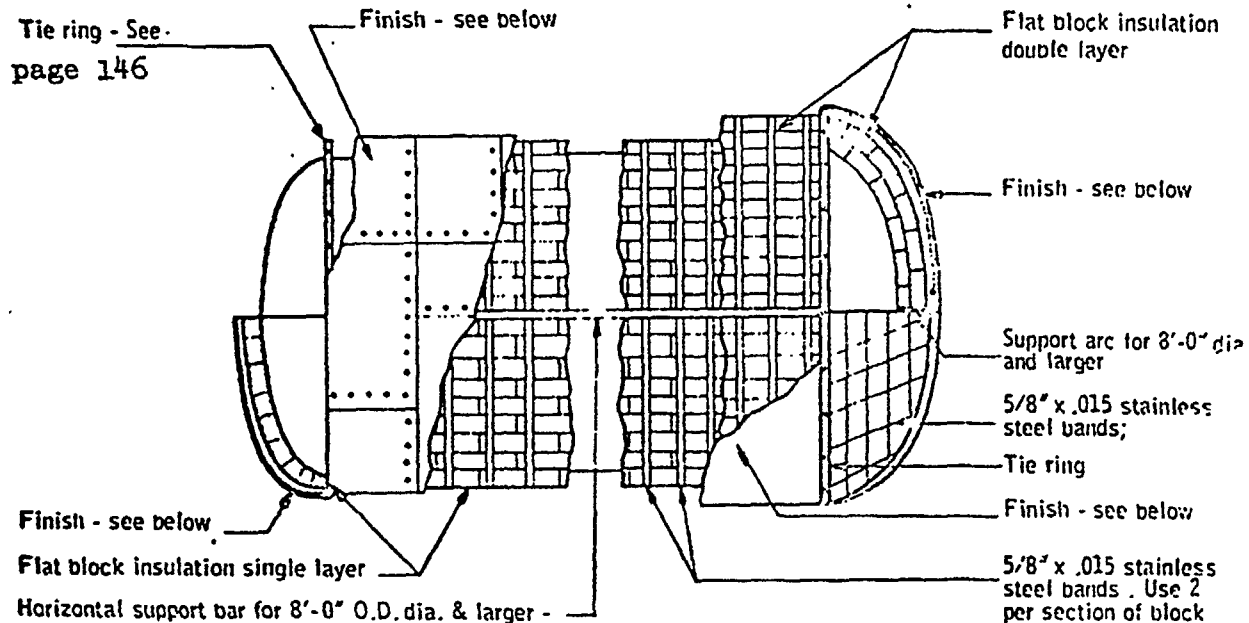
INDOOR

Cover with hydraulic setting insulating cement 3/8" minimum thickness.

WEATHERPROOF

Apply 1/8" minimum thickness of asphalt mastic while wet, imbed glass membrane fabric and follow with 1/8" final layer of asphalt mastic.

BLOCK INSULATION ON HORIZONTAL TANKS, 48" O.D. AND LARGER



APPLICATION

BODY & HEADS

Use__ block insulation or double layer, as required. Band heads as indicated on page 145. Point up joints and fill voids with hydraulic setting cement.

INDOOR FINISH

Heads - Apply 1" hex mesh galvanized wire netting and cover with hydraulic setting insulating cement 3/8" minimum thickness.

Body - Protective Jacketing - See page 57

1. Alternate - when specified. Weatherproof felt with 2" laps in each direction.

Fasten with staples on 2" centers.

WEATHERPROOF FINISH

Heads - Cover with two 1/8" layers of asphalt mastic with glass fabric between layers.

Body - Protective Jacketing -

ALTERNATES WHEN SPECIFIED.

1. Weatherproof felt as per (1.) above.

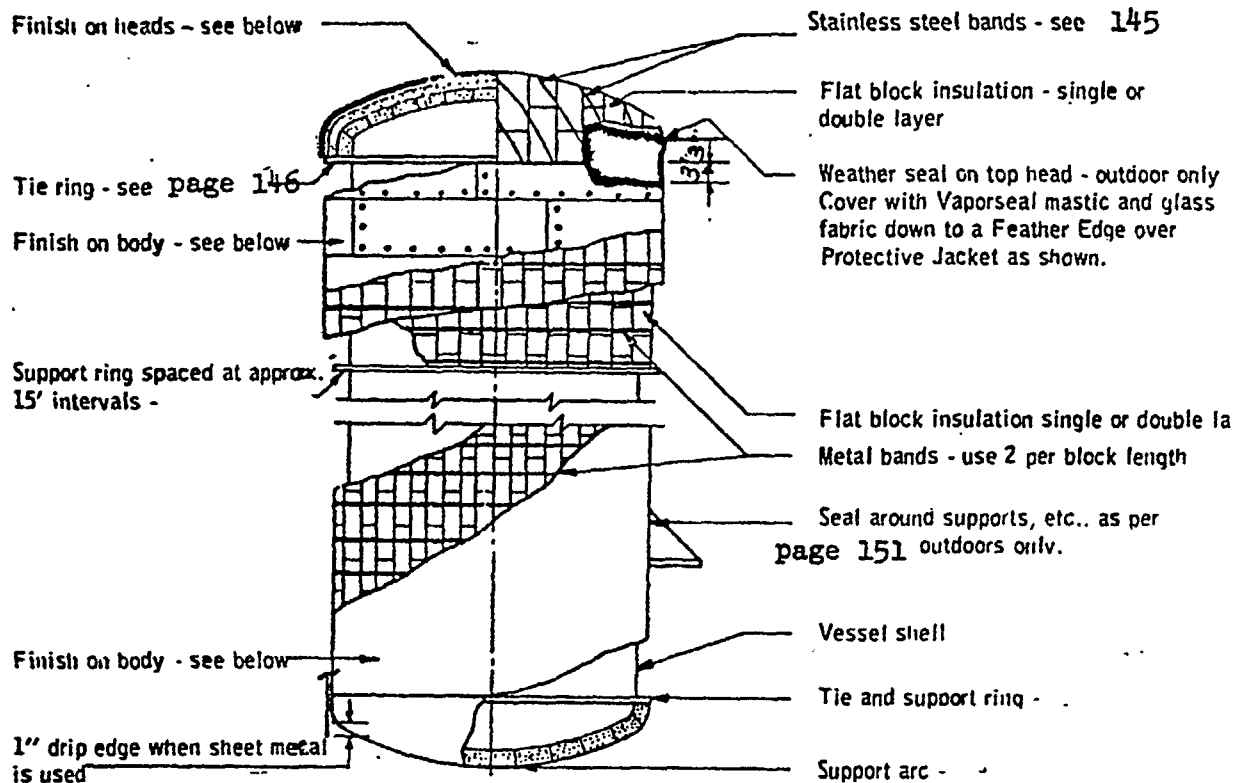
2. Cover with two 1/8" layers of asphalt mastic with glass fabric between layers.

Flashing - Seal around projecting nozzles, supports, etc., with flashing mastic and glass fabric.

MECHANICAL INJURY

Where vessel may be subject to severe mechanical injury, apply 3/8" layer of hydraulic setting insulating cement over the insulation, and finish body with protective jacketing.

BLOCK INSULATION ON VERTICAL VESSELS, 48" TO 12'0" O.D.



APPLICATION

BODY & HEADS

Use flat block insulation, single or double layer as required. Stainless steel band heads as indicated. Point up joints and fill voids with hydraulic setting cement.

INDOOR FINISH

Heads - Apply 1" hex mesh galvanized wire netting and cover with hydraulic setting insulating cement 3/8" minimum thickness.

Body - Protective Jacketing - See page 57

1. Alternate when specified: Weatherproof felt with 2" laps in each direction. Fasten with staples on 2" centers.

CORROSIVE AREAS

Use weatherproof finish as per alternate (2) below.

WEATHERPROOF FINISH

Heads - Cover with two 1/8" layers of asphalt mastic with glass fabric between layers.

Body - Protective Jacketing - See

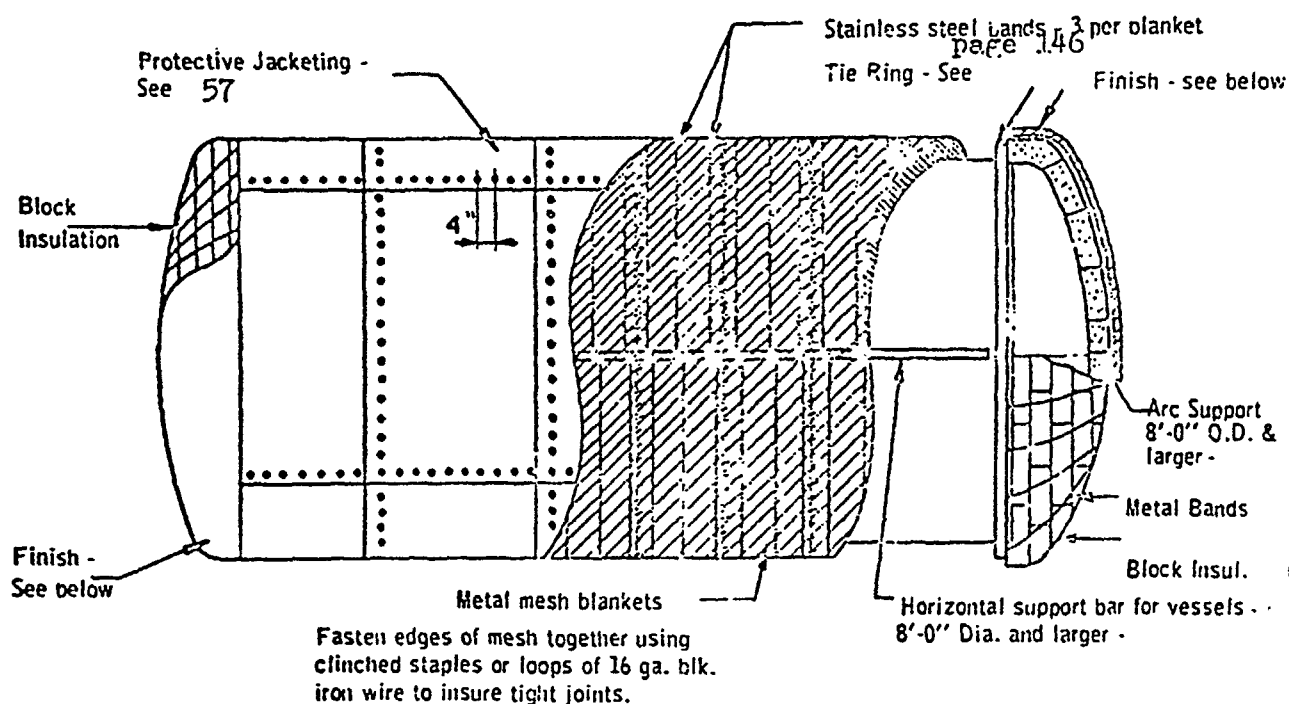
Alternates when specified:

1. Weatherproof felt as per (1) above.
2. Cover with two 1/8" layers of asphalt mastic with glass fabric between layers.

MECHANICAL INJURY

Where vessels may be subjected to severe mechanical injury, apply hydraulic setting insulating cement over the insulation and finish body with Protective Jacketing -

**BLANKET INSULATION ON HORIZONTAL
VESSELS, 48" O.D. AND LARGER**



1.0

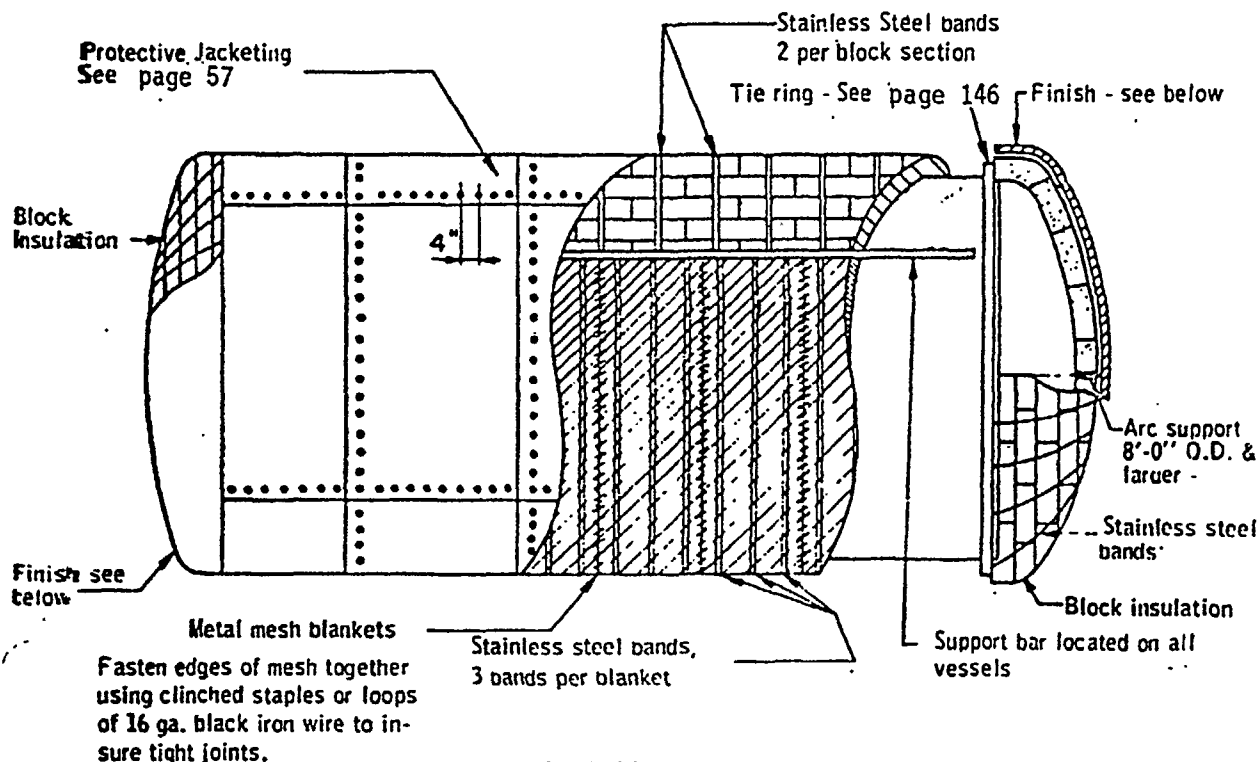
APPLICATION

- HEADS** Use flat block insulation. Stainless steel band and fasten as shown. Point up joints and fill voids with hydraulic setting cement.
- BODY** Use metal mesh blankets with 1" hex mesh galvanized wire netting on vessel side and expanded metal lath on outside. Tie and band as noted.
- INDOOR FINISH** Heads - Apply 1" hex mesh galvanized wire netting and cover with hydraulic setting insulating cement 3/8" minimum thickness.
Body - Protective Jacketing - See page 57.
- WEATHERPROOF** Heads - Apply two 1/8" layers asphaltic mastic emulsion with glass fabric between layers.
Body - Protective Jacketing

Where top of vessel may be subject to walking or other mechanical injury - See page 120

Where entire body will be exposed to severe mechanical injury - use block insulation. For application details see page 117

2.0 VESSELS EXPOSED TO MECHANICAL INJURY.

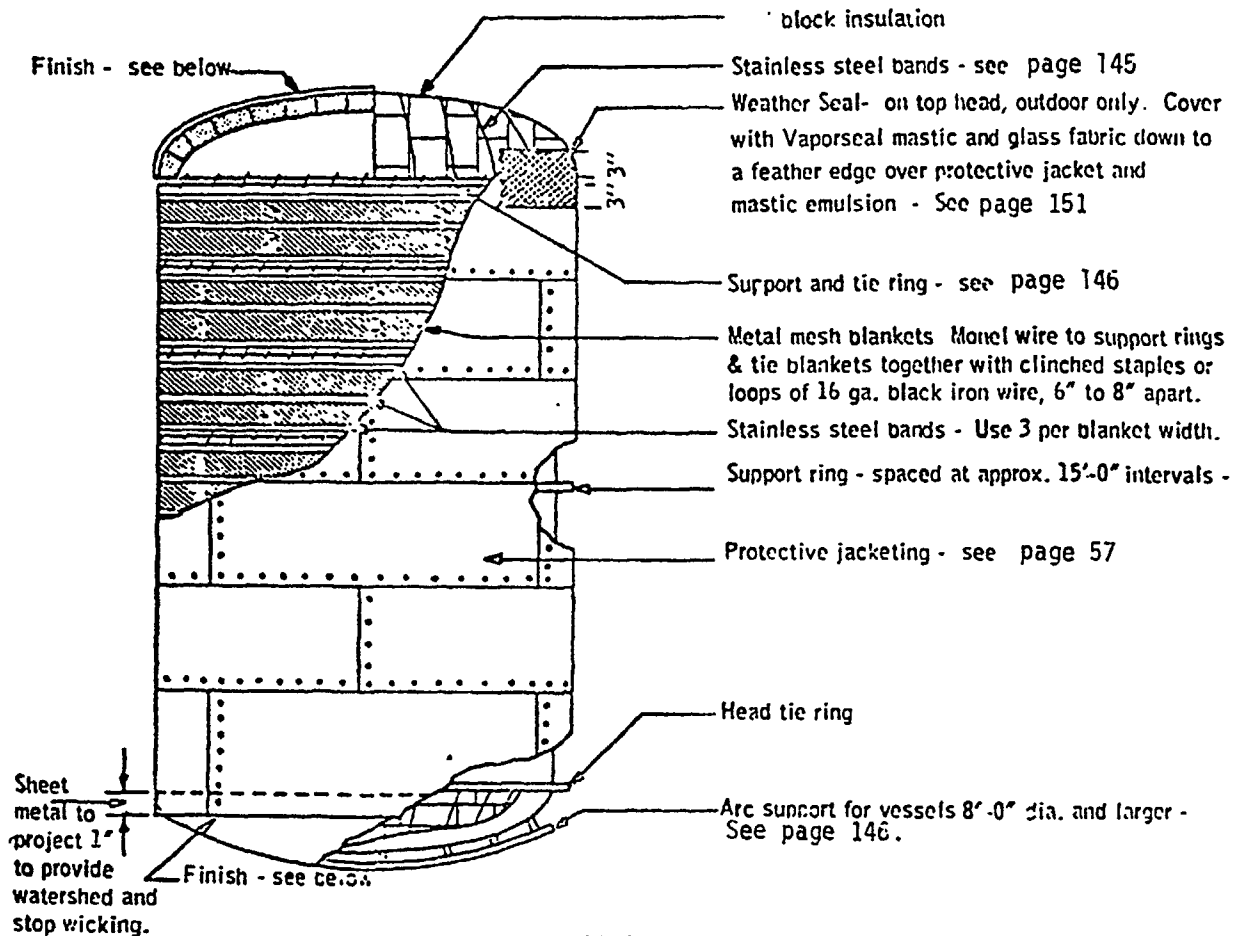
APPLICATION

HEADS	Use flat block insulation, stainless steel band, and fasten as shown. Point up joints and fill voids with hydraulic setting cement.	
BODY	Top 1/3 (120°)	Use block insulation, single or double layer as required. Point up all joints with hydraulic setting cement and band as noted.
	Bottom 2/3	Use metal mesh blankets with 1" hex mesh galvanized wire netting on vessel side and expanded metal lath on outside. Tie and stainless steel band as noted.
INDOOR FINISH	Heads -	Apply 1" hex mesh galvanized wire netting and cover with hydraulic setting cement 3/8" minimum thickness.
	Body -	Protective Jacketing - See page 57
WEATHERPROOF FINISH	Heads -	Apply two 1/8" layers asphaltic mastic with glass fabric between layers.
	Body -	Protective Jacketing -

Where any mechanical injury will be anticipated due to persons working or walking on top of vessel, use this method. For severe mechanical damage, use as on page 117.

NOTE: Platforms and walkways should be provided for normal operating access to top of the vessel. This Standard is intended only to reduce insulation damage resulting from inadvertent walking on vessels such as may occur during construction work.

BLANKET INSULATION ON VERTICAL
VESSELS, 48" O.D. TO 12'0" O.D.



APPLICATION

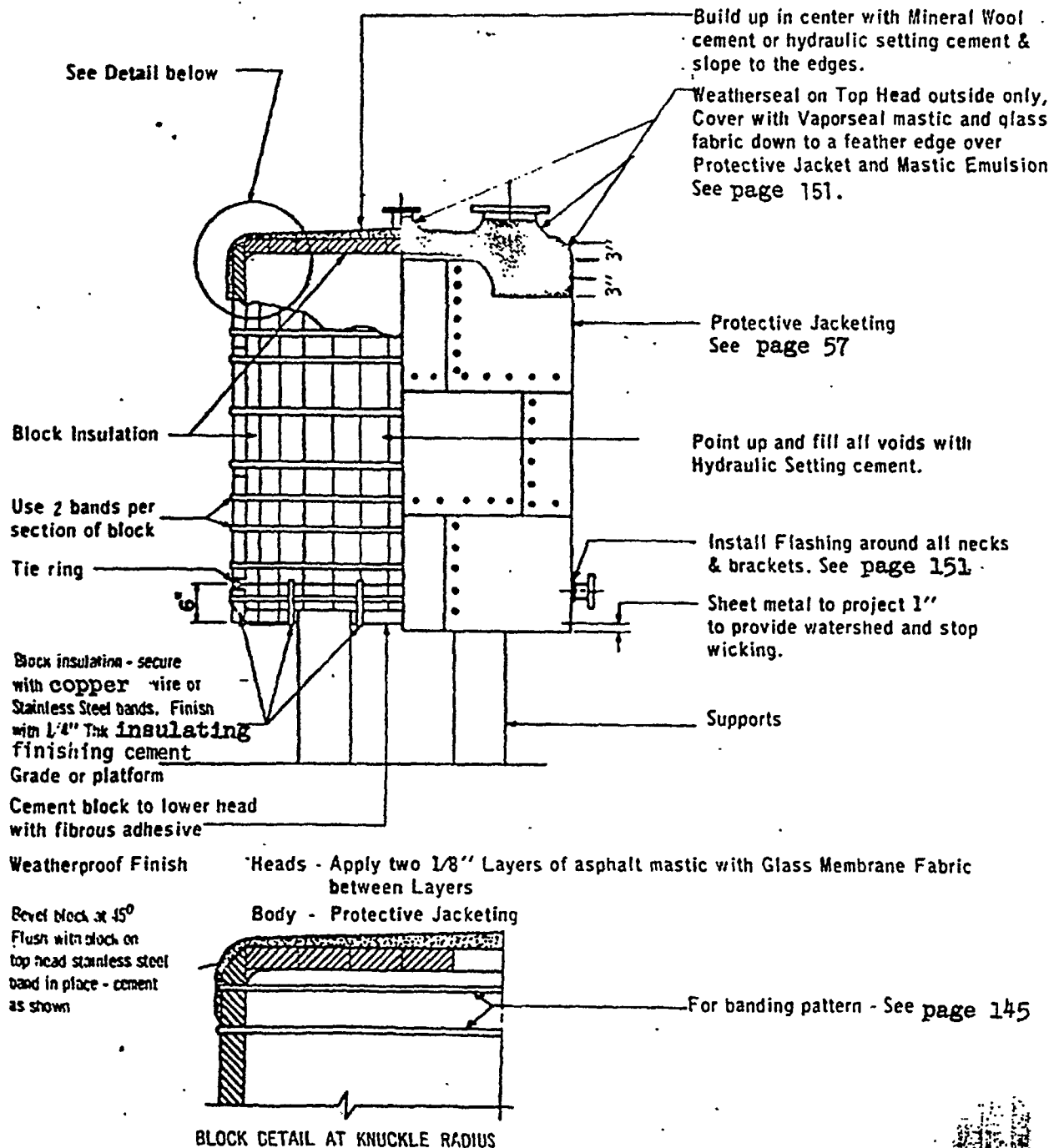
HEADS Use block insulation stainless steel band, as indicated. Point up joints and fill voids with hydraulic setting cement.

BODY Use metal mesh blankets with 1" hex mesh galvanized wire netting on vessel side and expanded metal lath on outside.
Hang from support rings, tie together and band as noted.

INDOOR FINISH Heads - Apply 1" hex mesh galvanized wire netting and cover with hydraulic setting insulating cement 3/8" minimum thickness.
Protective jacketing - see page 57

WEATHER-PROOF FINISH Heads - Two 1/8" layers of asphalt mastic with glass fabric between layers.
Body - Protective Jacketing
Alternate when specified: Weatherproof felt with 2" laps in each direction. Staple vertical seams with staples on 2" centers and band with 3 S.S. bands per strip of felt.
Where body will be exposed to severe mechanical injury use block

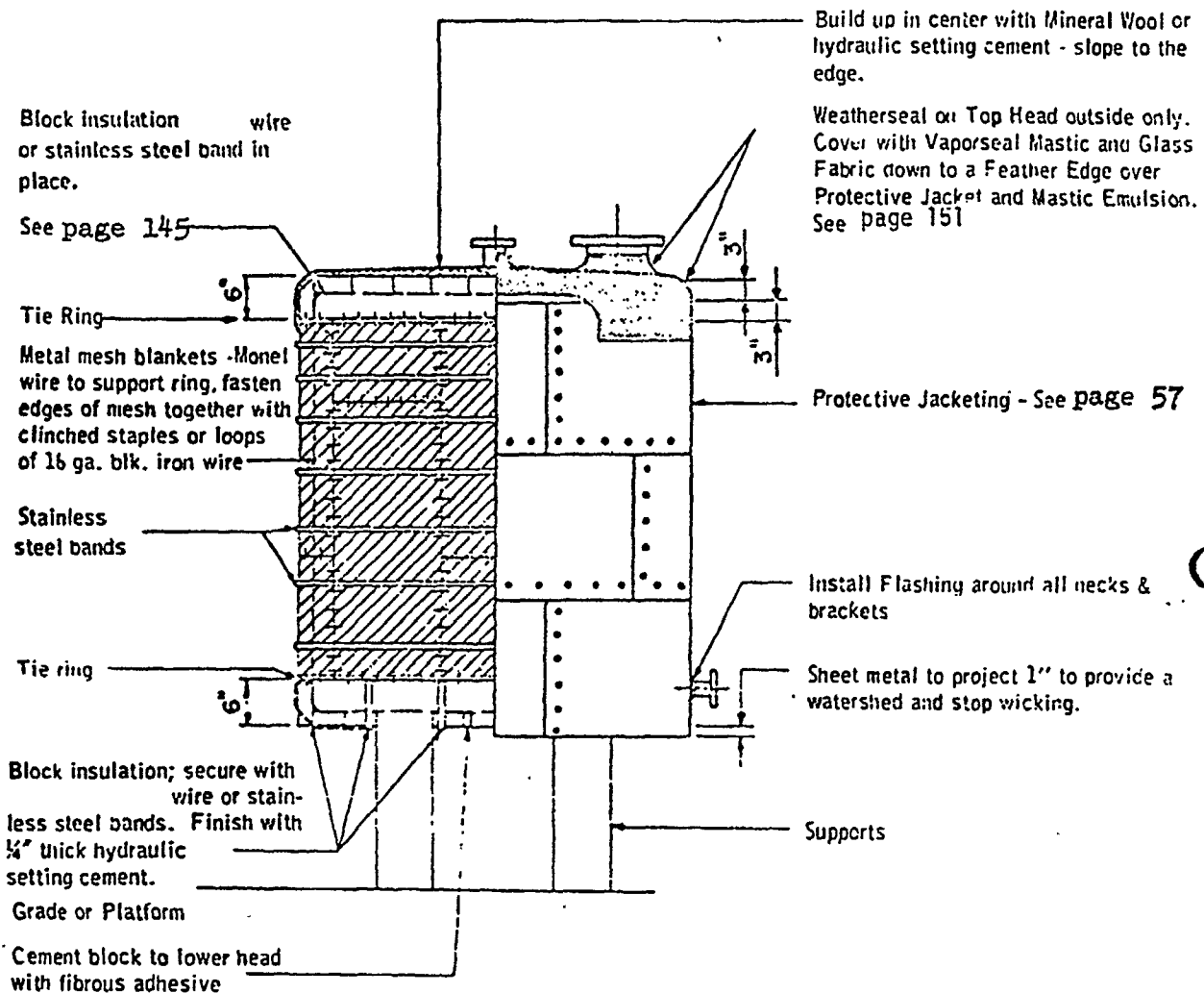
BLOCK INSULATION, FLAT HEAD VERTICAL VESSELS



ST0000833

page 123

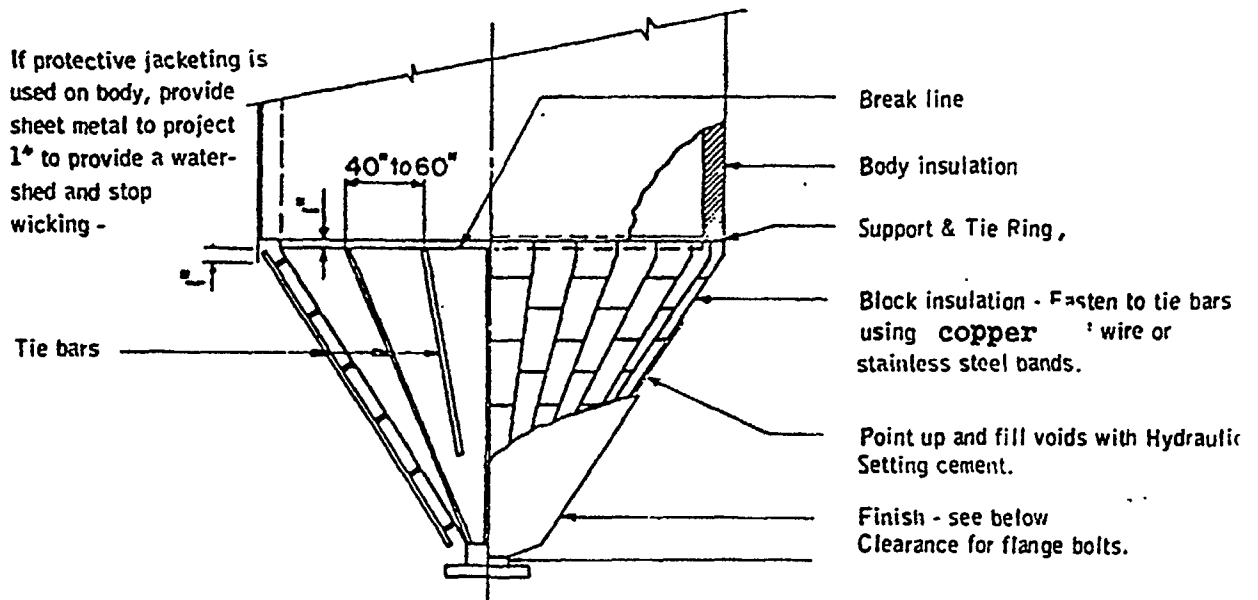
BLANKET INSULATION, 48" O.D. AND LARGER,
FLAT HEAD VERTICAL VESSELS



WEATHERPROOF FINISH

- Heads - Apply two 1/8" layers of asphalt mastic with glass membrane fabric between layers.
- Body - Protective Jacketing
- Flashing - Seal around projecting nozzles, supports, etc.

APPLYING INSULATION ON CONE BOTTOM VESSELS



INDOOR FINISH

Apply 1" Hex mesh galvanized netting and cover with hydraulic setting cement
3/8" minimum thickness and cover with Osnaburg Rag

WEATHERPROOF FINISH

Apply two 1/8" layers of asphalt mastic with glass membrane fabric between layers.

Flashing - Seal around projecting nozzles, supports, etc.

CONTRACTION AND EXPANSION JOINTS

Cold Temperature Equipment

Cold equipment insulated with cellular glass will be considered first. Although the intent of this practice is not to discuss specific materials and their application, cellular glass has properties so different from others that it must be considered in a separate generic classification.

Cellular glass, which has a vapor permeability of 0.000000 + is more vapor resistant than most vapor-barriers. By sealing cellular glass to itself with vapor sealers to form a complete enclosure around the vessel or equipment, the insulation forms its own vapor-barrier, and none is needed on its outer surface. However, it is important that it be installed in such a manner that these joints remain unbroken. The cellular glass insulation system should be so designed that movement, due to contraction of the vessel or equipment, is not transmitted to the insulation to cause opening of the sealed joints. The vapor sealer chosen to seal cellular glass must be selected with care. Because of its vapor resistance, sealers containing high solvent content will not dry when placed between butt ends of the insulation. For this reason, the sealer should be of high solid content and it must remain elastic and flexible to the lowest temperature to which it is to be subjected. Sealers containing water, or which become brittle and shrink at low temperatures, are not suitable.

The coefficient of expansion (or contraction) of cellular glass is 0.0000046, and that of steel, which has the lowest coefficient of the commonly used construction metal, is 0.0000065. Thus, when cellular glass is installed on a vessel at atmospheric temperature, and the vessel's temperature lowers, the circumferential dimension of the vessel reduces more than the circumferential dimension of the cellular glass for two reasons. First, the higher rate of contraction of the vessel, and second, the service temperature of the vessel is reduced almost twice the reduction of the mean temperature of the insulation. Thus, the vessel "pulls away" from the insulation, leaving a void. This void causes no harm to the insulation itself, but it does leave it with no "backing." Therefore, any pressure on the outer surface may break the vapor sealed joints of the installed insulation.

The insulation must also be designed to accommodate any axial contraction of the vessel. On the cylindrical surface, this change in dimension must be taken up by insulation contraction joints. The spacing of these joints is based upon the movement of the vessel and the weight of insulation to be supported.

Cold Temperature Equipment (Cont'd.)

On vessels operating below -100°F. , these joints should be spaced on approximately 12 foot centers. On vessels which operate above this temperature, the spacing is generally determined by the weight of the insulation being supported by itself at its bottom. The maximum spacing of supports should be 18 feet on centers when based on weight alone.

A contraction joint is always required just below the top on vertical vessels, as the contracting vessel will pull away from the top, leaving a void below if a joint is not located at this position.

Cellular glass should be installed in broken joint construction. On all installations of very low temperature insulations, broken joint construction is used for several reasons. First, it reinforces the joint by providing a back-up under it, and second, if the service temperature is below -50°F. , many sealers will freeze, harden, and cause spalling of the cellular glass. Frequently, one sealer possessing extremely low temperature properties is used on the inner layer, and another to seal the butt joints of the outer layer.

Cold equipment and piping insulated with organic foam has contraction problems just the reverse of that of equipment insulated with the cellular glass just described. This is because its coefficient of expansion (and contraction) is 0.000040-0.00005. In this case, the insulation contracts more than the vessel.

In most instances, these materials are more resilient than cellular glass, but they have a much larger coefficient of expansion than the metal itself. This creates another set of problems. The outside of the insulation surface at ambient temperature is about stable in dimension, whereas its inner dimension shrinks. Around a circular surface this creates a condition which leaves "V" shaped cracks. On small and moderate pipe sizes, when insulation can be foamed oversize and the bands tend to draw and compress it to a smaller circle, this action can be controlled relatively easily. On vessels, the problem must be dealt with as a basic problem of contraction. The way this is done is to provide a thickness of cushion blanket which can be compressed down to the circumference of the foamed insulation at the temperature of the vessel. The insulation must be pulled into this position by use of a stretched expansion or nylon band. See page 131.

To compensate for these factors on vessels operating below 32°F. , the recommended construction would be to have a thick layer of non-compressed cushion blanket, double layer, sealed joint construction with the best sealed vapor-barrier possible. If located outdoors, a weather-barrier over the vapor-barrier is recommended. All projections, nozzle insulation covers,

Cold Temperature Equipment (Cont'd.)

inside and outside corners, must be carefully vapor sealed to prevent the vapor from by-passing the areas covered with the vapor-barrier.

Moderate Temperature Equipment

Moderate temperature equipment (above ambient temperatures to 212°F.), because of its smaller problem of expansion or contraction, has less supporting and securing problems than either low or high temperature service equipment. If the insulation is dimensionally stable and has even a moderate compressibility, the blocks or curved segments can be applied directly to the surface and secured in position without space allowance for vessel movement. However, because of the limited heat available for water evaporating purposes, if located outdoors, or where the equipment can become wet, it is vital that either the insulation be moisture repellent, or that the weather-barrier keep the insulation dry. Once the insulation is water soaked, the temperature is not high enough to provide a vapor-driving force that will dry out the insulation in a reasonable length of time.

High Temperature Equipment

High temperature equipment (above 212°F.) gets back into the range where expansion movement must be considered. Again, because of the number of variables, there is no clearcut guide to follow. The effects of circumferential expansion on the tightness of the insulation joint is a function of the size of the vessel, its temperature, the shrinkage (or expansion) of the insulation, and its compressibility.

Such commonly used high temperature materials as Careytemp 1500 should be installed in wedge-shaped or curved segments. Kerfing and breaking blocks around cylindrical vessels cannot give as efficient an insulation application as properly cut and fitted segments. The resulting voids from such kerfing will reduce the thermal efficiency of the installation. If it is attempted to fill the voids completely with insulating cement, the resulting labor cost would be much greater than the proper cutting of the insulation. For vessels up to 10 feet in diameter and 400°F. in temperature, if the circumferential block is cut and fitted to be 1/2 inch greater in circumference

than the vessel, and secured so that the tension of bands produces the compression on the butt edges rather than on the surface toward the vessel, this little space and the compressiveness of blocks will most often suffice to take care of the expansion of the vessel. On vessels of greater diameter, definite provisions for expansion should be made.

Of course, the metal of the vessel is the controlling factor in the expansion of that vessel. To illustrate the dimensional changes of a vessel, see page 134. This Table gives the dimensional change in diameter and circumference of various metals at various temperatures and diameters of vessels. As can be seen from this Table, the changes in these dimensions are significant, and the installation design must make certain that the increases in dimensions do not open joints and ruin the installation. Of course, to these expansion figures must be added any shrinkage of insulation caused by temperature.

Numerous methods are used to provide an expansion area around the shell of a vessel. First is to wrap asbestos rope around the vessel; second, to place stainless steel, spring type bands around the vessel; and third, to install compressible blanket around the vessel, prior to the application of the insulation. The use of multiple layer, broken joint construction rigid insulation also helps, as there is bound to be an added degree of flexibility with multiple layers as compared to a single layer. In addition, any joint opening is restricted to only one layer, and there is always at least one layer left to act as a heat barrier. This reduces hot spots and heat disintegration of the weather barrier. These methods are illustrated on page 133. Of course, the block must be cut and fitted to the outside radius of the vessel plus the thickness of the spacer used. The insulation, when installed, should not compress the rope, spring band, or the blanket, otherwise they will not serve their purpose in allowing for the expansion of the vessel.

Where circumferential expansion control is necessary on the side walls, it is also necessary on the heads of the equipment. Use of compressible blanket under the rigid insulation on heads is easier to install than rope or expansion bands, and for this reason is more frequently used than the other two methods.

Use of Flexible Insulation in Combination with Rigid Insulation

Recovery is the ability of a material to return to its original size or form after it has been forced into a shape other than its original one. In installations where it is installed to a permanent shape other than its original,

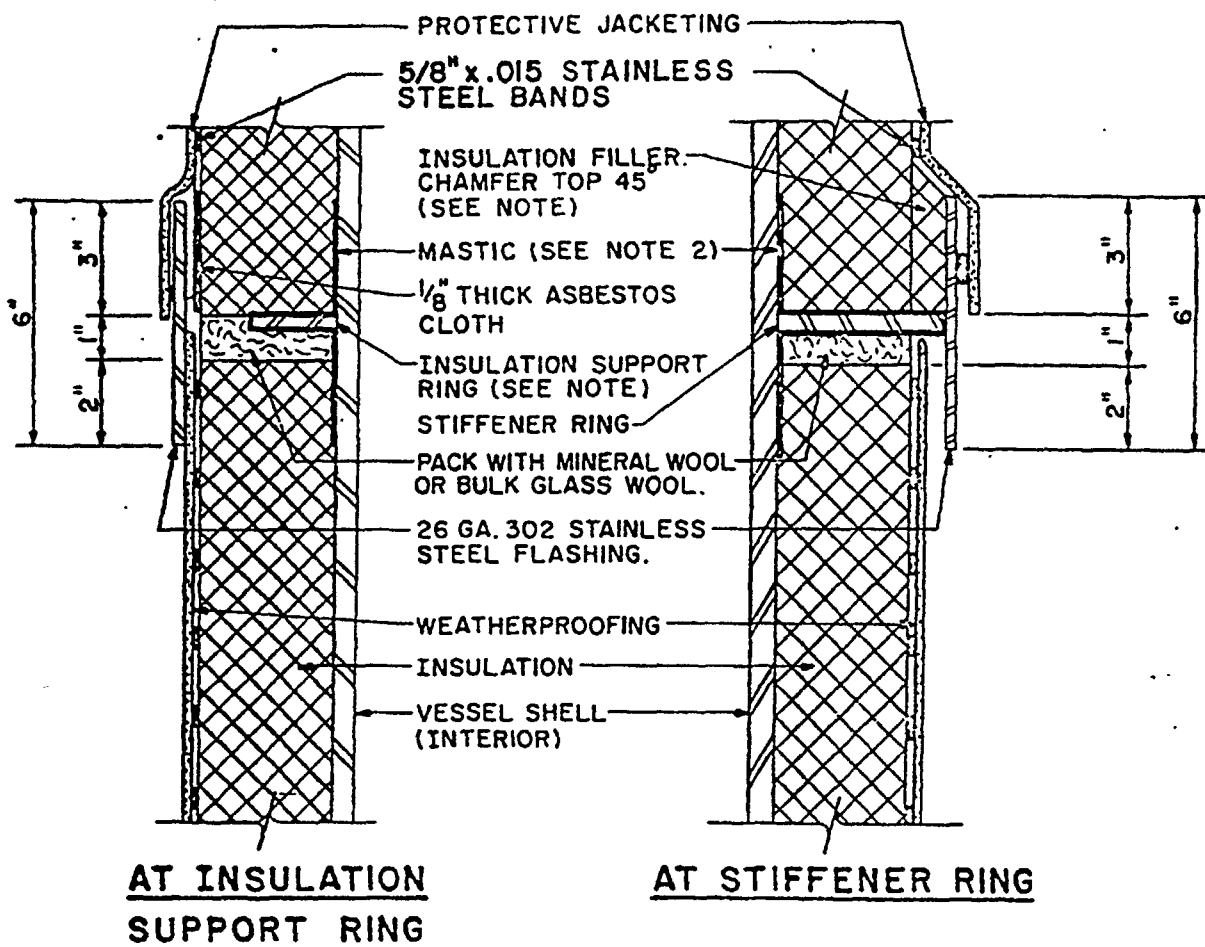
Use of Flexible Insulation in Combination with Rigid Insulation (Cont'd.)

excessive ability to recover is not an asset, and may be even detrimental. However, where the substrate changes position, size, or shape, recovery may be a most important property.

Because of these particular properties, blanket and flexible insulations are frequently used with rigid insulations to act as mechanical, and sometimes thermal "cushions." Page 130 and page 132 show methods of using a flexible insulation (most frequently fibrous blanket) to compensate for expansion of a vessel so that the joints in the rigid insulation remain tight. In the case of hot service, the flexible insulation should not be compressed during application. On low temperatures it should be compressed sufficiently so that the insulation's recovery faculty will expand it as the vessel contracts. Such applications are not necessary at moderate temperature differences and on small diameter equipment, but are essential where differentials from atmospheric temperature and equipment diameters are large. The larger the diameter, the smaller the temperature difference at which this type of construction becomes necessary. Care should be taken not to have expansion forces exceed the strength of the band securement.

On linear expansion joints, the situation is reversed from cylindrical expansion or contraction. The flexible insulation used in linear butt joints is compressed as temperatures drop below and expand as they rise above atmospheric. See page 89.

METHOD OF COMPENSATING FOR VESSEL EXPANSION
AT SUPPORT AND STIFFENER RINGS



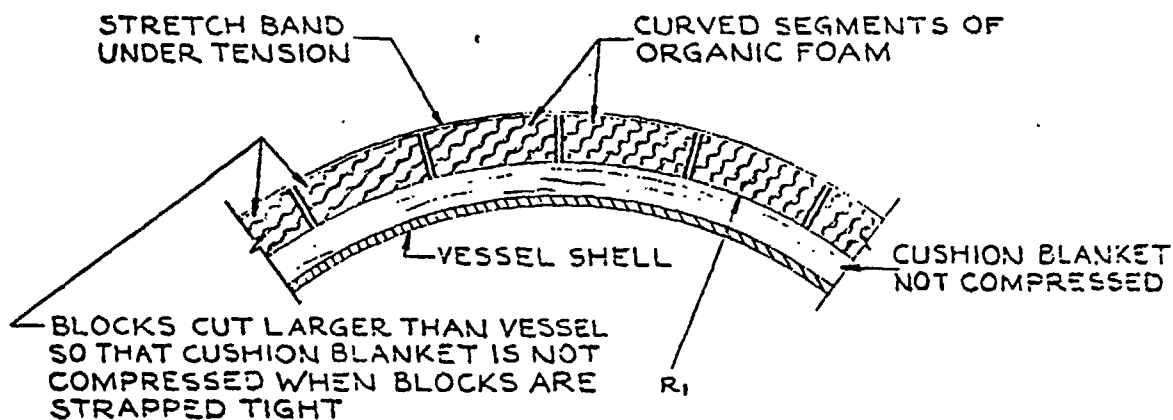
NOTE:
INSULATION SUPPORT RINGS ARE SPACED ON
18'-1" CTRS. THEIR WIDTH IS TWO THIRDS
THE THICKNESS OF THE INSULATION.

NOTE:
THE INSULATION FILLER PLUS THE VESSEL
INSULATION MUST HAVE A TOTAL THICKNESS
NOT LESS THAN THE WIDTH OF THE
STIFFENER RING.
THIS DETAIL IS REQUIRED ONLY WHEN STIFFENER
RINGS ARE WIDER THAN THE THICKNESS OF THE
INSULATION.

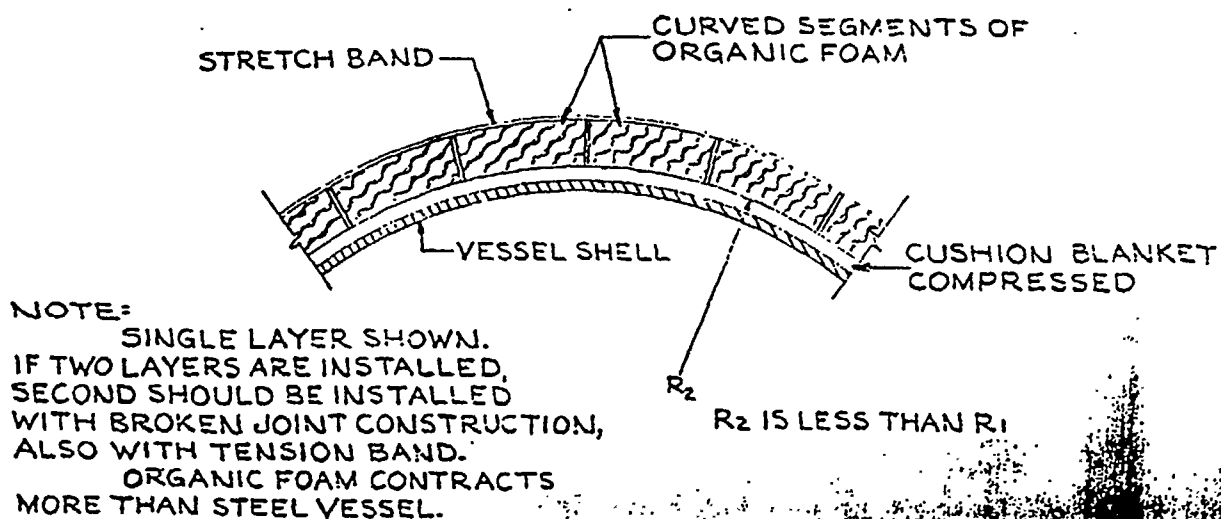
-GENERAL NOTES-

1. FOR INSULATION MATERIALS, THICKNESS, WEATHERPROOFING, MASTIC & BANDS, SEE SPECIFICATIONS.
2. FOR SERVICES WITH METAL TEMPERATURE 250° F. OR LOWER SET INSULATION IN MASTIC AS SHOWN.

METHOD OF INSTALLING ORGANIC FOAM ON LOW TEMPERATURE
VESSEL TO PROVIDE FOR CONTRACTION

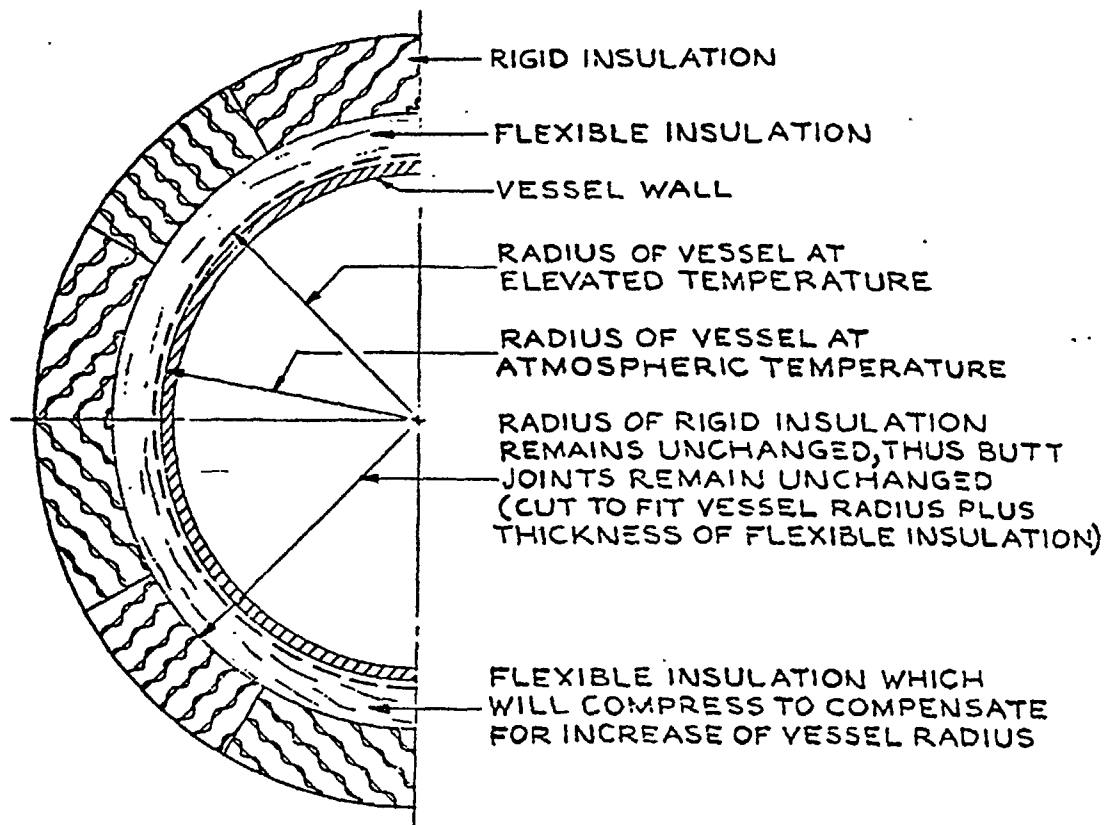


AFTER INSTALLATION, BUT BEFORE TEMPERATURE IS LOWERED

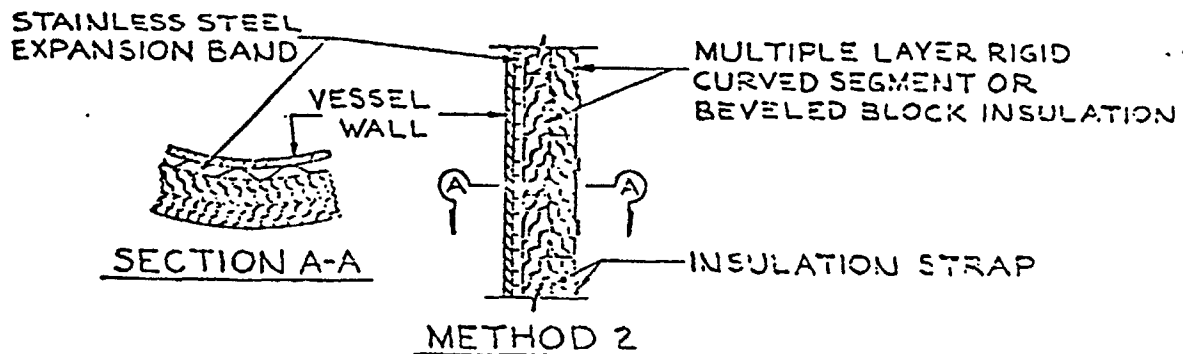
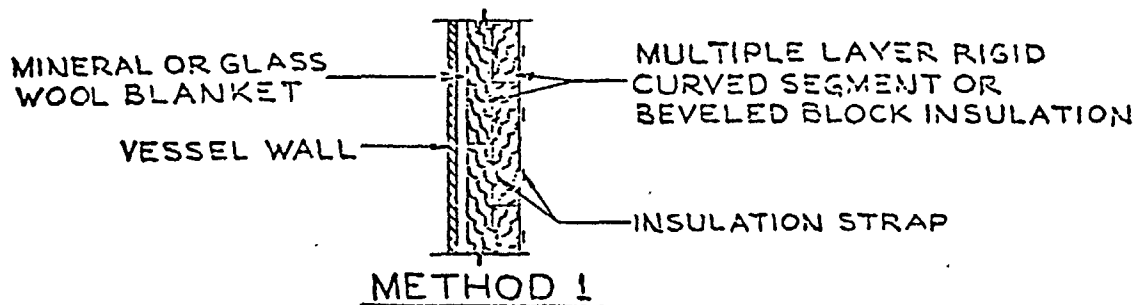


AFTER TEMPERATURE IS LOWERED

USE OF FLEXIBLE INSULATION IN COMBINATION WITH RIGID
INSULATION TO COMPENSATE FOR VESSEL EXPANSION



TWO METHODS USED TO PROVIDE FOR HIGH
TEMPERATURE VESSEL CYLINDRICAL EXPANSION



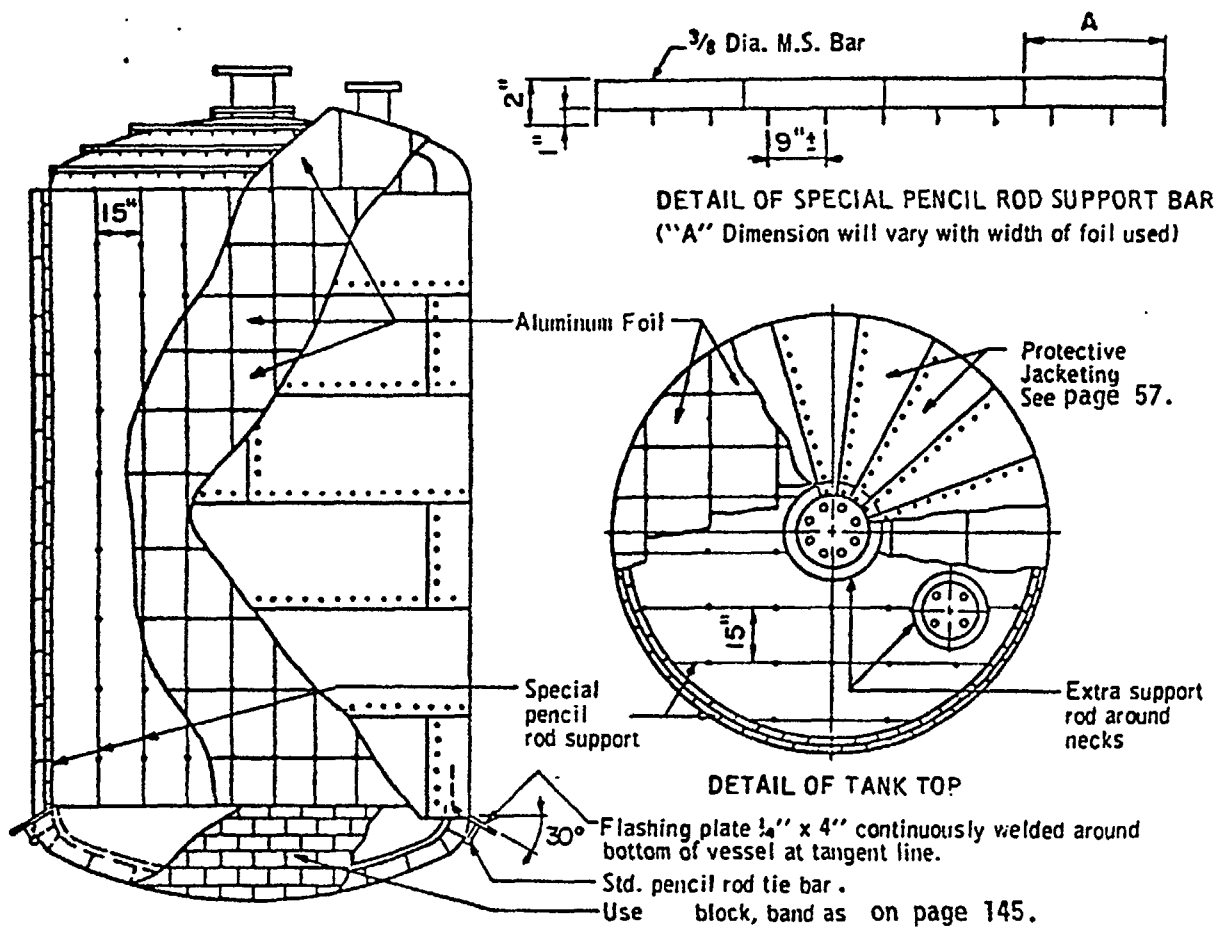
NOTE -

SINGLE LAYER INSTEAD OF MULTIPLE LAYER MAY BE USED IN METHODS SHOWN. CHOICE DEPENDS UPON TEMPERATURE AND SIZE OF VESSEL.

EXPANSION OF CYLINDRICAL VESSEL BASED ON 70°F AMBIENT		CYLINDRICAL DIMENSIONAL INCREASE IN INCHES DUE TO COEFFICIENT OF EXPANSION											
		CIRCUMFERENTIAL EXPANSION, IN.						DIAMETRAL EXPANSION, INCHES					
		5'	10'	15'	20'	30'	5'	10'	15'	20'	30'	5'	30'
OPERATING TEMP. OF VESSEL °F	METAL OF VESSEL	200	0.15	0.28	0.44	0.57	0.85	0.05	0.09	0.14	0.18	0.27	0.27
300		0.28	0.57	0.85	1.14	1.70	1.70	0.09	0.18	0.27	0.36	0.54	0.54
400		0.44	0.85	1.29	1.70	2.54	2.54	0.14	0.27	0.41	0.54	0.81	0.81
600	CARBON STEEL	0.72	1.44	2.17	2.79	4.33	4.33	0.23	0.46	0.69	0.92	1.38	1.38
800		1.07	2.10	3.17	4.21	5.98	5.98	0.34	0.67	1.01	1.34	1.91	1.91
1000		1.42	2.79	4.18	5.57	8.38	8.38	0.45	0.89	1.33	1.77	2.67	2.67
1200		1.75	3.49	5.24	6.93	10.47	10.47	0.56	1.11	1.67	2.22	3.33	3.33
1400		2.10	4.19	6.29	8.39	12.53	12.53	0.67	1.33	2.00	2.67	4.00	4.00
200	AUSTENITIC STAINLESS STEEL	0.22	0.44	0.66	0.85	1.24	1.24	0.07	0.14	0.21	0.28	0.42	0.42
300		0.41	0.82	1.22	1.63	2.45	2.45	0.13	0.26	0.39	0.52	0.78	0.78
400		0.60	1.19	1.63	2.39	3.53	3.53	0.19	0.38	0.52	0.76	1.14	1.14
600		1.01	1.95	2.92	3.90	5.83	5.83	0.32	0.62	0.93	1.24	1.86	1.86
800		1.38	2.76	4.14	5.53	8.29	8.29	0.44	0.88	1.32	1.76	2.64	2.64
1000		1.82	3.51	5.43	7.22	10.83	10.83	0.58	1.15	1.73	2.30	3.45	3.45
1200		2.23	4.47	6.70	8.93	13.40	13.40	0.71	1.42	2.13	2.84	4.26	4.26
1400		2.66	5.32	7.98	10.63	15.95	15.95	0.85	1.69	2.54	3.38	5.08	5.08
200	ALUMINUM	0.31	0.63	0.94	1.24	1.88	1.88	0.10	0.20	0.30	0.40	0.60	0.60
300		0.60	1.16	1.60	2.32	3.49	3.49	0.19	0.37	0.51	0.74	1.11	1.11
400		0.85	1.69	2.54	3.39	5.05	5.05	0.27	0.54	0.81	1.08	1.62	1.62
600		1.41	2.83	4.24	5.65	8.43	8.43	0.45	0.90	1.35	1.80	2.70	2.70
200	COPPER	0.25	0.47	0.72	0.94	1.41	1.41	0.08	0.15	0.23	0.30	0.45	0.45
300		0.44	0.85	1.29	1.69	2.54	2.54	0.14	0.27	0.41	0.54	0.81	0.81
400		0.63	1.22	1.85	2.45	4.63	4.63	0.20	0.39	0.59	0.78	1.47	1.47
600		1.01	2.01	3.01	4.02	6.03	6.03	0.32	0.64	0.96	1.28	1.92	1.92

TABLE 5.2

ALUMINUM FOIL ON VERTICAL VESSELS, 48" O.D. AND LARGER



APPLICATION

- 1.0 MATERIAL .002" to .0045" thick fully annealed pure aluminum foil in rolls, 12" to 14" wide.
- 2.0 BODY Weld special pencil rod support bars vertically around shell at approximately 15" centers, lining up the outer openings. Lace aluminum foil thru outer openings completely around circumference.
- 3.0 TOP HEAD Same as for body above. Use extra support bars around nozzle openings. See detail above.
- 4.0 BOTTOM HEAD Continuously weld 1/8" x 4" flashing plate all around bottom head as shown. Weld standard pencil rod to flashing plate. Use 1 1/2" thick block insulation stainless steel band

5.0 FINISH

Body - Protective Jacketing.
metal to flashing plate.

Extend sheet

Top Head - Apply protective jacketing fastened as above.
Extend protective jacketing down over protective jacketing
on body.

Bottom Head -

Indoor - Apply 1" hex galvanized wire netting
and cover with $\frac{1}{4}$ " hydraulic setting
insulating cement.

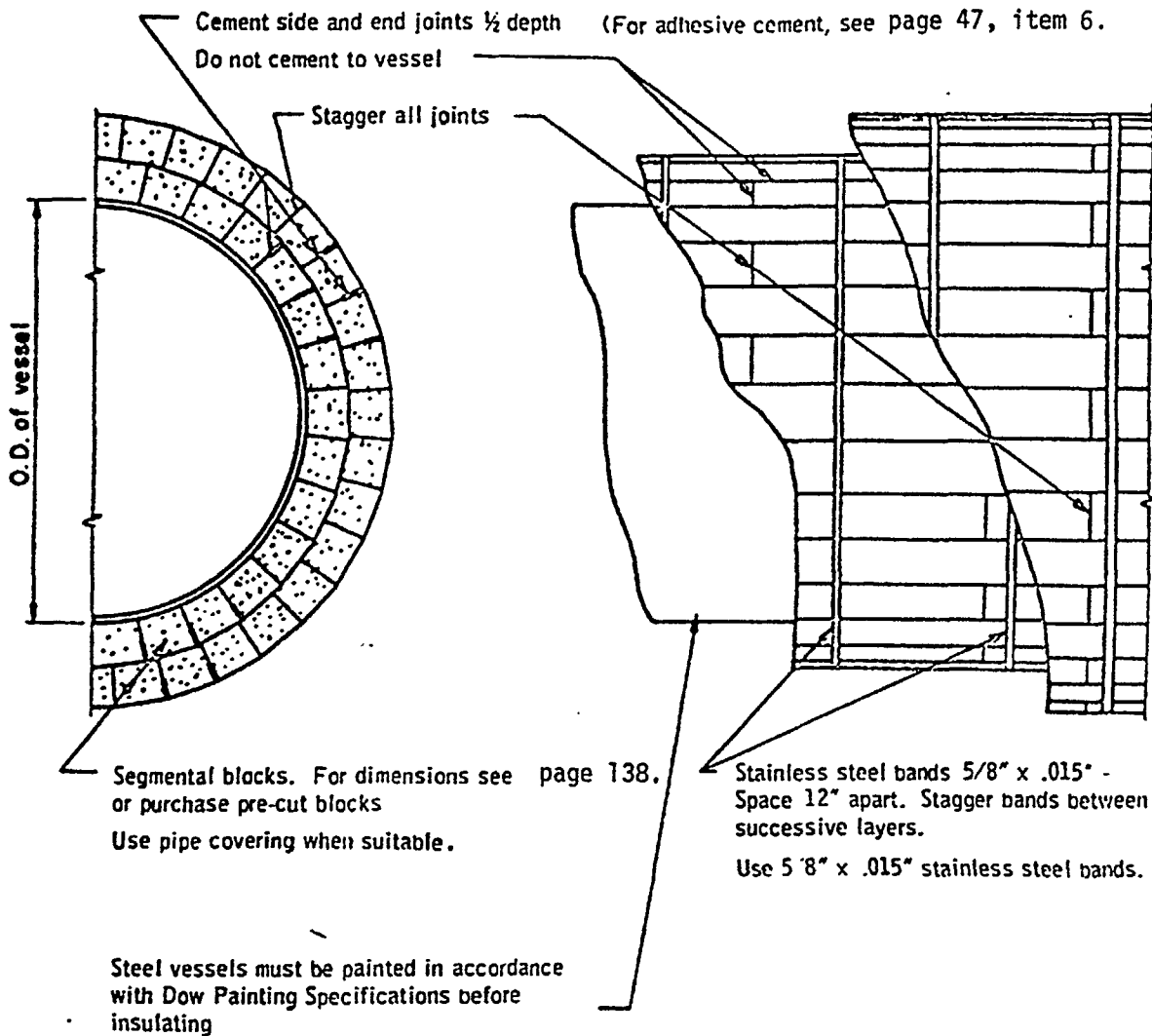
Weatherproof - Apply 1" hex mesh galvanized wire
netting and two $\frac{1}{8}$ " layers of asphalt
mastic emulsion.

6.0 NOTE: This method can be used on tanks to prevent auto-
ignition conditions resulting from product leaks or
spills. It should be used only with approval of
Plant Superintendent. This method has operated
on temperatures up to 360°F.

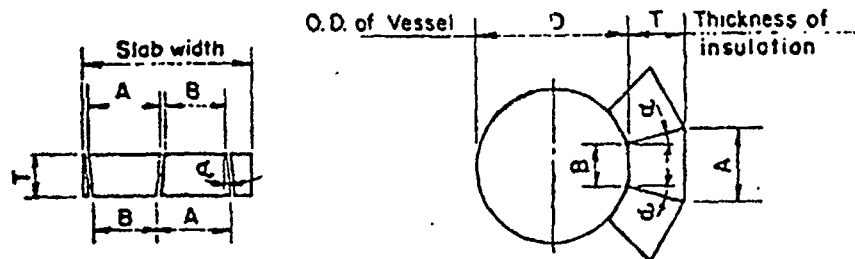
7.0 REFERENCE

See Auto Ignition, page 9.

APPLYING STYROFOAM[®] TO ROUND VESSELS, UP TO 12'0" O.D.



For ends of vessels, see pages 139 and 140.

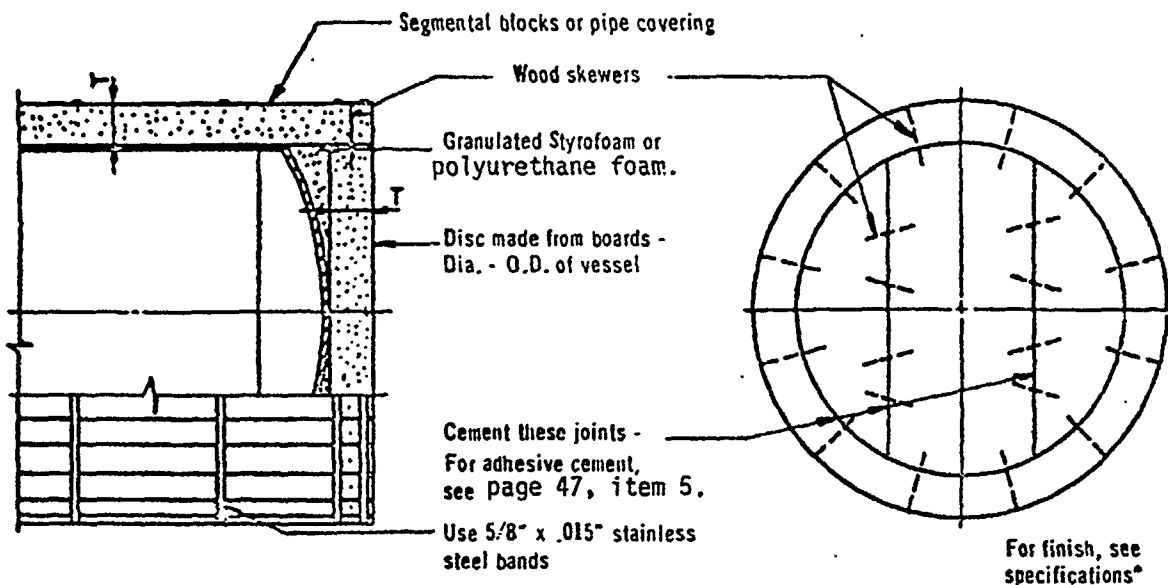


METHOD OF CUTTING SLABS

OUTSIDE DIAMETER FT. - IN.	NUMBER OF PIECES REQUIRED	α DEG. - MIN.	B INCHES	A IN INCHES FOR VARIOUS THICKNESSES			PIECES TO BE CUT FROM A SLAB THIS WIDE INCHES	NUMBER OF PIECES PER SLAB WIDTH
				WHEN T = 2"	WHEN T = 3"	WHEN T = 4"		
10'-0"	72	2° 30'	5 ⁵ / ₁₆	5 ¹ / ₂	5 ⁹ / ₁₆	5 ¹¹ / ₁₆	12	2
9'-6"	72	2° 30'	5 ¹ / ₁₆	5 ¹ / ₄	5 ¹¹ / ₃₂	5 ⁷ / ₁₆	12	2
9'-0"	72	2° 30'	4 ²⁵ / ₃₂	4 ³¹ / ₃₂	5 ¹ / ₁₆	5 ⁵ / ₃₂	12	2
8'-6"	60	3° 0'	5 ⁵ / ₁₆	5 ¹⁷ / ₃₂	5 ⁵ / ₈	5 ²³ / ₃₂	12	2
8'-0"	60	3° 0'	5	5 ⁷ / ₃₂	5 ⁵ / ₁₆	5 ¹³ / ₃₂	12	2
7'-6"	60	3° 0'	4 ¹¹ / ₁₆	4 ²⁹ / ₃₂	5	5 ¹ / ₃₂	12	2
7'-0"	52	3° 30'	5 ¹ / ₄	5 ¹ / ₂	5 ⁵ / ₈	5 ³ / ₄	12	2
6'-6"	45	4° 0'	5 ⁷ / ₁₆	5 ²⁷ / ₃₂	5 ⁷ / ₈	6	12	2
6'-0"	45	4° 0'	5 ¹ / ₁₆	5 ¹¹ / ₃₂	5 ¹ / ₂	5 ⁵ / ₈	12	2
5'-6"	45	4° 0'	4 ²¹ / ₃₂	4 ¹⁵ / ₁₆	5 ³ / ₃₂	5 ⁷ / ₃₂	12	2
5'-0"	40	4° 30'	4 ¹¹ / ₁₆	5	5 ⁵ / ₃₂	5 ⁵ / ₁₆	12	2
4'-6"	40	4° 30'	4 ⁷ / ₃₂	4 ¹⁷ / ₃₂	4 ¹¹ / ₁₆	4 ²⁷ / ₃₂	10	2
4'-2"	36	5° 0'	4 ⁷ / ₁₆	4 ²⁵ / ₃₂	4 ³¹ / ₃₂	5 ⁵ / ₃₂	12	2
4'-0"	36	5° 0'	4 ¹ / ₄	4 ¹⁹ / ₃₂	4 ²⁵ / ₃₂	4 ³¹ / ₃₂	10	2
3'-9"	36	5° 0'	4	4 ¹¹ / ₃₂	4 ¹⁷ / ₃₂	4 ²³ / ₃₂	10	2
3'-6"	40	4° 30'	3 ⁹ / ₃₂	3 ¹⁹ / ₃₂	3 ³ / ₄	3 ²⁹ / ₃₂	12	3
3'-2"	36	5° 0'	3 ³ / ₈	3 ²³ / ₃₂	3 ²⁹ / ₃₂	4 ³ / ₃₂	12	3
3'-0"	36	5° 0'	3 ³ / ₁₆	3 ¹⁷ / ₃₂	3 ²³ / ₃₂	3 ²⁹ / ₃₂	12	3
2'-10"	33	5° 30'	3 ¹ / ₄	3 ⁵ / ₈	3 ¹³ / ₁₆	4	12	3
2'-8"	30	6° 0'	3 ¹¹ / ₃₂	3 ³ / ₄	3 ³¹ / ₃₂	4 ⁵ / ₁₆	10	2
2'-6"	30	6° 0'	3 ¹ / ₈	3 ¹⁷ / ₃₂	3 ³ / ₄	3 ³¹ / ₃₂	12	3
2'-0"	26	7° 0'	2 ¹⁵ / ₁₆	3 ⁷ / ₁₆	3 ¹¹ / ₁₆	3 ¹⁵ / ₁₆	12	3
1'-8"	24	7° 30'	2 ¹⁹ / ₃₂	3 ¹ / ₈	3 ³ / ₈	3 ⁵ / ₈	12	3
1'-6"	23	8° 0'	2 ¹⁷ / ₃₂	3 ³ / ₃₂	3 ³ / ₈	3 ²¹ / ₃₂	12	3
1'-4"	22	8° 30'	2	2 ¹⁹ / ₃₂	3 ²⁹ / ₃₂	3 ⁷ / ₃₂	12	4
1'-2"	20	9° 0'	2 ⁷ / ₃₂	2 ²⁷ / ₃₂	3 ⁵ / ₃₂	3 ¹⁵ / ₃₂	10	3

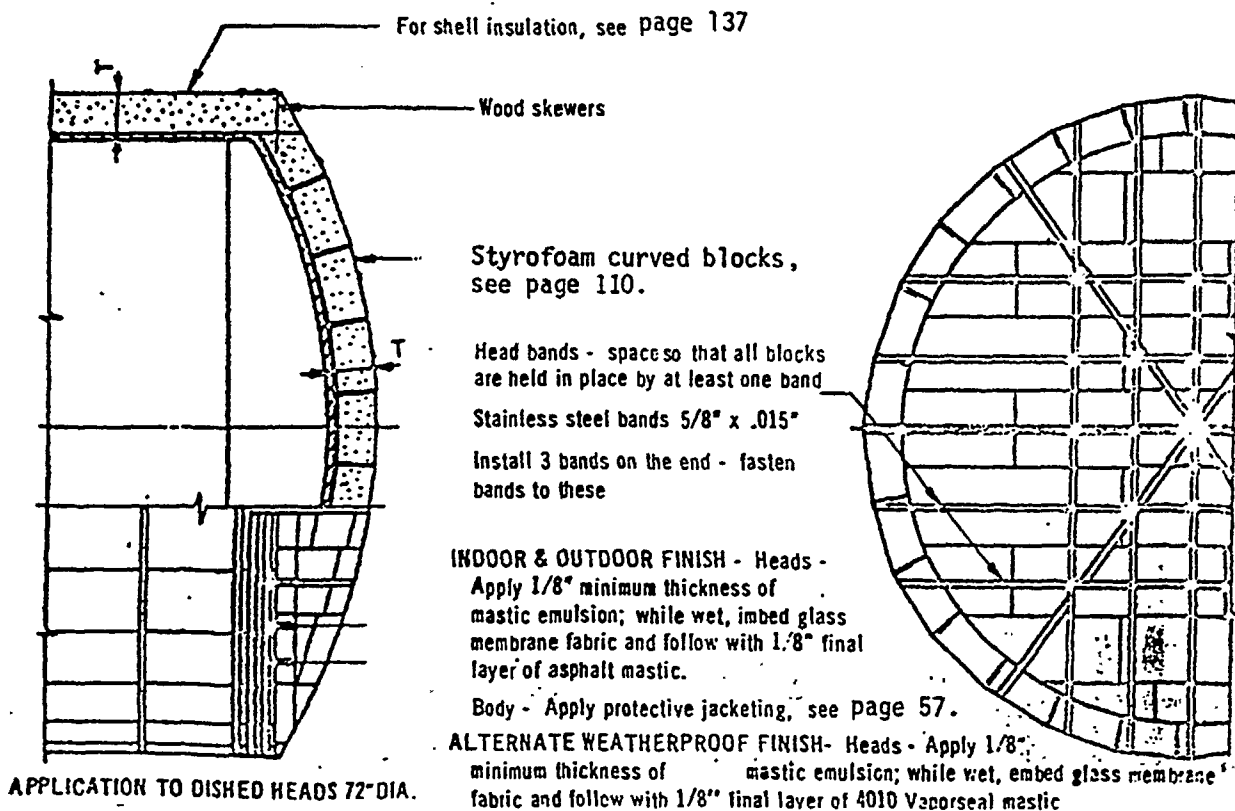
STYROFOAM SEGMENTAL BLOCKS

APPLYING STYROFOAM® TO DISHED HEADS



For finish, see specifications*

APPLICATION TO DISHED HEAD VESSELS UNDER 72" DIAMETER



INDOOR & OUTDOOR FINISH - Heads -

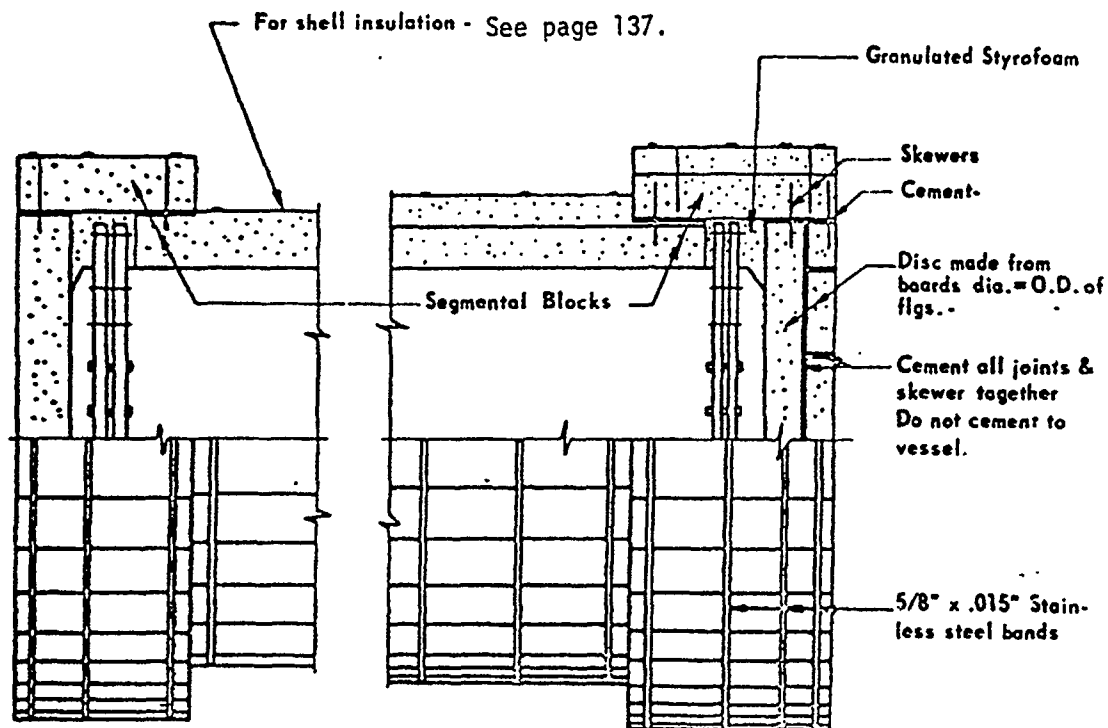
Apply 1/8" minimum thickness of mastic emulsion; while wet, embed glass membrane fabric and follow with 1/8" final layer of asphalt mastic.

Body - Apply protective jacketing, see page 57.

ALTERNATE WEATHERPROOF FINISH- Heads -

Apply 1/8" minimum thickness of mastic emulsion; while wet, embed glass membrane fabric and follow with 1/8" final layer of 4010 Vaporseal mastic

APPLYING STYROFOAM[®] TO FLANGED HEADS



NOTE: If head is dish and vessel is larger than 36" dia., use boards to cover heads.

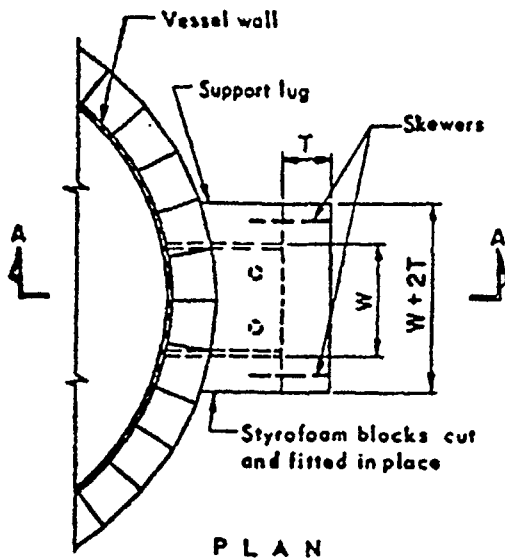
INDUOR AND OUTDOOR FINISH: Heads: apply 1/8" minimum thickness of asphalt mastic emulsion; while wet, embed glass membrane fabric and follow with 1/8" final layer of asphalt mastic.

Body: apply protective jacketing; See page 57.

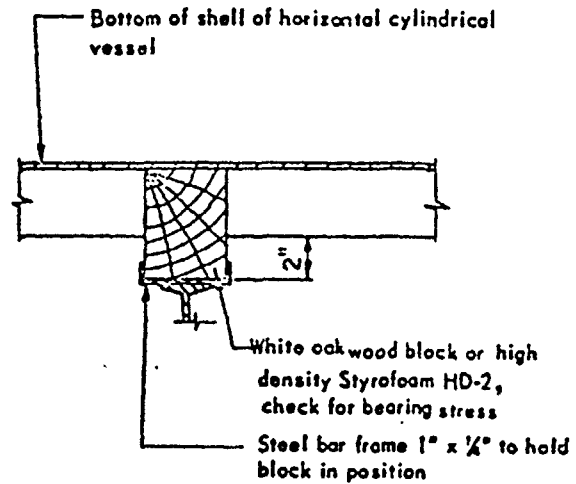
ALTERNATE - WEATHERPROOF FINISH: Heads: apply 1/8" minimum thickness of asphalt mastic emulsion; while wet, embed glass membrane fabric and follow with 1/8" final layer of 4010 vapor seal mastic.

Body: apply protective jacketing -

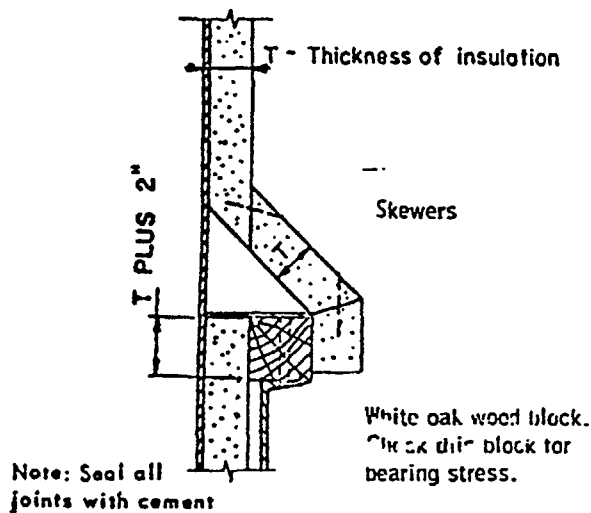
APPLYING STYROFOAM[®] TO VESSEL SUPPORTS



P L A N



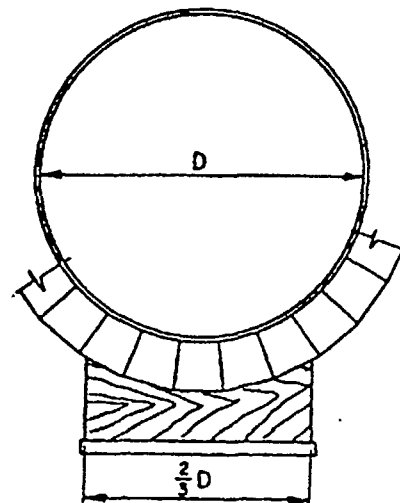
LONGITUDINAL SECTION THRU SUPPORT



SECTION A-A

APPLICATION TO SIDE SUPPORT

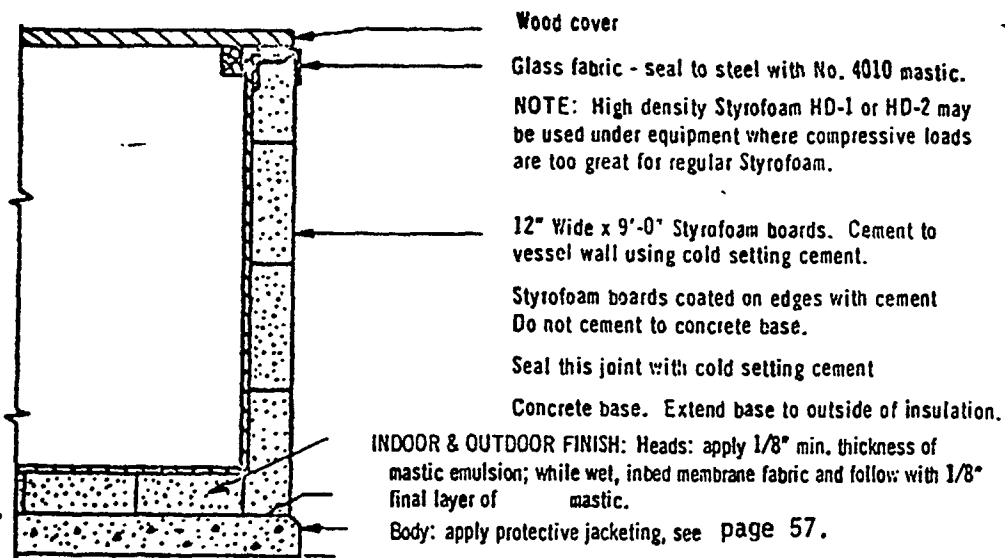
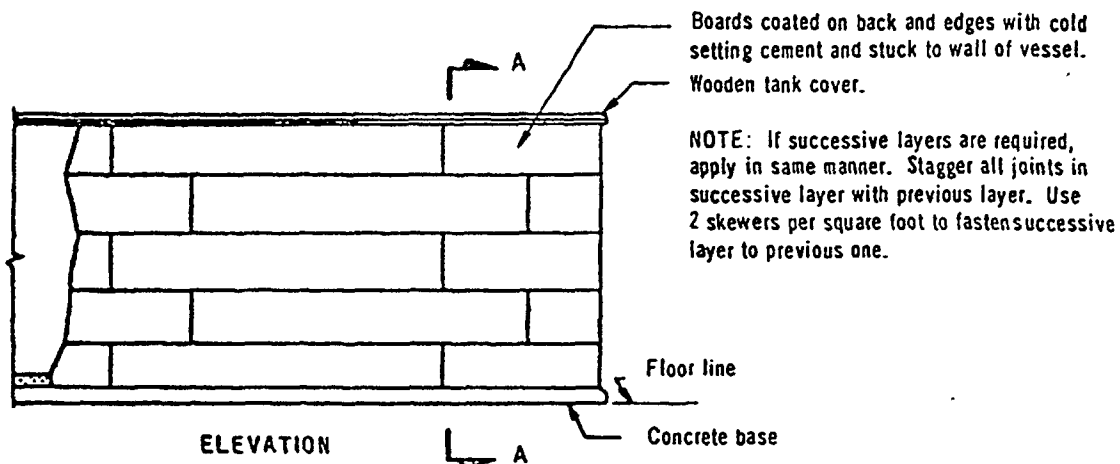
Note: High density Styrofoam HD-2 may be used in place of wood blocks. Allowable compressive strength — 60 psi



END VIEW OF SUPPORT

APPLICATION TO BOTTOM SUPPORT OF HORIZONTAL CYLINDRICAL VESSEL

APPLYING STYROFOAM® TO FLAT WALLED VESSELS



SECTION A-A

ALTERNATE: WEATHERPROOF FINISH: Heads: apply 1/8" min. thickness of asphalt mastic emulsion; while wet, embed glass membrane fabric and follow with 1/8" final layer of 4010 vapor seal mastic.

Body: apply protective jacketing.

ETHAFOAM[®] APPLICATION

1.0 APPLICATION:

1.1 BODY:

Use flat boards of expanded polyethylene with molding skin left on but with edges trimmed and squared. Wrap boards lengthwise around body with end joints staggered and fasten with stainless steel bands.

1 Layer - Band as shown in sketch on Page 144.

2 Layers - Stagger all joints and apply both layers together banding second layer only as shown on detail drawing.

Multiple Layers - Make application in multiples of two layers banding as per 2 layers above. If number of layers is odd, apply last layer as per 1 layer above.

1.2 FLAT HEADS:

Apply as indicated above using stainless steel bands, 3 per board width.

1.3 DISHED HEADS:

Apply first layer as shown on page 144. Second and successive layers to be installed same as first layer but rotated 45° from previous layer. Each layer to be fastened with 3 stainless steel bands per board width plus sufficient number of diagonal stainless steel bands to firmly secure the insulation to the heads.

1.4 SUPPORTS

Insulate around supports by methods shown on page 141 using HD-2 Styrofoam in place of wood blocks.

1.5 INDOOR FINISH:

1.51 None required. May be painted if desired.

1.52 Alternate when specified - cover body and head with one 1/8" wet layer of Insulmastic No. 4010 vapor barrier or other suitable mastic.

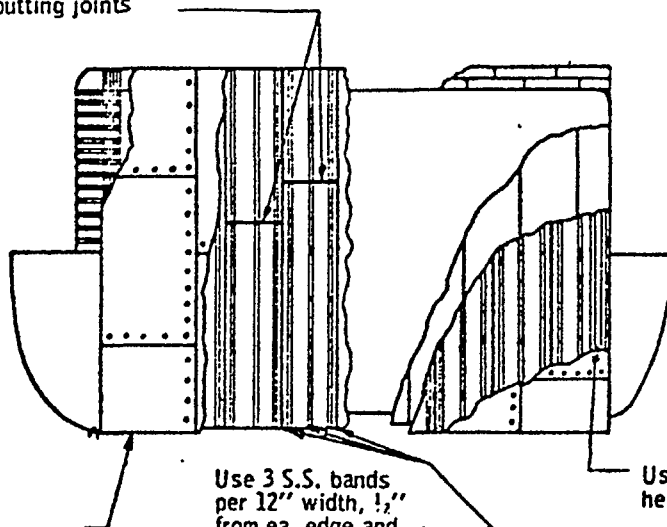
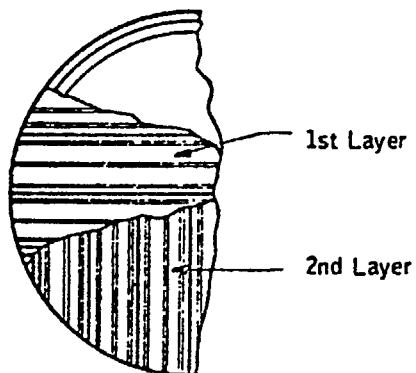
1.6 OUTDOOR FINISH:

1.61 Heads - Apply one 1/16" wet coat of Insulmastic No. 4010 reinforce with glass membrane fabric and apply second 1/8" coat of Insulmastic No. 4010 or other suitable mastic.

1.62 Body - Cover with Protective Jacketing. See page 142.

BANDING PATTERNS FOR EXPANDED POLYETHYLENE

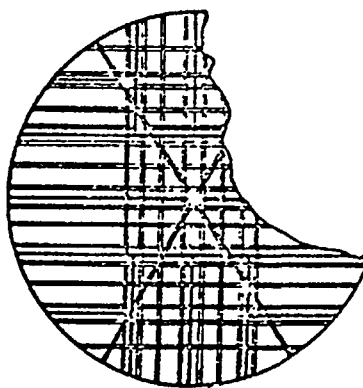
Miter & stagger butting joints

Protective Jacketing -
See page 57.Use 3 S.S. bands
per 12" width, $\frac{1}{2}$ "
from ea. edge and
one in centerUse 3 S.S. bands to secure
head bands.

1st Layer

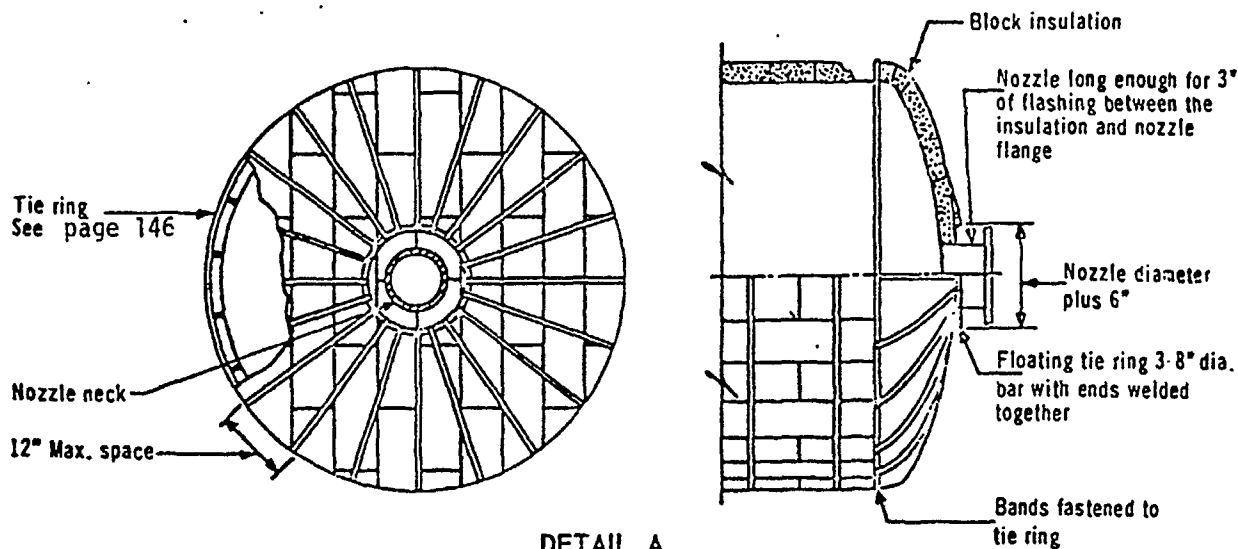
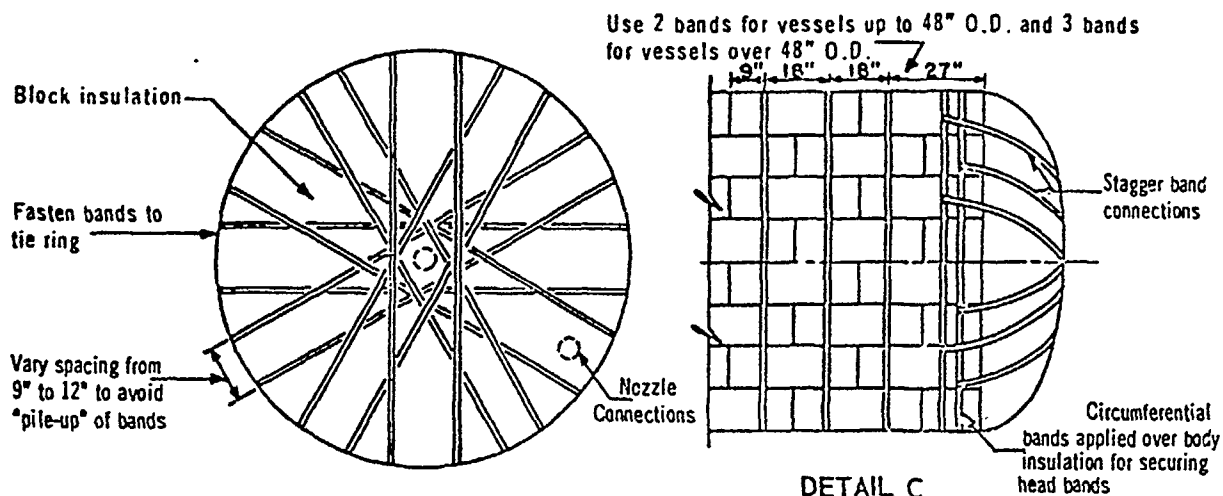
2nd Layer

FLAT HEAD



DISHED HEAD

BANDING PATTERN FOR BLOCK INSULATION

DETAIL ADETAIL BDETAIL C

NOTE: USE EITHER PATTERN AS SHOWN ABOVE

DETAIL A For heads 36" O.D. and larger with nozzle over 6" size.

DETAIL B For heads 36" O.D. and larger with or without nozzles up to 6" size.

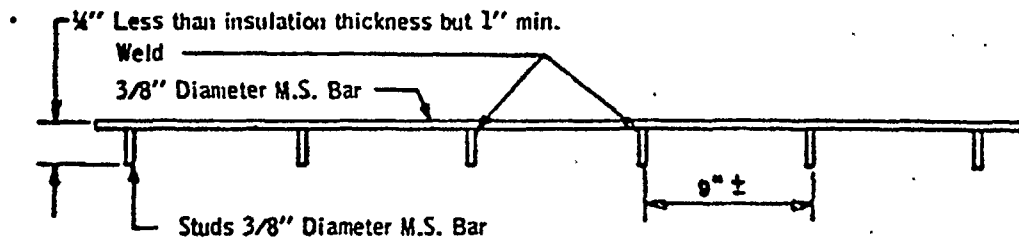
DETAIL C For vessels up to 35" O.D., or where welded or bolted tie ring cannot be used.

NOTE: ALL BANDING SHALL BE 5/8" X .015 STAINLESS STEEL.

ALL WIRE SHALL BE NO. 16 GAUGE MONEL OR COPPER.

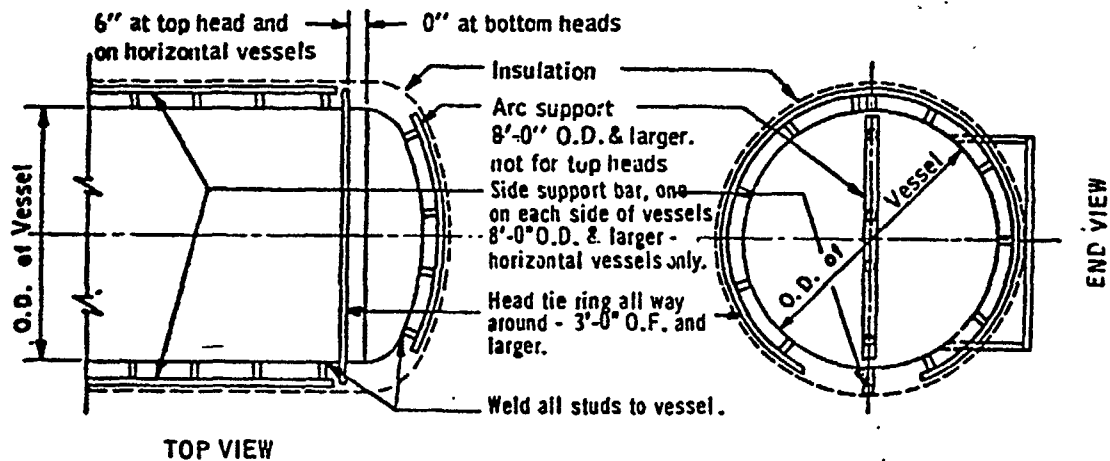
IN CASES WHERE BANDS CANNOT BE USED, MONEL WIRE MAY BE USED IF SPECIFIED OR APPROVED BY DOW REPRESENTATIVE.

INSULATION SUPPORT AND TIE RING, WELDING DETAILS



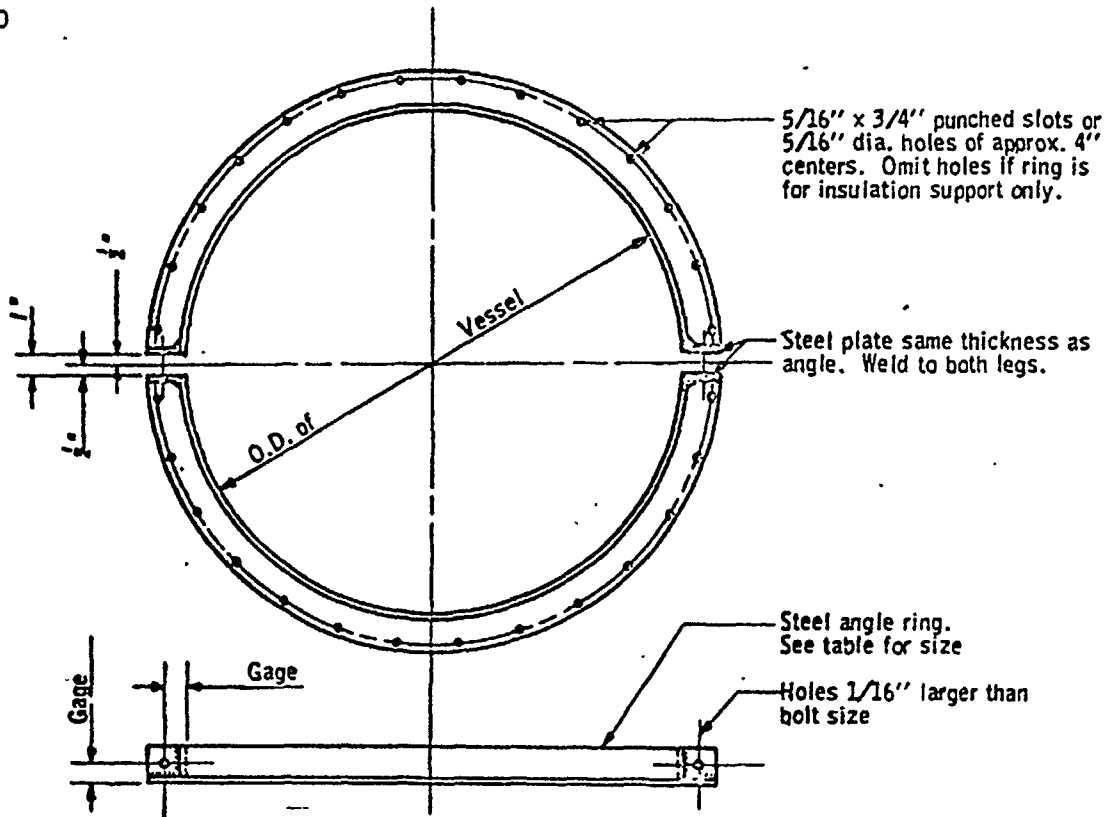
DETAIL OF PENCIL ROD SUPPORT AND TIE BAR

May be stocked in straight lengths for field installation.

SHOWING TYPICAL APPLICATION OF PENCIL ROD

SUPPORT AND TIE RING FOR INSULATION
ON LINED OR ALLOY VESSELS

1.0



Insulation Thickness	Size of Angle	Gage	Bolt Size
1"	1" x 1" x 1/8"	3/8"	5/16"
1 1/2"	1 1/4" x 1 1/4" x 3/16"	3/4"	3/8"
2"	1 1/2" x 1 1/2" x 3/16"	7/8"	1/2"
2 1/2"	2" x 2" x 1/4"	1 1/8"	1/2"
3"	2 1/2" x 2 1/2" x 1/4"	1 3/8"	3/4"
3 1/2"	3" x 3" x 1/4"	1 1/2"	3/4"

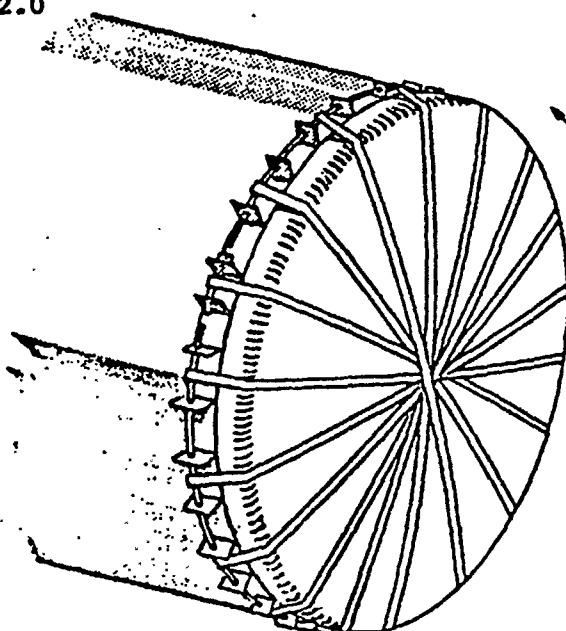
Note:

For vessels over 8'-0" dia.
make ring in 3 equal parts.

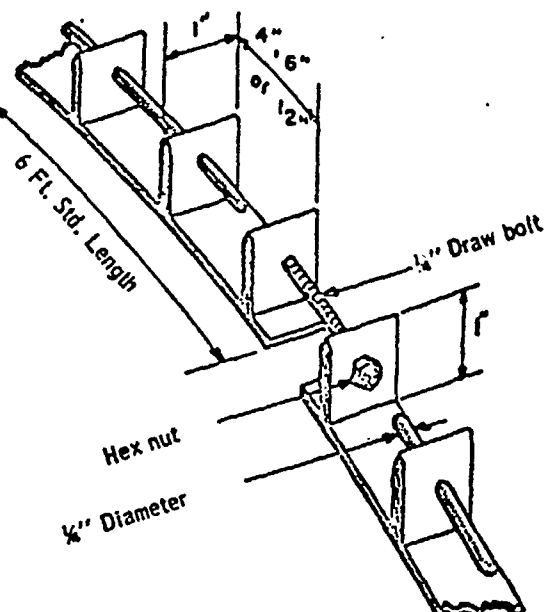
Notes:

1. To be used for insulation support on vertical vessels or for tie ring adjacent to dished heads, when welded type ring cannot be used.
2. For welded on support and tie ring see page 147

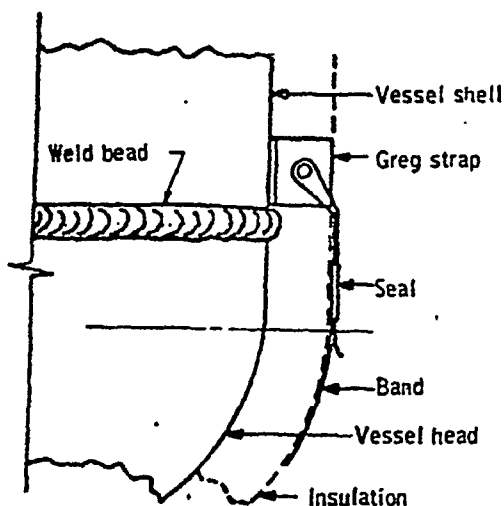
2.0



APPLICATION TO DISHED HEAD



DETAIL OF "GREG STRAP"

POSITION OF STRAP
With Respect to Weld Bead

DESCRIPTION

"Greg Strap" is manufactured of mild steel by Greg Manufacturing Co., 4947 S. Flajole Road, Midland, Mich. It is flexible, easily cut and can be bent by hand.

USES

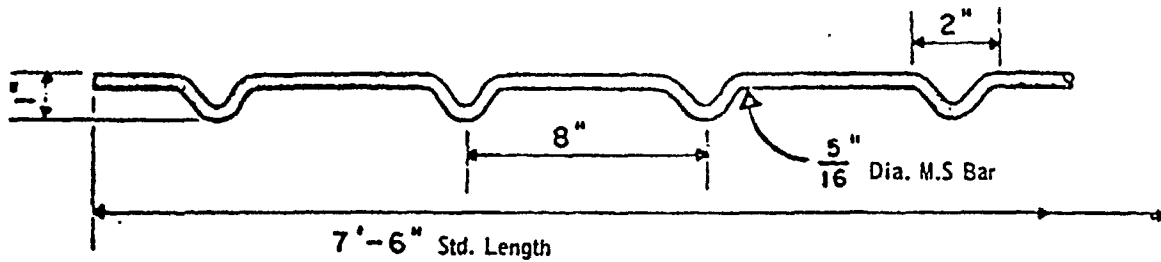
1. Head tie ring on horizontal and vertical vessels when welded ring is not provided.
2. For lined vessels or in hazardous areas where welding cannot be done.
3. May be used on flat surfaces by tack welding at close intervals.
4. Welded support and tie ring, See page 146.

ST0000859

page 149

3.0

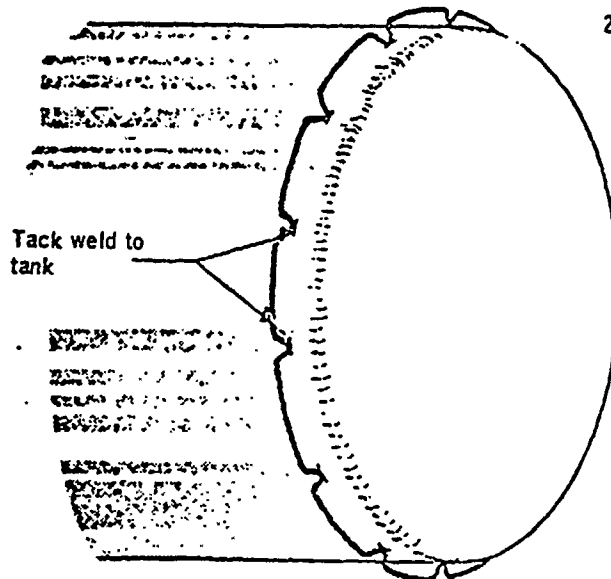
GREG MANUFACTURING COMPANY
4947 FLAJOLE ROAD
MIDLAND, MICHIGAN



DETAIL OF GREG SUPPORT AND TIE BAR

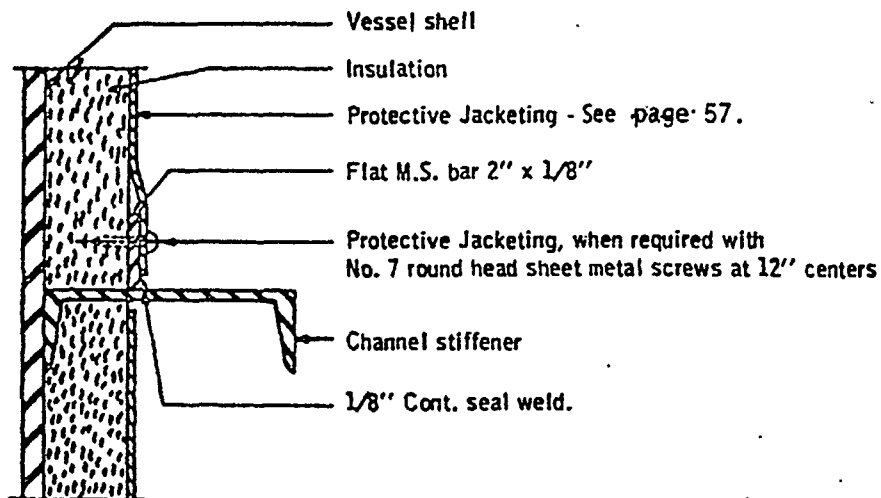
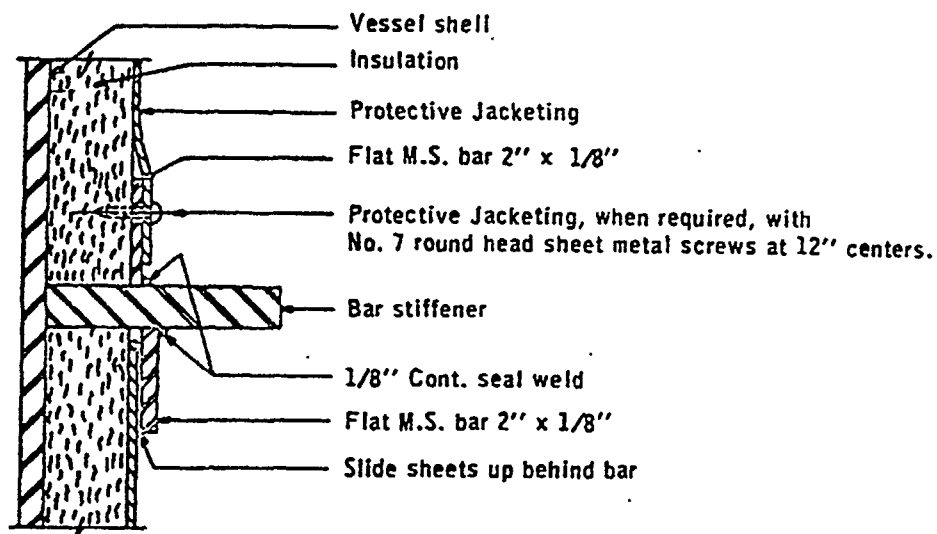
USES

1. Head tie ring on horizontal and vertical vessels.
2. May be used on flat surfaces by tack welding at contact points.

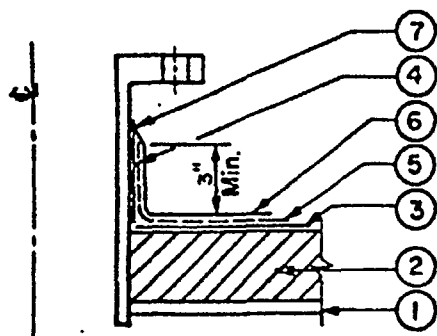


APPLICATION TO DISHED HEAD

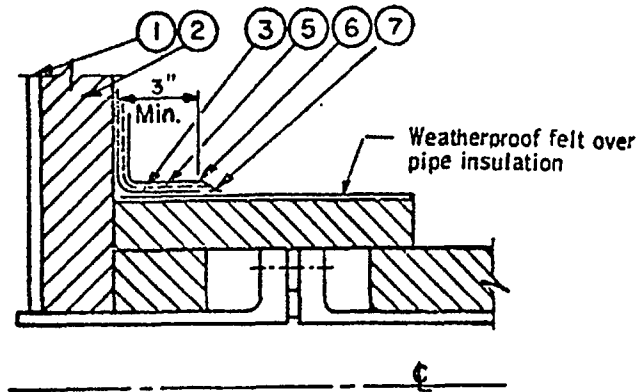
WEATHER SEAL AT RINGS ON VESSELS

DETAIL "A"VESSEL WITH CHANNEL STIFFENERDETAIL "B"VESSEL WITH FLAT BAR STIFFENER

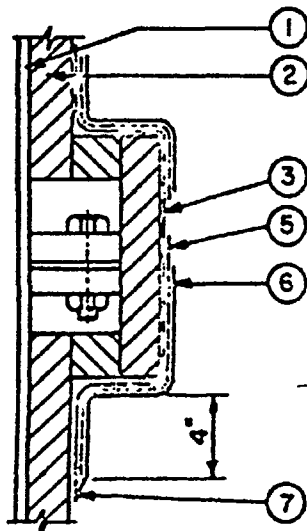
FLASHING DETAILS

DETAIL A

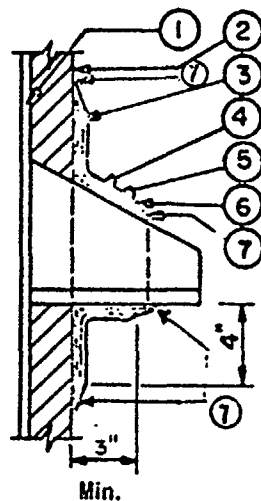
Nozzle not insulated

DETAIL B

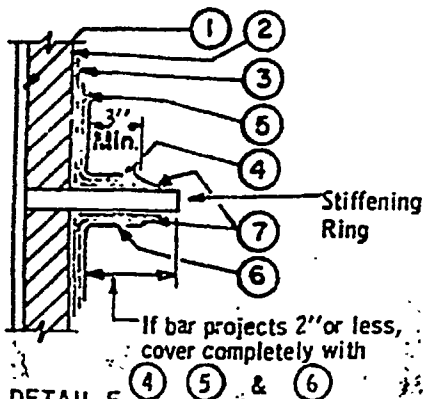
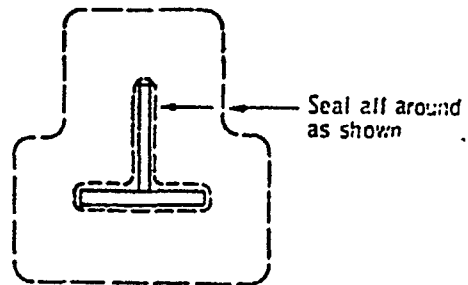
Insulated Nozzle

DETAIL C

Insulated Body Flange

DETAIL D

For Support lugs, platform brackets

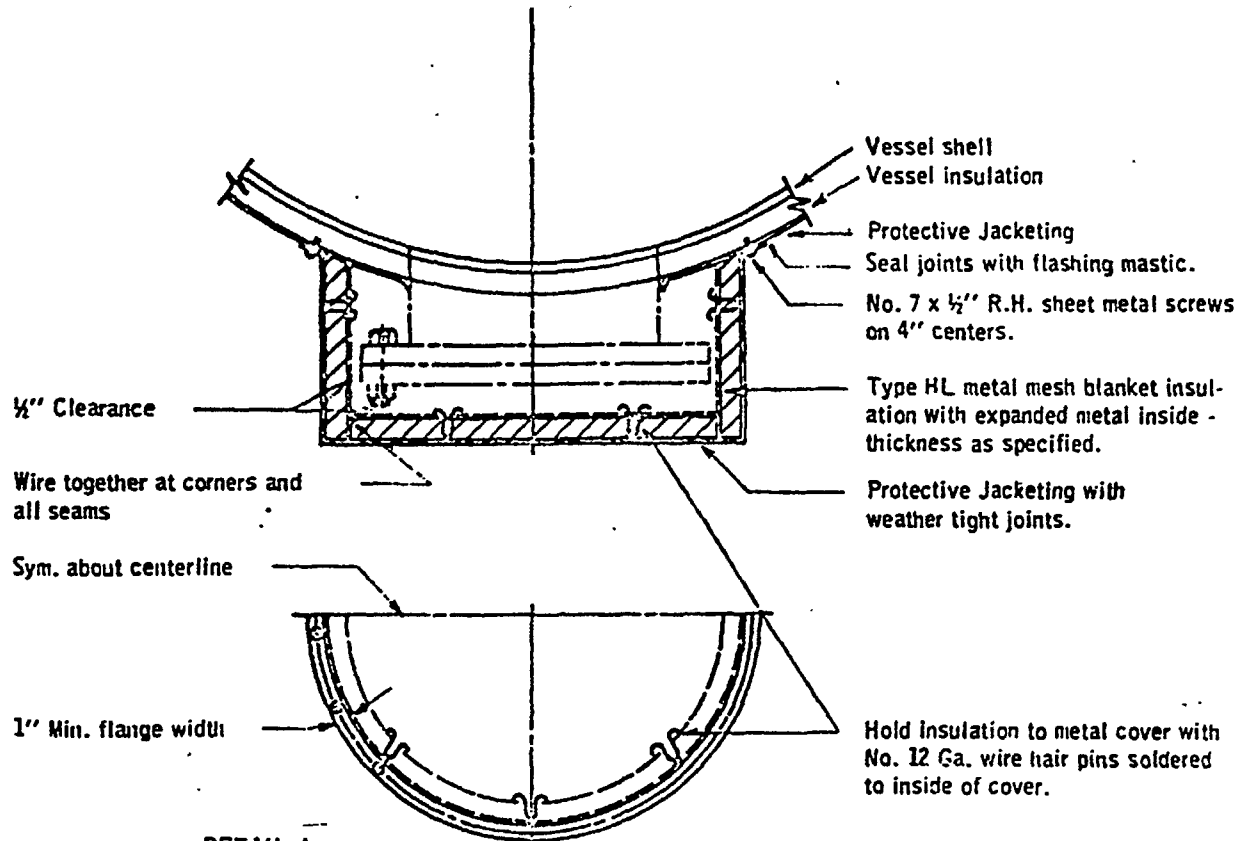
DETAIL E

Stiffening Ring

LEGEND

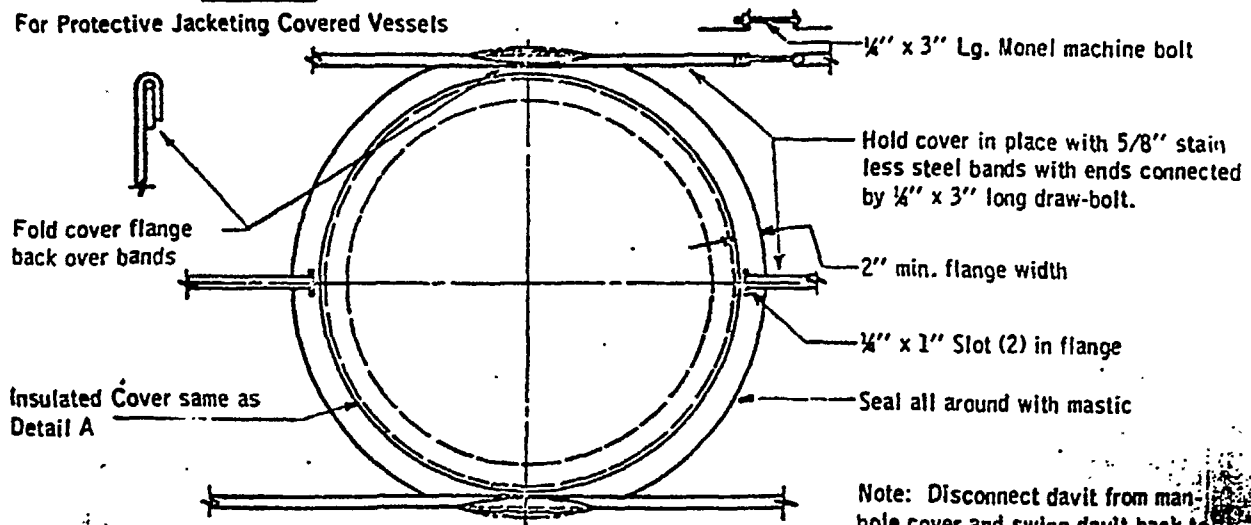
- ① Vessel wall
- ② Vessel insulation
- ③ First coat of weatherproofing vaporseal mastic
- ④ Prime metal with priming mastic
- ⑤ Glass membrane fabric
- ⑥ Final Vaporseal mastic coat
- ⑦ Feather edge of vaporseal mastic

REMOVABLE INSULATED COVERS



DETAIL A

For Protective Jacketing Covered Vessels



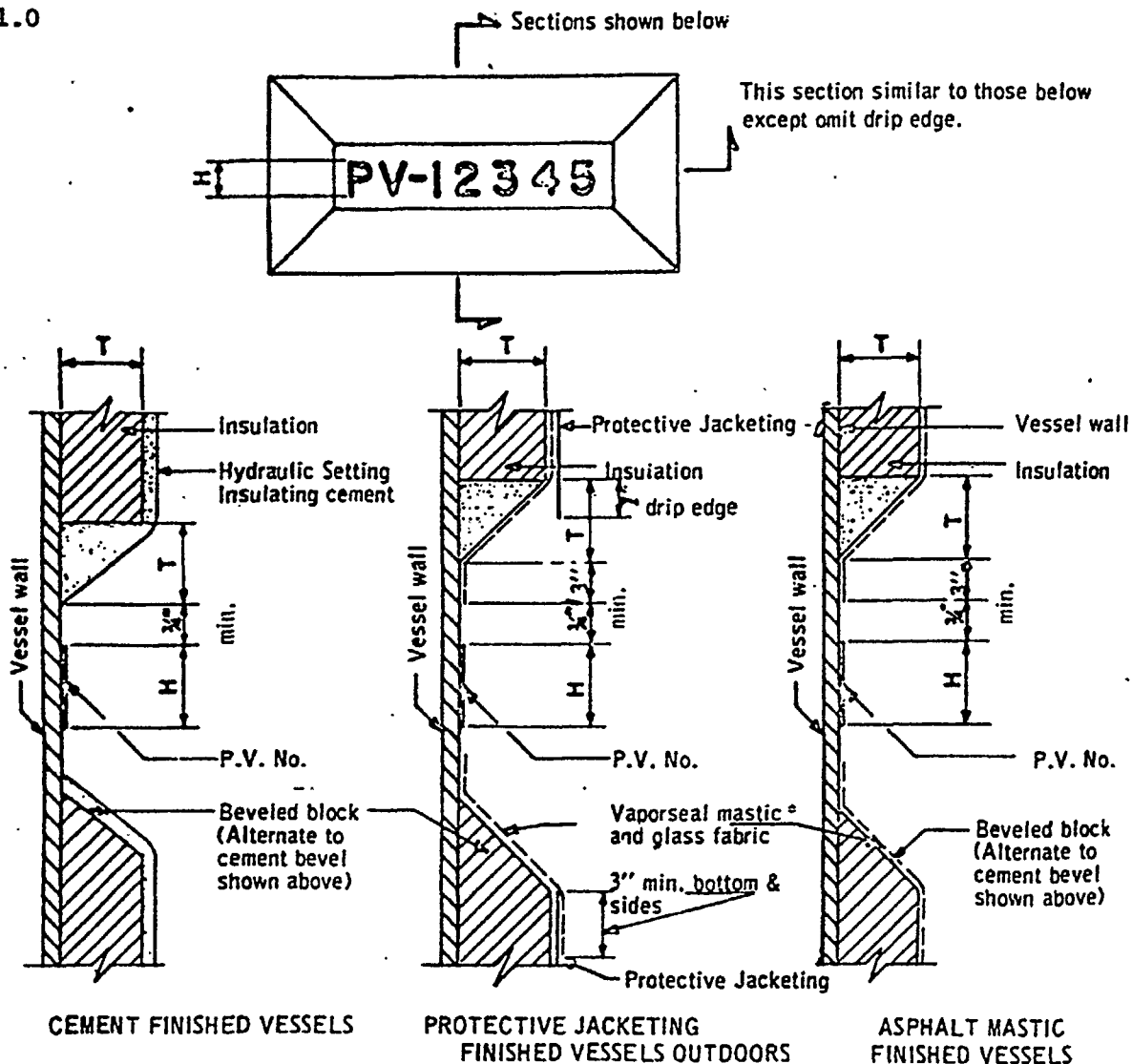
DETAIL B

For Mastic Covered Vessels

Note: Disconnect davit from man-hole cover and swing davit back to clear insulated cover.

PRESSURE VESSEL NUMBERS, OPENINGS OR BRACKET

1.0



(Omit drip edge & flashing mastic on indoor finish)

*For flashing over bevel and onto bare vessel and onto Protective Jacketing.

Vaporseal mastic shall be applied in two 1/8" coats with glass fabric between.

Use No. 4010 vaporseal mastic for vessel temperatures up to 250 degrees Fahrenheit.

Use Eagle-Picher "Stalastic", High Temp. Grade for temperatures over 250 to 500 degrees Fahrenheit.

H = Height of P.V. Numerals

T = Thickness of insulation

2.0

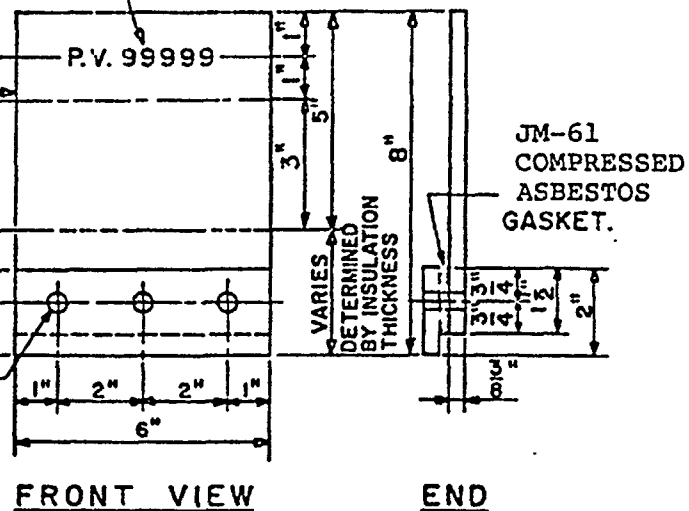
STAMP $\frac{1}{2}$ " HIGH NUMERALS
ON BRACKET.

M.S. PLATE
FOR INSTALLATION
SEE DETAIL BELOW.

FEATHER EDGE OF
FLASHING -

OUTSIDE FACE OF
INSULATION.

$\frac{7}{16}$ " DIA. B.H.



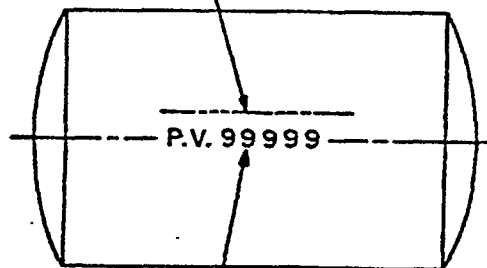
DETAIL OF BRACKET

SCALE: 3" = 1'-0"

NOTE:

FABRICATE AND COMPLETELY ASSEMBLE BRACKET.
AFTER COMPLETION DISASSEMBLE AND FASTEN TO OR
PUT INSIDE THE VESSEL IN SUCH A MANNER THAT THE
DISASSEMBLED PIECE WILL NOT BECOME LOST.

BRACKET - WELD TO UNIT
ADJACENT TO P.V. No.



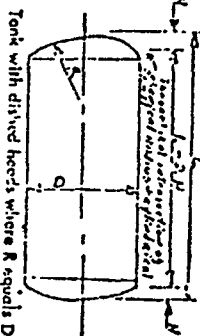
DEPOSIT DOW PRESSURE VESSEL
NUMBER IN $\frac{1}{8}$ " WELD BEAD IN $\frac{1}{2}$ "
HIGH NUMERALS ON VESSEL.

ST0000865

Area of dished head equals $\frac{2\pi R^2}{3}$
 Area of flat head equals $0.7854 D^2$
 Area per lin. ft. equals πR

AREAS OF TANKS
 FOR INSULATION COVERAGE

D equals diameter in feet
 R equals head radius in feet
 H equals 1.60D; R equals 1.605D



Tank with dished heads where R equals D

Tank Diame- ter ft.	Dished Head Area Sq. Ft.	Flat Head Area Sq. Ft.	Area Per L.F. of Cyl. Sq. Ft.	"H" Dimen- sion Inches
1'-0"	.04	.79	3.14	1.61
1'-1"	.09	.92	3.40	1.75
1'-2"	1.14	1.07	3.66	1.88
1'-3"	1.32	1.23	3.93	2.01
1'-4"	1.50	1.40	4.19	2.15
1'-5"	1.69	1.53	4.45	2.28
1'-6"	1.89	1.77	4.71	2.41
1'-7"	2.11	1.97	4.97	2.54
1'-8"	2.34	2.10	5.23	2.68
1'-9"	2.58	2.24	5.50	2.81
1'-10"	2.87	2.41	5.76	2.95
1'-11"	3.07	2.87	6.02	3.08
2'-0"	3.37	3.14	6.28	3.22
2'-1"	3.65	3.41	6.54	3.35
2'-2"	3.95	3.69	6.81	3.48
2'-3"	4.25	3.98	7.07	3.61
2'-4"	4.57	4.20	7.33	3.75
2'-5"	4.91	4.51	7.59	3.88
2'-6"	5.21	4.91	7.85	4.02
2'-7"	5.51	5.24	8.11	4.15
2'-8"	5.80	5.50	8.37	4.29
2'-9"	6.36	5.94	8.64	4.42
2'-10"	6.74	6.31	8.90	4.55
2'-11"	7.15	6.68	9.17	4.68

Tank Diame- ter ft.	Dished Head Area Sq. Ft.	Flat Head Area Sq. Ft.	Area Per L.F. of Cyl. Sq. Ft.	"H" Dimen- sion Inches
3'-0"	7.56	7.07	9.43	4.82
3'-1"	8.00	7.47	9.69	4.96
3'-2"	8.43	7.83	9.95	5.09
3'-3"	8.87	8.20	10.21	5.22
3'-4"	9.32	8.73	10.47	5.35
3'-5"	9.81	9.17	10.73	5.49
3'-6"	10.30	9.62	11.00	5.62
3'-7"	10.77	10.01	11.26	5.75
3'-8"	11.32	10.56	11.52	5.89
3'-9"	11.82	11.05	11.73	6.02
3'-10"	12.34	11.54	12.04	6.16
3'-11"	12.92	12.05	12.30	6.30
4'-0"	13.45	12.57	12.57	6.44
4'-1"	14.03	13.07	12.83	6.57
4'-2"	14.60	13.47	13.09	6.71
4'-3"	15.19	14.10	13.35	6.83
4'-4"	15.78	14.73	13.61	6.96
4'-5"	16.37	15.32	13.83	7.09
4'-6"	16.95	15.90	14.14	7.22
4'-7"	17.44	16.50	14.40	7.36
4'-8"	18.32	17.11	14.66	7.50
4'-9"	19.63	17.72	14.92	7.63
4'-10"	19.93	18.35	15.10	7.77
4'-11"	20.35	18.97	15.44	7.91

Tank Diame- ter ft.	Dished Head Area Sq. Ft.	Flat Head Area Sq. Ft.	Area Per L.F. of Cyl. Sq. Ft.	"H" Dimen- sion Inches
5'-0"	21.10	19.64	15.71	8.04
5'-1"	21.74	20.30	15.97	8.17
5'-2"	22.40	20.97	16.23	8.30
5'-3"	23.17	21.65	16.49	8.44
5'-4"	23.93	22.34	16.76	8.57
5'-5"	24.68	23.05	17.02	8.70
5'-6"	25.50	23.76	17.28	8.84
5'-7"	26.10	24.42	17.54	8.98
5'-8"	27.60	25.22	17.80	9.11
5'-9"	27.82	25.97	18.05	9.25
5'-10"	28.66	26.73	18.33	9.38
5'-11"	29.49	27.49	18.59	9.52
6'-0"	30.26	28.27	18.85	9.64
6'-1"	31.13	29.07	19.11	9.78
6'-2"	32.03	29.87	19.37	9.92
6'-3"	32.93	30.68	19.64	10.06
6'-4"	33.77	31.49	19.90	10.20
6'-5"	34.67	32.29	20.16	10.33
6'-6"	35.60	33.17	20.42	10.47
6'-7"	36.59	34.04	20.68	10.60
6'-8"	37.43	34.91	20.95	10.73
6'-9"	38.37	35.79	21.21	10.86
6'-10"	39.28	36.67	21.47	10.99
6'-11"	40.29	37.50	21.73	11.12

TABLE 5.4

AREAS OF TANKS FOR INSULATION COVERAGE

AREAS									
Tank Diameter Feet	Dished Head Area Sq. Ft.	Flat Head Area Sq. Ft.	Area Per L.F. of Cyl. Sq. Ft.	"H" Dimension Inches	Tank Diameter Feet	Dished Head Area Sq. Ft.	Flat Head Area Sq. Ft.	Area Per L.F. of Cyl. Sq. Ft.	"H" Dimension Inches
7'-0"	41.30	39.49	21.97	11.25	10'-0"	84.15	79.54	31.42	16.00
7'-1"	42.20	39.41	22.25	11.39	10'-1"	85.54	79.85	31.63	16.21
7'-2"	43.21	40.34	22.51	11.52	10'-2"	86.96	81.18	31.94	16.34
7'-3"	44.25	41.28	22.78	11.66	10'-3"	88.37	82.52	32.20	16.49
7'-4"	45.26	42.24	23.04	11.80	10'-4"	89.73	83.86	32.46	16.61
7'-5"	46.33	43.20	23.30	11.93	10'-5"	91.26	85.22	32.73	16.74
7'-6"	47.50	44.16	23.55	12.05	10'-6"	92.71	86.59	32.99	16.87
7'-7"	48.37	45.16	23.82	12.19	10'-7"	94.15	87.97	33.25	17.01
7'-8"	49.46	46.16	24.09	12.32	10'-8"	95.60	89.35	33.51	17.14
7'-9"	50.26	47.17	24.35	12.45	10'-9"	97.22	90.76	33.77	17.27
7'-10"	51.63	48.19	24.61	12.60	10'-10"	98.69	92.11	34.03	17.40
7'-11"	52.76	49.22	24.87	12.73	10'-11"	100.26	93.60	34.30	17.53
8'-0"	53.85	50.27	25.13	12.86	11'-0"	101.89	95.03	34.56	17.68
8'-1"	54.96	51.32	25.39	13.00	11'-1"	96.48	96.48	34.82	17.81
8'-2"	56.15	52.41	25.66	13.13	11'-2"	97.93	97.93	35.08	17.95
8'-3"	57.31	53.46	25.92	13.27	11'-3"	99.40	99.40	35.34	18.09
8'-4"	58.45	54.54	26.19	13.40	11'-4"	100.88	100.88	35.60	18.23
8'-5"	59.64	55.64	26.46	13.53	11'-5"	102.37	102.37	35.87	18.37
8'-6"	60.65	56.75	26.70	13.65	11'-6"	103.87	103.87	36.13	18.51
8'-7"	61.86	57.89	26.97	13.80	11'-7"	105.38	105.38	36.39	18.65
8'-8"	63.24	58.99	27.23	13.93	11'-8"	106.90	106.90	36.65	18.79
8'-9"	64.34	60.13	27.49	14.05	11'-9"	108.43	108.43	36.91	18.93
8'-10"	65.50	61.28	27.75	14.20	11'-10"	109.98	109.98	37.18	19.07
8'-11"	66.63	62.45	28.01	14.33	11'-11"	111.53	111.53	37.44	19.21
9'-0"	63.10	63.62	28.27	14.46	12'-0"	113.10	113.10	37.70	19.35
9'-1"	69.33	64.80	28.54	14.59	12'-1"	114.67	114.67	37.96	19.49
9'-2"	70.65	66.00	28.80	14.72	12'-2"	116.25	116.25	38.22	19.63
9'-3"	71.87	67.20	29.06	14.86	12'-3"	117.85	117.85	38.48	19.77
9'-4"	73.22	68.42	29.32	15.00	12'-4"	119.47	119.47	38.75	19.91
9'-5"	74.61	69.64	29.58	15.13	12'-5"	121.09	121.09	39.01	20.05
9'-6"	76.00	70.88	29.83	15.25	12'-6"	122.71	122.71	39.27	20.19
9'-7"	77.14	72.13	30.11	15.40	12'-7"	124.36	124.36	39.53	20.33
9'-8"	78.61	73.39	30.37	15.52	12'-8"	126.01	126.01	39.79	20.47
9'-9"	79.55	74.65	30.63	15.67	12'-9"	127.67	127.67	40.05	20.61
9'-10"	81.37	75.94	30.89	15.80	12'-10"	129.35	129.35	40.32	20.75
9'-11"	82.81	77.93	31.15	15.95	12'-11"	131.04	131.04	40.59	20.89

TABLE 5.4 (Continued)

AREAS AND VOLUMES - SPHERES

Diameter	Surface Area in Sq. Ft.	Volume in Cu. Ft.	Total Capacity in Gallons	Diameter	Surface Area in Sq. Ft.	Volume in Cu. Ft.	Total Capacity in Gallons
0'-6"	.7854	.0654	.4352	29'-0"	2542.1	12770.0	95500
1'-0"	3.1416	.5234	3.917	29'-6"	2734.0	13442.0	100000
1'-6"	7.0685	1.7671	13.22	30'-0"	2827.4	14127.0	105700
2'-0"	12.566	4.1888	31.33	30'-6"	2922.5	14856.0	111100
2'-6"	19.635	8.1812	61.20	31'-0"	3019.1	15599.0	116600
3'-0"	28.274	14.137	105.8	31'-6"	3117.2	16356.0	122100
3'-6"	33.495	22.449	167.9	32'-0"	3217.0	17137.0	127600
4'-0"	50.265	33.510	253.7	32'-6"	3318.3	17941.0	133100
4'-6"	63.617	47.713	356.9	33'-0"	3421.2	18768.0	138700
5'-0"	78.540	65.450	487.4	33'-6"	3525.7	19618.0	144400
5'-6"	95.033	87.114	651.7	34'-0"	3631.7	20502.0	150100
6'-0"	113.10	113.10	846.1	34'-6"	3739.3	21411.0	155900
6'-6"	132.73	143.79	1076	35'-0"	3848.5	22347.0	161700
7'-0"	153.94	179.57	1343	35'-6"	3959.2	23312.0	167600
7'-6"	176.71	220.00	1652	36'-0"	4071.5	24307.0	173600
8'-0"	201.05	283.63	2093	36'-6"	4185.4	25331.0	179700
8'-6"	226.93	321.55	2435	37'-0"	4300.8	26384.0	185900
9'-0"	254.47	331.70	2555	37'-6"	4417.9	27467.0	192200
9'-6"	283.53	448.92	3355	38'-0"	4536.5	28581.0	208700
10'-0"	314.16	523.60	3917	38'-6"	4656.6	29726.0	215300
10'-6"	346.36	606.13	4534	39'-0"	4778.4	30902.0	222000
11'-0"	380.13	696.91	5213	39'-6"	4901.7	32109.0	228800
11'-6"	415.43	795.33	5957	40'-0"	5026.5	33346.0	235700
12'-0"	452.37	904.78	6765	40'-6"	5153.0	34613.0	242700
12'-6"	490.87	1022.7	7650	41'-0"	5281.0	35910.0	249800
13'-0"	530.93	1150.3	8435	41'-6"	5410.6	37237.0	257000
13'-6"	572.56	1297.2	9637	42'-0"	5541.8	38592.0	264300
14'-0"	615.75	1453.5	10743	42'-6"	5674.5	40074.0	271700
14'-6"	660.52	1620.3	11941	43'-0"	5808.8	41583.0	279200
15'-0"	705.85	1797.1	13219	43'-6"	5944.7	43120.0	286800
15'-6"	754.77	1949.8	14586	44'-0"	6082.1	44682.0	294500
16'-0"	804.25	2144.7	16044	44'-6"	6221.1	46269.0	302300
16'-6"	855.30	2352.1	17595	45'-0"	6361.7	47883.0	310200
17'-0"	907.92	2572.4	19213	45'-6"	6503.9	49524.0	318200
17'-6"	962.11	2805.2	20742	46'-0"	6647.6	51192.0	326300
18'-0"	1017.9	3053.6	22313	46'-6"	6792.9	52885.0	334500
18'-6"	1075.2	3315.2	24799	47'-0"	6939.3	54602.0	342800
19'-0"	1134.1	3591.4	26866	47'-6"	7087.2	56345.0	351200
19'-6"	1194.6	3882.4	29042	48'-0"	7236.2	58115.0	359700
20'-0"	1255.6	4183.8	31334	48'-6"	7386.8	59910.0	368300
20'-6"	1320.3	4510.9	33744	49'-0"	7543.0	61731.0	377000
21'-0"	1385.4	4849.0	36273	49'-6"	7697.7	63576.0	385800
21'-6"	1452.2	5203.7	38932	50'-0"	7854.0	65445.0	394700
22'-0"	1520.5	5575.3	41705	50'-6"	8011.1	67338.0	403700
22'-6"	1590.4	5964.1	44615	51'-0"	8169.3	69255.0	412800
23'-0"	1661.9	6370.6	47655	51'-6"	8328.6	71196.0	422000
23'-6"	1734.9	6795.2	50832	52'-0"	8489.1	73161.0	431300
24'-0"	1807.6	7238.2	54145	52'-6"	8650.7	75150.0	440700
24'-6"	1885.7	7700.1	57601	53'-0"	8813.4	77163.0	450200
25'-0"	1963.5	8181.2	61200	53'-6"	8977.2	79199.0	459800
25'-6"	2042.8	8682.0	64945	54'-0"	9142.1	81258.0	469500
26'-0"	2123.7	9202.8	68941	54'-6"	9308.1	83339.0	479300
26'-6"	2205.2	9744.0	72990	55'-0"	9475.2	85442.0	489200
27'-0"	2270.2	10206.0	77094	55'-6"	9643.4	87567.0	499200
27'-6"	2355.8	10699.0	81455	56'-0"	9812.7	89714.0	509300
28'-0"	2423.0	11474.0	85931	56'-6"	9983.1	91883.0	519500
28'-6"	2551.8	12121.0	90671	57'-0"	10154.6	94074.0	529800

TABLE 5.5

SAFETY STANDARD NO. 45

ASBESTOS

SCOPE

This standard covers the safe work practices for handling, disposing and monitoring of asbestos and asbestos-containing materials.

POLICY

It is the policy of the Texas Division to protect the health of its employees by minimizing their exposure to asbestos fibers. This shall be accomplished through education of employees, engineering specifications, safe work practices and the replacement of asbestos containing materials as quickly as adequate substitutes can be found.

Guidelines for implementation of this policy are contained in the Handbook For Handling Asbestos Material, copies of which may be obtained from the Safety Department.

RESPONSIBILITIES - OWNER (OR USER)

1. Supervision must ensure that all personnel comply with the established handling procedures as outlined in the above handbook. Supervision should also actively look for and evaluate asbestos substitutes.
2. Employees handling asbestos must follow the established procedures and use the necessary protective measures.
3. Contractor personnel must also comply with the procedures established in the above handbook.

RESPONSIBILITIES - SUPPORTING SERVICES

1. Industrial Medicine will provide pre-employment and annual examinations for employees handling asbestos-containing materials.
2. Safety Directors will encourage supervision to make random audits of asbestos handling activities to ensure the potential for overexposure is minimized.
3. Environmental Health Services will provide educational information, conduct exposure surveys as required and recommend what protective measure should be used.
4. Environmental Services will coordinate the notification of the Texas Air Control Board as needed for demolition or renovation work involving asbestos materials.
5. Engineering and Purchasing will assist supervision through specifications and actively seeking and distributing information on asbestos substitutes.

Norvall Mears/ks

ST00002983



File Asbestos
THE DOW CHEMICAL COMPANY

TEXAS DIVISION
FREEPORT, TEXAS 77541

September 6, 1972

MAINTENANCE FOREMEN
MAINTENANCE MANAGERS AND SUPERINTENDENTS
SAFETY AND LOSS PREVENTION

GUIDELINES FOR HANDLING ASBESTOS MATERIALS

In order to obtain data on exposure levels during removal of asbestos-containing insulation, the Environmental Health Department must take several samples, during removal, of each type or class of asbestos insulation. This data must be obtained and evaluated prior to December 1, 1972.

Most high temperature insulations (above 800°F) installed prior to August, 1970, should be suspected of containing asbestos. Before removing this type material, the appropriate Plant A or Plant B Insulation Foreman should be advised of the job so that monitoring may be arranged as required. This information can most readily be conveyed through Cynthia Cervenka, #636 for Plant A or Orville Smith, 2581 for Plant B.

A complete revision of the "Handbook for Handling Asbestos Materials" is attached; it defines the procedures and safeguards required for proper handling. It should be noted that precautions for sawing of transite (cement-asbestos board) are included.

All waste asbestos-containing material must be properly bagged and labeled for disposal by the Yard Department. Labeling tags have been ordered (see attached sketch) but are not yet available. In the interim, attach a plain tag or label that is readily visible and clearly legible stating:

CAUTION, CONTAINS ASBESTOS FIBERS

You will be notified as soon as printed tags are available.

Jack Crouch
F. B. Crouch

cc
attach

ST0574415

H A N D B O O K
F O R
H A N D L I N G
A S B E S T O S M A T E R I A L

THE DOW CHEMICAL COMPANY
TEXAS DIVISION

Maintenance Department
Supporting Services

July 1972 Rev.

ST0574416

HANDBOOK FOR HANDLING ASBESTOS MATERIALS

Index

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Handling and Storing Asbestos Materials	7
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ST0574417

PURPOSE

The purpose of this handbook is to define safe handling procedures for asbestos materials used in the Texas Division. The intent is to control the exposure of employees to asbestos dust through the proper use of safe work procedures and by the substitution of non-asbestos containing materials.

Asbestos is widely used as structural wall board, insulation, and roofing material. Asbestos fibers are used as a mechanical reinforcing matrix in insulation, roofing paper, certain piping systems, etc. However, Dow Engineering Specifications were revised to exclude asbestos-containing insulation prior to installation of Federal regulations controlling the use and handling of asbestos. Eventually, the use of asbestos will be eliminated as the ultimate solution to the problem.

The OSHA standards which became effective July 7, 1972, define the precautions required for asbestos handling and the allowable safe working limits.

Should a hazard exist, and these procedures appear insufficient, contact the superintendent of the Plant A or B Functional groups for exceptions or variations.

These procedures will be reissued prior to 7 December 72 to incorporate revisions dictated by results obtained from the Division Monitoring Program.

ST0574418

SAFETY

The health of those who breathe asbestos dust may be seriously affected. Results can be similar but more serious than those caused by the more commonly known materials such as silica and coal dust. This phenomena has been observed for many centuries. Current medical discoveries show that handling of asbestos by a confirmed cigarette smoker is especially hazardous in the area of potentially serious lung disorders. It is recommended that those persons handling asbestos not smoke cigarettes in any quantity.

When working with materials which contain asbestos fiber, care must be taken to eliminate as much loose dust as possible. Wetting, isolating the work area, or other suitable procedures to eliminate the dust hazard are absolutely necessary. The main problem areas will be in removal of old, deteriorated insulation and the sawing of Transite.

Respiratory protection, dust collectors, blowers, etc., will be mandatory where asbestos-containing materials must be handled.

The two "nose and mouth" dust respirators which have been approved by the Safety Department are: (1) MSA Dustfoe 77, Dow Stock No. 15-28095, Cartridge No. 15-23775, and (2) Wilson Dust Respirator, Dow Stock No. 15-25460, Cartridge No. 15-23790.

Disposal of asbestos will be in polyethylene bags, Dow Stock No. 15-05080 for large bag and 15-04170 through 15-04195 for small bags.

As required, special protective clothing such as coveralls, head covering and gloves will be provided. Such requirements will be determined by the Division Monitoring Program.

Two lockers will be provided, to separated or isolated as to prevent contamination of the employee's street clothes from his work clothes.

Asbestos-contaminated clothing shall be placed in labeled, polyethylene bags for shipment to the laundry.

ST0574419

USE OF HANDBOOK
FOR
HANDLING ASBESTOS MATERIALS

The Safe Work Procedures outlined in this handbook are minimum requirements for working with asbestos containing materials.

In some cases, job conditions may dictate more stringent requirements. These could include completely wetting down the area with water when removing old insulation, or completely isolating the work area with tarpaulins, etc. Specific requirements for each job will be detailed on the "Insulators Safety Check List."

Because Dow's Engineering Specifications have been revised to exclude use of asbestos-containing insulation, most of the Safe Work Procedures in this section of the Manual will seldom be referred to for new installations.

These procedures are to be used in conjunction with Plant Safety Rules, Maintenance Standard Safe Work Procedures for the Area, and Safety Standards.

ST0571520

SAFE WORK PROCEDURE

Subject: Shop Fabrication With Asbestos Materials

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
3. There shall be a Dust Collecting System on Power Equipment adequate to remove large amounts of dust generated.
4. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Precautions:

1. Do not breathe asbestos dust.
2. Do not operate equipment if provision cannot be made to eliminate dust in a safe manner.
3. Normal precautions must be taken for working with power equipment. (See specific Safe Work Procedure for Operating Power Driven Tools if in doubt).
4. When cleaning out the vacuum system of the machines, a respirator must be worn. Wet down dust prior to handling. Place the wet material in polyethylene bags, seal, label and notify Yard Department that asbestos waste is ready for proper disposal at landfill.
5. Good housekeeping in the shop area is to be practiced. Asbestos dust must be vacuumed throughout the shop area if and when such conditions exist.
6. Keep all personnel not directly involved in the fabrication operation away from the area unless they observe minimum safety requirements and have been apprised of the hazard involved.

ST0574121

SAFE WORK PROCEDURE

Subject: Mixing Material Which Contains Asbestos

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
3. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Precautions:

1. Do not breathe asbestos dust.
2. When mixing whole sacks, do not open sacks and dump into open mixing tray. Moisten asbestos by adding water through a small hole in sack until danger of dust is eliminated. Then the material can be removed if necessary to complete mixing operation to desired consistency.
3. Slipping or falling is a hazard to be considered when working around wet asbestos mud.
4. Back strains from handling containers of mixed mud are also a hazard. A means of handling this mixture may need to be provided, depending on the circumstances.
5. Keep all personnel not directly involved in the mixing operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
6. All contaminated bags, boxes, waste, etc., shall be wetted, placed in labeled polyethylene bags and sent to landfill.

ST0574422

SAFE WORK PROCEDURE

Subject: Handling and Storing Asbestos Materials

Minimum Safety Equipment Requirements:

1. Side Shield Goggles must be worn.
2. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
3. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.

Special Precautions:

1. Do not breathe asbestos dust.
2. Handle materials in such a manner as to minimize exposure to dust. Moisten material with water spray before removing from container if material will not be damaged.
3. Areas used to store asbestos containing materials should be marked "Asbestos Material".
4. Cartons, boxes, etc., that have contained asbestos materials should be wetted, broken and placed in labeled polyethylene bags for disposal.
5. Good housekeeping of shop areas is to be practiced. Clean up all loose dust on floor, machines, shelves, etc., by vacuuming. Wet down, place in labeled polyethylene bags and dispose of dust while damp. Notify the Yard Department to dispose by landfill while material is still damp.

ST0574423

SAFE WORK PROCEDURE

Subject: Sawing and Cutting by Hand

Minimum Safety Equipment Requirements:

1. Hard Hat must be worn.
2. Side Shield Goggles must be worn.
3. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
4. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.
5. All other safety equipment which is required by job location must be used. (Read Area Safe Work Procedures.)

Special Precautions:

1. Do not breathe asbestos dust.
2. Wear the "Nose and Mouth" Dust Respirator when removing asbestos material from package, installing, or cutting.
3. Keep all personnel not directly involved in the operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
4. Special precautions shall be taken when using "Skil-Saw" for sawing asbestos materials. To eliminate dust hazards and protect all people in the area, an air operated saw shall be used and the material shall be flooded with water.
5. If water will damage the material, a hand saw shall be used and sawdust collected with a portable vacuum whenever possible. If site work prohibits use of a vacuum pick-up, cuts should be made directly over a collection box or polyethylene bag.
6. All contaminated bags, totes, waste, etc. shall be wetted, placed in labeled polyethylene bags and sent to landfill.

SAFE WORK PROCEDURE

Subject: Insulation Removal

Minimum Safety Equipment Requirements:

1. Hard Hat must be worn.
2. Side Shield Goggles must be worn.
3. Approved "Nose and Mouth" Dust Respirator must be worn at all times. (See Page 3)
4. An Insulator Safety Check List is to be filled out prior to the job and properly approved. Turn in to supervisor at completion of job.
5. All other safety equipment which is required by job location must be used. (Read Area Safe Work Procedure.)

Special Precautions:

1. Do not breathe asbestos dust.
2. Hazards from asbestos dust that falls, blows or may be scattered throughout the area must be eliminated.
3. Keep all personnel not directly involved in the insulation removal operation away from the area unless they observe minimum safety requirements and have been apprised of the hazards involved.
4. Use water to wet down the insulation before and during removal.
5. Seal all material in labeled polyethylene bags as removed. The Yard Department is to be notified for disposal at landfill.

ST0576425

INSULATOR SAFETY CHECK LIST

JOB DESCRIPTION: _____ DATE _____

LOCATION _____

- | | | |
|--|--------------------------|--------------------------|
| I. AREA | YES | NO |
| 1. Safe Work Permit Received | ☐ | ☐ |
| 2. Area Safe Work Procedure Known | ☐ | ☐ |
| 3. Nearest Phone _____ | | |
| 4. Nearest Eyebath and Safety Shower _____ | | |
| 5. Job Site in Safe Condition | ☐ | ☐ |
| 6. Is Pipe or Equipment Safe to Work On? | ☐ | ☐ |
| 7. Are Corrosive Chemicals Involved? | ☐ | ☐ |
| a. Can lines or equipment be drained? | ☐ | ☐ |
| 8. Is Adjacent Piping and Equipment Safe | ☐ | ☐ |
| 9. Red Tags Needed? | ☐ | ☐ |
| 10. Burn Hazards Present? | ☐ | ☐ |
| 11. Craftsmen Lined Up With Check List? | ☐ | ☐ |

- | | | |
|---|--------------------------|--------------------------|
| II. ASBESTOS WORK | YES | NO |
| 1. Handbook for Handling Asbestos Materials Used? | ☐ | ☐ |
| 2. Signs and/or Barricades Up to Warn Others ? | ☐ | ☐ |
| 3. Has Disposal of Debris Been Arranged ? | ☐ | ☐ |
| 4. Is Water Needed to Control Dust ? | ☐ | ☐ |
| 5. Stencil on Job to Denote Materials Used ? | ☐ | ☐ |
| 6. Have all Involved Personnel Been Informed ? | ☐ | ☐ |

III. Special Safety Equipment Required:

- | | |
|--------------------------|----------------------|
| ☐ | Coveralls |
| ☐ | Chemical Goggles |
| ☐ | Face Shield |
| ☐ | Acid Hood |
| ☐ | Air Mask |
| ☐ | Dust Respirator |
| ☐ | Rubber Gloves |
| ☐ | Rubber Boots |
| ☐ | Slicker Coat |
| ☐ | Slicker Pants |
| ☐ | Safety Belt |
| ☐ | Hearing Protection |
| ☐ | Other: Specify _____ |

ST0574425

Special Hazards _____

Special Safety Precautions _____

Checked and Approved By: _____ DATE: _____

Supt. _____

Foreman _____

Crewleader _____

Craftsman _____

IV. Personnel on Job (Name)	Exposure Time-Hrs.
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

THRESHOLD LIMIT VALUE

No employee shall be exposed at any time to airborne concentrations of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimeter of air. The eight hour time-weighted average shall not exceed five (5) fibers per cubic centimeter.*

In order to assure compliance with these limits, the Environmental Health Group will make random samples. When special field testing is desired, call Environmental Health at 238-2121.

In order to keep asbestos dust concentration within the proper limits, any dusty conditions connected with the handling of asbestos materials must be kept to an absolute minimum. This must be done as outlined in the previous Safe Work Procedures by wetting down the area, pre-soaking the material, or vacuuming the material as it is cut. Each individual job should be planned with this uppermost in mind.

* Effective 1 July 1976, this limit is reduced from five (5) to two (2) fibers per cubic centimeter.

color: Dark green background with white letters
1st: Same as 'red danger tags but with twist wire
instead of string.

CAUTION

Contains Asbestos Fibers

○ Avoid Creating Dust

Breathing Asbestos Dust May Cause
Serious Bodily Harm

(SEE OTHER SIDE)

FRONT

CAUTION

○ This tag may be removed by
authorized personnel only.

Attached by: _____ Date: _____

(SEE OTHER SIDE)

BACK

ST0574428



DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

EVALUATION OF ASBESTOS EXPOSURES,
DOW INDUSTRIAL SERVICES, HIGHWAY 332

FILE NO. M-152

DATE September 10, 1973

AUTHOR R.L. Silverthorne
L. G. Trahan

CHECKED R. C. Hala RS

DATE 9-10-73

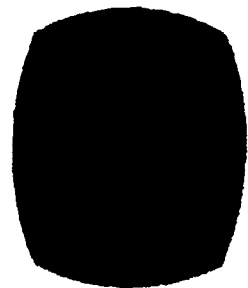
Summary

The employees exposure to asbestos fibers were evaluated during the cathode cleaning operations at Dow Industrial Services. The time weighted average and peak exposures to asbestos fibers are within acceptable levels.

ST0684751

Distribution

L. A. Little -
File



PROBLEM

Industrial Hygiene was asked to evaluate the exposure of Dow Industrial Service employees to asbestos fibers during the cathode cleaning operations.

CONCLUSIONS

- (1) The employees time-weighted average and peak exposures to asbestos fibers are within acceptable levels.
- (2) The entire cathode cleaning shed is covered with wet asbestos.
- (3) Asbestos fiber levels in the workers clothes were in the 0.09 to 0.16 fibers/ml range.

RECOMMENDATIONS

- (1) Wash down walls and floor of cathode cleaning shed daily.
- (2) Showering should be compulsory at the end of the work day for those employees who work at the cathode cleaning shed.
- (3) Employees should have clean work clothes daily.

PRESENTATION OF DATA

Table I shows the operators exposure to asbestos fibers based on an eight hour day when the cathode cleaning operation is in progress. The time weighted average and peak exposures are within acceptable levels based on the present standard.

Table A shows the results of the sample analyses for the various cathode cleaning operation. The highest asbestos fiber concentration, up to .166 fibers/ml, were found in the worker's clothes.

SAMPLE AND ANALYSIS

Breathing zone and general area air samples were collected on 47 mm diameter (.8 micron pore size) membrane filters at a sample rate of about 2.0 lpm. The fibers on the filters were counted by the standard phase-contrast microscopy technique at 450 magnification by the Texas Division Microscopy Laboratory.

S10684752

ST0684753

TABLE I

DOW INDUSTRIAL SERVICES OPERATOR (DIAPHRAGM CLEANING)

EXPOSURES TO ASBESTOS FIBERS, HIGHWAY 332

OPERATION	TIME PER 8 HR. DAY (MIN.)	A	B	A X B	
				AVERAGE CONC. (FIBERS/ML)	480
Employees working under shed.	420		.133		.116
Lunch & Breaks	60		----		-----
Time Weighted Average	480				.116
Threshold Limit Value*					5.0
Maximum Allowable Conc.			10.0		

*Threshold Limit Value (TLV) - The time weighted average concentration to which it is believed that most people could be exposed daily without adverse effect.

(

(

ST0684754

TABLE A

DOW INDUSTRIAL SERVICES SUMMARY OF SAMPLE ANALYSIS

AREA OPERATION	NUMBER OF SAMPLES	ASBESTOS CONCENTRATION FIBERS/ML	
		RANGE	AVERAGE
In middle of cathode cleaning shed on washing platform (no activity)	2	0-.014	.007
On cathode washing platform (washer and hand lance being used)	3	0-.107	.005
Man using hand lance for cleaning cathodes	3	.022-.129	.106
Shaking work clothes after they were dirty and dry.	2	.099-.166	.133
Man using hand lance to clean top and ends of cathode (pre- washing)	2	0	0
West end of shed during washing operation and lance cleaning of cathodes	2	.058-.062	.060

ENVIRONMENTAL RESEARCH SAMPLE RECORD

ST0684755

FILE NUMBER <i>M-152</i>	PROCESS <i>Cathode Cleaning Operation</i>	BLDG. NO. <i>D.I.S.</i>	DATE <i>5-8-73</i>
MATERIAL <i>Asbestos</i>	SAMPLING METHOD	TRAPPING MEDIUM <i>.8 μ Millipore Filter</i>	
EQUIPMENT NUMBER <i>1 & 2</i>	TYPE OF EQUIPMENT <i>MSA Monitor</i>	FLOW INDICATOR SETTING <i>8</i>	SAMPLE FLOW RATE <i></i>
REMARKS (VENTILATION, ETC.)		OUTSIDE TEMP. <i>°F</i>	INSIDE TEMP. <i>°F</i>

SAMPLE NO.	CONTAINER NO.	DESCRIPTION OF SAMPLE	TIME		CONCENTRATION
			START	INCREMENT	
Pump 1	1 x	In middle of slab area (no activity)	8:30 8:40	10 min	- 0 -
Pump 2	2 x	On cathode washing platform. Washer running & steam lance being used $\approx$ 20' N.W.	8:46 8:56	10 min	- 0 -
Pump 1	3 x	$\approx$ 8' W of man using lance to clean cathode	9:01 9:11	10 min	.0299 f/cc
Pump 2	4 x	$\approx$ 3' behind man using lance to clean ends of dirty cathodes	9:34 9:39	5 min	- 0 -
Pump 1	5 x	$\approx$ 3' behind man using lance to clean top of cathodes	9:51 9:56	5 min	- 0 -
Pump 2	6	Pump on man removing bolts holding copper plates on cathode (Washed the top of cathode with steam lance before removing copper plates)	10:27 10:37	10 min	- 0 -
Pump 1	7 x	Area sample on cathode east of washer. Men removing bolts with impact tools. Also sampled man using lance to clean cell.	10:31 10:41	30 min	.1293 f/cc

FILE NUMBER M-152	PROCESS Cathode Cleaning Operation	BLDG. NO. D.I.S.	DATE 5-8-73
MATERIAL Asbestos	SAMPLING METHOD	TRAPPING MEDIUM .8 μ Millipore Filter	
EQUIPMENT NUMBER 1 & 2	TYPE OF EQUIPMENT MSA Monitor	FLOW INDICATOR SETTING	SAMPLE FLOW RATE
REMARKS (VENTILATION, ETC.)		OUTSIDE TEMP. °F	INSIDE TEMP. °F

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ENVIRONMENTAL RESEARCH AMPLE RECORD

FILE NUMBER	PROCESS	BLDG. NO.	DATE
M-152	Cathode Cleaning Operation	DI 5	8-17-73
MATERIAL	SAMPLING METHOD	TRAPPING MEDIUM	
Asbestos	Cellulose Filter	0.8 μ millipore Filter	
EQUIPMENT NUMBER	TYPE OF EQUIPMENT	FLOW INDICATOR SETTING	SAMPLE FLOW RATE
5 & 6	MSA Monitor Pump	8	
REMARKS (VENTILATION, ETC.)		OUTSIDE TEMP.	INSIDE TEMP.
		°F	°F

SAMPLE NO.	CONTAINER NO.	DESCRIPTION OF SAMPLE	TIME		CONCENTRATION
			START	INCREMENT	
DIS #10	Pump 6*	In middle of slab area (no activity)		15	.014 f/cc
DIS #11	5*	On cathode washing pump platform. Washer is on and man is operating hand lance nearby.		14	.107 f/cc
DIS #12	6*	≈ 8' W of man using hand lance to clean cathode		15	.022 f/cc
DIS #17	6*	Area sampling. Sitting on caustic soda drum at W. end of bldg., down wind of washing operation. New automatic pre-washer is on ≈ 35' S of sample point. Also, hand lance operation is on.		19	.058 f/cc

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FILE NUMBER M-152		PROCESS Cathode Cleaning Operation			BLDG. NO. DIS		DATE 8-17-73	
MATERIAL Asbestos			SAMPLING METHOD Cellulose Filter		TRAPPING MEDIUM .8µs millipore filter			
EQUIPMENT NUMBER 5 ÷ 6		TYPE OF EQUIPMENT MSA Monitor Pumps		FLOW INDICATOR SETTING 8	SAMPLE FLOW RATE	OUTSIDE TEMP. °F		INSIDE TEMP. °F
REMARKS (VENTILATION, ETC.)								

FORM C-16670 PRINTED IN U.S.A. 10-62



DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

RE-EVALUATION OF ASBESTOS EXPOSURES,
CELL SERVICE, A-1323 AND A-1022 BUILDING

FILE NO. A10-196
DATE September 12, 1973
AUTHOR R.L. Silverthorne
L. G. Trahan
B. S. Horvath
CHECKED R.E. Flah
DATE 9-12-73

Summary

The cell service employees exposure to asbestos fibers were re-evaluated during the diaphragm drawing operations. The time-weighted average and peak exposures to asbestos fibers are within acceptable levels, though the peak exposures could approach the maximum allowable concentration. The employees should continue to wear respiratory protection during the weighing and dumping of asbestos into the drawing vat.

Attached are recommendations that could reduce exposure to airborne asbestos to employees even more than the precautions already taken.

245085015

Distribution

J. M. Hart A-1003
S. F. Edquist A-1201
File

AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY



PROBLEM

Industrial Hygiene was asked to re-evaluate the exposures of Cell Service employees to asbestos fibers during the diaphragm drawing operations.

CONCLUSIONS

- (1) The employees time-weighted average and peak exposures to asbestos fibers are within acceptable levels.
- (2) During the weighing and dumping of asbestos, peak concentrations could approach the maximum allowable concentration for short term exposure. The men working around the pulling tank when asbestos bags are handled and dumped into the vat should continue to wear respiratory protection.

RECOMMENDATIONS

- (1) Empty asbestos bags should be stored in a plastic bag and sealed before disposal.
- (2) Employees who work regularly with asbestos should have clean work clothes daily. (Work clothes are not to be taken home for laundering).
- (3) Continue the work practice of wearing respiratory protection whenever asbestos is handled.
- (4) Showering should be compulsory at the end of the work day for those employees with significant exposures.
- (5) Engineering methods to be utilized to eliminate asbestos exposure to employees.

PRESENTATION OF DATA

Table I, II, and III shows the operators exposure to asbestos fibers based on an 8 hour day when the drawing operation is in progress at A-1322 and A-1022. His time-weighted average and peak exposures were within acceptable levels based on the present standard.

Table A shows the results of the sample analyses for the various Cell Services operations. The highest asbestos fiber concentration, up to 5.86 fibers/ml, were found during the weighing and dumping

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PRESENTATION OF DATA (continued)

dumping of asbestos. Because of the variability in the asbestos handling procedures (and in the fiber counting technique) the operator peak exposures could exceed the allowable ceiling concentration. The men working around the drawing vat, during the handling of dry asbestos, should wear respiratory protection.

Asbestos fiber levels exceeding 0.5 fibers/ml were found only in the immediate area of the drawing vat. The exposures of the other employees working in the building were well within acceptable levels. Their TWA* exposure would be in the .01 to .03 fibers/ml range.

SAMPLE AND ANALYSIS

Breathing zone and general area air samples were collected on 47 mm diameter (.8 micron pore size) membrane filters at a sample rate of about 2.0 Lpm. The fibers on the filters were counted by the standard phase - contrast microscopy technique at 450 magnification by the Texas Division Microscopy Laboratory.

* Time-Weighted Average (TWA) - The average exposure of asbestos fibers to employees during an eight hour work day.

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9-12-73

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TABLE I

CELL SERVICES OPERATOR (DIAPHRAGM DRAWING) EXPOSURES

TO ASBESTOS FIBERS, CHLORINE 5, A-1322 BUILDING

OPERATION	A TIME PER 8 HR. DAY (MIN.)	B AVERAGE CONC. (FIBERS/ML)	$\frac{A \times B}{480}$
Weighing and dumping asbestos bags into mixing tank	12	2.21	.050
Diaphragm drawing operation	324	.009	.006
Lunch & Breaks and other misc. work	144	-	
Time-Weighted Average	480		.056
Threshold Limit Value *			5.0
Maximum Allowable Conc.		10.0	

* Threshold Limit Value (TLV) - The time weighted average concentration to which it is believed that most people could be exposed daily without adverse effect.

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TABLE II

CELL SERVICES OPERATOR (DIAPHRAGM DRAWING) EXPOSURES

TO ASBESTOS FIBERS, CELL SERVICES, A-1022 BUILDING

OPERATION	A TIME PER 8 HR. DAY (MIN.)	B AVERAGE CONC. (FIBERS/ML)	A X B	
			480	
Dumping Asbestos from bags into slurry tank	75	2	.31	
Slurry tank operation (dipping cathode)	75	.04	.006	
Analyzing slurry tank solution (Asbestos & caustic)	75	.04	.006	
Breaks, Lunch, misc. duties	255			
Time Weighted Average	480		.322	
Threshold Limit Value*			5.0	
Maximum Allowable Conc.		10.0		

*Threshold Limit Value (TLV) - The time-weighted average concentration to which it is believed that most people could be exposed daily without adverse effect.

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TABLE III

CELL SERVICES TOWMOTOR OPERATOR EXPOSURES TO ASBESTOSFIBERS, CHLORINE V, A-1322 BUILDING

OPERATION	A TIME PER 8 HR. DAY (MIN.)	B AVERAGE CONC. (FIBERS/MI)	A X B	
			480	
Transports Asbestos from A-1303 Warehouse to drawing vat	5	.033	.00	
Misc. duties, breaks, lunch	475			
Time-Weighted Average	480	.033	.00	
Threshold Limit Value*			5.0	
Maximum Allowable Conc.		10.0		

*Threshold Limit Value (TLV) - The time weighted average concentration to which it is believed that most people could be exposed daily without adverse effect.

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TABLE A

CELL SERVICES SUMMARY OF SAMPLE ANALYSIS

AREA OPERATION	NO. OF SAMPLES	ASBESTOS CONCENTRATION FIBERS/ML	
		Range	Average
OPERATOR Weighing and dumping asbestos into mixing tank (A-1323)	3	.41 to 3.34	2.210
OPERATOR Dumping asbestos into vat (A-1022)	4	.46 to 5.86	2.000
General work around drawing vat (A-1323) No activity	4	.0 to .030	.010
General work around drawing vat during dumping and drawing operation (A-1323)	7	0 to .06	.022
General work around drawing vat (A-1022) No activity	2	.029 to .041	.035
General work around drawing vat during dumping and drawing operation A-1022	11	.0 to 5.33	.581
Tow motor moving asbestos bags to vat (A-1323 & A-1022)	5	0 to .04	.027
Employees work clothes (dirty & dry)	1	1.3	1.3

8-29-73
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ENVIRONMENTAL RESEARCH. SAMPLE RECORD

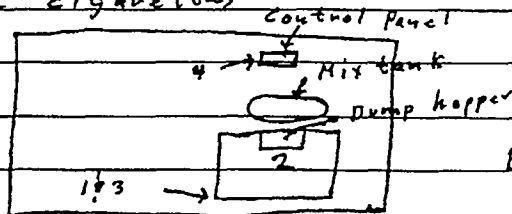
FILE NUMBER A-10-196	PROCESS Cell Services (Asbestos) Drawing	BLOG. NO. A-1323	DATE 6-6-73
MATERIAL Asbestos	SAMPLING METHOD Cellulose Filter	TRAPPING MEDIUM .8 μ Millipore Filter	
EQUIPMENT NUMBER	TYPE OF EQUIPMENT MSA Monitor Pumps	FLOW INDICATOR SETTING 8	SAMPLE FLOW RATE ≈ 2 l/m
		OUTSIDE TEMP.	INSIDE TEMP.

REMARKS (VENTILATION, ETC.)

Drawing M-61 cells, two at a time.

Pump

SAMPLE NO.	CONTAINER NO.	DESCRIPTION OF SAMPLE	TIME		CONCENTRATION
			START	INCREMENT	
CS-1	4	On northeast railing of dumping platform. No dumping going on. Ventilation; none to speak of. Doors to bldg. are all open.	8:35 to 9:05	30min	.021 f/cc
CS-2	1	On operator Edwards. Dumped 250 lbs of asbestos into the hopper. Asbestos fiber dumps in air above hopper, but did not generally fly around. Operator Edwards wore Acme respirator.	9:00 to 9:05	5min	3.34 f/cc
CS-3	1	Same as CS-1 on platform during drawing. Post dumping.	9:05 to 9:35	30min	.006 f/cc
CS-4	4	At control panel for drawing operation. During drawing operation, post dumping. Note: both operators Edwards & Cook smoke cigarettes.	9:05 to 9:35	30min	.009 f/cc



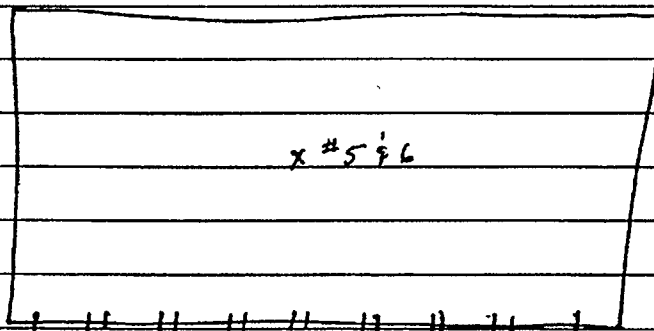
B. S. Harvath
6-6-73

ST0580549

ENVIRONMENTAL RESEARCH SAMPLE RECORD

FILE NUMBER A-10-196	PROCESS Asbestos Warehouse	BLDG. NO. A-1303	DATE 6-6-73
MATERIAL Asbestos	SAMPLING METHOD Cellulose Filter	TRAPPING MEDIUM .8 μ Millipore Filter	
EQUIPMENT NUMBER	TYPE OF EQUIPMENT MSA Monitor Pumps	FLOW INDICATOR SETTING 8	SAMPLE FLOW RATE ≈ 2 l/m
REMARKS (VENTILATION, ETC.)		OUTSIDE TEMP.	INSIDE TEMP.

Pump		DESCRIPTION OF SAMPLE	TIME		CONCENTRATION
SAMPLE NO.	CONTAINER NO.		START	INCREMENT	
CS-5	1	A-1303 Warehouse (No Activity)	2:23 to 2:43	20 min	.015 f/cc
CS-6	4	Same location as CS-5, but with tow motor coming in and out	2:52 to 3:02	10 min	.032 f/cc
CS-7	1	On tow motor operator. Man making 4 runs at the warehouse using same pallet load of intact bags.	2:52 to 3:02	10 min	.030 f/cc



8 doors equally spaced on south wall

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ENVIRONMENTAL RESEARCH SAMPLE RECORD

FILE NUMBER A10-196	PROCESS Cell Services (Asbestos) Drawing	BLDG. NO. 1022	DATE 6-6-73
MATERIAL Asbestos	SAMPLING METHOD Cellulose Filter	TRAPPING MEDIUM .8µ Millipore Filter	
EQUIPMENT NUMBER	TYPE OF EQUIPMENT MSA Monitor Pump	FLOW INDICATOR SETTING 8	SAMPLE FLOW RATE 22 L/min
		OUTSIDE TEMP.	INSIDE TEMP.

REMARKS (VENTILATION, ETC.)

Used Cleco type holders except on sample 205 (All doors Pump open in A-¹⁰²²~~1923~~)

SAMPLE NO.	CONTAINER NO.	DESCRIPTION OF SAMPLE	TIME		CONCENTRATION
			START	INCREMENT	
101	2	On man dumping asbestos into vat (Dumped 3½ bags weighing 240 lbs) Visible asbestos in air during dumping operation	11:08 to 11:18	10min	.466 f/cc
102	8 hour pump 5	Center of bldg. ≈ 30' S.W. of drawing vat during dumping of asbestos during sample 101	11:13 to 11:28	15min	.099 f/cc
103	1	In center of bldg (no activity)	10:53 to 11:13	20min	.029 f/cc
201	2	On handrail behind platform far vat. (Complete operation after dumping asbestos) Dumping cathode & drying.	12:03 to 1:09	66min	.018 f/cc
202	8 hour pump 5	Middle of bldg. ≈ 30' S.W. of vat (Complete operation after dumping asbestos) Dumping cathode & drying	12:03 to 1:09	66min	-0-

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ENVIRONMENTAL RESEARCH SAMPLE RECORD

FILE NUMBER A10-196	PROCESS Cell Services Diaphragm Drawing	BLDG. NO. A-1022	DATE 6-7-73
MATERIAL Asbestos	SAMPLING METHOD Cellulose Filter	TRAPPING MEDIUM .8 μ Millipore Filter	
EQUIPMENT NUMBER 4, 5, & 6	TYPE OF EQUIPMENT MSA Monitor Pump	FLOW INDICATOR SETTING 8	SAMPLE FLOW RATE
REMARKS (VENTILATION, ETC.)		OUTSIDE TEMP. °F	INSIDE TEMP. °F

SAMPLE NO.	CONTAINER NO.	DESCRIPTION OF SAMPLE	TIME		CONCENTRATION
			START	INCREMENT	
Pump 1	203	Mixing asbestos & epoxy for repairing Cl ₂ cells. between A-1020 & 1022. Monitor on man. He is mixing epoxy and dry asbestos with electric motor mixer in 10 qt. bucket. Takes asbestos out of open bag with 1 gal. container & adds to bucket & starts mixer again. This was done 3 times. Puts gloves in trash container. Dry asbestos can be seen on his clothes. (Washes and clothes at home)	12:22 to 12:32	10m	1.31 f
Pump 1	204	101 oven B (in middle) 200°F in oven	11:04 to 11:06	2m	.149
Pump 4	205	A-1023 Asbestos Storage	11:10 to 11:45		0

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ENVIRONMENTAL RESEARCH SAMPLE RECORD

FILE NUMBER A10-196	PROCESS Cell Services Diaphragm Drawing	BLDG. NO. A-1022	DATE 6-7-73
MATERIAL Asbestos	SAMPLING METHOD Cellulose Filter	TRAPPING MEDIUM .8μ millipore filter	
EQUIPMENT NUMBER 4,5 & 6	TYPE OF EQUIPMENT MSA Monitor Pumps	FLOW INDICATOR SETTING 8	SAMPLE FLOW RATE
REMARKS (VENTILATION, ETC.)		OUTSIDE TEMP.	INSIDE TEMP.

[illegible]

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R & D REPORT

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LABORATORY REPORT CODE

NBH2.12-28-1(2-5)

DATE ISSUED

September 24, 1973

DEPARTMENT

DIG Chemical Biology Research

ACCOUNT NO

377

PROJECT NUMBER

9080903

TITLE

ASBESTOS EXPOSURES DURING MAINTENANCE, DEMOLITION AND TRANSITE FABRI-
CATION, 500, 580, X199, 349, X376, 150 and 596 BUILDINGS

AUTHOR'S SIGNATURE

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M. F. Stevenson 9-25-73

G. H. Flores

G. H. Flores 9-25-73

REVIEWER'S SIGNATURE

H. R. Hoyle

*H. R. Hoyle**9-25-73 / ds*DESCRIPTIVE SUMMARY
WITH CONCLUSIONS:

(Include in this space references to data books, and to earlier related reports, patents and publications.)

Air samples to determine asbestos exposures were taken during various construction and demolition operations. The outdoor demolition work and indoor pipe stripping work at X199, X376 and 349 Building showed the lowest asbestos counts of the three areas sampled. The maintenance work at 500 and 580 Buildings approached the maximum allowable concentration. Transite fabrication at 596 and 150 Buildings approached and exceeded the maximum allowable concentration of 10 fibers per milliliter (fibers/ml).

Anyone working in the immediate vicinity of such jobs should use approved respiratory protection.

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ST0000982

CRI NUMBER

ST0000983

PROBLEM

The Industrial Hygiene Section of DGC Chemical Biology Research was asked to evaluate asbestos exposures during maintenance, demolition and transite fabrication at various buildings in the Midland Division.

CONCLUSIONS

1. Exposure to asbestos fibers was greatest during transite fabrication. Levels recorded at 596 and 150 Buildings approached and exceeded the maximum allowable concentration of 10 fibers/ml.
2. Exposure to asbestos fibers approached the maximum allowable concentration at 500 and 580 Buildings during the removal of insulation from boilers and crackers.
3. Asbestos exposures were minimal while removing covering from pipes at X199, X376 and 349 Buildings.
4. Wetting down and careful handling while removing asbestos insulation reduces airborne asbestos fiber concentrations (See Table 1 and 2).

RECOMMENDATIONS

1. The use of procedures & equipment required by Occupational Safety and Health Act and Environmental Protection Agency regulations such as signs, roped off areas, dust tight bags and approved respirators should be continued.
2. No friable asbestos debris should be dropped or thrown to the ground or to any floor below for any building or structure 50 feet or greater in height. This debris should be transported to the ground via dust tight chutes or containers. (See Federal Register, Volume 38, Number 66, 61.22 - EPA Emission Standards).
3. When removing asbestos in an outdoor environment the section to be removed should be kept wet until final disposal has been accomplished.
4. Workers working down wind from an asbestos stripping operation should be advised to wear respiratory protection until air samples are taken to prove otherwise.
5. Sawing equipment used in fabricating transite should be equipped with dust control devices. A wet cutting blade, local exhaust for the cutting area or a combination of the

ST0000985

-4-

above two methods should be considered as possible engineering control methods. Air sampling will be required to assure satisfactory control of asbestos fibers.

6. A possible reduction in the speed of the cutting blades when fabricating transite should also be considered as a viable method in the reduction of airborne dust.

DISCUSSION

As per Federal Register, Volume 37, Number 202, paragraph 1910.93a, every employer shall monitor the air breathed by workmen who might be exposed to asbestos to assure that the concentration of asbestos fibers is within accepted limits. The areas monitored thus far include demolition of buildings, removal of asbestos insulation from pipes, boilers and crackers (maintenance purposes) and transite fabrications.

1. Demolition Operations - Asbestos was used extensively in old buildings as an insulating material for tanks and pipes. Asbestos is a fibrous material and tends to become airborne when buildings are demolished. Therefore, monitoring for asbestos at X199 and X376 Buildings was done in May of 1973, by the Industrial Hygiene Section of DIG Chemical Biology

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Research. Breathing zone samples and area samples were obtained. These readings ranged from 0.11 to 0.48 fibers/ml. (See Table 3) The ground was damp and equipment ranging from small bulldozers to large cranes was being used. Small pieces of flaky asbestos particles were seen on the ground and entangled in parts of the steel structures. A transite sample was obtained for analysis to determine the percent asbestos and related elements (See Table 4). None of the precautionary measures required by regulation was in evidence at the time of sampling.

Removing asbestos insulation from pipes can present high exposure possibilities. At 349 Building, breathing zone samples were taken while removing insulation, the results ranged from 0.3 to 2.3 fibers/ml. The men at this operation were handling the asbestos carefully. They were using dust tight bags to contain the insulation as it was removed. Pipes had been wet down earlier that morning.. The results indicate that a workers exposure can be controlled. The majority of respirators worn were not Dow or U. S. Bureau of Mines approved and further education of the contractors is needed.

2. Maintenance Operations - Here, as above, removing asbestos insulation was the primary concern. At 500 Building asbestos was being removed from a boiler. It was an indoor job with a

ST0000987

-6-

strong wind coming from the east entrance and blowing northerly. No signs or ropes were in evidence. Disposable respirators were worn but were not the type recommended. Recommended types of respirators and filters to be used while working with asbestos are: Mine Safety Appliance Ultra Filter respirator with Cartridge "H"; Amiercan Optical with respirator "3M 2304" with R57 cartridge; 3M Brand, No. 871C respirator, disposable. Disposal of asbestos was improper - no dust tight bags were used at all. Asbestos removal was done in two different ways. First, the asbestos was shoveled into a wheel barrow and emptied into an open dumpster. Second, the asbestos was shoveled into the running water used to carry fly ash, etc., into holding areas. See Table 5 for results of 500 Building sampling.

At 580 Building, "L" cracker, an outdoor asbestos stripping operation was going on. A strong wind was blowing northwesterly toward other maintenance workers not envolved in asbestos removal. Precautionary measures taken included all but the wetting down process. Samples were taken prior to and after the work area was wet down (See Table 1). The operator was told that he should wear his respirator whenever working in this area and that samples would be taken. The results ranged from 1.5 to 9.1 fibers/ml.

-7-

3. Transite Fabrication - Transite is a heat resistant substance used at Dow for reactor enclosures, etc. This fabricating substance is known to contain about 30 to 40% chrysotile, one of six different types of asbestos (See Table 4 and AL#060798).

Prior to the installation of transite the material must be cut to proper size. Sawing transite creates a very dusty situation not only for those doing the cutting but for others working in the immediate area.

Samples were obtained at 596 and 150 Buildings. At 150 Building results ranged from 32 to 42 fibers/ml. The work done here was in a partially enclosed area. At 596 Building sample results ranged from 0.1 to 11.1 fibers/ml of air sampled. The samples taken here were primarily outdoors and brisk winds tended to disperse the dust. (Tables 6 and 7)

SAMPLING AND ANALYSIS

Breathing zone and general area air samples were collected by two different methods:

1. For breathing zone samples personnel sampling pumps with millipore filter cassettes (0.8 micron pore size) were used at sample rates of about 2 liters per minute.

ST0000989

-8-

2. General area air samples were obtained by using personnel pumps and gast pumps. Filters used with the gast pumps were 47 mm in diameter and 0.8 micron pore size. Sampling rate of about 23 liters per minute was obtained by use of a No. 5 limited orifice.

Fibers on the filters were counted by standard phase contrast microscopy technique at 450 magnification by the Midland Division Microscopy Laboratory (AL#64-788, 65-073, 059824, 059837 and AA#73-271).

Bulk samples were obtained of asbestos and transite to determine content by percent composition (AL#060798, AL#060786). These results were obtained by x-ray diffraction analysis.

TABLE 1

Stripping Asbestos From "L" Cracker, 580 Building

<u>Sample Number</u>	<u>Operation</u>	<u>Asbestos Concentration (fibers/ml)</u>
1	Picking up loose asbestos (wet)	1.8
2	Picking up loose asbestos (wet)	1.5
3	Stripping asbestos from Cracker (not wet)	8.9
4	Stripping asbestos from Cracker (not wet)	9.1
5	Stripping asbestos from Cracker (wet)	6.2
6	Crane Area - down wind	4.8

NOTE: Sample 6 was a general area sample and sample 3 was loose dust picked up off the crane. All others are breathing zone samples.

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TABLE 2

Removing Asbestos From Pipes, 349 Building

<u>Sample Number</u>	<u>Operation</u>	<u>Asbestos Concentration (fibers/ml)</u>
1	Removing insulation & bagging asbestos	0.7
2	Removing pipe covering	2.3
3	General area -	0.2
4	Removing insulation & bagging	1.5
5	Removing insulation from pipes	0.6
6	General area	0.3

NOTE: Breathing zone samples except where indicated.

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TABLE 3

Demolition of Old Buildings with Asbestos Insulation on
Pipes, Reactors and Transite Walls: X199 & 376 Buildings

<u>Sample Number</u>	<u>Operation</u>	<u>Asbestos Concentration (fibers/ml)</u>
<u>X376 Building</u>		
7	Area sample	0.48
8	Outside cab of crane	0.29
<u>X199 Building</u>		
9	Man operating catipillae (loading truck with debris)	0.18
10	Man operating small utility bull- dozer - pushing debris into stacks	0.12
11	Man operating crane	0.11
12	Area sample, approximately 100 feet north of building - down wind	0.13

ST0000993

TABLE 4

Transite Sample From X376 Building - Sent to X-ray
Diffraction to Determine Asbestos Content and
Other Crystalline Materials

<u>Substance Found</u>	<u>Percent</u>
Chrysotile	30-40
Calcite (CaCO_3)	10-20
Vaterite (CaCO_3)	15-25
Quartz	15
Noncrystalline	5-15

Range of percent was confirmed by removing soluble carbonates (calcite & vaterite) and rerunning insoluble residues.

A loose dust sample was collected at 580 Building from crane - microscopic examination indicated that the dust is probably amosite, one of the six different types of asbestos present.

ST0000994

TABLE 5

Stripping Asbestos From #14 Boiler, 500 Building

<u>Sample Number</u>	<u>Operation</u>	<u>Asbestos Concentration (fibers/ml)</u>
1	Pulling asbestos block insulation from boiler	8.0
2	Pulling asbestos block insulation from boiler	6.0
3	Area sample, approximately 6 feet from work area	0.2
4	Pulling asbestos from boiler	1.3
5	Picking up loose asbestos	0.7
6	Picking up & emptying into dempsters	4.5
7	Area sample, approximately 20 feet from work area but down wind from draft	1.0
8	Area sample approximately 8 feet lateral from work area	<0.1
9	Pulling asbestos from boiler	8.9
10	Area sample approximately 6 feet from work area	0.1

ST0000995

TABLE 6

Fabrication of Transite, 596 Building

<u>Sample Number</u>	<u>Operation</u>	<u>Asbestos Concentration (Fibers/ml)</u>
1	Cutting transite with rotary saw	9.7
2	Man installing transite on platform	1.6
3	Background around doorway	0.1
4	Measuring transite board and cutting with rotary saw	11.1
5	Man installing panels, occasionally drilling screw holes	1.2
6	General area, breathing zone height, around doorway	1.3

NOTE: All samples are in the breathing zone

ST0000996

TABLE 7

Transite Fabrication, 150 Building

<u>Sample Number</u>	<u>Operation</u>	<u>Asbestos Concentration (Fibers/ml)</u>
1	Cutting transite with rotary saw	40.7
2	Man standing to immediate right of operating saw	32.0
3	Man standing to left of saw-- holding board down	42.5

NOTE: All samples were taken in the breathing zone



DOW CHEMICAL U.S.A.

Livingston

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

EVALUATION OF ASBESTOS EXPOSURE
TO INSULATORS AT GLYCOL "A"

FILE NO. A18-237

DATE November 21, 1973

AUTHOR R.L. Silverthorne

CHECKED R.L. Daniel

DATE 11/21/73

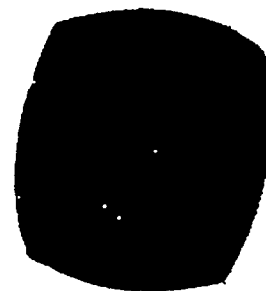
Summary

Contractor insulator exposure to asbestos fibers were evaluated during the removal of insulation on two columns at Glycol "A". The time-weighted average (the average exposure of asbestos fibers to employees during an eight hour work day) and peak exposures to asbestos fibers are within acceptable levels, although the peak exposures could approach maximum allowable concentrations due to the variability in the asbestos handling procedures. The employees should continue to wear respiratory protection during the handling of asbestos, and every effort should be made to wet down the asbestos insulation before and during removal.

ST0015109

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INTRODUCTION

Environmental Health Services was asked to evaluate the exposure of Insulators to asbestos fibers during the removal of asbestos insulation from two reaction towers at Glycol "A".

METHODOLOGY

Breathing zone and general area air samples were collected on 47 mm-diameter(.8 micron pore size) membrane filters at a sample rate of about 2.0 LPM. The air pumps used were M.S.A. permissible portable personnel pumps. The fibers on the filters were counted by the standard phase-contrast microscopy technique at 450 magnification by the Texas Division Microscopy Laboratory.

DISCUSSION

Table A shows the insulator exposures to asbestos fibers based on an eight hour work day when insulation is being removed from reaction towers. His time weighted average and peak exposure are within acceptable levels based on the present OSHA standard.

Table B shows the results of the sample analyses for the various Insulator operations. The highest asbestos fiber concentration, up to 1.29 fibers/ml, were found during the actual removal of insulation by the employee. Because of the variability in the asbestos handling procedures the employee peak exposures could exceed the allowable ceiling concentration:

ST0015110

CONCLUSION

1. The employees time weighted average and peak exposures to asbestos fibers are within acceptable levels.

RECOMMENDATION

1. Asbestos insulation should be stored in plastic bags, tagged and sealed for disposal.
2. Employees who work regularly with asbestos should have clean work clothes daily. (Work clothes should not be taken home for laundering).

RECOMMENDATIONS (continued)

3. Continue the work practice of wearing respiratory protection whenever asbestos is handled.
4. Employees with significant exposure should shower at the end of the work day.
5. Water should be used to wet down the insulation before and during the dismantling operation. This will reduce the possibility of asbestos fibers becoming air borne.
6. Environmental measurements should be made annually to determine the adequacy of precautions taken.
7. The contractor employer should be familiar with Subpart G, section 1910.93a, of the Federal Register.

ST0015111

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ST0015112

TABLE A
CONTRACTOR INSULATOR EXPOSURES
TO ASBESTOS FIBERS, GLYCOL "A"

OPERATION	*TIME WEIGHTED AVERAGE (fibers/ml)	*THRESHOLD LIMIT		MAXIMUM ALLOWABLE CONCENTRATIONS
		VALUE (fibers/ml)		
Insulator wearing personnel monitor during the removal of insulation from the towers. He is putting the insulation in plastic bags.	1.43	5		10
Insulator wearing personnel monitor while at ground level. He is tagging & stacking the plastic bags full of insula- tion.	.063	5		10

* Threshold Limit Value (TLV) ---The time-weighted average concentration to which it is believed most people could be exposed daily without adverse effect.

* Time Weighted Average ----- The average exposure of asbestos fibers to employees during an eight hour work day.

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TABLE B

INSULATORS SUMMARY OF SAMPLE ANALYSIS

AREA OPERATION	NO. OF SAMPLES	ASBESTOS CONCENTRATION FIBERS/ML	
		<u>AVERAGE</u>	<u>RANGE</u>
Personnel monitor on employee actually removing insulation from tower. (Only able to obtain one sample due to short operation).	1	1.43	---
Personnel monitor on Insulator at ground level, tagging each plastic bag full of asbestos & stacking it for removal later. (Only able to obtain one sample due to short operation).	1	.063	---
Area sampling around towers.	6	.243	0 to 1.31

EHS
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11-21-73

SAFETY AND LOSS PREVENTION MANUAL FOR CONTRACTORS

ST0028264



THE DOW CHEMICAL COMPANY

ENGINEERING & CONSTRUCTION SERVICES

NOVEMBER 1973

SAFETY AND LOSS PREVENTION MANUAL FOR CONTRACTORS

ST0028265

"It is the objective of Engineering and Construction Services to establish and maintain an active, successful accident prevention program that will ultimately result in top safety performance by contractors doing work for The Dow Chemical Company."

THE DOW CHEMICAL COMPANY

ENGINEERING & CONSTRUCTION SERVICES

NOVEMBER 1973

ST0028266

This manual supersedes Safety and Loss Prevention Manual for Contractors dated February, 1970.

SAFETY MANUAL FOR CONTRACTORS

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ST0028267

INTRODUCTION

This safety manual contains the minimum safety rules and procedures for performance of work by contractors and their subcontractors as required by Engineering and Construction Services, The Dow Chemical Company, for any division, subsidiary or affiliate, hereinafter referred to as "owner." This manual will apply at all Engineering and Construction Services project locations unless the owner has an existing set of safety rules specifically for contractors. Exceptions to this manual, or any part thereof, will be agreed upon prior to starting any field work. The owner will be represented on construction as defined in the contract and hereinafter referred to as "owner's representative."

Contractor assumes and has the full responsibility and liability for the safety of its agents, servants and employees and for the compliance of its subcontractors and anything contained herein does not relieve the contractor of such responsibility or liability.

Safety rules and procedures are an integral part of each contract and must be carried out fully, as any other specification for the job. The contractor will be held responsible for his subcontractors conforming with these safety rules and procedures. Any exception to the rules set forth herein, during the course of any project, must have prior written authorization from the owner's representative.

Contractors and contractor supervision unable or unwilling to secure personnel performance in keeping with these rules will not be acceptable as supervisors. Contractor employees who exhibit a poor attitude toward safe work and safety procedures will not be acceptable. Employees leaving a job due to safety violations will not be allowed to return to any owner's work without proper authorization from the owner. The contractor's safety record will be one criteria used to judge his qualifications for bidding.

In addition to the rules set forth herein, contractors working in or near an existing operating facility must be cognizant of and conform to owner's safety rules for that area and any federal, state or local laws governing.

Should any procedure set forth herein conflict with applicable federal, state or local laws, the latter will apply.

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1.0 GENERAL SAFETY RULES

1.1 The contractor shall actively and adequately promote safe working performances on the part of his employees. He shall participate in activities to this end, such as safety organizations, incentive award programs, contractor-owner programs, etc. It is expected that each contractor will conduct his own safety programs to best suit his particular needs.

1.1.1 American Standards Association, Z-16.1 Standard, "Recording and Measuring Work Injury Experience," shall be used as a guide to classify contractor injuries.

1.2 Prior to starting any field work on each job, the owner's representative will conduct a prejob safety conference with an authorized representative of the contractor, a manufacturing representative, when available, available subcontractor's representatives and owner's Safety Department representative, when available. At this time, the nature of any chemical hazards or special safety rules for the area will be reviewed with the manufacturing representative and the contractor will be provided with printed copies of area rules where applicable. The "Prejob Safety Check Sheet" form (see sample) will be prepared by the owner's representative and a copy furnished to the contractor.

1.3 An effective system of indoctrination and education of employees in safety and loss prevention shall be provided by each contractor. Contractors shall inform all their employees of all safety rules and all safety procedures before working in an owner's plant.

1.3.1 Contractors shall inform all of their employees of the location and the use of nearest safety shower, eye bath and emergency equipment such as gas masks, fire extinguishers, and fire blankets.

1.4 Contractors shall use a regular system of work inspection to detect and correct hazardous conditions, safety rule violations and unsafe working conditions. These safety inspections shall be reported to owner's representative in writing each week.

1.4.1 Orderliness is a basic requirement for all jobs and must be maintained at all times. Special attention must be given to maintaining clear walkways and roadways, removal of trash, removal of slipping and tripping hazards and proper storage of materials. Contractors must make every effort to keep mud, slush or other slippery substances off of plant roads. In cases where this cannot be avoided, contractors must clean the roadways immediately.

1.5 Temporary buildings and material storage areas shall be set up as neatly as possible to present an orderly appearance.

1.5.1 Temporary building shall be sheeted with noncombustible material, such as transite or metal siding and roof, and each must be identified with the contractor's name.

1.5.2 Metal buildings served with electricity must have the skin of the building properly grounded as well as the service entrance switch.



CONSTRUCTION PRE-JOB SAFETY CHECK SHEET

DATE: _____

JOB: _____

BLOCK: _____

JOB or C O NUMBER _____ CONTRACTOR _____

- | | | |
|---|------------------------------|-------------------------------|
| 1. Standard Emergency signals fully understood? | Yes ☐ | N.A. ☐ |
| 2. Contractor responsibility in time of emergency understood? | Yes ☐ | N.A. ☐ |
| 3. Fire and ambulance telephone numbers known? | Yes ☐ | N.A. ☐ |
| 4. Location of available medical facilities known? | Yes ☐ | N.A. ☐ |
| 5. Areas for possible evacuation designated? | Yes ☐ | N.A. ☐ |
| 6. Fire protection requirements known and plans made for provision of adequate equipment? | Yes ☐ | N.A. ☐ |
| 7. Special safety rules and signals for this area known?
(Owner will provide written special rules where applicable.) | Yes ☐ | N.A. ☐ |
| 8. Nature of chemical or special hazards for area reviewed with Manufacturing Representative? | Yes ☐ | N.A. ☐ |
| 9. Special safety equipment for this area known? | Yes ☐ | N.A. ☐ |
| 10. Safety Showers and Eye Wash locations known? | Yes ☐ | N.A. ☐ |
| 11. Safe work permit understood? (Designated place(s) to obtain known?) | Yes ☐ | N.A. ☐ |
| 12. Name of individual(s) to issue safe work permit _____ | Yes ☐ | N.A. ☐ |
| 13. Red Tag rule understood? | Yes ☐ | N.A. ☐ |
| 14. Smoking area designated? | Yes ☐ | N.A. ☐ |
| 15. Contractor scaffold rules known? | Yes ☐ | N.A. ☐ |
| 16. Crane inspection and critical lift procedure understood? | Yes ☐ | N.A. ☐ |
| 17. Unfired pressure vessel test procedure understood? | Yes ☐ | N.A. ☐ |
| 18. Do you have a copy of and understand "Safety & Loss Prevention Manual for Contractors"? | Yes ☐ | N.A. ☐ |
| 19. Contractor assumes responsibility for and control of their vendors entering the plant for compliance with plant safety rules and regulations? | Yes ☐ | N.A. ☐ |
| 20. Are your subcontractors aware of rules and procedures? | Yes ☐ | N.A. ☐ |

REMARKS: _____

_____ Contractor Representative	_____ Date	_____ Subcontractor	_____ Date
_____ Owner's Representative	_____ Date	_____ Subcontractor	_____ Date
_____ Manufacturing Representative	_____ Date	_____ Subcontractor	_____ Date
_____ Owner's Safety Representative	_____ Date	_____ Subcontractor	_____ Date

1.6 Contractors must furnish trash containers made of metal, each with metal covers kept in place.

1.7 Contractors must report to the owner's representative, by name, those employees discharged for safety rule infractions.

1.8 Contractors shall maintain continuous safety planning to cover jobs where circumstances have changed and new hazards require new controls.

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2.0 EMERGENCY PROCEDURES

2.1 Contractors must inform their employees of existing plant procedures for first aid and ambulance calls. If none exist, the contractor shall submit to the owner's representative prior to starting work, an outline of the procedure to be followed.

2.2 In the event of an explosion or fire, contractor personnel working in the area affected must observe the following rules.

2.2.1 Shut down all equipment in operation and leave the area at once.

2.2.2 Report to your company field office immediately, in person or by phone.

2.2.3 DO NOT re-enter the area until authorized by the owner's representative.

2.2.4 The contractor shall notify the owner's representative in person or by telephone as soon as possible that all employees in the area are accounted for or that specific employees cannot be accounted for.

2.3 If operating a motor vehicle in an affected area, turn off engine, get out of the vehicle, and be prepared to leave the area if necessary. Motor vehicles, other than emergency units, must not be driven into an area downwind of a gas release. Barricades across plant roads must be honored by all vehicles at all times.

2.4 Contractors shall inform their employees of pertinent emergency signals and procedures for the area in which they work. If none exist, the contractor shall outline and inform employees of steps to be taken in the event of disaster emergencies that could arise.

3.0 FIRST AID - INJURIES - REPORTS

3.1 The owner's representative shall be notified immediately in the event of any death, occupational disease, disabling injury or potentially significant injury to a contractor employee (whether or not it is determined that "lost time" will be involved) while at work on the owner's job.

3.1.1 The contractor must thoroughly investigate, determine and report all details of an accident and cooperate with the owner's inspection teams.

3.1.2 A written report must be submitted on every injury requiring medical treatment of any kind, to the owner's representative on the job, no later than 10:00 a.m. of the day following the injury. Also any near miss, potentially serious or hazardous condition that occurs, must be reported in the same manner, although no injury to personnel may be involved. Forms for these reports, "Notice of Contractor Accident and Property Loss" are available through the owner's representative (see sample).

3.1.3 All fires must be reported regardless of duration or extent.

3.2 Employees must report any injury to their immediate supervisor even though it may be considered slight.

3.2.1 The contractor will assure that all injured personnel report to a recognized medical facility.

3.2.2 In the event of any serious injury, an ambulance **MUST** be called.

3.2.3 In the event of accidents, ambulance run, etc., contractors must exert all possible effort to keep onlookers from the scene. The only personnel required in such areas are those directly engaged in assisting in the emergency.

3.3 Employees must not attempt to remove foreign material from the eyes, except by washing with water. If foreign materials get in the eye, the eye must be washed immediately with running water, preferably at an eyewash station and the washing continued uninterrupted for at least fifteen minutes. It is vital that the injured employee and others who are able to help him make sure that thorough and complete washing of the eye is accomplished.

3.4 If chemicals come in contact with the body, the affected parts must be washed with running water for at least fifteen minutes. To make sure that adequate washing is accomplished, shoes and clothing covering affected parts must be removed. The owner's representative must be consulted before reuse of clothing and shoes that may have been contaminated.



NOTICE OF CONTRACTOR ACCIDENT OR PROPERTY LOSS

THIS NOTICE TO BE SUBMITTED BY CONTRACTOR TO THE OWNER REPRESENTATIVE AS SOON AS POSSIBLE, BUT NOT LATER THAN 10:00 A.M. THE DAY AFTER ANY INJURY REQUIRING MEDICAL TREATMENT OF ANY KIND, OR FOR ANY POTENTIALLY SERIOUS INCIDENT OR HAZARDOUS CONDITION OCCURRING, ALTHOUGH NO INJURY WAS INVOLVED.

CONTRACTOR _____ SUB CONTRACTOR _____

P. O. # _____ DATE _____ TIME _____ A.M. P.M. LOCATION _____

NAME OF INJURED _____ AGE _____

CRAFT _____ CLOCK NUMBER _____

EXTENT OF INJURY _____

WHERE TREATED _____

IS THIS A DISABLING INJURY _____ YES _____ NO _____ INDEFINITE _____

WHAT HAPPENED _____

CAUSE _____

CORRECTIVE ACTION TAKEN _____

SAFETY INVESTIGATION MADE BY _____

FOREMAN _____ DATE _____ OWNER REPRESENTATIVE _____ DATE _____

GENERAL FOREMAN _____ DATE _____ FOR CONSTRUCTION SPT _____ DATE _____

PRIME CONTRACTOR SPT. _____ DATE _____ _____ DATE _____

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4.0 INDIVIDUAL ACTION

- 4.1 Horseplay in any form is not allowed.
- 4.2 Running in the job site must be avoided except in case of an emergency.
- 4.3 Personnel must not climb through, under, over, or between railroad cars of a train except in the performance of assigned duties.
- 4.4 Personnel must not make inoperative or operate safety devices such as relief valves, deluge valves, gate valves, electrical and mechanical interlocks, guards, electrical switches, etc.
 - 4.4.1 Any accidental interruption of lines or equipment in service or any irregularities observed must be reported to the owner's representative immediately.
- 4.5 Unsafe shortcuts, such as walking pipelines, sliding down pipe or stanchions and cutting corners to save a few steps, must be avoided.
- 4.6 Tools, materials or equipment must not be intentionally dropped or thrown from one level to another unless adequate precautions have been taken to assure that no injury to persons or damage to equipment will occur.
- 4.7 Personnel must not ride a load being handled by a crane. Slings, hooks, etc., must not be ridden, except where a crane basket or a bosuns' chair and safety belt are used.
- 4.8 Personnel must not walk, drop or jump onto a transite roof. Care should be exercised while erecting new transite roofs.

5.0 VEHICLES AND TRAFFIC

5.1 Personnel will comply with all safety rules and signs regarding traffic and vehicles at all times

5.2 The maximum speed limit on open roads in the plant is 25 miles per hour and 10 miles per hour within work areas, unless otherwise designated by signs.

5.3 Vehicles stopped on plant roadways for the purpose of loading or discharging passengers must not be passed in either direction except, after coming to a complete stop, the vehicle may be passed at no more than 10 miles per hour provided the way is clear.

5.4 Fuel tanks on motorized equipment must not be filled while the engine is running or when welding or other hot work is being done nearby. Smoking will not be allowed during fueling operations

5.5 Equipment such as welding machines, pumps, etc., shall not be transported with the engine running.

5.6 All equipment must be in safe mechanical working condition at all times. In addition to complying with state requirements as to brakes, lights, signals, horns, mufflers, etc., vehicles must be periodically inspected by a representative of the contractor. Necessary repairs and adjustments must be made prior to their use on owner's property

5.7 The use of winch trucks, flatbeds, stakebeds, etc., as transportation for personnel will not be permitted unless adequate safety provisions are made and the vehicle is adapted for that purpose. In any case, the number of personnel must not cause overcrowding.

5.8 Riding of "Cherry Pickers" or cranes is permitted only when adequate safety provisions such as seats, platforms, rails, etc., are provided for passengers.

5.9 The maximum number of people who may ride in a pickup truck is three in the cab and six seated on the floor of the bed, or on approved "built-in" seats

5.10 Personnel must be sitting down at all times when the vehicle they are riding is in motion and must not have any part of their body over the sides.

5.11 Pedestrian paths and walkways must be used whenever provided. In their absence, personnel using streets and roadways must walk facing approaching traffic, on left-hand side of road

5.12 The following rules must be observed in the operation of cranes, cherry pickers, winch trucks and other equipment having booms or extended loads which extend 15 feet or more in front of or to the rear of the equipment.

5.12.1 Stop at all stop signs

5.12.2 At intersections, when the equipment is to proceed straight across a thoroughfare or turn either way, the equipment must stop; the flagman must get off the equipment, clear all traffic, then flag the equipment through the intersection or around the corner.

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- 5.12.3 Before entering any thoroughfare, street, road, etc., from a work area, the flagman must clear the traffic and flag the equipment onto the road.
- 5.12.4 All booms or loads extending more than 15 feet must be marked or flagged with high visibility material when moving on plant roads.
- 5.12.5 A flagman must be provided and swinging must be controlled with a tag line when moving in a congested area or where there is personnel.
- 5.12.6 Hauled material that overhangs the sides or ends of a truck must be red flagged at the extent of the overhang. Loads must not be hauled from a single suspension cable that allows free swinging beyond the sides of the vehicle. Loads or vehicles that extend out of the normal road lanes require flagman or escorts.
- 5.12.7 Contractors must check vertical clearances on the route to be used prior to moving equipment or high loads.
- 5.13 Contractors must determine from the owner's representative when and which roads are to be used, prior to moving extremely heavy loads such as large rubber-mounted equipment and low-boy loads.

6.0 PROTECTIVE EQUIPMENT AND CLOTHING

6.1 The contractor and his employees shall recognize the importance and the use of special protective equipment and clothing.

6.1.1 The contractor shall be responsible for knowing and enforcing special owner area or job rules requiring special personnel protection.

6.1.2 Contractors shall provide their employees with the proper protective equipment required.

6.2 Approved safety glasses shall be a minimum requirement on all jobs at all times. Safety glasses with side shields are required when grinding, chipping or performing any job where side shields would afford protection from flying particles.

6.2.1 Approved safety glasses must fulfill federal requirements (GGG-G-513) for drop ball testing and safety code for polarized "Strain" pattern.

6.2.2 Employees wearing contact lens must wear chemical goggles.

6.3 Chemical goggles, approved prior to their use, are required for working in or entering certain chemical areas which are posted with signs, or while doing chipping or power tool cleaning work on pressurized lines or equipment which contains hazardous chemicals

6.3.1 All employees working in the vicinity of hazardous chemicals must know where the nearest safety shower and eye bath facilities are located.

6.3.2 When chemical type goggles are in use, the headband must be around the back of the head, not around the safety hat.

6.4 Approved safety hats are required for all contractor work. Metal hats must not be used where electrical hazards exist.

6.4.1 Approved safety hats must fulfill requirements in Federal Specification GGG-11-142b. The major requirement in this specification says, "The specimen must withstand the drop of an 8-pound spherical weight, approximately 3.8 inches in diameter, from a distance of 5 feet, without breaking the hat, bottoming out or breaking suspension." Most skull caps, scalp guards, bump helmets, etc., will not meet this test. Safety hats shall not be drilled or punched for ventilation holes, or edges trimmed off hats.

6.5 All personnel shall wear air hoods, or equivalent, supplied with filtered air, when sandblasting or applying volatile or toxic material inside tanks, rooms or any other area not adequately ventilated

6.6 Safety belts or harnesses, with lifelines attached, are to be worn by employees when performing work in elevated positions where the use of scaffolds or ladders is impractical and where a slip might result in a serious fall.

6.7 Personnel must wear owner approved life jackets or otherwise be protected by handrails or lifelines when working over water wherein a drowning hazard exists.

6.8 Personnel shall wear personal clothing that is safe and proper for their job. Wearing of canvas shoes, sneakers or houseshoes and working in an undershirt, shorts or stripped to the waist, is prohibited. Safety shoes are strongly recommended.

6.9 Fixed blade knives used as tools of the trade must be carried in sheaths while not in use.

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7.0 FIRE PROTECTION

7.1 Accumulation of trash, oily rags, combustible materials and similar fire hazards of any nature will not be permitted.

7.2 The area around welding operations must be kept free of hoses and flammable material of all kind.

7.2.1 There must be a fire extinguisher or water hose easily accessible for each welding, cutting, burning or other such operations, located in close proximity to the operation. It is the contractor's responsibility to obtain the required fire extinguishers for his welding operations.

7.2.2 Special care must be taken during overhead welding operations to safeguard personnel and prevent falling sparks from starting a fire.

7.3 All tarpaulins shall be fire-retardant and identified as such by stenciling: "FR-treated (date)" with a minimum of two-inch letters in diagonal corners. In lieu of this treatment, fireproof blankets such as fiberglass or asbestos are acceptable.

7.3.1 Contractors must inspect and test all tarpaulins at least once each six months to be sure that they are still fire-retardant. Tarpaulins needing it must be retreated or removed from the plant immediately. At this time the tarpaulins must be restenciled in the same manner as in 7.3 above.

7.4 Fire plugs, extinguishers, hose racks and other emergency equipment, shall not be covered or blocked and fire equipment lanes must always be kept clear.

7.5 All heating units for offices, shops, work areas, change rooms, etc., must be in good working order and periodically inspected. Gas units must be provided with "flame-out" protective devices and electrical units must be grounded. All heating units must be turned off at the end of each work day.

7.6 Flammable or explosive type material such as fuel, oil, cleaning agents, etc., must be properly contained, clearly identified, separately stored and kept clear of work areas. Appropriate signs must be provided in storage areas.

7.7 All cans used for transporting or transferring gasoline or fuel must be labeled by Underwriters' Laboratories or Factory Mutual Laboratories.

7.8 Fuel storage tanks, filler hoses and the dispersing vehicle or containers must be properly grounded.

7.8.1 A quick shut-off valve is required on the dispensing end of fuel hoses.

7.8.2 Equipment fuel tanks must not be filled while the engine is running.

7.8.3 Smoking, welding or any spark- or flame-producing operation must be stopped in the immediate area during refueling operations.

7.9 Welding rod cabinets presenting a fire or safety hazard will not be permitted. Cabinets of fireproof materials equipped with strip heaters are recommended. If light bulbs are used, they must be securely guarded with adequate spacing in regard to the cabinet and to stored material. Metal

cabinets must be grounded in an approved manner.

7.10 Volatile materials must not be applied near an open flame. If such material is to be applied in a vessel, or other poorly ventilated, confined area, only explosion-proof lights and connections will be used. The contractor must designate such areas as "No Smoking."

7.11 Heating equipment for freeze protection of concrete must be approved by the owner's representative prior to use.

7.12 Welding or cutting torches and hoses must not be connected to cylinders when stored in any enclosure or building. When work is shut down and equipment is unattended, close all valves at the gas and oxygen cylinders, bleed lines and check five minutes later for pressure build-up. If there is no build-up, bleed hoses at the torch, remove hoses from cylinders and store. No smoking will be permitted during this shutdown procedure.

7.13 Gas and oxygen cylinders must be handled with care, properly supported in an upright position away from any source of heat or flame and securely tied off. All cylinders not in use must have their caps in place and stored as above.

7.13.1 Oxygen cylinders in storage and not in use must be separated from gas cylinders by a fire retardant partition or a minimum distance of 10 feet.

7.13.2 When gas and oxygen cylinders are lifted by hoisting equipment, a basket, a cradle, or similar handling device must be used. Cylinders must not be lifted by the valve protection caps.

7.14 All "No Smoking" restrictions must be strictly observed. Smoking is not permitted in vehicles in designated "No Smoking" areas.

7.15 Compressed gases must not be used for cleaning of clothes, the body or work areas. Oxygen must not be used for pressure testing purposes.

7.16 Adequate ventilation must be provided when cleaning agents are used.

7.17 Contractors must not dump flammable or toxic materials into sanitary sewers or waste water system without prior clearance of the owner's representative.

8.0 MACHINERY, TOOLS AND EQUIPMENT

8.1 The safe designed capacity of any tool or piece of equipment must not be exceeded. Tools and equipment must not be modified in any manner that reduces the original safety capacity.

8.2 All contractor owned, leased or rented equipment must be in safe mechanical working condition to render safe service at all times.

8.2.1 Equipment must be inspected by contractor supervision prior to its use on a job and periodically thereafter to insure that it is in safe working order. Crane inspection must be submitted in writing to owner's representative using the owner's "Hoisting Equipment Inspection" form. (See Sample.) Special attention must be given to such items as cables, guards, booms, blocks, hooks, grounds, electrical cords and safety devices. Equipment must be shut down before repairs or adjustments are made.

8.2.2 Defective tools and equipment must be removed from the job immediately and if repairable, must be properly repaired before reuse on owner's job.

8.2.3 Machinery, tools and equipment must not be operated without all guards and safety devices in place and functioning properly.

8.2.4 The contractor has the complete responsibility for a safe operation when using hoisting equipment to make lifts. The contractor shall verify weights of loads to be lifted. No load shall be lifted which exceeds the manufacturer's rated capacity of the crane. When one of the following conditions prevail, the contractor must submit in writing, using the owner's "Check List for Critical Lifts" (see sample), an outline of the safety planning for the lift to the owner's representative prior to starting the lift.

- a. The load exceeds 80 percent of rated load charts for crane.
- b. The load exceeds 50 percent of rated load chart for crane, and possible failure would endanger existing facilities.
- c. Two booms are required to make the lift.
- d. Poles or derricks have been erected for this specific lift.

8.2.5 If burning of lugs or other such flame-producing operations may be required during crane hoisting operations, arrangements for proper safe work permits must be made before the lifting operations begin.

8.3 Equipment with exposed gears, belts, couplings, etc., must be provided with proper guards.

8.4 Electrical tools and equipment operating at more than 32 volts must be properly grounded. Certain test equipment such as oscilloscopes, vacuum tube voltmeters and signal generators, as well as certain areas where exposed d-c equipment is used, do not require grounding and proper operational procedures must be ascertained from the owner's representative.

8.5 Only 32-volt, or less electrical service is to be used in connection with drop lights when working inside metallic vessels, unless 115-volt service is essential for the operation of equipment.

(Use Hydraulic Crane Inspection Form for Hydraulic Cranes)

OWNER _____ DATE _____
EQUIPMENT NO. _____
=====

MANUFACTURER/MODEL _____
MAXIMUM CAPACITY _____
SERIAL NO. _____
DATE OF MANUFACTURE _____
COUNTERWEIGHT FOR NORMAL USE _____
BOOM LENGTH FOR NORMAL USE _____
COUNTERWEIGHT FOR CAPACITY LIFT _____
BOOM LENGTH FOR CAPACITY LIFT _____
CAPACITY CHART POSTED IN CAB () YES () NO

CONDITION

1. Identification and high visibility markings
2. Hooks (pins-swivels)
3. Boom sheaves and blocks (straps)
4. Traveling block (pins-grease fittings)
5. Cable drums (facing and becket)
6. Hoist lock (catch on brakes)
7. Clutches (bands-pins-cotter pins)
8. Whip line (condition of cable, age)
9. Load line (condition of cable, age)
10. Boom line (condition of cable, sockets, age)
11. Boom and jib pendants (condition of cable, sockets, age)
12. Main boom (structural members - pins)
13. Jib (structural members - pins)
14. Gantry (A-frame) - (pins-sheaves-straps)
15. Swing lock
16. Hydraulic or air system
17. Lighting system
18. Painting
19. Drive chains (tension)
20. Tires (air pressure-damage)
21. Steering mechanism
22. Counterweights (adequate or not)
23. Cab, platforms, handrailing, steps, glass, etc. (access)
24. Fire extinguisher
25. Boom hoist safety device
26. Power lowering - whip line
27. Power lowering - load line
28. Boom base pins
29. Housekeeping

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OVERALL EVALUATION OF CONDITION

() Good, Safe () Fair, Safe () Unsafe

Inspector (Owner) _____

Audited by (Dow) _____

Tag No. _____ Date _____

CHECK LIST FOR CRITICAL LIFTS

1. ACC. #/W. O. # _____
2. JOB DESCRIPTION _____

3. LOCATION _____
4. DOW REPRESENTATIVE _____
5. PLANNING DATA:
 - A. 1. CONTRACTOR _____
2. SUPERINTENDENT _____
3. SUPERVISOR RESPONSIBLE FOR LIFT _____
 - B. DESCRIPTION OF ITEM TO BE RAISED _____

 - C. MAJOR HOISTING EQUIPMENT TO BE USED (MUST INCLUDE INSPECTION TAG
NUMBER AND DATE. TAGS ARE VALID FOR FOUR MONTHS.)
 1. _____
 2. _____
 3. _____
 4. _____
 - D. EQUIPMENT & LIFT RELATIONSHIP
 1. OPERATING RADIUS _____
 2. BOOM LENGTH _____
 3. ALLOWABLE LOAD (FROM LOAD CHART) _____
 4. RATIO OF LIFT TO ALLOWABLE LOAD _____

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CHECK LIST FOR
CRITICAL LIFTS

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5. CLEARANCE BETWEEN BOOM & LIFT _____

6. CLEARANCE TO SURROUNDING FACILITIES _____

E. SCHEDULE OF OPERATIONS (INCLUDE TIME FOR RIGGING & EQUIPMENT
INSPECTIONS).

6. BASIS FOR CRITICAL LIFT:

A. LOAD EXCEEDS 80% OF LOAD CHART FOR CRANE OR DERRICK _____

B. LOAD EXCEEDS 50% OF LOAD CHART, AND FAILURE WOULD ENDANGER
EXISTING FACILITIES _____

C. TWO BOOMS ARE REQUIRED _____

D. POLES OR DERRICKS HAVE BEEN ERECTED FOR THIS SPECIFIC LIFT _____

7. HOW WEIGHT OF CRITICAL LIFT WAS OBTAINED:

A. CERTIFIED SCALE WEIGHT _____

B. CALCULATED INDEPENDENTLY BY MORE THAN ONE SOURCE. _____

1. SOURCE _____ WEIGHT _____

2. SOURCE _____ WEIGHT _____

C. IF LIFT IS AN EXISTING ITEM (BEING REMOVED OR DEMOLISHED), THE
WEIGHT IS TO BE RECALCULATED, TAKING INTO ACCOUNT ALL MODIFICA-
TIONS INCLUDING INTERNAL AS WELL AS AN ALLOWANCE FOR SCALE,
SEDIMENT, SLUDGE, INSULATION, LIQUID, ETC.

1. SOURCE _____ WEIGHT _____

2. SOURCE _____ WEIGHT _____

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CHECK LIST FOR
CRITICAL LIFTS

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8. CONDITION OF HOISTING EQUIPMENT & RIGGING:

- A. HAS EQUIPMENT BEEN REINSPECTED FOR THIS LIFT? _____
- B. HAS ALL EQUIPMENT & RIGGING BEEN INSPECTED AND FOUND IN ACCEPT-
ABLE CONDITION FOR THIS LIFT? _____

9. GUYS ANCHORS & GUYS:

- A. ADEQUACY OF FOUNDATION FOR FOOT BLOCKS _____
- B. ADEQUACY, NUMBER, AND LOCATION OF GUYS & ANCHORS _____

- C. FOOT BLOCKS ARE TO BE ANCHORED _____
- D. CONDITION OF ALL CABLE, INCLUDING SPLICES, CLAMPS; THIMBLES, AND
OTHER HARDWARE _____

10. STABILITY OF GROUND AREA:

- A. CHECK SOIL BEARING ALLOWABLE LOAD _____
- B. WILL MATS BE REQUIRED? _____
- C. ANY UNDERGROUND INSTALLATIONS NEEDING SPECIAL TREATMENT _____

11. OPERATORS:

WHAT IS OPERATOR'S EXPERIENCE ON THIS EQUIPMENT AND THIS TYPE OF
LIFT? _____

12. REMARKS:

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CHECK LIST FOR
CRITICAL LIFTS

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NOTHING IN THIS SUBMISSION AND/OR ACCEPTANCE OF THIS CHECK LIST
IS TO BE CONSIDERED AS RELIEVING THE CONTRACTORS OF ANY RESPON-
SIBILITY FOR A SAFE OPERATION.

CONTRACTOR

BY: _____

TITLE: _____

RESUME OF ACTUAL SCHEDULE:

DATE OF LIFT _____

INSPECTIONS COMPLETED _____

LIFT STARTED _____

PERMANENT SUPPORTS COMPLETED _____

TOTAL TIME _____

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8.6 When arc welding is being done in an area restricted by a safe work permit, the grounding lead must be connected to the work within the limits as provided in the safe work permit.

8.7 Any contact provision for connections to an owner's plant services for construction use must be cleared with the owner's representative. Authorized connections must be made under the direction of the owner's personnel. The turning off and on of the supply shall be done only by authorized owner's personnel.

8.8 Gloves must not be worn while using grinders, drills, saws or any tools where gloves are apt to become entangled.

8.9 Loose clothing must not be worn while working around machinery.

8.10 Personnel must not crank any machinery with their feet.

8.11 Hose connectors and adaptors must be of a standard manufacture and used only for the type of service intended.

8.11.1 In order to insure positive locking at all times, connectors must be in good condition and not abused. Sandblast hose connections shall be the safety lock type which prevents accidental disengagements.

8.11.2 Air pressure on pneumatic tools must be bled down before tools are disconnected from air supply.

9.0 LADDERS AND SCAFFOLDS

9.1 All ladders must be of the proper length and in good condition before using them. All unacceptable ladders must be immediately removed from owner's property.

9.1.1 Ladders are not to be painted with anything other than clear paint or linseed oil.

9.1.2 All straight ladders must be tied off or held. Stepladders higher than ten feet must be tied off at the top or held at the bottom by another workman. Personnel must not stand on the top step of any stepladder.

9.1.3 When climbing a ladder, personnel must face the ladder and keep both hands free for climbing.

9.1.4 Set straight ladders so that the bottom is out from the vertical about one-fourth of the distance from the upper support to the bottom.

9.1.5 All ladders should be provided with nonskid adjustable feet or properly supported on a level surface.

9.1.6 The area around the bottom of all ladders must be free from slippery substance and tripping hazards.

9.1.7 Ladders are not to be used as pencil or scaffold boards.

9.1.8 The top section of extension ladders are not to be used by themselves.

9.2 The use of No. 9 soft annealed wire should be minimized on scaffolds.

9.2.1 When No. 9 soft annealed wire is used, a minimum of two separate strands must be used to tie scaffold handrails, braces, etc. The ties must be crossed to form a lock and prevent slipping in any direction.

9.2.2 Do not reuse No. 9 wire for any purpose.

9.3 Makeshift scaffolds such as boxes, crates and drums must not be used.

9.4 Wood scaffolding, aluminum ladders, aluminum scaffolds and aluminum pencil boards are not permitted except in special cases as specified in operating area rules and job specifications or by prior written approval from the owner's representative

9.5 The following rules apply to all patented metal scaffolds:

9.5.1 Scaffolds must be erected with proper fixtures made for each type of scaffolding. Scaffolds and associated equipment must not be modified in any manner that reduces the manufacturer's designed performance.

9.5.2 All scaffolds and allied equipment must be kept in good repair.

9.5.3 Equipment that is damaged or deteriorated to the extent that it is unsafe shall not be used. Such equipment shall be removed from the owner's property.

9.5.4 Compensate for unevenness of ground by using adjusting screws in addition to proper blocking.

- 9.5.5 Do not force braces to fit. Adjust evenness of scaffold until the proper fit can be made with ease.
- 9.5.6 Use ladders when climbing scaffold rather than the cross braces and handrails.
- 9.5.7 Personnel shall use ladders when climbing scaffold rather than the cross braces.
- 9.5.8 Horizontal diagonal bracing shall be used at bottom and intermediate levels of thirty feet to prevent racking of all scaffolds.
- 9.5.9 Planking overhang shall be 3-5/8" on stackup scaffolds. 1" by 4" wood cleats shall be nailed across top of planking at each end outside end frames. 2" by 2" cleats shall be bolted underside each end of plank with 2-1/4" stove bolts.
- 9.5.10 The maximum span for guying or tying off all fixed towers is every 18' of elevation.
- 9.6 The following rules apply to rolling tower scaffolds:
- 9.6.1 The minimum base dimensions for towers shall be 5' by 7'.
- 9.6.2 Towers of a height greater than three times the minimum base dimension must be guyed or tied off while being erected, used or dismantled.
- 9.6.3 Caster brakes must be applied when not in motion.
- 9.6.4 Towers must be free of men, material and equipment while being moved. Care must be exercised while moving.
- 9.6.5 Surface area where tower is being moved shall be free of rubble or any material that may cause the tower to tip.
- 9.6.6 Do not attempt to move a rolling tower without sufficient help.
- 9.6.7 Do not extend adjusting screws beyond the limits specified by the equipment manufacturer.
- 9.6.8 The minimum size for casters shall be 6". Scaffolds higher than 25' must be stabilized either with outriggers or hand lines while being moved.
- 9.6.9 Horizontal diagonal bracing is to be used at the bottom and at intermediate levels of 30 feet.
- 9.6.10 Do not use knee braces or cantilevered brackets on rolling towers.
- 9.7 The following rules apply to suspended scaffolds:
- 9.7.1 Chains or 1/4" (minimum) steel cable shall be used to support suspended scaffolds. All suspended scaffolds shall be anchored to prevent swinging. Chains so used shall be made of not less than 1/4" links* and shall be inspected immediately prior to each use.

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TABLE I
SAFE CENTER LOADS FOR SCAFFOLD
PLANK IN POUNDS

Span in Feet	SIZE OF PLANK			
	2 x 10 Dressed To 1-5/8 x 9'	2 x 12 Dressed To 1-5/8 x 11'	3 x 10 Dressed To 2-5/8 x 9'	3 x 12 Dressed To 2-5/8 x 11'
6	256	309	667	807
8	192	232	500	605
10	153	186	400	484
12	128	155	333	404
14	110	133	286	346
16		116	250	303

TABLE II
SAFE CENTER LOADS ON TIMBER USED AS
BEAMS IN POUNDS

Nominal Timber Size	LENGTH OF SPAN IN FEET								
	5	6	8	10	12	14	16	20	24
2 x 4	440	290	210						
4 x 4	725	575	420	330	260	215			
2 x 6	780	650	470	360	290	240	190		
2 x 8	1400	1150	850	660	530	450	370	270	190
2 x 10	2190	1820	1350	1050	860	710	600	450	320
2 x 12	2800	2630	1950	1530	1250	1050	890	670	510
3 x 8	2100	1730	1290	990	810	680	560	410	290
3 x 10	3290	2750	2120	1590	1300	1070	900	670	490
3 x 12	4525	3940	2920	2300	1880	1570	1340	1000	660

TABLE III
SAFE LOADING FOR SIMPLE MATERIAL
HOIST ON CANTILEVER BEAM IN POUNDS

Beam Size	LENGTH OF CANTILEVER (B) IN FEET						
	2	3	4	5	6	7	8
4 x 4	220	160	105	80	65		
4 x 6	495	320	260	190	150	125	105
6 x 6	740	490	360	285	230	190	160
6 x 8	1325	875	650	515	420	350	300
8 x 6	1765	1165	865	685	560	470	400

Horizontal dimension from front bearing to rear anchor must be equal to or greater than cantilever Projection "B" in table

• 1/4" proof coil loading chain Safe Load	900 lbs.
5/16" proof coil loading chain Safe Load	1,360 lbs.
5/16" proof coil loading chain Proof-tested Safe Load	2,720 lbs.
5/16" proof coil loading chain Unlimited Safe Load	5,440 lbs.

9.7.2 The suspended support must be insulated when arc welding is to be performed from platform, thus avoiding accidental arcing and subsequent failure.

9.7.3 Block and falls shall be a minimum of two sheaves for 3/4" rope and the minimum size rope shall be 5/8". Acid resistant rope shall be used in acid or caustic areas. Tail ropes shall be placed in an open container for protection while used in an acid area or above operating machinery, pumps, etc. All ropes and blocks must be inspected and tested prior to each use and taken down and stored inside at the end of each work day.

9.8 The following rules apply to all scaffolds:

9.8.1 Scaffolds and related material shall be carefully inspected at regular intervals and particularly just before using.

9.8.2 Provide sufficient sills or underpinning on all scaffolds to be erected on filled or otherwise soft ground. Scaffold boards shall not be used for this purpose.

9.8.3 All scaffolds must be plumb and reasonably level at all times.

9.8.4 Anchor running scaffolds to wall approximately every 28' of length and 18' of height. Use additional care when using pulley arms.

9.8.5 Handrailing and access ladders must be used on all scaffolds regardless of height. Scaffolds higher than 30' around columns, tanks, etc., must have access ladders constructed on the inside, unless a ladder cage is provided. Handrails must be at a height sufficient to provide maximum personnel safety.

9.8.6 Scaffolds must not be used as material hoist towers or for mounting derricks without first determining the loads and stresses involved.

9.8.7 Erect scaffolds in such a manner that ladder is accessible and lined up from top to bottom.

9.8.8 Lumber used in the construction of platforms shall be of good quality and reasonably straight grained. It shall be free from defects such as injurious ring shakes, checks, splits, cross grains, unsound knots, knots in groups, decay and growth characteristics or any other defect which materially decreases the strength of the lumber. Planking shall not be painted all over, as this would conceal any defects. Scaffold boards shall be identified by painting each end. All scaffold boards shall be used exclusively for that purpose. Nothing less than 2" by 4" material shall be used as handrails on wooden scaffolds.

9.8.9 The normal size of planking shall be determined from Table I. These values are for planks with the wide face up, with the loads concentrated at the center. Loads given in the table are net. Allowance has been made for the weight of the planking. If select structural coast region Douglas fir, merchantable structural square and sound southern pine are used, the loads may be increased 45 percent.

9.8.10 Planks used for platforms shall be of uniform thickness, laid close together. These planks must be overlapped at the bearers. An overlap of at least 2' must be allowed with the bearing in the center of the overlap. When planks overhang a bearer more than one-tenth of the length of the span, the planks must be securely fastened to the bearer at the opposite end to prevent tipping.

9.8.11 All nails used in scaffold construction shall be driven full length. If double headed nails are used, they shall be driven to the first head only and may not be used on platforms or walkways. No nail smaller than 8d shall be used in this construction. The design must be such that no nail is subject to a direct pull.

9.8.12 Where beams are used in scaffolding, the schedule of loads shown in Table II shall be followed. Loading on cantilever type beams for tool and material hoists is shown in Table III. It should be noted that the loading at the center of bearing point is 4 times as great as the load being lifted and the bearing should be checked to ascertain if it will support the contemplated load. The inboard end of the beam has a force upward of twice the load and must be securely fastened with no nails in direct pull.

9.8.13 Platforms shall be kept clear of slippery substances and tripping hazards.

10.0 DANGER, WARNING AND CAUTION TAGS

10.1 Danger Tags (Red)

10.1.1 To insure that operating status of equipment is not changed while it is being used or worked on, red danger tags must be attached to the controls so that personnel will know not to use them. These tags must be used to protect personnel exposed to hazards of equipment and must be respected by all personnel. The personnel responsible for the operation of equipment or their designee must clear and tag the equipment. Any personnel whose safety could be endangered while working on this equipment must affix their tag. Violation of red danger tag rules will result in disciplinary action up to and including rejection from any work on owner's property.

10.1.2 No control such as a valve, switch, clutch, etc., is to be operated by anyone while a red danger tag is attached. If a control must be operated intermittently such as for testing equipment, the red danger tag must be properly removed before each operation. Attachment of danger tags to equipment controls does not mean that equipment has been cleared to work on. When work is to be done on tagged-out equipment, personnel responsible for the operation of the equipment are responsible for clearing the equipment and making it safe for others to work on.

10.1.3 Whenever the operation or use of any equipment may endanger anyone, a request must be made to supervision of the group which operates the equipment to clear and tag the equipment. "Clearing" means making the equipment inoperable and safe for others to work on. The authority to clear and tag equipment may be delegated by this supervision to any qualified personnel after supervision has assured themselves that the person delegated can properly clear the particular job involved.

10.1.4 After the group which operates the equipment has cleared and tagged the equipment, each worker or group of workers who may be exposed to the hazards must tag the equipment for their protection. When red danger tags are attached to equipment by persons other than those responsible for its operation, prior approval from the person responsible shall be obtained.

10.1.5 As the individual jobs have been completed, each worker or group of workers must remove their tags immediately.

10.1.6 The group responsible for the equipment must place their tag first and remove their tags last.

10.1.7 Red danger tags may be removed only upon authorization of the person designated on the tag. The supervisor of any person who fails to remove a red danger tag when a job has been completed may authorize the removal of the tag after he has determined to his complete satisfaction that the equipment can be operated in a safe manner. In the space on the tag entitled "Removal Will be Ordered By", it is permissible to designate a classification such as shift foreman, electrician, or machinist instead of a specific individual's name.

10.1.8 At the discretion of the supervisor, locks may be used on valves and switches in addition to, but not replacing red danger tags.

10.1.9 Tags removed must be filled out and turned in to the owner's representative.

10.2 Warning Tags (Green)

10.2.1 When it is necessary to convey instructions or information prior to operation of equipment controls, green "warning" tags are to be attached to the controls.

10.2.2 Green "Warning" tags should be removed when conditions set forth on the tag have been met.

10.3 Caution Tags (White)

10.3.1 White caution tags are affixed to mechanical or electric equipment by the owner's representative to prevent operation of such equipment by anyone until items on the tag have been completed.

10.3.2 The tag provides spaces for meggering, rotation, final alignment and lubrication of equipment. When appropriate action has been taken, the personnel performing the work signs and dates the tag.

10.3.3 When tagged equipment is released to the owner, a representative of operations and the owner's representative sign the tag which is kept by the owner's representative until job completion.

11.0 SAFE WORK PERMITS

11.1 Safe work permits issued by the owner to contractor personnel may be required for certain hazardous locations and conditions. These permits are designed to provide a means of checking at the job site the safety of such jobs as, but not limited to, entering closed vessels; working on electrical gear; welding, cutting on, breaking into or repairing pipelines or vessels in operation or under pressure or that have contained hazardous materials. These permits also cover work involving the use of flame or spark producing equipment in hazardous areas or near an open ditch and work on machinery.

11.2 Contractor supervision must be in close contact with the progress of work as well as communicating with the owner's representative for up-to-date status of operations. Further, contractor supervision must be certain that all personnel involved are informed as to specific procedures and changes in the situation.

11.3 Safe work permits are to be initially requested through the owner's representative and issued by the owner's operating area or facility supervision involved on any job where the safe work permit is applicable. More than one safe work permit may be required on certain jobs which will be ascertained upon obtaining each safe work permit. Permits are issued on a day-to-day basis.

11.4 Personnel must give to the person issuing the safe work permit a careful and complete description of the work to be done.

11.4.1 Where a job presents a serious man hazard due to chemical, mechanical, electrical, temperature or height exposure, it is mandatory that a written safe job procedure accompany the request for the safe work permit. This procedure is to be signed by the owner's representative, process representative, and the contractor, who thereby agree that the procedure allows the job to be done safely

11.5 Directions and restrictions noted on safe work permits must be carefully followed.

11.6 A safe work permit must be reissued for a job if there is evidence that conditions have changed subsequent to the issuance of the original safe work permit.

11.7 Permits issued for jobs that last longer than one day will normally be issued for that job each day. By mutual consent of the parties involved, permits for these jobs may be issued for longer or shorter periods of time.

11.8 Vessels in an existing facility to be entered must be made safe for personnel by such measures as disconnecting, blinding, or double block and bleed on connecting piping. If such precautions are impractical, a detailed procedure for performing the work in a safe manner must be prescribed as specified in Paragraph 11.4.1.

11.9 Vessels in an existing facility to be welded on, or cut, must be positively checked inside for flammable or explosive gas and or liquids and safe work permits issued before heat is applied.

11.10 The contractor may request safe work permits for his own protection. Safety checks by the owner for dangerous gases or chemicals should be requested through the owner's representative when there is any uncertainty.

11.11 All safe work permits in the area affected are automatically cancelled when an emergency signal is sounded and must be reissued after the all-clear signal.

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12.0 EXCAVATIONS, FLOOR OPENINGS, BARRICADES

12.1 Where a safety hazard would be created for any personnel, excavations such as ditches, trenches, or bell holes should be sufficiently sloped to prevent cave-ins or slides. If sloping is impractical, shoring must be used in cases whenever the vertical dimension exceeds four feet.

12.1.1 Personnel removing shoring after completion of work must not be in the bottom of the excavation. Shoring must be removed in such a manner to prevent cave-in on personnel.

12.2 Contractors must provide adequate barricades, covers, handrails, signals, flagmen, or other appropriate warning devices to protect personnel near any hazardous operation or excavation. Floor openings, open trenches, excavations, etc., shall be covered when handrails or barricades do not provide adequate protection to personnel.

12.2.1 Contractors must notify the owner's representative of necessary obstruction on road shoulders on the day it occurs.

12.2.2 Contractors must obtain approval from the owner's representative at least one day prior to cutting roads or otherwise obstructing traffic on plant roads.

12.3 Grade lines, ropes, chains, etc., must be sufficiently marked in order to be visible day or night.

12.4 No obstruction of any kind, whether permanent or temporary, is permitted within 8'-9" horizontally from the centerline of any railroad track and within 22'-6" vertically from the top of the rail. Specific authorization from the owner's representative as well as blue flags are required prior to boring under or excavating adjacent to railroad tracks. Blue flags must be placed on railroad tracks when the entrance of a train would present a hazard to personnel or equipment.

12.5 In locations where strictly temporary loading or unloading operations are to be undertaken, portable derails must be used by personnel engaged in these operations to prevent overrunning of the cars by a train.

12.6 Blue flags meeting ICC specifications, available through the owner's representative, must be placed on railroad tracks when the entrance of a train would present a hazard to personnel or equipment and in addition to, or in conjunction with, derails during loading or unloading operations. Blue lights, available from the owner's representative, must be attached to blue flags at night.

12.6.1 Blue flags must be placed on the tracks so they will be in unobstructed view of the train crew and they must be placed a minimum of two-car lengths (100 feet) in front of the end car they are intended to protect. Exceptions to the minimum distance may be made by the owner's representative where existing installations do not allow sufficient space.

12.6.2 Blue flags must be removed immediately when the hazard for which they were installed no longer exists.

13.0 RADIATION

13.1 All state and/or federal laws governing use, storage or handling of a radiation source must be complied with.

13.2 A minimum of qualified people are required for the performance of any radiographic work.

13.3 In locations where a radiation source is used or stored, regulations require that it be marked with a "Radiation Material" sign. This sign is for the purpose of informing anyone in the area that such material is present, and not that a safety hazard due to radiation exists

13.3.1 Only authorized personnel may enter an area marked by "Radiation Area" sign.

13.3.2 All areas where a radiation hazard exists must be roped off and marked conspicuously by standard signs at a safe distance from the source of radiation. These signs bear the radiation symbol of magenta (or purple) on a yellow background with the words "Caution—Radiation Area."

13.3.3 "Radiation Area" signs must be removed when a radiation hazard no longer exists in the affected area.

13.4 Equipment containing a source of radiation must not be handled, uncrated or installed without prior clearance with the owner's representative.

14.0 DEMOLITION

14.1 This section specifically covers the demolition (removal of facilities that have been abandoned). Due to the inherent hazards in this type of work, special care must be devoted to safe procedures, scope understanding and communications concerning the safe clearance of work.

14.2 It is not appropriate to make assumptions in any stage of a demolition job. Responsibilities must be delegated only to those whose profession qualifies them to make the necessary judgments and decisions that are required to assure the safest possible prosecution of the job. From start to finish, each person connected with a demolition job must adopt an attitude of "prepare for any possibility."

14.3 The contractor shall make certain that all lines, services and equipment have been cleaned or purged and properly cleared for safe removal. All lines (including water and steam) are to be considered hot until positive safe clearance has been obtained.

14.4 Special care shall be exercised to locate and mark old underground or otherwise hidden lines, cables and sewers using the best available information and owner's assistance.

14.5 The prejob safety meeting with the contractor, as covered in Section 1 of this manual, shall devote special attention to preplanning the safety aspects of demolition jobs.

14.5.1 Steps of dismantling and loads to be handled shall be reviewed with the owner's representative prior to starting work.

14.5.2 Temporary provisions must be made where safety showers, eyewash baths and fire extinguishers are being moved in the work area.

SERVICE CONTRACT

THIS CONTRACT, entered into this 12th day of March, 1976, by and between DOW CHEMICAL U.S.A., TEXAS DIVISION, an Operating Unit of THE DOW CHEMICAL COMPANY, a Delaware corporation with an office in Freeport, Texas (DOW), and U. S. CONTRACTORS, INC. (Contractor),

W I T N E S S E T H :

ARTICLE I - DESCRIPTION OF THE WORK

1.01 Contractor agrees to furnish supervision and labor to perform in a workmanlike manner the work assigned to it from time to time by Dow.

1.02 All work to be performed hereunder shall be authorized by Dow in writing and shall not commence until authorization is acknowledged and accepted by Contractor or his designated representative. Both Dow and Contractor shall submit to each other the name of their personal representatives for the specific work so authorized.

1.03 Should Contractor at any time refuse or neglect to supply a sufficiency of properly skilled workmen or fail in any respect to prosecute the work hereunder with diligence, Dow may terminate Contractor's right to proceed with the work.

1.04 All work shall be performed in accordance with the individual departmental safety rules and the terms and conditions of Dow's Safety and Loss Prevention Manual for Contractors, a

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current copy of which has been furnished to the Contractor. Contractor shall comply with all applicable provisions of Federal, State and municipal safety laws and building codes to prevent accidents or injuries to persons or damage to property on or about or adjacent to the premises where the work is being performed.

1.05 All equipment, tools, safety equipment and special clothing will be furnished by Dow.

1.06 This contract is an individual agreement and in no way shall affect any other contract between the parties hereto.

ARTICLE II - COST OF THE WORK

2.01 Labor

(a) For performance of the work assigned to Contractor under this agreement, Dow shall pay Contractor in accordance with the terms set forth in Exhibit "A", which is attached hereto and made a part hereof.

(b) Contractor's fee shall include, but is not limited to, all salaries, wages, insurance premiums, if any, office personnel, transportation, profit and overhead.

(1) Contractor shall be reimbursed for actual statutory assessments for payroll taxes (FICA, FUT, SUT). Actual taxes assessed shall be expressed as a percent of each monthly payroll to which they apply. Each month's payroll tax percent shall be used in invoicing each succeeding month.

ARTICLE III - INVOICING AND PAYMENT

3.01 Contractor shall submit invoices in duplicate to Dow, attention General Accounting Department, as soon as practical at

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the end of each week, or at such time as may be requested by Dow. Invoices are to be supported by properly authorized time reports and such other support as Dow may require for validation of amounts billed.

3.02 All such invoices shall be paid by Dow within ten (10) Dow business days after the receipt thereof, unless any items thereon are questioned by Dow, in which event Dow shall have the right to withhold payment thereof until verification of both the amount claimed and the validity of said claim. Dow's investigation thereof shall proceed as promptly as possible, with which investigation Contractor shall provide complete cooperation. With respect to invoices so questioned and later approved by Dow, payment shall be made as promptly as possible and practical after such approval.

ARTICLE IV - LIENS

4.01 Contractor (a) shall indemnify and save harmless Dow from any and all claims, demands, causes of action or suits of whatever nature arising out of the services and labor furnished by Contractor under this contract, and from all liens upon the real property upon which the work is located arising out of the services furnished by Contractor under this contract and (b) agrees to defend any suit or action brought against Dow based on any such claims, demands, or proceedings to enforce or foreclose any such liens based on any such work performed hereunder, and to pay all costs and expenses, including attorney's fees, in connection therewith or arising therefrom in a manner that will keep said property free and

ST0533122

clear of all liens, claims and encumbrances arising from the performance of this contract by Contractor.

4.02 Contractor shall notify Dow immediately of the filing of any liens upon Dow's property upon which the work is located arising out of the services furnished by Contractor under this contract. If required, Contractor shall furnish (a) a good and sufficient release or waiver of lien or (b) receipts in full, together with an affidavit that the receipts cover all the services for which a lien might be filed except as covered by the releases and waivers of liens, but if any laborer or other person refuses to furnish a waiver or release or receipt in full, Contractor may furnish a bond, in an amount and with such sureties as may be approved by Dow, conditioned to indemnify Dow against any claim or lien or otherwise. In the event Contractor fails or refuses to have such lien released or furnish such bond when so required, Dow shall have the right to pay any sums necessary to obtain the release of such lien and to deduct the amount paid therefor from any sums due Contractor hereunder.

ARTICLE V - LIABILITY FOR INJURY TO PERSONS

5.01 Contractor assumes the entire responsibility and liability and will indemnify and hold harmless Dow, its agents, servants and employees from and against any and all losses, expenses, demands and claims made against Dow, its agents, servants and employees, by any employee or officer of Contractor because of injury or alleged injury (including death), whether caused by Dow's negligence or otherwise, arising from any source while said employee or officer

S10533123

is on premises owned, operated or leased by Dow or under the control of Dow, or while said employee or officer of Contractor is performing under this agreement, and agrees to defend any suit or action brought against Dow based on any such alleged injury, and to pay all costs and expenses, including attorney's fees, in connection therewith or resulting therefrom.

ARTICLE VI - INSURANCE

6.01 Insurance to be carried by Contractor shall be in accordance with Exhibit "B" which is attached hereto and made a part hereof.

ARTICLE VII - PERMITS, LICENSES AND APPLICABLE LAWS

7.01 Contractor shall procure all other necessary permits and licenses, observe and abide by all applicable laws, regulations, ordinances and other rules of the State, territory or other political subdivision thereof, wherein the work is done, or any other duly constituted public authority, and further agrees to hold Dow harmless from liability or penalty which might be imposed by reason of an asserted or established violation of such laws, regulations, ordinances or other rules.

7.02 Contractor shall comply with any and all State and Federal laws regarding age, citizenship, hours, wages and conditions of employment affecting the work covered by this agreement. The wage rate to be paid by Contractor to personnel employed directly upon the site of the work shall not exceed the prevailing construction industry wage rate in the work area.

ST0533124

7.03 Unless this contract is within one of the exemptions provided for in Executive Order 11246, effective September 24, 1965, as amended by Executive Order 11374 signed October 13, 1967, Contractor shall comply with paragraphs (1) through (7) of Section 202 of Executive Order 11246 (as amended) which are incorporated herein by reference.

ARTICLE VIII - TITLE TO THE WORK

8.01 The title to all work completed and in the course of construction and of all materials which are delivered and stored at the site and which will necessarily be incorporated in the work, as between Dow and Contractor shall be in Dow. All drawings, designs and specifications prepared for the work, whether furnished by Dow or Contractor shall become the property of Dow, and upon completion of the work, or termination of this agreement, be delivered to Dow.

ARTICEL IX - INDEPENDENT CONTRACTOR

9.01 Contractor shall be an independent contractor under this agreement and shall assume all of the rights, obligations and liabilities applicable to it as such independent contractor hereunder and any provisions in this contract which may appear to give Dow the right to direct Contractor as to the details of doing the work herein convered or to exercise a measure of control over the work shall be deemed to mean that Contractor shall follow the desires of Dow in the results of the work only.

S10533125

ARTICLE X - NOTICES

10.01 Any notice or order provided for in this agreement shall be considered as having been given to Dow if delivered personally to Dow's representative at the site of the work, or if mailed by registered mail, postage prepaid to:

Dow Chemical U.S.A.

Texas Division

Freeport, Texas 77541

Attention: Purchasing Department

10.02 Any notice or order provided for in this contract shall be considered as having been given to Contractor if delivered personally to its representative at the site of the work, or if mailed by registered mail, postage prepaid, to it at the following address:

U. S. Contractors, Inc.

P. O. Box 338

Lake Jackson, Texas 77566

ARTICLE XI - PUBLICITY

11.01 Any information relative to the services performed under this contract shall not be released or used by Contractor for publication, advertising or any other purpose without the prior written approval of Dow.

ARTICLE XII - TERM

12.01 This contract shall cancel and supersede that certain contract dated October 20, 1975, and shall continue after the effective date hereof until terminated by either party giving to

ST0533126

the other party thirty (30) days' prior written notice. Contractor shall complete any and all work assigned to it by Dow prior to notice of termination, all in accordance with the terms and conditions of this agreement.

EXECUTED as of the day and year first above written.

DOW CHEMICAL U.S.A.
TEXAS DIVISION, an operating unit
of THE DOW CHEMICAL COMPANY

By *F. R. West*
Title Purchasing Department

U. S. CONTRACTORS, INC.

By *W. E. Mc Intyre*
Title President

ST0533127



DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

AIRBORNE ASBESTOS SURVEY
CHLORINE VI, A-5024

FILE NO. A50-865

DATE May 13, 1976

AUTHOR H. N. Edwards
L. R. Joe

CHECKED R. L. Daniel

DATE May 23, 1976

Summary

Only one of the 85 samples analyzed for airborne asbestos was above the newly proposed level of 0.5 fibers per cubic centimeters. It is therefore concluded that workmen are not being overexposed to asbestos within the Chlorine VI area.

It is recommended that each workman be made aware of the results found, the hazards of overexposure and the necessity for keeping these levels below the prescribed limits. This informing should be documented.

ST0014619

Distribution

J. D. Dean A5024
S. F. Edquist B2401
R. E. Flake B101
W. H. Fletcher B101
L. R. Joe A5024
J. D. Laman B1226
O/F. Schumm B101

✓file

- (2) R. R. Langner 1803 Bldg.-Midland
Marlene Swank 1803 Bldg.-Midland
* F. D. Axe - Pittsburg
* C. H. Van Metre - OCD
* C. E. Halphen - Plaquemine
* R. D. Olson 607 Bldg.-Midland
* C. L. Sercu - Ohio

May 13, 1976

INTRODUCTION

The Occupational Safety and Health Act (OSHA) requires that occupational exposures to airborne asbestos be controlled so that no worker is exposed to more than 5.0 asbestos fibers per cubic centimeter of air based on a count of fibers greater than 5 micrometers in length. These are determined by a time-weighted average (TWA) exposure for an eight hour work day, and no peak concentrations of asbestos more than 10.0 fibers per cubic centimeter as determined by a minimum sampling time of 15 minutes.

In July, 1976, the limit will be lowered to 2.0 fibers per cubic centimeter.

It is now proposed to lower the limit to 0.5 fibers per cubic centimeter with a peak of 5.0 fibers.

This survey was conducted at Chlorine VI to evaluate the worker exposures by personnel monitoring. The tests were taken from 12-8-75 to 4-15-76.

METHODOLOGY

Airborne samples were collected using a Bendix Permissible air sampling pump (Bendix Corp., Baltimore, Md.). The fibers were collected by pulling air through a Millipore filter (AAWG 03700) mounted in a Millipore disposable cassette. Flow rates for the pumps were calibrated at 1400 cubic centimeters per minute and sampling times were four hours or greater (Table I). All samples were collected by L. R. Joe of Chlorine VI.

Samples were analyzed by Lee Martin of Central Laboratory using the following technique:

Four marked squares are cut from a filter about half-way from the edge to the center. This section is then placed on a drop of clearing solution¹ and placed on a microscope slide. The sample is covered with a cover slip and allowed to clear (about 15 minutes). The sample count is made on a Reichert Zetopan Optical microscope using Nomaraki interference contrast at 500 magnification. Counts are made for particles greater than 5.0 microns, and reported as fibers per filter square.

RESULTS

Results of the airborne sample analyses are shown in Table I. All levels are below the new proposed standards except one.

1

Clearing solution: 0.1 g/ml of clean Millipore filter paper in 1:1 diethyloxalate: dimethylphthalate.

ST0014620

May 13, 1976

CONCLUSIONS

Workmen are not being overexposed to asbestos within the Chlorine VI area.

RECOMMENDATIONS

It is recommended that each workman be made aware of the results found, the hazards of overexposure, and the necessity for keeping these levels below the prescribed limits. This informing should be documented.

ST0014621

EHS
HNE/bbs
5-13-76

TABLE I (continued)

NAME	MASTER NO.	JOB CLASSIFICATION	DATE	SAMPLING TIME	FIBERS/CC	>5.0 μ M
D. W. Tennison	138895	Class 2 Oper.	2-20-76	205 min.	0.061	
L. A. Warren	138825	Class 2 Oper.	3-29-76	225 min.	0.002	
D. E. Williams	136236	Class 2 Oper.	3-31-76	240 min.	0.013	
E. A. Engeling	107860	Sr. Asst. Chem. Class B	2-20-76	235 min.	0.006	
O. E. Lewis	130122	Asst. Chemist Class B	2-23-76	232 min.	0.002	
C. E. Cruseturner	SI4-4729	U.S. Contractor Specialist	4-14-76	269 min.	0.006	
C. R. Darba	CT4-9139	U. S. Contractor Mechanic	4-14-76	251 min.	0.000	
S. L. Elledge	154 MCGill	Machinist	4-15-76	252 min.	0.000	
W. Foreman	SC-160-14-462	Electrician	4-8-76	266 min.	0.002	
P. P. Garcia	C34-8846	U. S. Contractor Mechanic	4-14-76	251 min.	0.002	
Rodney Holt	SC-160-14-895	G.S. Electrician	4-7-76	262 min.	0.000	
Mike Kelly	SC-160-14-027	G.S. Electrician	4-7-76	262 min.	0.021	
P. Mariam	CI-4-1434	U. S. Contractor Mechanic	4-15-76	270 min.	0.008	
Gordon Mathis	FI-4-7370	U. S. Contractor Mechanic Foreman	4-13-76	268 min.	0.000	
Bill Peavey	SC160-14-451	Gulf States Electrical Foreman	4-8-76	264 min.	0.002	
Walter Rose	SC160-14-171	Gulf States Electrician	4-7-76	262 min.	0.002	
Dexter Tilke	CI-4-1047	U. S. Contractor Mechanic	4-13-76	268 min.	0.000	
C. Wright	HI-2-2962	U. S. Contractor Helper	4-15-76	249 min.	0.011	

ST0014622

TABLE I (continued)

NAME	MASTER NO.	JOB CLASSIFICATION	DATE	SAMPLING TIME	FIBER/CC	>5.0 μ M
J. W. Christy	134071	Control Oper. C	12-17-75	222 min.	0.032	
G. H. Cox	114380	Control Oper. C	1-17-76	245 min	0.108	
C. A. Fritze	116142	Control Oper. C	12-31-75	240 min.	0.106	
C. E. Barton	135195	Class 1 Oper.	12-27-75	240 min.	0.128	
D. J. Gheen	138301	Class 1 Oper.	1-18-76	240 min.	0.006	
E. Griggs, Jr.	137292	Class 1 Oper.	12-30-75	240 min.	0.088	
J. D. Hancock	117331	Class 1 Oper.	1-17-76	240 min.	0.124	
J. D. Hancock	117331	Class 1 Oper.	2-23-76	245 min.	0.084	
V. A. Huett, Jr.	133621	Class 1 Oper.	12-15-76	165 min.	0.128	
S. E. Lewis	137377	Class 1 Oper.	2-5-76	212 min.	0.316	
J. C. Malloy	137301	Class 1 Oper.	1-17-76	240 min.	0.626	
R. D. Mickle, Jr.	138177	Class 1 Oper.	2-8-76	250 min.	0.028	
M. V. Montgomery, Jr.	131902	Class 1 Oper.	1-17-76	245 min.	0.410	
R. W. Roddy	134864	Class 1 Oper.	1-21-76	300 min.	0.106	
W. M. Tyson	135085	Class 1 Oper.	3-2-76	245 min.	0.089	
E. J. Wiley	136698	Class 1 Oper.	12-30-75	240 min.	0.068	
J. M. Aguilar, Jr.	138003	Class 2 Oper.	4-5-76	240 min.	0.301	
R. E. Cooper	135124	Class 2 Oper.	3-29-76	228 min.	0.088	
L. E. Barrera, Jr.	135720	Class 2 Oper.	3-31-76	240 min.	0.121	
G. E. Brown	138813	Class 2 Oper.	3-3-76	214 min.	0.310	
L. J. Cortemelia	138835	Class 2 Oper.	3-24-76	205 min.	0.082	
D. Falcon	137632	Class 2 Oper.	3-30-76	240 min.	0.006	
H. L. Fields	136189	Class 2 Oper.	4-5-76	240 min.	0.061	
G. Flores	138866	Class 2 Oper.	3-29-76	225 min.	0.006	
O. T. Garcia	133888	Class 2 Oper.	3-25-76	240 min.	0.061	
R. J. Garner	136251	Class 2 Oper.	3-30-76	240 min.	0.002	
P. Gonzales, Jr.	135143	Class 2 Oper.	3-24-76	195 min.	0.413	
G. H. Gear	139239	Class 2 Oper.	3-25-76	240 min.	0.082	
W. B. Hall	139240	Class 2 Oper.	3-29-76	215 min.	0.016	
D. Heinrich	134880	Class 2 Oper.	3-29-76	225 min.	0.128	
D. L. Hobbs	136252	Class 2 Oper.	3-30-76	240 min.	0.090	
E. C. Mata	133775	Class 2 Oper.	3-26-76	240 min.	0.102	
R. L. Mickens	139063	Class 2 Oper.	3-26-76	240 min.	0.022	
O. Ramirez	138449	Class 2 Oper.	3-24-76	205 min.	0.103	
J. L. Robers-n	139188	Class 2 Oper.	3-25-76	240 min.	0.122	
N. Rodriguez	137390	Class 2 Oper.	3-26-76	240 min.	0.086	
W. W. Shimek	131677	Class 2 Oper.	3-29-76	215 min.	0.082	

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TABLE I
ASBESTOS ANALYSES
CHLORINE VI
Fibers/cc

NAME	MASTER NO.	JOB CLASSIFICATION	DATE	SAMPLING TIME	FIBER/CC	>5.0 µM
J. D. Dean	118829	Production Supt.	3-11-76	275 min.	0.000	
T. H. Canady	132970	Asst. Prod. Supt.	3-11-76	255 min.	0.003	
E. W. Kelly, Jr.	112241	Sr. Prod. Engineer Cl.3	3-10-76	242 min.	0.006	
R. D. Duke	136971	Production Engineer	3-3-76	240 min.	0.001	
L. R. Joe	139406	Res. & Dev. Engineer	12-8-75	238 min.	0.008	
S. M. Hazelwood	139368	Res. & Dev. Engineer	2-20-76	240 min.	0.003	
S. E. Knox	122119	Production Foreman	3-10-76	244 min.	0.008	
C. M. Warren	113835	Production Foreman	4-1-76	235 min.	0.006	
W. L. English	137945	Foreman	4-8-76	264 min.	0.021	
K. E. Guffey	115399	Foreman	2-23-76	188 min.	0.008	
H. Solis	135084	Foreman	3-31-76	240 min.	0.081	
J. E. Wheeler	130985	Foreman	4-13-76	268 min.	0.006	
G. S. Bengt	119051	Rot. Shift Foreman	1-19-76	240 min.	0.021	
S. R. Brown	131719	Rot. Shift Foreman	12-30-75	240 min.	0.013	
G. P. Crofton	137536	Rot. Shift Foreman	1-6-76	245 min.	0.008	
C. S. Dalmolin	119459	Rot. Shift Foreman	12-16-75	241 min.	0.008	
H. C. Dayton	135208	Rot. Shift Foreman	3-23-76	243 min.	0.006	
H. A. McDougal	134962	Rot. Shift Foreman	3-2-76	255 min.	0.000	
M. G. Garza	133521	Sr. Instr. Technician	3-3-76	245 min.	0.000	
T. D. Bratton	134201	Instr. Processman	2-23-76	239 min.	0.000	
L. J. Skinner	138979	Instr. Trainee	3-2-76	236 min.	0.006	
S. A. Bond	108898	Sr. Material Cont. Techn.	3-4-76	212 min.	0.000	
M. Lashlee	114731	Production Clerk	2-25-76	255 min.	0.018	
C. Anderson	115435	Control Oper. A	1-12-76	200 min.	0.082	
N. E. Leopold	111508	Control Oper. A	1-17-76	240 min.	0.008	
J. A. Menefee	112934	Control Oper. A	2-24-76	245 min.	0.061	
R. P. Myers	110304	Control Oper. A	12-17-76	230 min.	0.006	
R. R. Rustin	113814	Control Oper. A	1-19-76	240 min.	0.006	
W. D. Wood	115122	Control Oper. A	12-16-75	249 min.	0.006	
W. D. Wood	115122	Control Oper. A	2-25-76	298 min.	0.006	

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file



DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

AIRBORNE ASBESTOS
PERSONNEL MONITORING
CHLORINE 6
BUILDING A-5024

FILE NO. A50-1304

DATE October 17, 1977

AUTHOR H. N. Edwards

T. J. Loftus

CHECKED R. L. Daniel

DATE October 28, 1977

Summary

None of the 42 samples analyzed for airborne asbestos was above the required level of 2.0 fibers/cc. It is therefore concluded that employees are not being overexposed to asbestos within the Chlorine 6 area.

It is recommended that each employee be made aware of the results found, the hazards of overexposure and the necessity for keeping these levels below the prescribed limit. This informing should be documented.

bbs

Distribution

J. D. Dean A-5024
S. F. Edquist A-1201
R. E. Flake B-101
W. H. Fletcher B-101
T. J. Loftus A-5024
O. F. Schumm B-101
File

(2) R. R. Langner 1803 Midland
Marlene Swank 1803 Midland
Donna J. Roberts - 2020 Midland
* F. D. Axe - Pittsburg
* C. E. Halphen - Plaquemine
* Paul Greenfield-Grandville, Ohio
* R. D. Olson 433 Midland
* C. H. VanMetre - OCD

ST0607026

INTRODUCTION

The Occupational Safety and Health Act (OSHA) requires that occupational exposures to airborne asbestos be controlled so that no worker is exposed to more than 2.0 asbestos fibers per cubic centimeter of air based on a count of fibers greater than 5 micrometers in length. These are determined by a time-weighted average (TWA) exposure for an eight hour work day, and no peak concentrations of asbestos more than 10.0 fibers per cubic centimeter as determined by a minimum sampling time of 15 minutes.

It is now proposed to lower the limit to 0.5 fibers per cubic centimeter with a peak of 5.0 fibers.

This survey was conducted at Chlorine 6 to evaluate the worker exposures by personnel monitoring. The tests were taken from 4-27-77 to 9-1-77.

METHODOLOGY

Airborne samples were collected using a Bendix Permissible air sampling pump (Bendix Corp., Baltimore, Md.). The fibers were collected by pulling air through a Millipore filter (AAWG03700) mounted in a Millipore disposable cassette. Flow rates for the pumps were calibrated at 1400 cubic centimeters per minute and sampling times were four hours or greater (Table I). All samples were collected by T. J. Loftus of Chlorine 6.

Samples were analyzed by Lee Martin of Central Laboratory using the following technique:

Four marked squares are cut from a filter about half-way from the edge to the center. This section is then placed on a drop of clearing solution¹ and placed on a microscope slide. The sample is covered with a cover slip and allowed to clear (about 15 minutes). The sample count is made on a Reichert Zetopan Optical microscope using Nomarski interference contrast at 500 magnification. Counts are made for particles greater than 5.0 microns, and reported as fibers per filter square.

RESULTS

Results of the airborne sample analyses are shown in Table I. All levels are below the new proposed standards.

CONCLUSIONS

Workmen are not being overexposed to asbestos within the Chlorine 6 area.

¹ Clearing solution: 0.1 g/ml of clean Millipore filter paper in 1:1 diethyloxalate: dimethylphthalate.

ST0607027

File A50-1304

-3-

October 17, 1977

RECOMMENDATIONS

It is recommended that each workman be made aware of the results found, the hazards of overexposure, and the necessity for keeping these levels below the prescribed limits. This informing should be documented.

EHS
HNE/bbs
10-17-77

STU60/0901S

TABLE I
AIRBORNE ASBESTOS
CHLORINE 6
FIBERS/CC > 5.0 uM

NAME	MASTER NO.	JOB CLASSIFICATION	DATE	TIME HRS.	RESULTS
K. E. Guffey	115399	Foreman	7-26-77	4	< 0.1
J. E. Wheeler	130985	Foreman	4-29-77	4	< 0.1
S. E. Lewis	137377	Control Oper. B.	7-22-77	4	< 0.1
G. E. Brown	138813	Control Oper. C.	7-22-77	4	< 0.1
R. J. Bugg, Jr.	139770	Control Oper. C.	9-1-77	4	< 0.1
E. Griggs, Jr.	137292	Control Oper. C.	7-29-77	4	< 0.1
M. V. Montgomery, Jr.	131902	Control Oper. C.	8-2-77	4	< 0.1
E. J. Wiley	136698	Control Oper. C.	7-26-77	4	< 0.1
L. L. Barrera, Jr.	135720	Class 1 Oper.	7-29-77	4	< 0.1
F. R. Carroll	138181	Class 2 Oper.	8-8-77	4	< 0.1
L. J. Cortemelia	138835	Class 2 Oper.	8-16-77	4	< 0.1
M. D. Davis	138985	Class 2 Oper.	4-25-77	4	< 0.1
M. D. Davis	138985	Class 2 Oper.	8-11-77	4	< 0.1
J. Freelon, Jr.	137693	Class 2 Oper.	8-12-77	4	< 0.1
D. T. Garcia	136510	Class 2 Oper.	8-4-77	4	< 0.1
F. Gonzales, Jr.	135143	Class 2 Oper.	8-4-77	4	< 0.1
G. H. Grear	139239	Class 2 Oper.	8-4-77	4	< 0.1
D. L. Hobbs	136252	Class 2 Oper.	8-16-77	4	< 0.1
E. C. Mata	133775	Class 2 Oper.	4-25-77	4	< 0.1
R. L. Mickens	139063	Class 2 Oper.	8-1-77	4	< 0.1
E. G. Nunez	138517	Class 2 Oper.	8-9-77	4	< 0.1
A. Ramirez	134956	Class 2 Oper.	8-15-77	4	< 0.1
O. Ramirez	138449	Class 2 Oper.	8-9-77	4	< 0.1
J. L. Roberson	139188	Class 2 Oper.	8-4-77	4	< 0.1
W. W. Shimek	131677	Class 2 Oper.	8-11-77	4	0.2
V. King	McGill		5-18-77	4	< 0.1
J. Perkins	McGill		5-18-77	4	< 0.1
C. Cladwell	Gulf States		7-13-77	4	< 0.1
R. Holt	Gulf States		6-15-77	4	< 0.1
D. Robertson	Gulf States		6-15-77	4	< 0.1
W. Rose	Gulf States		7-13-77	4	< 0.1
Cruzeturner	U.S. Contractor		5-31-77	4	< 0.1
C. Dirba	U.S. Contractor		5-2-77	4	< 0.1
R. Draks	U.S. Contractor		4-27-77	4	< 0.1
P. Garcia	U.S. Contractor		5-24-77	4	< 0.1
B. Gray	U.S. Contractor		5-31-77	4	< 0.1
L. Mann	U.S. Contractor		6-10-77	4	< 0.1
G. Mathis, Jr.	U.S. Contractor		4-29-77	4	< 0.1

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TABLE I (continued)

NAME	MASTER NO.	JOB CLASSIFICATION	DATE	TIME HRS.	RESULTS
G. Mathis, Sr.	U.S. Contractor		5-24-77	4	< 0.1
P. Miram	U.S. Contractor		4-27-77	4	< 0.1
D. Tielke	U.S. Contractor		5-2-77	4	< 0.1
D. Tielke	U.S. Contractor		5-6-77	4	< 0.1

ST0607030

SERVICE CONTRACT

THIS CONTRACT, entered into this 23rd day of October,
19 78, by and between DOW CHEMICAL U.S.A., TEXAS DIVISION, an
Operating Unit of THE DOW CHEMICAL COMPANY, a Delaware corporation
with an office in Freeport, Texas (DOW), and U. S. CONTRACTORS, INC.

(Contractor),

W I T N E S S E T H :

ARTICLE I - DESCRIPTION OF THE WORK

1.01 Contractor agrees to furnish supervision, labor, and
when requested, contractor owned equipment to perform in a work-
manlike manner the work assigned to it from time to time by Dow.
Contractor shall comply with any and all designs, working drawings,
and specifications furnished by Dow for such work.

1.02 All work to be performed hereunder shall be authorized
by Dow in writing and shall not commence until authorization is
acknowledged and accepted by Contractor or his designated repre-
sentative. Both Dow and Contractor shall submit to each other the
name of their designated representatives for the specific work so
authorized. The Contractor shall designate Plant A and Plant B
representatives. Such Contractor representatives shall have the
authority for and exercise all direction of and control over all
individual employees and agents of Contractor performing the work
under this contract.

ST0025437

1.03 Speed of performance being a consideration of this agreement, Contractor shall maintain such speed of performance as shall be consistent with good work in order to maintain completion dates. Should the Contractor fail or refuse in any respect to prosecute the work hereunder with diligence, including but not limited to a refusal or inability to provide sufficient skilled personnel or materials, Dow may terminate Contractor's right to proceed with the work and may enter upon the premises for the purpose of completing the same and take possession of all materials and appliances thereon and finish their work by any method Dow may deem advisable.

1.04 All work shall be performed in accordance with the individual departmental safety rules and the terms and conditions of Dow's Safety and Loss Prevention Manual for Contractors, a current copy of which has been furnished to the Contractor. Contractor shall comply with all applicable provisions of Federal, State and municipal safety laws and building codes to prevent accidents or injuries to persons or damage to property on or about or adjacent to the premises where the work is being performed.

1.05 Contractor shall require each of its employees to comply with the above safety rules and terms and conditions of Dow's Safety and Loss Prevention Manual for Contractors and failure of any Contractor employee to fully comply with same shall constitute sufficient cause for Dow to exclude that Contractor employee or Contractor from the Dow plant site. In the event of a breach of

ST0025438

such rules, terms or conditions, at Dow's request, Contractor will immediately withdraw such employee from Dow premises.

1.06 The Contractor will furnish Dow approved hard hats, chemical goggles, side shield safety glasses, and required respirators. Except as otherwise provided for in this contract, all material, tools and other safety equipment will be furnished by Dow.

ARTICLE II - COST OF THE WORK

2.01 Labor

(a) For performance of the work assigned to Contractor under this agreement, Dow shall pay Contractor in accordance with the terms set forth in Exhibit "A" which is attached hereto and made a part hereof.

(b) Contractor's base rates per hour shall include, but are not limited to, hourly wage rates, salaries, insurance premiums, if any, office personnel, transportation¹, overhead and profit. In addition to the base rate per hour as noted in Exhibit "A", the Contractor shall specify "adders" on a cost-per-hour basis in accordance with Section 5 of Exhibit "A". All other expenses will be a part of Contractor's base rate.

(c) Contractor shall be reimbursed for actual statutory assessments for payroll taxes (FICA, FUT, SUT). Actual taxes assessed shall be expressed as a percent of each monthly payroll

¹Transportation is defined as movement of people and equipment to the job site at starting and quitting times. Any additional movement of people, tools, materials, and equipment at the job site other than starting and quitting time will be reimbursed by Dow.

ST0025439

to which they apply. Each month's payroll tax percent shall be used in invoicing each succeeding month.

(d) Contractor shall submit as Exhibit "C" to this contract, a description of his minimum qualifications for each classification he desires to furnish.

2.02 Overtime

Dow, if it deems necessary, may require Contractor to work overtime. If the work has not been delayed by the fault or negligence of Contractor, as determined by Dow, Dow will pay Contractor the overtime rate in accordance with Exhibit "A".

2.03 Equipment

Contractor shall submit a list of Contractor owned equipment available for rent showing the rental rates (hour, day, week, month) of each piece of equipment. Dow will pay Contractor the lowest applicable rate (hour, day, week, month) available for the time the particular piece of equipment is rented. It is intended that there be no third party rentals in this contract.

2.04 Material

The intent of this contract is that Dow furnish all material. There may be extenuating circumstances when a Contractor may be requested to furnish material. When so requested, Dow shall reimburse Contractor the actual cost of material less any discounts Contractor may receive or be entitled to receive plus a fee of five percent (5%). Contractor shall take advantage of and pass on to Dow all terms of discount for prompt payment of bills.

ST0025440

ARTICLE III - INVOICING AND PAYMENT

3.01 Contractor shall submit invoices in duplicate to Dow, attention General Accounting Department, as soon as practical at the end of each week, or at such time as may be requested by Dow. Invoices are to be supported by properly authorized time reports and such other support as Dow may require for validation of amounts billed.

3.02 All such invoices shall be paid by Dow within ten (10) Dow business days after the receipt thereof, unless any items thereon are questioned by Dow, in which event Dow shall have the right to withhold payment thereof until verification of both the amount claimed and the validity of said claim. Dow's investigation thereof shall proceed as promptly as possible, with which investigation Contractor shall provide complete cooperation. With respect to invoices so questioned and later approved by Dow, payment shall be made as promptly as possible and practical after such approval.

ARTICLE IV - LIENS

4.01 Contractor (a) shall indemnify and save harmless Dow from any and all claims, demands, causes of action or suits of whatever nature arising out of the services and labor furnished by Contractor under this contract, and from all liens upon the real property upon which the work is located arising out of the services furnished by Contractor under this contract and (b) agrees to defend any suit or action brought against Dow based on any such

ST0025441

claims, demands, or proceedings to enforce or foreclose any such liens based on any such work performed hereunder, and to pay all costs and expenses, including attorney's fees, in connection therewith or arising therefrom in a manner that will keep said property free and clear of all liens, claims and encumbrances arising from the performance of this contract by Contractor.

4.02 Contractor shall notify Dow immediately of the filing of any liens upon Dow's property upon which the work is located arising out of the services furnished by Contractor under this contract. If required, Contractor shall furnish (a) a good and sufficient release or waiver of lien or (b) receipts in full, together with an affidavit that the receipts cover all the services for which a lien might be filed except as covered by the releases and waivers of liens, but if any laborer or other person refuses to furnish a waiver or release or receipt in full, Contractor may furnish a bond, in an amount and with such sureties as may be approved by Dow, conditioned to indemnify Dow against any claim or lien or otherwise. In the event Contractor fails or refuses to have such lien released or furnish such bond when so required, Dow shall have the right to pay any sums necessary to obtain the release of such lien and to deduct the amount paid therefor from any sums due Contractor hereunder.

ARTICLE V - GUARANTY

Contractor further guarantees all the work to be performed under this contract against defects in Contractor-furnished

ST0025442

material and workmanship up to one (1) year from the date of final acceptance of the completed work by Dow. Contractor shall, within a reasonable time after receipt of notice, repair or replace any defect in materials or workmanship which may develop during said one-year period, at its own expense and without cost to Dow. Dow may, at its option, repair said defect itself at Contractor's expense.

ARTICLE VI - ACCEPTANCE

6.01 The making of progress payments by Dow shall not be construed as acceptance of the work done up to the time of such payments, except as to such matters as are open and obvious. Dow, however, shall exercise reasonable diligence in discovering and reporting to Contractor, as the work progresses, all labor and material which is not in accordance with drawings and specifications so as to avoid unnecessary trouble and cost to Contractor in making good defective work.

6.02 Contractor's acceptance of final payment of any individual project shall be held to be a waiver of all claims against Dow on that individual project. No partial use or occupancy of the work by Dow, nor any payment to the Contractor, other than final payment, shall constitute an acceptance of the work.

ARTICLE VII - LIABILITY FOR INJURY TO PERSONS

7.01 Contractor assumes the entire responsibility and liability and will indemnify and hold harmless Dow, its agents, servants

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and employees, from and against any and all losses, expenses, demands and claims made against Dow, its agents, servants and employees, by any employee or officer of Contractor because of injury or alleged injury (including death), whether caused by Dow's negligence or otherwise, arising from any source while said employee or officer is on premises owned, operated or leased by Dow or under the control of Dow, or while said employee or officer of Contractor is performing under this agreement, and agrees to defend any suit or action brought against Dow based on any such alleged injury, and to pay all costs and expenses, including attorney's fees, in connection therewith or resulting therefrom

ARTICLE VIII - INSURANCE

Insurance to be carried by Contractor shall be in accordance with Exhibit "B" which is attached hereto and made a part hereof.

ARTICLE IX - PERMITS, LICENSES AND APPLICABLE LAWS

9.01 Contractor shall procure all other necessary permits and licenses, observe and abide by all applicable laws, regulations, ordinances and other rules of the State, territory or other political subdivision thereof, wherein the work is done, or any other duly constituted public authority and further agrees to hold Dow harmless from liability or penalty which might be imposed by reason of an asserted or established violation of such laws, regulations, ordinances or other rules.

ST0025444

9.02 Contractor shall comply with any and all State and Federal laws regarding age, citizenship, hours, wages and conditions of employment affecting the work covered by this agreement.

9.03 Unless otherwise exempted, Contractor shall comply with the applicable requirements of Executive Order 11246, as amended, the Vietnam Era Veterans Readjustment Assistance Act of 1974 and the Rehabilitation Act of 1973.

ARTICLE X - TITLE TO THE WORK

The title to all work completed and in the course of construction and of all materials which are delivered and stored at the site and which will necessarily be incorporated in the work, as between Dow and Contractor shall be in Dow. All drawings, designs and specifications prepared for the work, whether furnished by Dow or Contractor shall become the property of Dow, and upon completion of the work, or termination of this agreement, be delivered to Dow.

ARTICLE XI - INDEPENDENT CONTRACTOR

11.01 Contractor shall be an independent contractor under this agreement and shall assume all of the rights, obligations and liabilities applicable to it as such independent contractor hereunder and any provisions in this contract which may appear to give Dow the right to direct Contractor as to the details of doing the work herein covered or to exercise a measure of control over the work shall be deemed to mean that Contractor shall follow the desires of Dow in the results of the work only.

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11.02 Contractor shall make all appropriate withholdings from the wages of its employees assigned to the work and shall, upon request, provide to Dow proof that such withholdings have been properly deposited with the appropriate Federal, State or local authority.

11.03 Contractor recognizes that its employees and agents, while employed on the premises of the Dow Chemical Company, might be working in areas where various chemicals and chemical vapors exist. In the interest of safety, Contractor agrees that the Dow Chemical Company may, from time to time, request that the Contractor's employees submit to physical examinations to be conducted by medical personnel employed by the Dow Chemical Company. The expenses of such examinations will be paid by the Dow Chemical Company.

ARTICLE XII - NOTICES

12.01 Any notice or order provided for in this agreement shall be considered as having been given to Dow if delivered personally to Dow's representative at the site of the work, or if mailed by registered mail, postage prepaid to:

Dow Chemical U.S.A.

Texas Division

Freeport, Texas 77541

Attention: Purchasing Department

ST0025446

12.02 Any notice or order provided for in this contract shall be considered as having been given to Contractor if delivered personally to its representative at the site of the work, or if mailed by registered mail, postage prepaid, to it at the following address:

U. S. CONTRACTORS, INC.

P. O. DRAWER 447

CLUTE, TEXAS 77531

ST0025447

ARTICLE XIII - PUBLICITY

Any information relative to the services performed under this contract shall not be released or used by Contractor for publication, advertising or any other purpose without the prior written approval of Dow. This includes the use of Citizen Band Radios or other public communications within the Plants to disseminate information on any aspect of Dow's business or its Plants. Contractor further agrees that it will so inform its agents, servants and employees of this restriction.

ARTICLE XIV - SECRECY AGREEMENT

14.01 In order to enable Contractor to consider or perform the work, it has been or may be necessary for Dow to disclose to Contractor information concerning Dow's business plants, commercial practices and industrial technology including processes, drawings, flowsheets, equipment, composition, auxiliaries, associated facilities and the like or provide items such as

equipment, parts, samples, compositions and the like. Contractor agrees to maintain all such information received as confidential information, and agrees that it will not disclose any of such information to third parties or otherwise use the same without the written permission of an officer of Dow. Contractor's agreement hereunder shall remain in effect only so long and to the extent that such information or item does not correspond to that furnished or made known to Contractor by third parties as a matter of right and without restriction on disclosure, which Contractor can show was not acquired directly or indirectly from Dow or which becomes part of the public domain through no fault of the Contractor, but only to the extent known in the public domain.

14.02 Contractor also agrees that if it is found necessary to contact third parties in order to fulfill any part of the work, Contractor shall so advise Dow in order that Dow's representative may be present during any such contact so that the need for additional agreements of confidentiality can be construed.

14.03 Contractor further agrees that it will so inform its agents, servants and employees having access to Dow information of the confidential nature of such information and, if requested by Dow, will obtain from them and forward to Dow a secrecy agreement on their part in a form provided by Dow.

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ARTICLE XV - NON-ASSIGNABILITY

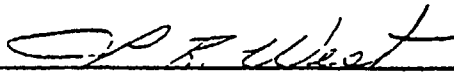
This agreement shall be binding upon the heirs, successors and assigns of the parties hereto, however, Contractor shall not transfer or assign any of his rights or obligations hereunder or subcontract any work to be performed by him hereunder without first having obtained the written consent of Dow's Purchasing Department.

ARTICLE XVI - TERM

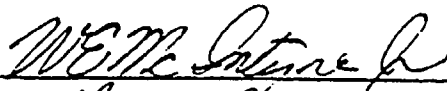
This contract cancels and supersedes those certain contracts dated March 12, 1976 and March 15, 1976, and shall continue for one calendar year after the effective date hereof or until terminated by either party giving to the other party thirty (30) days prior written notice. Contractor shall complete any and all work assigned to it by Dow prior to notice of termination, all in accordance with the terms and conditions of this agreement.

EXECUTED as of the day and year first above written.

DOW CHEMICAL U.S.A.
TEXAS DIVISION, an operating unit
of THE DOW CHEMICAL COMPANY

By 
Title Purchasing Department

U. S. CONTRACTORS, INC.

By 
Title Vice President

ST0025449

 HOLD HARMLESS-RESPONSIBILITY-INSURANCE AGREEMENT

.....July..3..... 19...72

NOTE TO CONTRACTOR: This is submitted in duplicate. If the terms and conditions herein meet with your approval, please sign and return one copy for our files. This agreement applies to all work performed by you in Dow's plant under any contract or purchase order until cancelled by either party by fifteen (15) days' prior written notice.

I. Hold Harmless:

Contractor assumes the entire responsibility and liability and will indemnify and hold harmless DOW, its agents, servants and employees from and against any and all losses, expenses, demands and claims made against DOW, its agents, servants and employees, by any employee or officer of Contractor or its subcontractor because of injury, or alleged injury (including death), whether caused by DOW's negligence or otherwise, arising from any source while said employee or officer is on premises owned, operated or leased by DOW or under the control of DOW, or while said employee or officer of Contractor or its subcontractor is performing under this agreement and agrees to defend any suit or action brought against DOW based on any such alleged injury, and to pay all costs and expenses, including attorney's fees, in connection therewith or resulting therefrom.

II Responsibilities:

1. Contractor shall be an independent contractor under this agreement and shall assume all of the rights, obligations and liabilities applicable to it as such independent contractor hereunder and any provisions in this contract which may appear to give DOW the right to direct Contractor as to the details of doing the work herein covered or to exercise a measure of control over the work shall be deemed to mean that Contractor shall follow the desires of DOW in the results of the work only.

2. Unless any agreement covered hereunder is within one of the exemptions provided for in Executive Order 11246, effective September 24, 1965, as amended by Executive Order 11375 signed October 13, 1967, Contractor shall comply with paragraphs (1) through (7) of Section 202 of Executive Order 11246 (as amended) which are incorporated by reference herein.

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III Insurance

1. *Physical Extended Coverage*—DOW, at its expense, shall provide insurance protecting the work against damage or loss arising from fire, explosion, windstorm, riot or civil commotion, sprinkler leakage, smoke, aircraft, land vehicle, and lightning, said insurance to cover the interest of the Contractor in the work and all supplies, materials, equipment, machinery, and apparatus entering into or used in the construction of the work, including expendable items of Contractor's property which are used in, or are incident to, the construction of the work but do not become a part thereof (such as, temporary sheds, scaffolding, forms and the like), and which are not otherwise insured, all while in, on or about the work, or at, or within one hundred (100) feet of the site thereof, but excluding all non-expendable items of property, whether owned by the Contractor or for which Contractor is liable, which are used in or are incident to the construction of the work but do not become a part thereof.

2. *Contractor's Insurance*—During the term of this agreement and until final acceptance by DOW of all work to be performed hereunder, Contractor shall carry the following minimum insurance:

- (a) Full coverage and compliance under the Workmen's Compensation laws of the State of Texas.
- (b) General Public Liability insurance in an amount not less than \$300,000.00 covering accidents including death to any one person and in an amount not less than \$500,000.00 for any one accident including death involving two or more persons, and in an amount not less than \$100,000.00 covering damage to the property of DOW and of third parties.
- (c) Upon each and every unit of automotive equipment operated or used by Contractor in the performance of this contract, as follows:
 - (1) Automotive Public Liability insurance in an amount not less than \$100,000.00 covering accidents, including death, to one person in any one accident, and not less than \$300,000.00 covering accidents, including death, to more than one person in any one accident, and Automotive Property Damage insurance in an amount not less than \$100,000.00

3. *Certificates of Insurance*—All such insurance shall be carried in companies approved by DOW, and Contractor shall furnish DOW a certificate or certificates properly executed by the insurance carrier, showing all such insurance to be in force and said certificate or certificates shall include the following statement: "The General Liability insurance certified hereunder includes Contractor's Assumed Liability coverage for liability assumed by the Insured under all written contracts between The Dow Chemical Company and the Insured." The certificate or certificates shall permit the cancellation or alteration of such policies only after ten (10) days' written notice to DOW, which such certificate or certificates shall be furnished DOW prior to the commencement of any operations under this agreement. Nothing contained in this Paragraph III should be construed as limiting the liability assumed by Contractor under Paragraph I.

RECE

ACCEPTED

U. S. Contractors, Inc.

(Contractor)

By

Lynn D. Moncal
July 18, 1972

Date

DOW CHEMICAL COMPANY USA
Texas Division Freeport, Texas

AUG 1

Vincent H.

G. P. N. Nenson
(Authorized Agent)

July 3, 1972

(Date)



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Carpenter's Handbook



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CARPENTER'S HANDBOOK

R. H. Richmond

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Distributed by
The Trades and Operator Training Department

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INTRODUCTION

The objective of this handbook is to provide carpenters with a single, basic source of information pertinent to their work.

A number of Dow Engineering Standards have been inserted throughout the text where they apply to the subject under discussion; the carpenter may obtain information about sources referred to in those standards from his or her supervisor.

An index of Dow Safety Standards has been included in Section A; should a carpenter wish to review those standards, a copy may be obtained from his or her supervisor.

ACKNOWLEDGEMENTS

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SAFETY

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THERE IS NO SUBSTITUTE FOR COMMON SENSE

PERSONAL PROTECTION

1. Wear proper eye protection at all times (S-725)
 - a) Safety glasses and/or mono-goggles generally.
 - b) Tinted glasses for burning and welding.
 - d) Full face shield for grinding and chipping.
2. When working in high noise areas, check need for ear protection (S-770).
3. Use respirator when cutting Transite® asbestos cement. Use vacuum cleaner or other device to capture dust from saw.
4. Do not use any solvents in confined areas without adequate ventilation.
5. Wear hard hat at all times during working hours (unless variance has been obtained).
6. Wear proper gloves when handling lumber, cable and steel to avoid slivers.
7. Do not work on railroad right-of-way without permit from Railroad Department (S-760).
8. Do not work under suspended loads.
9. Do not work closer than ten feet to overhead lines without clearance from EDM (S-335).
10. Do not enter any vessel or pit without a Vessel Entry Permit (S-850).

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11. Obtain roof access permit (via Job Planning Card) from Plant prior to entering roof area (S-735).
12. Always provide adequate ventilation when working in vessel or pit. If using air mover, have it drawing air out of vessel rather than blowing it in.
13. When working over water or other liquids, a life preserver must be worn except when working within permanently railed walkways or platforms.
14. Eight inch high shoes or spats are required for burning and welding operations.
15. Consider any liquid as a hazardous chemical until otherwise informed
16. Chemical Exposures (S-122),
 - a) Speed is essential for treatment of chemical exposures.
 - b) Flush with water.
 - c) Soap may be used.
 - d) Call Emergency Service: Dial 1-2-3.
17. Know location of eye and safety showers at your job location. Check them before starting job.

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EQUIPMENT

1. Check all chains, cables, ropes and hoists before using.
2. Do not wrap the load chain or cable of a hoist around a load as a choker.
3. Check all ladders for splits, broken rungs or other defects before using.
4. Do not use a drop cord unless there is a guard over the bulb.
5. Hand tools
 - a) Keep burrs ground off all tool handles.
 - b) Keep tools sharp.
 - c) Never use tools with defective handles.
 - d) Use the right tool for the job.
 - e) Inspect all ropes before using.
6. Power Tools
 - a) Check need for a Hot Permit (S-900) before using power tools in production areas.
 - b) Be sure all guards are in place and operating properly.
 - c) Do not use electric tools without an equipment ground. Check grounds frequently.
 - d) Check with supervisor on need for GFI with portable electric tools.

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- d) When using air driven tools, be sure to make connection to an air source and be sure all connections between the source and tool are properly made.
- d) Always use an excess flow valve ahead of any hose 5/8 inch or larger that is connected to an air-operated tool.
- f) Concrete busters should be grounded unless it can be verified that there are no electrical lines buried in the area.
- g) Protect any hoses or cords that must be strung across a vehicle or foot traffic area.
- h) Use two men when using a 3/4 inch or larger drill motor.

7. Burning Equipment.

- a) Always procure Hot Permit (S-900) before using torch outside of regular shops. Be sure sewer and manholes are considered on Hot Permit.
- b) Know and follow proper start-up and shut-down procedures.
- c) Do not use torch as a hammer.
- d) Never leave torch or hose in vessel or pit except when in immediate use.

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- e) Do not lay an acetylene cylinder on its side.
 - f) Always support any compressed gas cylinder in the upright position and secure to prevent tipping.
 - g) Never take cylinders into vessel or pit.
 - h) Use Swedish Wool in ears to prevent sparks or slag from entering ear canal when burning or welding.
 - i) Do not move or transport cylinders without protector cap on.
 - j) Do not burn into pipes that have both ends closed.
 - k) Do not stand in front of gauges when turning pressure on.
 - l) Check hoses periodically for leaks.
 - m) Do not leave pressure on hoses when not in use.
8. When operating an electrical disconnect switch, stand to the right of the switch, turn face over right shoulder, and operate handle with your left hand in one quick movement.
9. For switches with handle located in the center of the cover, stand at the hinged side of the door, look away from the switch, and turn the handle.

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WORKING IN ELEVATED POSITIONS
(S-810, S-630, S-750)

1. If working over seven feet above floor or ground, working surface must be railed or safety belt and lanyard must be used. Use lanyard to prevent fall rather than to catch you after fall.
2. If working from bosun chair or swing stage, you must wear a safety harness or belt attached to an independent line.
3. Do not walk on Transite roofs without planking (S-735).
4. Folding scaffolds (upright) should not be erected over two lifts high.
5. Wood constructed scaffolds shall be constructed per S-810.
6. No device such as a crane or air hoist shall be used to raise or lower people unless it requires power to lower as well as to raise (no freefall).
7. Do not move scaffolds with people or material on them.
8. Do not work from straight ladder unless it is held by someone or is tied off.

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GENERAL

1. Housekeeping.
 - a) Keep work area properly cleared.
 - b) Keep tools and materials in their proper places.
 - c) Keep materials covered whenever possible.
 - d) Clean up job site when work is completed.
2. Bend nails over in any scrap lumber.
3. Obtain an underground clearance from Engineering before doing any digging or other underground work.
4. Barricade all floor openings sufficiently to prevent entry. If floor openings are covered, make sure covering is fastened to prevent movement.
5. Use hand lines to raise material or tools instead of carrying them up a ladder.
6. Use hand lines or other suitable safety devices when cutting things loose and letting them down.
7. Be careful of valves and gauges if there is a possibility of bumping them with lumber, tools, etc.
8. Do not fill gasoline tanks with the motor running.

ST0221401

SAFETY STANDARDS INDEX

DOW CHEMICAL USA, MICHIGAN DIVISION

S-001 General Administrative Safety Standard (11-3-76)

CHEMICAL 100 Series

S-120 Use of Cleaning & Degreasing Solvents (4-18-73)

S-122 Chemical Exposure (1-17-73)

S-129 Flammability Identification Symbols (3-1-77)

S-130 Storage & Handling of Flammable Liquids in Small Quantities (9-19-73)

S-131 Oxidizing Materials (9-25-63)

S-135 Reactive Chemicals (10-18-72)

S-140 Asbestos (4-7-76)

ELECTRICAL 300 Series

S-315 Electrical Grounding (5-3-77)

S-320 Lockout of Power Driven Equipment (5-7-75)

S-325 Portable Lights for Hazardous & Semi-Hazardous Areas (8-20-75)

S-335 Power Line Clearance (3-21-73)

S-385 Temporary Wiring (3-6-74)

EQUIPMENT 400 Series

S-400 Flexible Joints Used in Hazardous Service (4-7-76)

S-430 Guarding of Mechanical Equipment (9-20-72)

S-440 Sight Glasses (4-26-76)

S-450 Hand Rigging Equipment For Material Handling (6-20-73)

S-466 Roll Type Equipment (4-19-77)

S-468 Pressure Vessels (4-21-76)

S-477 Control of Radiation Hazards (1-1-72)

S-497 Storage of Hazardous Chemicals in Refrigerated Storage Cabinets (4-5-77)

MATERIALS HANDLING 600 Series

S-620 Storage & Location of Gasoline Tanks For Refueling of Gasoline Fork Trucks and Similar Equipment (6-20-73)

ST0221402

S-622 Cylinder Regulators (5-17-72)
S-623 Compressed Gas Cylinders (8-6-75)
S-624 Proper Labeling of Containers for Storage & Transfer (8-16-72)
S-625 Dempster Tanks & Dempster Stations (3-6-74)
S-626 Semi-Trailer Units (10-18-72)
S-627 Power-Lift Trucks (8-15-73)
S-630 Vehicle-Mounted or Supported Work Platforms (4-23-75)
S-640 Loading & Unloading Tank Trucks (3-15-77)
S-641 Loading & Unloading Tank Cars (3-15-77)
S-645 Pipeline Identification & Emergency Plans (1-21-76)

MISCELLANEOUS 700-900 Series

S-700 Temporary Barriers (6-21-72)
S-710 Checking of Emergency Equipment (12-20-72)
S-715 Emergency Alarms (1-21-76)
S-720 Equipment Transfer (9-6-72)
S-725 Eye Protection (4-18-73)
S-730 Steam & Hot Water Hose (2-15-77)
S-735 Roofs (12-17-75)
S-740 Danger Red Tag (4-19-72)
S-745 Respiratory Protection (10-6-76)
S-750 Ladders (8-4-71)
S-760 Railroad Warning Signs (4-5-77)
S-765 Safe Drinking Water (3-21-73)
S-770 Control of Hazardous Noise (4-19-77)
S-775 Line and Equipment Opening (10-17-73)
S-800 Excavation for Construction and/or Maintenance (8-16-72)
S-810 Elevated Work Platforms (4-19-72)
S-820 Distribution Emergency Response System (5-16-73)
S-850 Vessel Entry (1-31-77)
S-900 Hot Work Permits (8-4-76)

Safety Department
kso
5-23-77

ST0221403



ST0221404

Spectra-glazed walls are used in lobbies, stair wells, toilets, lunch rooms, and locker rooms. They have been used in No. 690, No. 574, and No. 678 Buildings.

6.55 Gypsum Block Partitions

Gypsum partitions are made of gypsum block size 30" x 12" and 3" or 4" thick. They are plastered on both sides to make a finished wall.

These partitions are relatively cheap, are light weight, and are easily installed.

This material should not be used where water or dampness is present, such as in toilet or shower partitions.

These partitions are suitable for office buildings only.

7.0 Steel Stud

- 7.1 Steel stud partitions have not been extensively used at Dow but are suitable for low cost fixed partitions using plaster or dry wall finish on steel studs.
- 7.2 Lath and plaster fastened on steel studs makes a good, strong, and fairly economical partition for offices. The thickness of walls can be varied to include pipes of various sizes, conduits, etc.
- 7.3 By using 5/8" thick sheetrock on both sides, it is possible to obtain a one-hour fire rating on the wall. Rock lath may be fastened to the steel studs with either screws or ratchet nails. These studs are made by Penn Metal Company, Inc., New York 17, N. Y.
- 7.4 Steel studs which will receive nails are also manufactured by Stran-Steel Division of Great Lakes Steel Corporation.

8.0 Movable Asbestos

- 8.1 Johns-Manville "Universal" asbestos panels. These panels are easy to erect and relocate. They consist of a wood framed core, sealed and faced on both sides with asbestos cement sheets.
- 8.2 The panels are 1-3/4" thick and come in standard sizes and in standard colors. Door and window frames are of metal. Space for wiring is provided in the base.

ST0221405

ST0221406

8.3 These partitions have been used in No. 433 and No. 672 Buildings and present a very good appearance. See catalogs for details.

8.4 Refer to manufacturer's catalogs for details.

9.0 Plastic Wall Tile

9.1 Plastic wall tile cemented to a concrete block wall give a very good partition to use in toilet, locker and lunch rooms.

9.2 The tiles are easy to clean and are inexpensive to repair or replace. The appearance is excellent as many colors are available.

9.3 The tile comes in 4" x 4" and 8" x 8" sizes.

9.4 If the masonry wall is not smooth, give it one coat of plaster before installing the tile. A rubber cove base is generally used with plastic tile walls.

10.0 Steel Plate

10.1 These partitions are used for starter rooms in hazardous or semi-hazardous areas. The walls consist of 16 gauge steel plate, seal welded to structural steel channel studs spaced at 2'-0 1/16" o.c.

10.2 The steel studs should be welded to steel supports at the floor and the ceiling. The bottom of the steel wall sometimes rests on a concrete curb 6" or 8" high.

10.3 See Drawing No. C1-80841 for a steel plate, explosion proof, insulated wall as used in No. 637 Building.

10.4 All steel studs used in steel plate partitions should be spaced at 2'-0 1/16" to give a 3/16" joint for 6'-0" wide plates and 1/4" joint for 8'-0" wide plates.

10.5 6' and 8' plates are carried in Dow Stock.



DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

ASBESTOS MONITORING
MAGNESIUM III
B-800

FILE NO. B8-1702

DATE January 26, 1979

AUTHOR E. P. Whatley

CHECKER [Signature]

DATE January 26, 1979

Summary

A survey was conducted to evaluate employee exposures to asbestos fibers during a plant shut down at Magnesium III, B-800, on November 28, 1978. All potential employee exposures were well within the permissible exposure limit.

Monitoring should be repeated during the next plant shut-down.

Employees should be informed of the results of this survey, and the informing documented.

Distribution

J. E. Grau B-815
A. L. McDowell B-101
W. A. Toler B-815
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AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

510003260

January 26, 1979

INTRODUCTION

At the request of supervision, a survey was conducted at Magnesium III, B-800, on November 28, 1978, to evaluate employee exposures to asbestos fibers during a planned plant shut down for electrical repairs.

PROCESS DESCRIPTION

At Magnesium III, molten magnesium is produced electrolytically from magnesium chloride in a bath of mixed salts. By-products of the process are chlorine, hydrogen chloride (both are removed by a vacuum system), magnesium oxide, water vapor, and cell sludge. Magnesium chloride is fed to the cells via an automated conveyor system, and other salts are manually poured from bags into the cells. Vanadium pentoxide, an additive which increases cell efficiency, is added to the cells in sealed plastic bags. Molten magnesium is pumped from wells at the front of the cells into a crucible in the basement, which is then transferred to the casting plant.

Asbestos paper has two major uses at Magnesium III. It is used in small quantities (generally one piece at a time) when cells are being patched by the Running Repair Operators. A piece of asbestos paper is torn to cover the hole being patched while the employee takes a short break to cool off. The purpose of the paper is to keep the metal around the hole from freezing, and to keep the cell sealed to insure that suction on the cell can be maintained. In general, a given Running Repair Operator patches cells about every two weeks.

Once or twice a year, the plant is shut down (usually two buildings at a time) for major electrical repairs. On these occasions, several employees tear pieces of asbestos paper to cover the metal wells and plug the feed and suction pipes. It takes 3-4 employees about an hour to cover the cells in two buildings (approximately 60 cells), and from 1/2-1 hour to remove and dispose of the paper after repairs are completed. The plant shutdown clearly represents the highest potential employee exposures to asbestos fibers, and is the procedure which was monitored in this study.

METHODOLOGY

Personnel samples were collected during both handling procedures (covering cells and paper removal) to determine employee exposures to asbestos fibers. The samples were collected by drawing a measured volume of air (approximately 1.5 liters per minute) at employee breathing zone height through aerosol filters (Millipore MAWG 937A0) with Bendix Micronair II sampling pumps. The pumps were calibrated before and after use with a calibrated Brooks rotameter. Fibers were counted using optical microscopy by Central Laboratory, B-1225.

ST0003261

January 26, 1979

EVALUATION CRITERIA

Permissible exposure limits (PEL's) are concentrations of airborne substances to which nearly all employees may be repeatedly exposed throughout a working lifetime without adverse effect. Most PEL's are time-weighted average concentrations for 8 to 12-hour work days and 40-hour work weeks. Permissible exposure limits do not represent line lines between safe and dangerous exposures; they are based on industrial experience and experimental human and animal toxicological studies, and are intended for use as guides for plant design and for evaluating employee exposures.

The permissible exposure limit for asbestos fibers is two fibers per cubic centimeter of air (2 fibers/cc), as an eight-hour time-weighted average. An asbestos fiber is defined as a particle greater than or equal to five microns in length. Ten fibers/cc are allowed as a ceiling concentration for periods up to 15 minutes, provided the exposure for the entire 8-12 hour work day does not exceed 2 fibers/cc, and there are no more than four excursions per day, which are separated by at least an hour.

RESULTS AND DISCUSSION

The results of the personnel monitoring for asbestos fibers are shown in Table 1. All potential employee exposures (nose-mouth respirators were worn during the entire procedure) to asbestos during the handling procedures were well within the permissible exposure limit of two fibers per cubic centimeter of air. The highest potential exposure was about 20% of the allowed level; however, all others were 5% or less.

CONCLUSIONS AND RECOMMENDATIONS

Employees at Magnesium III are not being overexposed to asbestos fibers. The highest potential exposures occur during plant shut downs once or twice a year, and are well within the permissible exposure limit.

It is recommended that monitoring be repeated during the next plant shut down to further substantiate the results of this survey. Monitoring for asbestos fibers during cell patching procedures is not necessary at this time.

It is also recommended that employees be informed of the results of this survey, the consequences of overexposure to asbestos fibers, methods of control, and the care and use of respiratory protective equipment. This informing process should be documented.

FHS
EPW/bbs
1-26-79

ST0003262

File 88-1702

TABLE I
ASBESTOS MONITORING RESULTS

SAMPLE NO.	EMPLOYEE MASTER NO.	DATE	TIME (MIN.)	ASBESTOS CONCENTRATION (FIBERS/CC)
B8-1702-1	140319	11-28-78	45	0.068
2	133302	11-28-78	50	0.073
3	134916	11-28-78	--	pump stopped
4	135541	11-28-78	25	0.34
5	140319	11-28-78	--	pump stopped
6	135541	11-28-78	17	0.080
7	135541	11-28-78	36	0.040
8	140319	11-28-78	61	0.044
9	141180	11-28-78	48	0.099
10	141298	11-28-78	34	0.007

Permissible exposure limit (fibers/cc air)* 2

* 8 hour time-weighted average

Samples 1-6 represent cell covering procedures; 7-10 were collected during paper removal and disposal.

ST0003263

CONSEQUENCES OF OVEREXPOSURE

COMPOUND: ASBESTOS

EXPOSURE LIMIT: 2 FIBERS/ML , > 5 MICRONS IN LENGTH

ODOR: NONE

EYES: CONTACT WITH THE DUST CAN CAUSE IRRITATION
SIMILAR TO THAT CAUSED BY SIMILAR FOREIGN
BODIES.

INGESTION: SOME EVIDENCE INDICATES THAT SWALLOWED
ASBESTOS MAY INCREASE CHANCES OF STOMACH
CANCER.

DUST INHALATION:

SHORT TERM: INHALATION OF HIGH CONCENTRATIONS
OF THE DUST MAY CAUSE MODERATE
DISCOMFORT. INHALATION OF
MODERATELY HIGH CONCENTRATIONS
MAY CAUSE NO DISCOMFORT.

LONG TERM: INHALATION OF THE ASBESTOS FIBERS
IN CONJUNCTION WITH SMOKING HAS BEEN
SHOWN TO INCREASE CHANCES OF LUNG
CANCER BY ABOUT 90 TIMES THAT OF A
PERSON WHO NEITHER SMOKES NOR WORKS
WITH ASBESTOS. CAN ALSO CAUSE A
SERIOUS LUNG DISEASE CALLED ASBESTOSIS.
CAN ALSO CAUSE CANCER OF THE CHEST
LINING.

COMMENTS: PROPER RESPIRATOR IS REQUIRED WHEN WORKING WITH
ASBESTOS.

510003264



DOW CHEMICAL U.S.A.

2.1-5-B

7146

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

ASBESTOS FIBERS
MAGNESIUM CASTING B
B-842

FILE NO. B8-1818

DATE June 1, 1979

AUTHOR E. P. Whatley

CHECKED

DATE

George A. Jones
June 11, 1979

Summary

A survey was conducted to determine employee exposures to asbestos fibers while racking unquenched ingots at Magnesium Casting B, B-842, during April, 1979. Employee exposures were about 1% of the short term exposure limit, and less than 0.5% of the permissible exposure limit calculated as an 8 hour time-weighted average.

Further monitoring is not necessary at this time.

Employees should be informed of the results of this survey, and the informing documented.

bbs

Distribution

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A. L. McDowell B-101

File

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AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

ST00003272

June 1, 1979

INTRODUCTION

A survey was conducted to determine employee exposures to asbestos fibers at Magnesium Casting B, B-342, on April 18, 1979.

PROCESS DESCRIPTION

Molten magnesium from Magnesium III is transported to Magnesium Casting B in covered crucibles, where it is then poured into furnaces. The magnesium is pumped from the furnaces into molds on conveyors, and is allowed to cool in both air and water as the molds traverse the length of the conveyors. At the ends of three of the conveyors, the ingots are hand- or mechanically-stacked; a towmotor is used to remove and stack the large ingots from the remaining conveyor.

Occasionally the magnesium ingots do not fall out of the molds into the water quenchers; as a result they fall under the conveyor as the molds turn upside-down while traveling back to the end of the conveyors to be refilled. Since these ingots have not been through the water quenchers, they are too hot to handle with the cotton gloves routinely worn by the Casting Operators while racking ingots, and asbestos gloves are worn during the few moments necessary to retrieve and rack them.

METHODOLOGY

Since only a few moments are normally required to retrieve and rack the ingots which fall under the conveyors, a simulated procedure was used to determine the employee exposures to asbestos fibers at these times. The water quencher was turned off on conveyor #4, and employees wearing asbestos gloves racked the hot (dry) ingots for periods of 10-25 minutes.

Fixed station and personnel samples were collected by drawing a measured volume of air (approximately 1.5 liters per minute) through aerosol filters (Millipore MAWG 937AO) using Bendix Micronair II air sampling pumps. The pumps were calibrated before and after use with a calibrated Gilmont rotameter (S/N B-2241). Sampline times ranged from about 10 to 50 minutes. Analyses were done by optical microscopy at Central Laboratory, B-1225. Sampling locations are shown in Figure 1.

EVALUATION CRITERIA

Permissible exposure limits (PEL's) are concentrations of airborne substances to which nearly all employees may be repeatedly exposed throughout a working lifetime without adverse effect.

ST0003273

June 1, 1979

EVALUATION CRITERIA (continued)

Most PEL's are time-weighted average concentrations for 8 to 12 hour work days and 40 hour work weeks. Permissible exposure limits do not represent fine lines between safe and dangerous exposures; they are based on industrial experience and experimental human and animal toxicological studies, and are intended for use as guides for plant design and for evaluating employee exposures.

The permissible exposure limit for asbestos fibers is two fibers per cubic centimeter of air (2 fibers/cc), as an eight-hour time-weighted average. An asbestos fiber is defined as a particle greater than or equal to five microns in length. Ten fibers/cc are allowed as a ceiling concentration for periods up to 15 minutes, provided the exposure for the entire 8-12 hour work day does not exceed 2 fibers/cc, and there are no more than four excursions per day, which are separated by at least an hour.

RESULTS AND DISCUSSION

Monitoring results are shown in Table I.

Employee exposures to asbestos fibers while racking unquenched ingots are significantly below allowed exposure levels. The average employee exposure to asbestos fibers while racking was 0.1 fibers/cc air, substantially less than both the short term exposure limit of 10 fibers/cc air (for periods up to 15 minutes) and the permissible exposure limit of 2 fibers/cc air (as an 8 hour time-weighted-average).

The average asbestos concentration in the area surrounding the employee (about 2 feet away) was approximately half of the average employee exposure, or 0.04 fibers/cc air.

CONCLUSIONS AND RECOMMENDATIONS

Employees at Magnesium Casting B are not being overexposed to asbestos fibers while racking unquenched ingots. Exposure levels are so low that the total employee exposure for racking a full 8 hour shift would be only 5% of the permissible exposure limit. Since racking unquenched ingots is not a routine procedure and the time involved is unlikely to exceed 15 minutes per shift, employee exposures are actually closer to 0.5% of the permissible exposure limit (as an 8 hour time-weighted-average)*, and 1% of the short term exposure limit for the few minutes spent actually racking.

* Calculated using the following equation:

$$8 \text{ hour average exposure} = \frac{\text{asbestos concentration} \times \text{duration of exposure (hr)}}{8 \text{ hr.}}$$

510003274

June 1, 1979

CONCLUSIONS AND RECOMMENDATIONS (continued)

Further monitoring is not necessary at this time.

Employees should be informed of the results of this survey, the consequences of overexposure to asbestos fibers (attached), methods of control, and the care and use of protective equipment. This informing process should be documented.

EHS
EPW/bbs
6-1-79

ST0003275

B8-1818

TABLE 1
ASBESTOS MONITORING RESULTS

EMPLOYEE* /LOCATION	SAMPLE #	ASBESTOS CONCENTRATION (FIBERS/CC AIR)
140613	B8-1818-1	.064
141514	B8-1818-6	.094
140613	B8-1818-7	.16
141514	B8-1818-10	.12
Average employee exposure during racking procedures		.11
On conveyor - to left of employee	- 2	.045
On conveyor - to left of employee	- 5	.048
On pallet - behind employee	- 4	.018
On pallet - behind employee	- 9	.066
On pallet - to left of employee	- 3	.032
On pallet - to left of employee	- 8	.048
Average area concentration		.042

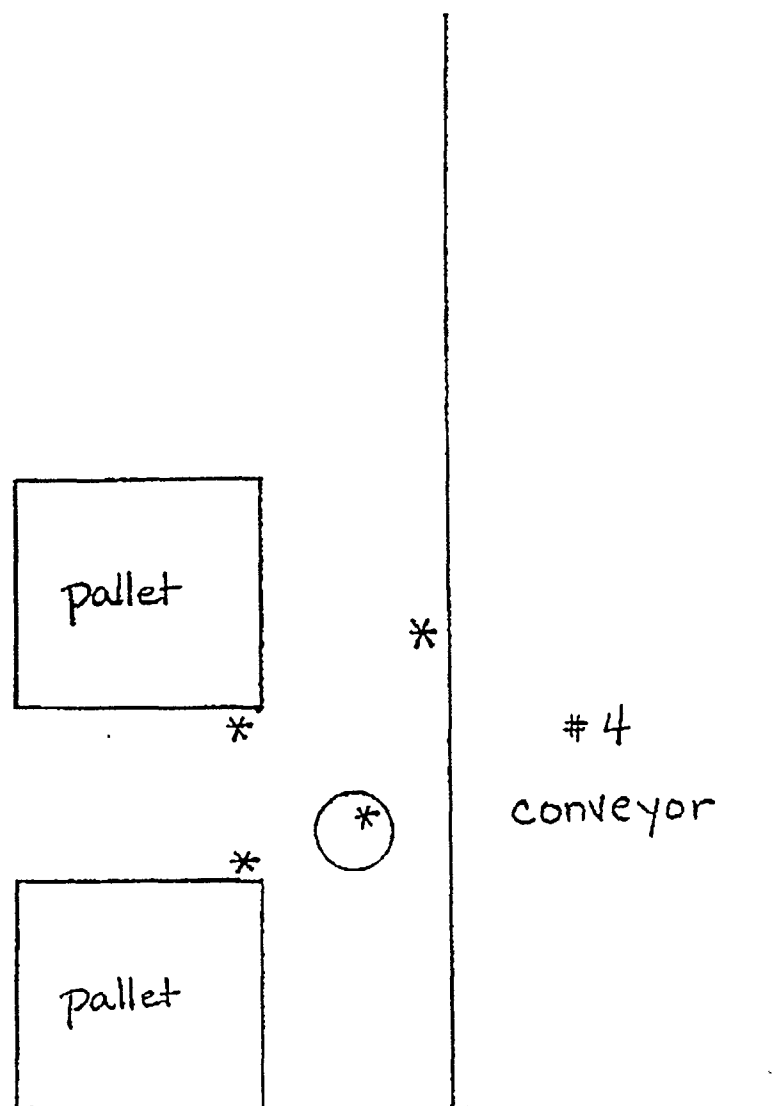
Short term exposure limit (periods up to 15 minutes) - 10 fibers/cc air
Permissible exposure limit (8 hour time-weighted average) - 2 fibers/cc air

* Master numbers are shown for the employees monitored

ST0003276

File B8 - 1818

Figure 1 - Asbestos sampling locations, B-842



* - sample locations
○ - employee position

ST9903277

CONSEQUENCES OF OVEREXPOSURE

COMPOUND: ASBESTOS

EXPOSURE LIMIT: 2 FIBERS/ML , > 5 MICRONS IN LENGTH

ODOR: NONE

EYES: CONTACT WITH THE DUST CAN CAUSE IRRITATION
SIMILAR TO THAT CAUSED BY SIMILAR FOREIGN
BODIES.

INGESTION: SOME EVIDENCE INDICATES THAT SWALLOWED
ASBESTOS MAY INCREASE CHANCES OF STOMACH .
CANCER.

DUST INHALATION:

SHORT TERM: INHALATION OF HIGH CONCENTRATIONS
OF THE DUST MAY CAUSE MODERATE
DISCOMFORT. INHALATION OF
MODERATELY HIGH CONCENTRATIONS
MAY CAUSE NO DISCOMFORT.

LONG TERM: INHALATION OF THE ASBESTOS FIBERS
IN CONJUNCTION WITH SMOKING HAS BEEN
SHOWN TO INCREASE CHANCES OF LUNG
CANCER BY ABOUT 90 TIMES THAT OF A
PERSON WHO NEITHER SMOKES NOR WORKS
WITH ASBESTOS. CAN ALSO CAUSE A
SERIOUS LUNG DISEASE CALLED ASBESTOSIS.
CAN ALSO CAUSE CANCER OF THE CHEST
LINING.

COMMENTS: PROPER RESPIRATOR IS REQUIRED WHEN WORKING WITH
ASBESTOS.

File



50983

DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

EVALUATION OF EXPOSURES TO
CHLORINE (Cl₂) AND ASBESTOS
CHLORINE VI
A-5000

FILE NO. A50-1950

DATE July 14, 1980

AUTHOR E. P. Whatley
E. A. Engeling

CHECKED *Serge H. Flores*
DATE July 24, 1980

Summary

A survey was conducted from November, 1979-January, 1980 to determine employee exposures to chlorine and asbestos.

All employee exposures were within acceptable levels.

Future monitoring emphasis should be placed on short term or peak exposures to employees while performing those job procedures with the highest potentials for exposure.

Employees should be informed of the results of this survey and the informing documented.

bbs

Distribution

D. E. Billings A-5024
✓ R. E. Flake B-101
O. N. Hollis A-1201
K. L. Johnson A-5024
File

L. W. Rampy 1803 Midland
R. R. Langner 1603 Midland
Marlene Swank 1803 Midland
* F. D. Axe - Pittsburg
* C. E. Halphen - Plaquemine
* R. J. McCormick - Strongsville
* R. D. Olson - Sarnia
* S. A. Goode - OCD

496909015

July 14, 1980

INTRODUCTION

A survey was conducted November, 1979 - January, 1980 to determine employee exposures to chlorine (Cl_2) and asbestos at Chlorine VI, A-5000.

PROCESS AND JOB DESCRIPTIONS

Chlorine is produced electrolytically from sodium chloride brine in asbestos drawn diaphragm cells. By-products are hydrogen and 8-10% sodium hydroxide (cell effluent). The chlorine is cooled to condense and remove water, and is further dried by bubbling through concentrated sulfuric acid. The dry chlorine is then compressed and liquefied, stored in spheres, and piped to Dow user plants or to Chlorine V for shipment to outside customers. The electrolytic cells are fabricated and repaired on site, but the asbestos drawing is done by the Cell Services Department. Brief summaries of the job duties of Chlorine VI employees follow:

Superintendent and Engineers - most of their time is spent in the A-5024 office, with 15-25% in the cell area, brine and liquefaction plants.

Shift Foreman - generally spend 75% of their time outside in all three plants.

Production Foreman - spends an average of 50% of his working time outside in the three plant areas, balance in office.

Maintenance Foreman - usually outside in plant areas 60% of time.

Cell Repair Foreman - work in the A-5022 shop except during turn-arounds, at which time virtually all of their time is spent in the cell areas. Turn-arounds usually occur every 1-2 months.

Control A Operators - operate the board in the control room, and are seldom outside unless problems in the plant develop.

Control B Operators - work in the liquefaction plant, generally spending 50% of the shift out in the plant. Also responsible for collecting quality control samples of concentrated sulfuric acid (completely slickered plus respiratory protection).

S10606965

July 14, 1980

PROCESS AND JOB DESCRIPTIONS (continued)

Control C Operators - "Cell Operators" who spend the majority of their time in the cell areas. Collect & analyze chlorine and cell effluent samples, as well as brine as it comes into the block from Chlorine I. Also pulp cells with wet asbestos slurry from the Cell Services Department.

Control C Operators - Brine Plant - much time is spent outside collecting grab samples of brine and carb liquor (sodium carbonate). Also responsible for waste water treatment in that area.

Class 1 & Class 2 - Cell Repair - erect and dismantle cells in cell areas. Clean & rebuild cells in the cell repair shop (disassemble, remove graphite, scrape off putty, wash down, and replace graphite & putty (cathodes are further cleaned at cathode cleaning facility at Dow Oyster Creek)).

Class 2 Unloader - unloads asbestos slurry, sulfur dioxide, sulfuric acid (98%), and sodium thiosulfate tank trucks. Checks cell effluent (sodium hydroxide), chlorine, and carb liquor (sodium carbonate) pipelines for leaks, and cleans & greases chlorine & cell effluent valves. Also runs a diesel engine and changes air conditioning filters in A-5024. Generally spends 60-70% of his workday outside in various areas of the plant.

Jr. Assistant Chemist, Class B - collects chlorine sample from CDC (cooling, drying & compression) area; spends majority of time analyzing chlorine, brine & sulfuric acid samples.

METHODOLOGY

Personnel chlorine and asbestos samples were collected by E. A. Engeling of Chlorine VI. Bendix BDX44 Super Sampler pumps were used to collect chlorine samples on 5 gram charcoal tubes, and asbestos on Millipore[®] filters (MAWG 037AO, Millipore Corp., Bedford, Mass.). The samples were collected by drawing a measured volume of air (approx. 1.5 liters per minute) through a Millipore filter together with a charcoal tube in line for six hours. The Bendix pumps were calibrated before and after use with a calibrated Gilmont rotameter, S/N B3895. Sampling was conducted while employees performed routine job duties.

Analyses for chlorine were performed by Analytical Services, B-2406 by extraction of the charcoal with sodium hydroxide and potentiometric titration for total chloride ion content. The chloride content was doubled to obtain the total chlorine content. Analyses for asbestos were performed by Analytical Services, B-1225, using optical microscopy.

510606966

July 14, 1980

EVALUATION CRITERIA

Permissible-exposure limits (PEL's) are concentrations of air-borne substances to which nearly all employees may be repeatedly exposed throughout a working lifetime without adverse effect. These levels are based on industrial experience, and on experimental human and animal toxicological studies. Permissible exposure levels do not represent fine lines between safe and dangerous exposures. As the name indicates, they are to be used by Industrial Hygienists as guides for plant design and for evaluating occupational exposures. PEL's for gases and vapors are usually expressed on a molar volume basis as parts contaminant per million parts of air (ppm); for dusts, mists, aerosols and fumes, they are usually expressed as milligram or microgram of contaminant per cubic meter of air (mg/m^3 and ug/m^3 , respectively). For asbestos fibers, PEL's are expressed as asbestos fibers per cubic centimeter of air. An asbestos fiber is defined as a particle greater than or equal to 5 microns in length.

Most PEL's are time-weighted average concentrations for 8-12 hour work days and 40 hour work weeks. For many substances, higher Short Term Exposure Limits (STEL's) are allowed for periods up to 15 minutes, provided that there are no more than four excursions per day with at least 60 minutes between exposure periods. Ceiling PEL's are designated for some substances, in which cases short term exposures to higher levels are not permitted.

The PEL's for chlorine and asbestos are as follows:

	<u>8 Hour Average</u>	<u>STEL</u>
Chlorine	1 ppm ceiling	
Asbestos	2 fibers/cc air	10 fibers/cc air

RESULTS AND DISCUSSION

Chlorine VI employee exposures to chlorine and asbestos are summarized by job classification in Table I; individual employee exposures are shown in Appendix A. Contractor Maintenance employee exposures are summarized in Table II, and are shown individually in Appendix B.

All employee exposures to both chlorine and asbestos were within allowed exposure levels.

Average employee exposures to chlorine by job classification were 30% or less of the allowed exposure limit, with the highest average exposures being those of the Control C Operators. However, actual employee exposures ranged as high as 70% of the allowed exposure limit; in these cases employees may have received short term or peak exposures in excess of the allowed 1 ppm. Average employee exposures to asbestos were less than 1 % of the allowed exposure limit.

510606967

July 14, 1980

CONCLUSIONS AND RECOMMENDATIONS

Employee exposures to chlorine and asbestos at Chlorine VI are well within acceptable levels.

Future monitoring for chlorine and asbestos should be conducted with emphasis on short term or peak exposures during those job procedures with the highest potentials for exposure.

Employees should be informed of the results of this survey, the consequences of overexposure to chlorine and asbestos (attached), methods of exposure control, and the care and use of protective equipment. This informing process should be documented.

ST0606968

TABLE I
EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

JOB CLASSIFICATION	CHLORINE (PPM)		ASBESTOS (FIBERS/CC)		NO. SAMPLES
	AVERAGE	RANGE	AVERAGE	RANGE	
Superintendent & Engineers	.11	.04 - .23	.009	.003 - .015	7
Production Foremen	.08	.06 - .09	.010	.007 - .012	2
Foremen	.14	.04 - .26	.012	.007 - .017	5
Shift Foremen	.13	.01 - .35	.006	.004 - .008	5
Instrument	.20	.07 - .24	.008	.003 - .012	4
Matl. & Production Clerks	.08	.07 - .09	.005	.003 - .007	2
Maintenance (machinists, welders, pipefitters)	.06	.04 - .09	.012	.009 - .013	5
Control A Operator	.12	.03 - .23	.007	.003 - .013	9
Control B Operator (Liquefaction Plant)	.20	.04 - .36	.007	.002 - .013	4
Control C Operator (Cell Operators)	.30	.13 - .70	.007	.003 - .014	9
Control C Operator (Brine Plant)	.11	.05 - .22	.008	.006 - .009	3
Class 1 & Class 2 Operators (Cell Repair)	.13	.04 - .45	.012	.002 - .017	26
Class 2 Operator (Unloader)	.27	---	.016	--	1
Sr. Asst. Chemist Class B	.12	---	.008	--	1
Allowed Exposure Level	1 ppm Ceiling		2 fibers/CC Air		

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File 450-1950

TABLE II
CONTRACTOR EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

JOB CLASSIFICATION	EMPLOYER	CHLORINE (PPM)		ASBESTOS (FIBERS/CC)		NO. SAMPLES
		AVERAGE	RANGE	AVERAGE	RANGE	
Foreman	U.S. Contractor	.13	--	.012	--	1
Pipefitter	U.S. Contractor	.06	.03--.07	.011	.006--.016	6
Carpenter & Pipefitter	U.S. Contractor	.09	--	.012	--	1
Welder	U.S. Contractor	.16	--	--*	--	1
Fiberglass work	U.S. Contractor	.09	--	--*	--	1
Electrician Foreman	Gulf States	.07	--	.016	--	1
Electrician	Gulf States	.09	.06-.11	.013	.002--.020	6
Machinist	McGill Maintenance	.16	.11-.20	.003	.002--.004	2
Janitor	Ramirez	.15	--	.008	--	1

Allowed exposure level 1 ppm (ceiling) 2 fibers/cc air

* Filters were too dirty to obtain asbestos fiber counts

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File A50-1950

APPENDIX B
CONTRACTOR MAINTENANCE EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

EMPLOYEE	EMPLOYEE NO.	EMPLOYER	DATE	CL ₂ (PPM)	ASBESTOS (FIBERS/CC AIR)
<u>Foreman</u>	7370	U.S. Cont.	1-5-80	0.13	.012
<u>Pipefitter</u>	8846	"	1-3-80	0.06	.006
	3735	"	12-31-79	0.06	.011
	3801	"	1-4-80	0.05	.011
	9791	"	12-31-79	0.03	.007
	4656	"	12-31-79	0.06	.016
	4208	"	1-4-80	0.07	.014
<u>Welder</u>	7995	"	1-4-80	0.16	too dirty to count
<u>Carpenter & Pipefitter</u>	15783	"	1-3-80	0.09	.012
<u>Fiberglass Work</u>	17840	"	1-3-80	0.09	too dirty to count
<u>Electrical Foreman</u>	171	Gulf States	1-9-80	0.07	.016
<u>Electrician</u>	850	"	1-9-80	0.15	.011
	3597	"	1-7-80	0.10	.016
	428	"	1-7-80	0.07	.012
	3367	"	1-9-80	0.07	.015
	3494	"	1-7-80	0.11	.020
	533	"	1-7-80	0.06	.002
<u>Machinist</u>	145	McGill Maint.	1-4-80	0.11	.004
	049	"	1-10-80	0.20	.002
<u>Janitor</u>	014	Ramirez	1-10-80	0.15	.008

NOTE: Filters "too dirty to count" represent normal welding or glass fiber work - no asbestos handling involved.

ST0606971

File A50-1950

APPENDIX A (continued)

EMPLOYEE	MASTER NO.	DATE	Cl ₂ (PPM)	ASBESTOS FIBERS/CC AIR
<u>Class 2 Operator(conti.)</u>				
	130801	12-19-79	0.04	.015
	142123	12-13-79	0.05	.009
	142130	12-13-79	0.05	.014
	141622	12-13-79	0.06	.017
	138397	12-14-79	0.05	.017
	133775	12-3-79	0.27	.016
	139063	11-29-79	0.17	.011
	138305	12-14-79	0.10	.007
	138517	11-30-79	0.19	.017
	138449	12-7-79	0.08	.015
	139188	12-20-79	0.21	.002
	142128	12-13-79	0.04	.014
	137390	12-14-79	0.09	.015
	131677	12-6-79	0.44	.012
	139765	12-21-79	0.05	.016
	138473	12-6-79	0.25	.012
	138825	11-29-79	0.15	.012
	142124	12-7-79	0.04	.013
	136236	12-20-79	0.07	.011
<u>Sr. Asst. Chemist Class B</u>				
	107860	1-10-80	0.12	.008
	142168	12-27-79	0.02	.014

NOTE: Filters "too dirty to count" represent normal welding work -- no asbestos handling involved.

ST0606972

APPENDIX A (continued)

EMPLOYEE	MASTER NO.	DATE	CL ₂ (PPM)	ASBESTOS FIBERS/CC AIR
<u>Welder</u>	117055	1-2-80	0.07	too dirty to count
<u>Control A Operator</u>	115435	12-3-79	0.22	.006
	134071	11-18-79	0.16	.005
	116142	11-26-79	0.11	.005
	142033	12-27-79	0.05	.013
	141582	12-28-79	0.03	too dirty to count.
<u>Control A Operator</u>	130122	12-4-79	0.18	.010
	110304	12-11-79	0.06	.009
	113814	12-17-79	0.07	.003
	115122	11-27-79	0.23	.006
<u>Control B Operator</u>	134880	11-28-79	0.36	.013
	137377	12-5-79	0.27	.002
	138177	12-12-79	0.04	.006
	136698	11-26-79	0.14	.006
<u>Control C. Operator</u>	138003	11-26-79	0.19	.004
	142129	1-2-80	0.13	.004
	139770	12-4-79	0.34	.006
	138835	12-17-79	0.21	.008
	138866	11-27-79	0.36	.003
	136251	12-4-79	0.25	.005
	133621	12-11-79	0.06	.008
	137301	12-4-79	0.70	.006
	141492	12-20-79	0.31	.010
	131902	12-28-79	0.05	.009
	134864	12-4-79	0.25	.014
	135085	12-5-79	0.22	.006
<u>Class 1 Operator</u>	136252	12-7-79	0.06	.013
<u>Class 2 Operator</u>	139655	12-20-79	0.05	.014
	138181	11-30-79	0.06	.017
	142126	11-30-79	0.18	.016
	138985	12-7-79	0.10	.012
	132824	12-14-79	0.08	.011
	137632	12-14-79	0.08	.016
	142421	12-7-79	0.06	.008
	135143	12-6-79	0.45	.016
	139239	12-13-79	0.04	.015
	140712	12-6-79	0.27	.007
	139240	11-29-79	0.15	.005

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FILE A50-1950

APPENDIX A

EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

EMPLOYEE	MASTER NO.	DATE	Cl ₂ (PPM)	ASBESTOS FIBERS/CC AIR
<u>Prod. Supt.</u>	132154	12-12-79	0.07	.006
<u>Sr. Prod. Engineer</u>	138154	12-11-79	0.14	.008
	506930	12-17-79	0.06	.014
	138898	12-3-79	0.23	.015
<u>Prod. Engineer</u>	138576	12-12-79	0.05	.007
<u>Engineer</u>	141912	12-3-79	0.22	.003
	142251	12-17-79	0.04	.007
<u>Prod. Foreman</u>	131719	12-12-79	0.09	.007
	113835	12-19-79	0.06	.012
<u>Foreman</u>	132330	12-19-79	0.04	.039
	137945	12-19-79	0.06	.007
	104582	12-21-79	0.11	.017
	115399	12-3-79	0.26	.008
	134255	12-19-79	0.24	.017
<u>Rotating Shift Foreman</u>	119051	12-21-79	0.01	.004
	137536	12-12-79	0.07	.005
	119459	12-27-79	0.16	.004
	135208	12-28-79	0.35	.008
	134962	1-9-80	0.07	.007
<u>Instrument Technologist</u>	133521	12-5-79	0.24	.011
<u>Instrument Technician</u>	140002	12-17-79	0.07	.003
	131433	12-5-79	0.24	.005
<u>Inst. Trainee</u>	140342	12-5-79	0.26	.012
<u>Material Control Clerk</u>	100744	12-20-79	0.07	.007
<u>Prod. Clerk</u>	132572	12-11-79	0.09	.003
<u>Machinist</u>	136674	12-27-79	0.04	.013
<u>Pipefitter</u>	131795	1-2-80	0.05	.011
	134847	12-21-79	0.05	.013
	132878	12-28-79	0.09	.009

81060697H

ASBESTOS/BRICKMASONS A+B ✓
ASBESTOS/CARPENTERS A+B ✓
ASBESTOS/INSULATORS
ASBESTOS/SALVAGE

I. TESTING SCHEDULE

- A. Audiograms - Annually if the 8-hour equivalent for noise exposure is greater than 85 decibels for 8 hours.
- B. AM Blood Work (to include CBC, UA, liver and renal function tests) - annually.
- C. Stools for Occult Blood over age 40 - annually.
- D. Chest x-ray, expirogram, respiratory symptomology history - annually.
- E. Sputum cytology over age 40 or with greater than 10 years potential exposure - annually.
- F. Core Exam - Every 2 years.
- G. Hands on physical examination every 2 years over 40 years of age and every 4 years under 40 years of age.

II. JUSTIFICATION FOR DEVIATION FROM THE CORE EXAM

- A. Audiograms - Conforms with Dow guideline for hearing conservation.
- B. Annual AM Blood Work and stools for occult blood - Dictated by tradition.
- C. Annual chest x-ray, expirogram, and respiratory history - Dictated by the Asbestos Standard published in the Federal Register, Volume 40, No. 197, on Thursday, October 9, 1975.
- D. Annual Sputum Cytology - Dictated by tradition and the Asbestos Standard. (The Standard states age 45, but traditionally it has been offered to those over age 40.)
- E. Physical Exam - Dictated by tradition.
To deviate from this tradition would probably have a detrimental impact on participation and attitude toward our periodic health surveillance program.

C
CKB/ske
10-16-80

510582823

PROTOCOL FOR HEALTH SURVEILLANCE OF THE PLANT A & B CARPENTERS

PROBLEM

1. These individuals are potentially exposed to asbestos and thus are covered by the Asbestos Standard published in the Federal Register, Volume 40, No. 197, on Thursday, October 9, 1975.
2. The Dow guideline for hearing conservation states that audiograms are to be done annually if the 8-hour equivalent for noise exposure is greater than 85 decibels. According to the noise survey dated February 19, 1981, there is potential for exposure to noise in excess of 85 decibels.

METHOD

1. Add an annual health history, expirogram, and chest x-ray for all individuals who work with asbestos in addition to the Core examination every two years to comply with the Standard. Also, add a physical examination based on age. Those over 40 years of age will be examined every two years and those under 40 will be examined every four years. This is to look for additional signs of possible disease or cancer.
2. Add an annual audiogram.

INTERPRETATION OF RESULTS

The history and all tests will be evaluated individually for each employee. The group will be analyzed for trends or changes in symptoms or signs of respiratory disease, if these exist. The audiograms will be analyzed for trends to facilitate hearing conservation.

DISSEMINATION OF RESULTS

The results of all tests will be individually communicated to each employee in writing. Any significant abnormalities will be discussed with supervision and a representative of Environmental Health Services. There will be no further dissemination or publication of the results without a separate approved protocol.

C. K. Browdy, M.D.
C. K. Browdy, M.D.
Sr. Industrial Physician

W. A. Fishbeck, M.D.
W. A. Fishbeck, M.D.
Medical Director

J. R. Venable, M.D.
J. R. Venable, M.D.
U. S. Area Medical Director

GKB/ske
2-16-82

ST0582822

STATISTICAL EVALUATION OF RESPIRATORY SYSTEM INDICATORS
AMONG INSULATORS

Introduction

This report presents statistical findings developed from an epidemiologic study of insulators employed by the Texas Division of The Dow Chemical Company. The report does not include a literature review or a medical interpretation of the results. These crucial elements of a study are properly left to the industrial physician responsible for the health of these workers.

The objectives of the statistical evaluation were: (1) to identify through personnel records all employees who worked as insulators at the Texas Division; (2) to determine the current status of these workers and the dates of their employment as insulators; and, (3) to examine the relationship between exposure duration and several respiratory system indicators, namely the number of morbidity episodes due to diseases of the respiratory system, the number of deaths due to respiratory cancer and two respiratory function measures, the forced midexpiratory flow (FEF_{25-75%}) and the forced expiratory volume at three seconds (FEV₃).

The insulator craft has existed since 1941 at the Texas Division. Between 1941 and 1971, seventy-two men who worked as insulators were identified through personnel lists. As of August 1971, the status of these workers was as follows:

Total -----	72
Still Working For Texas Division -	30
Active Insulators -----	29
Not Active As Insulators -	1
Released From Company -----	29
Retired -----	9
Transferred From Texas Div. -----	2
Deceased -----	2

Two factors which pose limitations on the statistical analysis are evident from the above tabulation. These factors are: (1) the rather small size of the exposed-to risk population (72 men), and, (2) the large percent of these employees released from employment (40%).

ST0002927

Methodology

Seniority lists for the insulator craft which were available through the Personnel Department were reviewed to identify the population-at-risk. Since insulators participated in the periodic health exam program, a double check of the population was possible. The verification procedure revealed that the seniority lists had provided complete and accurate identification of the population. The work history card for each in-scope employee was examined to determine the date of birth, the current status of the employee, and the dates during which the employee worked as an insulator. Years-on-job was subsequently used as an indicator of relative exposure levels.

Morbidity Data

Morbidity episodes are recorded in the employee's medical record. The date of the episode and the physician's diagnosis are listed for each event. Extracting this information was most time consuming because of the need to pull individual records and the unedited nature of the data. Since no prior use of these data for statistical purposes is known to the author, it was necessary to assume that the completeness of reporting and quality of the information was adequate. Morbidity data for the exposed-to-risk population were abstracted beginning in 1960. The number of episodes by cause and the frequency of episodes per 100 work-years-at-risk were tabulated for the total insulator population. A matched pairs design was used to compare the morbidity experience of the insulators with that of a suitable control group. In this case, the control group was selected from Power Department employees. Resources were conserved by restricting the comparison to the 24 insulators who worked continuously from 1960 through July 1971 versus 24 Power Department employees of the same age. These employees also worked continuously during the observation period. The pairing procedure eliminated the need to take into account the age of the worker or the period of observation in comparisons between the two groups. Until such time that routine data processing of morbidity data is initiated, the matched pairs type of analysis will remain the most efficient way to statistically treat morbidity data.

100002988

Spirometric Measurements

Spirometric measurements for insulators were provided through the periodic health exam program. The most recent testing for each insulator was selected for analysis. Readings were available for 42 insulators. Two measures, the FEF_{25-75%} and the FEV₃, were selected for analysis. The age and height, as well as smoking history, were obtained for each insulator at the time of his exam. Because of several limitations, three categories--nonsmoker, current smokers of at least one pack per day, and all others,--were used to describe the smoking history for each worker. The objective of this phase of the study was to determine if the two respiratory function measures, corrected for age, height and smoking history, were related to years-on-job. Age and height corrections for the FEV₃ were based on "Guides To The Evaluation of Permanent Impairment - The Respiratory System" (1965). A factor of .95 was used to adjust FVC readings to FEV₃ readings. Age and height corrections for the FEF_{25-75%} were obtained from "Spirometric Standards For Healthy Nonsmoking Adults" by Morris, et al (1971). The FEF_{25-75%} readings were dichotomized according to the sign of the deviations from predicted norms to simplify the analysis.

Mortality Data

The mortality analysis was based on copies of death certificates received by the Company Group Insurance Department as proof of death. Individuals released from the Company, excluding retirees, are lost to any mortality study based strictly on insurance records. The potential biases introduced by this loss of information have been discussed in the literature. The control group for the mortality comparisons consisted of a cohort of 6500 Midland location hourly workers followed between 1954 and 1969. The expected numbers of deaths were calculated based on mortality rates for the cohort population, adjusting for age by the indirect method.

ST0002929

Results

Morbidity Analysis

The overall morbidity experience for insulators from 1960 to August 1971 is summarized in Table 1. As expected, episodes related to diseases of the respiratory system account for over forty percent of the total absences due to sickness.

Table 2 shows a comparison of morbidity experience between insulators and Power Department employees. The between individual range in the number of total episodes (0 to 20) indicates the wide variability in utilization of group insurance benefits. There are no statistically significant differences at the .05 level between the two groups. This is true both with respect to total episodes and with respect to episodes due to diseases of the respiratory system.

Spirometric Analysis

Table 3 shows the average deviations of FEV₃ readings from predicted norms by years of exposure. No significant association at the .05 level was found between years of exposure and FEV₃. Adjustments for smoking history had little effect on the results. The scatter plot of individual FEV₃ deviations from predicted versus years-on-job is shown in Figure I. In contrast, Table 5 indicates that nonsmokers perform near predicted norms and about .4 liters better than the average of either of the two smoking groups. Similar results are obtained for the percent of FEF_{25-75%} readings below predicted norms. Thus, smoking history was found to be related to respiratory function performance while years on the job was not. The possible effects on these readings of selection biases, such as population attrition, are unknown.

Mortality Analysis

Table 6 summarizes the mortality findings of the study. The observed deaths among insulators is less than expected in each category of comparison. However, since the exposed-to-risk population is relatively small and the period of observation is short, the favorable experience to date does not, in itself, insure similar results in the future.

ST00002930

Summary

The statistical evaluation was carried out along the lines set forth in the Introduction of this report. While the necessary data were indeed available, they were sometimes a burden to gather. This was especially true when they had been microfilmed. With regard to the insulators, no evidence was found to indicate an association between years on the job and the respiratory system indicators which were investigated. The many qualification statements which appeared in the report attest to the fact that the data were collected under real world and not laboratory conditions.

ST0002931

Table 1. Episodes Of Morbidity Observed Since 1960 Among
46 Insulators Actively Employed As Of 1960.

Cause	Number Of Episodes	Number Of Episodes Per 100 Person Years At Risk
All Causes	166	39.1
Diseases of the Respiratory System	70	16.5
Accidental Injuries	20	4.7
Diseases of the Digestive System	18	4.2
Diseases of the Circulatory System	14	3.3
Diseases of the Genito-Urinary System	14	3.3
Diseases of the Nervous System and Sense Organs	8	1.9
Infective & Parasitic Diseases	7	1.7
Diseases of the Musculoskeletal System & Connective Tissue	7	1.7
Neoplasms - Total	4	.9
Endocrine, Nutritional & Metabolic Diseases	--	---
Mental Disorders	--	---
Diseases of the Skin & Subcutaneous Tissue	--	---
All Other Causes	4	.9

ST0002932

Table 2. Comparison Of Morbidity Episodes Occurring Between
January 1960 And July 1971 For 24 Insulators Paired
With 24 Power Department Employees Based On Age.

Pair Number	Total Episodes		Respiratory Episodes	
	Insulators	Power Dept. Empl.	Insulators	Power Dept. Empl.
1	2	17	0	10
2	0	7	0	4
3	8	0	5	0
4	5	6	0	1
5	3	4	0	0
6	3	20	2	8
7	6	2	3	1
8	2	5	1	3
9	7	5	5	3
10	2	0	2	0
11	4	4	3	0
12	6	3	2	0
13	2	5	1	0
14	2	0	1	0
15	1	1	0	0
16	3	4	1	1
17	6	12	1	8
18	10	7	7	2
19	11	5	2	4
20	6	1	3	0
21	8	2	5	1
22	3	5	1	1
23	6	2	3	1
24	4	6	1	3
Total	110	123	49	51
Number of Episodes/100 Person Years At Risk	40.0	44.2	17.6	18.4

ST0002933

Table 3. Mean FEV₃ Readings Expressed As Deviations From Predicted Norms By Exposure Group, Adjusted And Unadjusted For Smoking History.

Exposure Group	Average Exposure Years	Number of Men	FEV ₃ In Liters	
			Adjusted For Smoking History	Unadjusted For Smoking History
< 10 Years	3.1	8	-.13	-.13
10 - 19 Years	16.1	17	-.28	-.34
20 - 29 Years	24.5	17	-.19	-.14

Table 4. Percent Of FEF_{25-75%} Readings Below Predicted Norm By Exposure Group, Adjusted And Unadjusted For Smoking History.

Exposure Group	Average Exposure Years	Number of Men	% Of FEF _{25-75%} Below Predicted Norm	
			Adjusted For Smoking History	Unadjusted For Smoking History
< 10 Years	3.1	8	38	38
10 - 19 Years	16.1	17	42	47
20 - 29 Years	24.5	17	38	35

Table 5. Mean FEV₃ Readings Expressed As Deviations From Predicted Norms And Percent Of FEF_{25-75%} Readings Below Predicted Norm By Smoking Category.

Smoking Category	Number of Men	Deviations Of FEV ₃ In Liters From Predicted Norms	% Of FEF _{25-75%} Below Predicted Norms
Nonsmokers	10	+.09	10
Current Smokers Of At Least One Pack Per Day	13	-.32	46
All Other	19	-.31	53

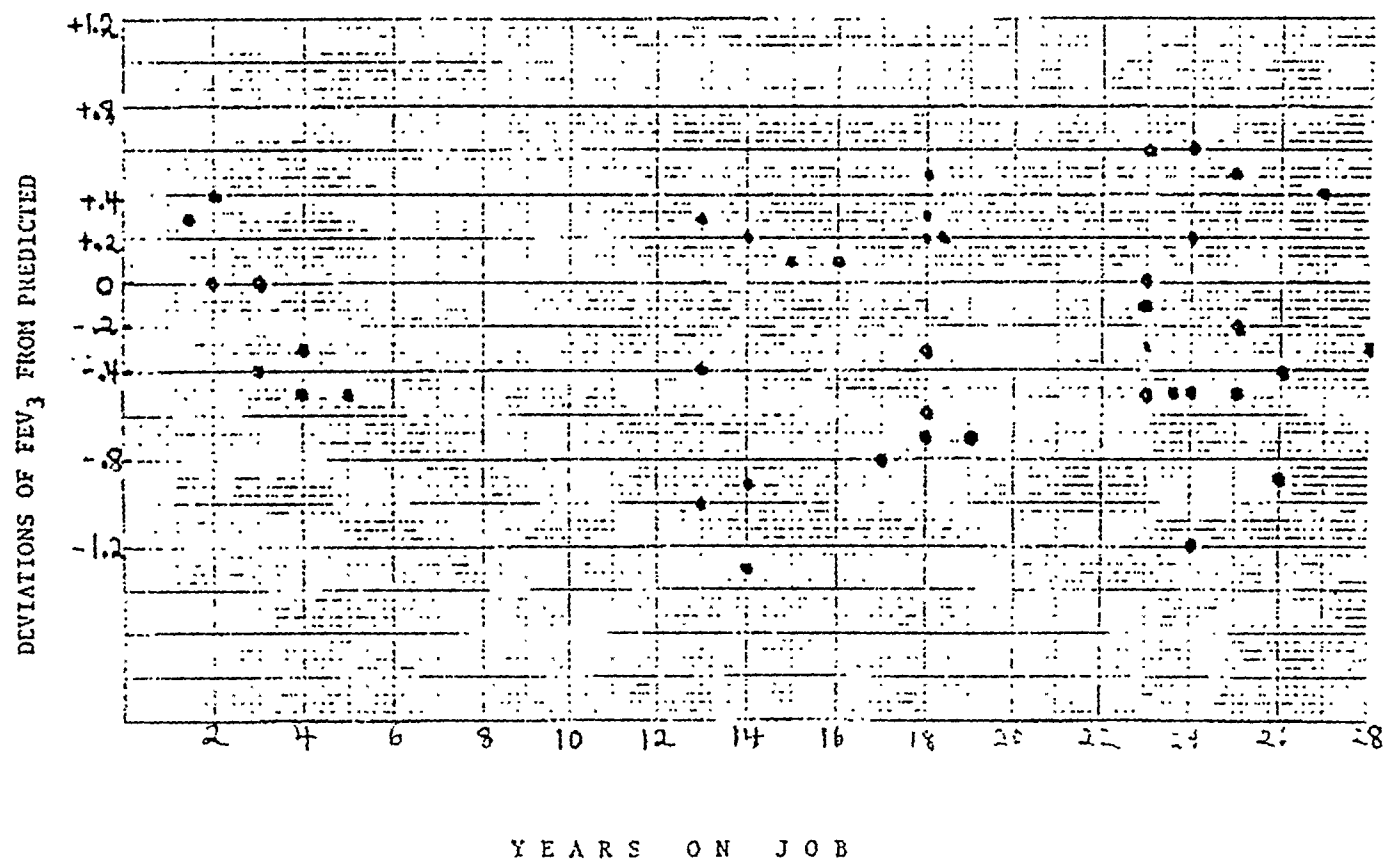
ST0002934

Table 6. Observed And Expected Deaths Among Insulators
By Interval Since First Exposure

Interval Since First Exposure	Years Exposed To Risk	Total Deaths		Deaths Due To Respiratory Cancer	
		Observed	Expected	Observed	Expected
Total	942.1	2	4.4	0	.3
Less Than 20 Years	806.2	2	2.7	0	.2
More Than 20 Years	135.9	0	1.7	0	.1

ST0002935

FIGURE 1. SCATTER PLOT OF DEVIATIONS IN FEV_3 FROM PREDICTED VERSUS YEARS ON JOB FOR 42 INSULATORS (ADJUSTED FOR SMOKING HISTORY)



ST0002936



THE DOW CHEMICAL COMPANY

TEXAS DIVISION
FREEPORT TEXAS 77541

May 13, 1968

R. L. Buell
B-1201

RE: Insulators

We have done annual periodic examinations on the insulators since 1960. The examination is directed primarily to the lungs and consists of chest x-rays, ventilatory measurements (pulmonary function) hematocrit, ECG, and examination of heart and lungs by a physician.

The concern of the Union about the welfare of their men is a just one and has come about probably because of the wave of cases that has hit the medical literature recently. The incidence of the usual type lung cancer is much higher in asbestos workers who smoke - the smoking and asbestos exposure seem to be additive. There is an unusual type of cancer effecting the lining of the chest and abdominal cavities called mesothelioma which is due to asbestos exposure. Any asbestos worker's death due to mesothelioma would be considered due to asbestos exposure until proven otherwise.

I appreciate Mr. Kinsel's concern about whether the insulators are being examined periodically but I gather from the tone of his letter that he is not concerned from a humanitarian viewpoint.

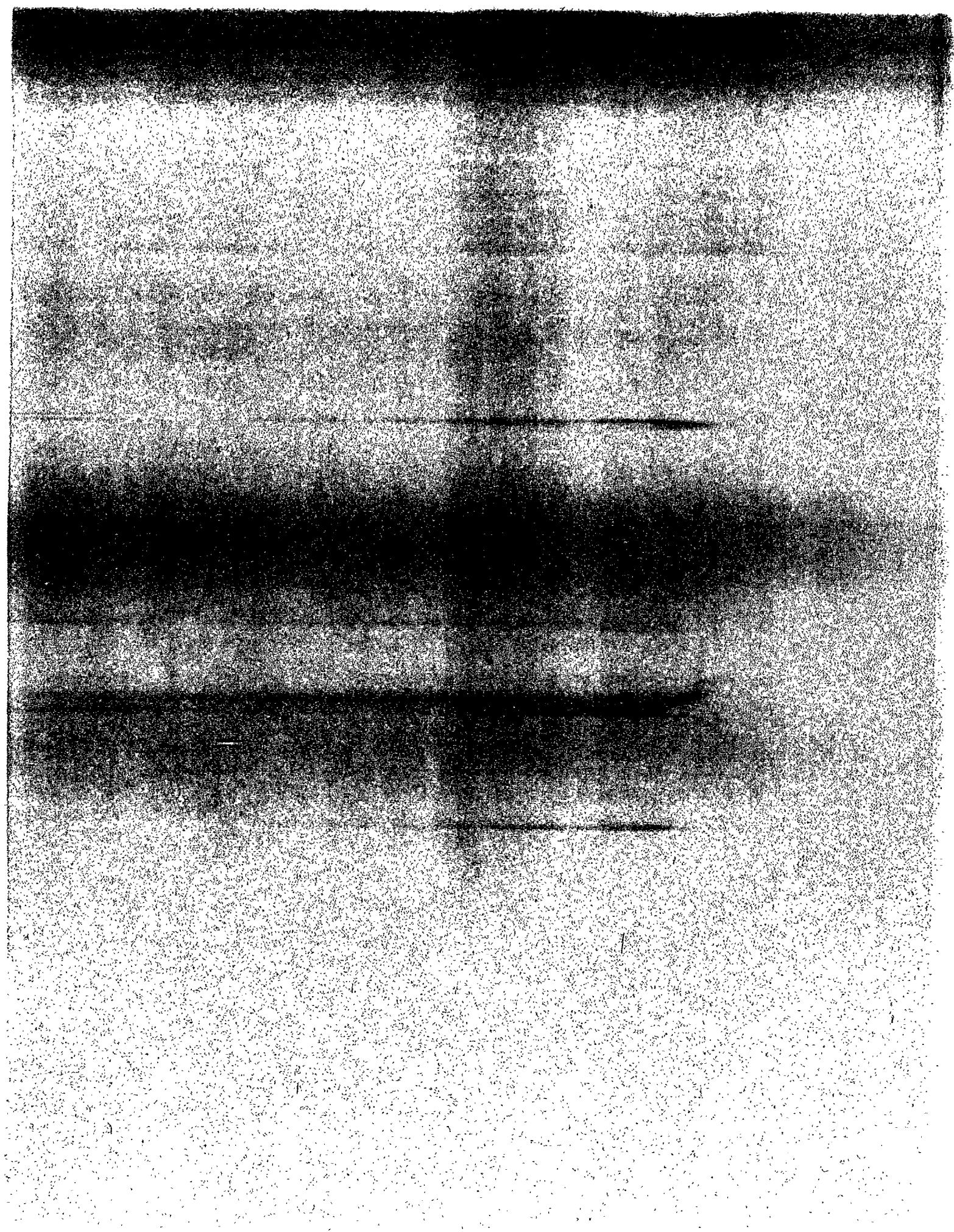
As a matter of interest one of the union agents for the insulators stated he heard a talk by a physician at a union meeting which seemed out of place judging from the words of this union agent. The talk seemed to be a scare-type talk and was either misinterpreted by the audience or misinformation was given out.

I hope this may be of help to you.

R. E. Flake
R. E. Flake, M. D.
Industrial Medicine

REF:mfr

ST0583215



PLAINTIFF'S EXHIBIT

DOW-2903

C. F. Porter

**STANDARD RULES
AND
REGULATIONS**

Texas Division

**THE
DOW CHEMICAL
COMPANY**

Freeport, Texas



INCLUDING THE
**SAFETY RULES AND
REGULATIONS**

April, 1941

ST0014088

FOREWORD

The Dow Chemical Company is made possible by the combined efforts of every employee, by the use of capital and equipment furnished by stockholders, and by the patronage of customers who buy our products. This great enterprise will be successful if these three groups are well served and to whatever degree we understand one another.

The employee is entitled to advance as much as possible, receive courteous and fair treatment at all times, and work with the surrounding conditions maintained at the highest possible standard.

The stockholders are entitled to a fair return from their investment. It is the duty of all employees to protect this investment by the proper use and care of equipment, by elimination of waste, and by giving a fair return for wages received.

The customer must receive as much or more for his money than our competitors can give if our business is to be permanently successful.

To accomplish these things in the fullest measure, a real challenge is continually before each and every employee.

PURPOSE OF THIS BOOK

This book is presented to you as a basis for friendly understanding. It is hoped that it will prove to be of mutual benefit, and a contributing factor in creating and maintaining harmonious relations between you, your employer, and your fellow workers.

ABSENCE FROM WORK

Every employee should think enough of his job to promptly notify his superior when it is necessary to be absent. This is only asking good business practice. Starting January 1, 1941, all unexcused absences in excess of one regular work period will be investigated.

Employees will be discharged for failure to report for work for three consecutive working days unless the employee notifies his superior or the Employment Department and receives permission for absence from work.

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ASSIGNMENT OF WAGES

In all cases where an assignment of wages involving an employee is served on The Dow Chemical Company, the employee will be automatically discharged for cause.

BADGES

An hourly employee when hired is furnished with two badges so that it will not be necessary to change badges from street clothes to work clothes. The small badge must be in plain sight on your outer garments when you pass through the clockroom. Pay checks are given to employees only when they are wearing their badge. In case of loss, badges will be replaced at a cost of \$1.00 each; this is deducted from your pay check.

CLEANLINESS

It is the duty of all Service and Construction Crews to clean-up after completing their work. Remove all the litter and scrap to places provided for the same, and turn the equipment back to the Production Department in a workmanlike manner.

Workmen are particularly cautioned to conform to special practices in various places to guard against the contamination of products. The use of a little grease or oil in the wrong place can spoil a valuable product.

By the practice of cleanliness every employee can contribute a great deal in promoting the sale of our products. Many prospective customers visit our plant. The appearance of equipment, aisles, and work benches, and the cleanliness and attitude of all employees are very important factors in helping to favorably impress such visitors.

DELIVERY SERVICE

Express delivery service is maintained from the Stockroom to all parts of the plant. Learn the service available from this system before making yourself subject to criticism by calling personally for items of stock.

GRIEVANCES

In case an employee has a grievance it should first be presented to the foreman for settlement. If

ST0014090

no satisfactory answer is given, the grievance should be taken to the superintendent. Any complaint not settled in this manner may be taken up with the Employment Manager, who will present the grievance to the management.

HOLIDAYS

Six holidays are observed as follows:

New Year's Day	Labor Day
San Jacinto Day	Thanksgiving Day
Independence Day	Christmas Day

INSURANCE

Metropolitan Life and Health and Accident Insurance paying \$1700.00 upon death and \$14.00 per week for up to 13 weeks during disability resulting from sickness or accident has been made available to all employees at a cost to them of 84c per month, the balance of the cost being borne by The Dow Chemical Company. The \$1700.00 life insurance benefit is paid to your named beneficiary upon your death, regardless of cause, while the weekly sickness and accident benefits are paid when you are disabled from causes not connected with your employment.

Benefits are payable after the seventh day of disability. It is your responsibility to contact the Employment Department for the necessary blanks and instructions needed in filing your claim.

A large number of insurance checks, both large and small, have been received by employees or their families since this insurance plan was first offered, and the benefits of the plan have been proven.

LAUNDRY SERVICE

Wear clean clothing. Laundry service for the following personally owned cotton work garments is free:

Work pants	Coveralls
Work shirts	Shop Coats
Overalls	Shop Aprons
Jackets	Shop Caps

There is danger in dirty greasy clothing, and certain chemicals may cause irritation or damage to the skin. Frequent washing of garments removes these

ST0014091

LOANING OF COMPANY TOOLS

NO COMPANY TOOLS ARE LOANED FOR PERSONAL HOME USE. Adequate tool rooms and loan service are provided throughout the plant to supply employees with special tools: such tools are charged to the employee by tool checks or loan slip method. Tools lost or broken by workmen are charged to their account, when it is felt that such loss or breakage is the result of carelessness or negligence.

MAIL

All personal mail should be addressed to your home and not to you in care of the company. For your convenience the company will handle outgoing mail if deposited in any one of the various department mail boxes. All first class mail received at the main office will be opened and the receiving date stamped thereon.

PAY DAYS

You will be paid by check on the 5th and 20th of each month for time worked prior to 8:00 a. m. on the 1st or 16th, respectively. Checks are available after 3:00 p. m. on pay days.

PERSONAL TOOLS

Personal tools may be taken for home work by a pass out card issued by stock room department.

Removal of personal tools belonging to employees who have been released is executed the same way. Department heads are asked to cooperate fully in this regard by giving the Stockroom Department sufficient notice in all cases of release.

PLANT RULES—BULLETIN BOARDS

Any changes in or additions to Company rules or general instructions will be posted on departmental bulletin boards before the rules or instructions are to take effect.

All notices of departmental or general interest must be approved by the department superintendent before being posted.

ST0014092

SMOKING

SMOKING IS PROHIBITED AT ALL TIMES IN CERTAIN PLANTS.

In plants where smoking is prohibited, NO SMOKING signs have been posted on all building doors, or to include specific areas.

Employees violating this regulation will be automatically discharged.

SOLICITATIONS

No solicitation of any kind will be permitted within the plant or offices of the plant, unless the same is authorized by the department head and approved by management and conducted under the supervision of the department head.

SUGGESTIONS

THE COMPANY WELCOMES SUGGESTIONS FROM ANY OF ITS EMPLOYEES AND ALWAYS APPRECIATES CONSTRUCTIVE CRITICISM.

TIME CLOCKS

Every employee of The Dow Chemical Company, including the President and General Manager, has a time card and rings it regularly. No exception to this rule is made. Employees are positively forbidden to ring for each other. Ringing late will not be tolerated. You are expected to be at your place of work a few minutes before the whistle blows.

USE OF COMPANY AUTOMOBILES

Drivers of company cars must conform to all rules and regulations pertaining to the same. The maximum speed limit within the plant is twenty-five miles per hour. All signs must be observed.

It is not permissible for passengers to ride on the outside of cars. The maximum number of passengers in the driver's seat is two besides the driver.

Use the company car the same as you would your own.

ST0014093

USE OF TELEPHONE

During working hours the use of the telephone for personal calls cannot be extended to employees. However, urgent incoming messages will be delivered.

Quite often urgent messages are received at the plant at times when workmen are off duty; therefore, it is important for workmen to report changes of address to their foreman and the Employment Department.

WASTE

Compressed air costs money; the required amount of air (5c per 1,000 cu. ft.) for two shops is 300 cu. ft. per minute. A few leaks could double this requirement and also make it impossible to reach the best working pressure. Watch for and report all leaks.

Provision for strict observance of economy in light must be planned and carried out by the foreman. Definite responsibility must be placed or assumed by the foreman to avoid wasting of light.

Water is so much used that it is very easy to misuse. Equipment requiring water cooling is quite often found shut down after the work shift but the water is left running.

Industrial wastes cause losses of millions of dollars yearly; most of it could be stopped. Your attitude toward waste is very important. You are more valuable, as an employee, if you help prevent waste.

WORKING HOURS—OVERTIME

1. The work-day shall begin at 8:00 A. M. and end at 8:00 A. M. on the following day. The work-week shall begin at 8:00 A. M. on any Monday and end at 8:00 A. M. on the following Monday.

2. Time and one-half will be paid for all work done on the following holidays: New Year's Day, San Jacinto Day, Independence Day, Labor Day, Thanksgiving Day and Christmas.

3. Time and one-half will be paid for all work done in excess of 8 hours in any work-day except

ST0014094

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Page 7

by utility or relief operators or shift men filling in for other operators off duty unless the shift man is on a job other than his own.

4. Time and one-half will be paid for all work done in excess of 40 hours in any work-week.

5. (a) Except for shift men $\frac{1}{2}$ hour will be deducted when Company furnishes meal.

(b) No schedule allowable calling for more than 8 hours per day.

(c) Minimum pay for emergency calls: one hour at time and one-half rate.

6. In any event time and one-half will be paid whenever required by the Federal "Fair Labor Standards Act of 1940."

ST0014096

TEXAS DIVISION

**THE
DOW CHEMICAL COMPANY**
Freeport, Texas



SAFETY RULES
and
REGULATIONS
FOR ALL EMPLOYEES

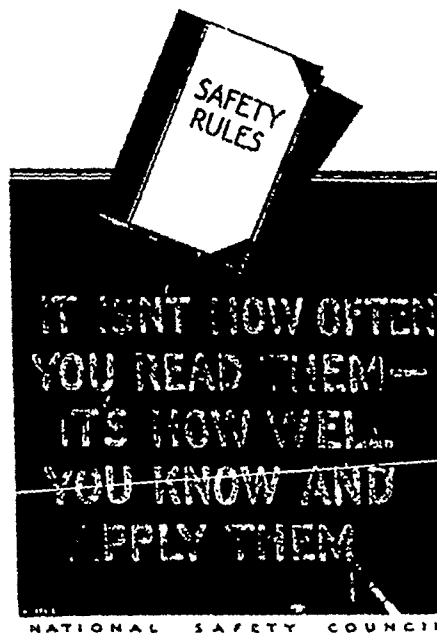


You Are Not Required to Take Un-
necessary Chances—Do Your
Work the Safe Way

DEPARTMENT OF SAFETY

The purpose of this section is to set forth the active duties of the Safety Department of (Texas Division) The Dow Chemical Company and to present to you certain recommended practices and policies which have been worked out while studying the subject of health and safety.

Your company is more concerned with the problem of health and safety than with any other problem with which it has to deal. There is no recommendation that any employee can make re-



garding safety that is too insignificant to be considered. This is the attitude of the company, but the company cannot practice safety. The practice of safety and the effectiveness of safety measures, safety devices and safety rules are all dependent upon the attitude of the employee. Employees must be safety minded and assume the greatest part of the responsibility of promoting safety.

Safety is the Right Way of Doing Things

ST0014097

SAFETY

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Take safety seriously. Be as good about protect-
ing your fellow workman as you would about
helping them if they were hurt. It is kinder and
more profitable to all.

COMPENSATION

The Dow Chemical Company operates under the
Workman's Compensation Law of the State of
Texas in settlement of all claims for personal in-
juries of employees arising out of and in the course
of their employment with the company. Under this
act an employee who is so injured will receive com-
pensation at the rate of sixty percent of his weekly
wage, but not more than \$20.00 per week nor less
than \$7.00 per week for such time as he is unable
to work. This payment starts on the eighth day
of incapacity following the date of injury. If inca-
pacity continues for four weeks or longer, the first
week's compensation is also paid. Various standard-
ized schedules have been incorporated in the law
in regard to the length of time for which compensa-
tion shall be received for total, or partial, tempor-
ary or permanent disability. During the first nine-
ty-one days after the injury the employer furnishes
reasonable medical, surgical and hospital service.

All matters pertaining to compensation are
handled by the Employment Department.

FIRST AID

It is the policy of the Company to maintain, for
the benefit of its employees, the best possible First
Aid facilities. The First Aid room is located at the
garage, 901 building. The Department is sufficiently
equipped to handle emergency first aid cases. The
personnel includes four graduate nurses. There is a
nurse on duty twenty-four hours a day.

The First Aid is maintained solely for you: con-
sider it your duty to use it at any time for even
the slightest injury received while at work.

It is considered to be in order to call at the First
Aid for relief treatment for minor AILMENTS
NOT ATTRIBUTABLE to your employment, when
such treatments will permit you to complete your



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Think! Is It Safe?

ST0014098

Page 12

regular work period. You are urged, however, to consult your family physician as neglect to do so often results in acute cases. The First Aid is not intended to completely diagnose such cases and no responsibility is being assumed in rendering relief treatments of this nature.

SAFETY ENGINEERING

The Dow Chemical Company is showing, through the Safety Department, its sincere interest in maintaining safe working conditions for its employees. One member of the department devotes his full time to safety engineering, establishing safe practices, and safety education throughout the plant. The facilities of this Department are constantly at the service of any of the employees of the company.

If you have a carefully thought out suggestion for improving working conditions from the standpoint of health or safety—explain it to your foreman and submit a written report of the suggestion to the Safety Department.

At the Safety Department a complete display of safety equipment is arranged to assist foremen and employees in selecting the proper equipment to safely handle their jobs. You are urged to visit this room and keep in touch with the new types of equipment.

Accidents Are Preventable and Repeatable—
Be Careful

ST0014099

ST0014100

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SAFETY RULES

The following safety standards have been adopted by The Dow Chemical Company (Texas Division) and govern all persons in its employ. Certain departments or classes of work have further detailed instructions for the men in those departments or undertaking that type of work.

Before starting to work, ask your foreman for safety instructions.

Every effort is being made to safeguard all operations as far as possible. Various machines are provided with guards, and special tools are provided for certain operations. **Use Them.** Guards can prevent only a small number of accidents. **Most accidents are caused by using defective tools, disregarding safety instructions, or neglecting to use safety appliances.**

RULES AND GUARDS ARE FOR YOUR PROTECTION



WHY CHEAT?

NATIONAL SAFETY COUNCIL

You will be expected to be thoroughly familiar with the information on the following pages, and.

Personal Caution is the Most Efficient Safeguard

therefore, are asked to read them carefully. After you have read and studied the booklet, sign the printed statement on the last page and return it to the Safety Department.

GENERAL RULES

1. While no attempt will be made to set up definite procedures in case of a serious accident, the following general rules should be studied as a guide:

- (a) The ambulance and First Aid phone number are in large letters on the cover of the phone book. Call the ambulance immediately. Call the First Aid as well, so that the nurse on duty may call for help if needed.
- (b) Be calm and explicit. Deliver the message so that there is no chance for a mistake. Be sure to give the building name, the building number, and the type of accident.
- (c) Unless specific instructions have been given you what to do—remove the person from further danger, make him as comfortable as possible, and make sure that there is no danger from exposure.
- (d) In moving an injured person to a place of safety, extreme care must be exercised as there may be fractured bones. Move the patient as little as necessary.
- (e) In cases of bad acid or caustic burns, flood the burned area with water—and lots of it—and get the patient to the First Aid. Running water is far better than just immersing the burned area.

2. It is hereby declared to be a rule of The Dow Chemical Company, that WHENEVER AN EMPLOYEE RECEIVES AN INJURY, EVEN THOUGH IT BE CONSIDERED SLIGHT, HE MUST REPORT AT ONCE TO THE FIRST AID STATION. If the foreman or crew leader is present, the injured employee shall advise him of the injury before reporting to the First Aid; but if the foreman or crew leader is not present, then the injured

We Need Your Help in Preventing Accidents

ST0014101

employee shall go direct to the First Aid. THE FOREMAN SHALL MAKE A WRITTEN REPORT TO THE FIRST AID OF THE DETAILS OF ALL INJURIES RECEIVED BY EMPLOYEES UNDER HIM.

Prompt and proper treatment of a minor injury will prevent unnecessary suffering and loss of time. Our First Aid staff is for your benefit and protection—many bad cases of infection have been caused by home use of iodine by men in our own plant.

	IDENTICAL INJURIES This man spent ten minutes in the First Aid room.
This man waited 5 days before reporting injury---He lost 12 weeks with blood poisoning	

3. The practice of fellow employees removing foreign particles from eyes is strictly forbidden. This practice often results in serious if not permanent infection to the eye. Each time a particle enters the eyeball a slight laceration is made which is easily infected. Go to the First Aid.

4. We will not be responsible for any bills of outside doctors unless a properly written order granting permission to call upon such doctors is obtained in advance.

Learn by the Experience of Others

ST0014102

5. Horse play, scuffling, throwing things, and fooling with compressed air in the plant are dangerous and will not be tolerated.

6. Few men realize the danger in the use of compressed air. The air hose should never be directed toward an individual.

Before using compressed air, as an aid to removing dust from clothing, the equipment used for the purpose must meet the approval of the Department of Safety.

7. Personal cleanliness is an important item in the maintenance of healthy and safe working conditions:

(a) Always wash up before eating—particularly if you have been handling paint, lead, or chemicals.

8. Watch the Safety Bulletin Boards. Each poster is a lesson in itself; you can easily profit by reading it.

9. When you see a warning or danger sign, be sure you are safe before going ahead. Not to do so is to invite injury.

10. Boards with nails sticking up must not be left lying around. When you see such boards, turn them over, pull the nails, or put the boards where they can do no harm.

11. Do not climb through, under, over, nor between railroad cars. Wait until the train passes, or walk around the end of the train. With the exception of the engine or switching crew, no one is allowed to ride yard locomotives or freight cars.

12. Do not attempt to lift or push objects which are too heavy for you—ask for help when you need it. Learn to lift the right way to avoid strains: bend your knees, keep your body erect; then push upward with your legs. It is much easier and safer.

13. When working on any kind of a pressure line be sure that the supply is shut off and a warning sign placed on the supply valve. Never open or close a valve on a pipe line unless you *know* it is safe to do so.

Practice Safety Yourself—Others Will Follow You

ST0014103

A SPRAINED BACK *Caused by Wrong Lifting*



14. All excavations, open manholes, and other places where persons might fall must be protected by suitable railings and lights.

15. When walking on plant roadways walk on the left hand side of the road, unless paths or walks are established.

16. The speed limit in the plant for all company and private cars or trucks is twenty-five miles per hour. This limit must not be exceeded.

17. The driver of a company car, truck, or taxi is responsible for the condition of his car while it is entrusted to him. Any irregularities of brakes, lights, horn, fumes in cab, or general operation of the automobile must be reported to the garage on the regular form provided for the purpose. It is requested that drivers of plant cars keep on the roads designated for travel and refrain from driving on areas not designated for car traffic as much as possible.

Good Housekeeping is Good Safety

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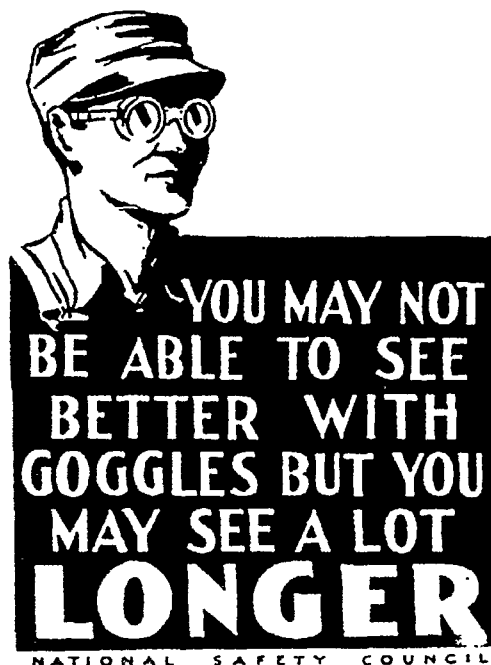
18. Pickup trucks carrying passengers must be equipped with the standard seating arrangement. The Service Department is responsible for seeing that new pick-up trucks are so equipped before being issued to individuals or departments.

19. If your work requires you to enter other departments, familiarize yourselves with the rules and dangers of these departments.

GOGGLES—CLOTHING

1. Goggles or face shields must be worn as protection on the following jobs:

- (a) While working on or around magnesium cells.
- (b) While working with or pouring molten metal.
- (c) On any grinding operation.
- (d) On any chipping operation—goggles only.
- (e) Breaking up concrete or brickwork—goggles only.



Wear Safe Shoes

ST0014105

(f) Any welding or burning operation.

(g) When the handling of chemicals is particularly hazardous.

2. You are required to wear goggles when and where you are instructed to do so. For the safety of your eyes do not neglect to do it. Protect your eyes when working near welding equipment.

3. Where the heat is excessive, men are advised to wear sweatbands on the forehead to keep perspiration out of the eyes. Anti-fog sticks may be secured from the Safety Department. A small amount applied to goggle lenses will prevent steaming. Goggles should be adjusted to fit the face comfortably. Head straps should fit over the tops of the ears and well down on the back of the neck.

4. You are especially cautioned to roll up your sleeves, not wear a necktie, and not wear gloves while working around any revolving machinery.

5. Rings, watch chains, key chains, loose jackets are all potential accident makers and should not be worn in the shops or around moving machinery. The results from an accident caused by one of these factors are often extremely serious.

6. If you are working where there are heavy fumes or dust you will be required to wear the respirators provided for your protection.

TOOLS—EQUIPMENT

1. Safety devices and guards are for your protection. Keep them in place at all times. Removing or tampering with safety guards is forbidden by law.

2. In using grinder—be sure that the tool rest is within one-eighth of an inch of the wheel and that guards and hood provided are in proper position and in good repair. Wear goggles for all grinding work, unless the grinder is equipped with an approved glass shield.

3. Stop machinery to clean, oil, adjust or repair by pulling the main switch. Lock the switch or hang a warning sign on it if there is a hazard due to someone starting the equipment before it is ready.

You Can't See Through a Glass Eye



NATIONAL SAFETY COUNCIL

4. Never use defective punches, wrenches, chisels or other tools. Flying chips from tools with mushroomed or split heads cause many injuries. In the use of personal tools, the man is wholly responsible for the condition of his tools. If you are using plant tools insist upon getting proper tools for the work you have to do.

5. All gears where exposed to contact must be guarded.

6. All drive belts exposed to contact, except those moving so slowly that there is no possibility of danger, must be properly guarded. Proper lacing of belts is important. The joint should be made close and smooth. Rawhide lacing must be used in cases where belts are to be shifted by hand.

7. Whenever possible, line shafts should be shut down while belt is being put on—employee should be stationed at starting switch as a precautionary measure. Never allow inexperienced men to replace belts on moving pulleys.

You Can't Depend on Luck; You Can on Safety

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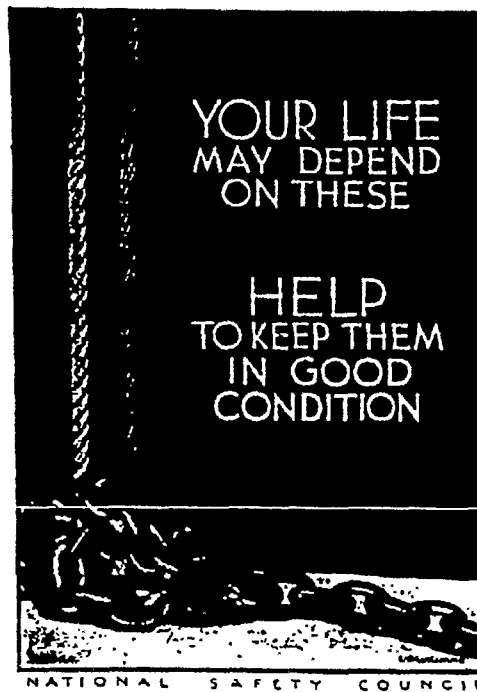
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8. All belt shifters must be within easy reach of the operator. Shifters which will not stay in position without fastening should be reported to the proper service department.

9. All chains, hooks, and cables used under heavy stress must be regularly inspected and annealed.

10. No worn or frayed rope slings are to be used. Whenever rope becomes frayed or worn, notify your foreman—who will either have it repaired or replaced. Do not take any chances.



11. Keep the floor space around machinery as clean and as free from obstructions as possible. Loose material, oil, and grease are all definite hazards in any location, particularly so around machinery of any kind.

CRANES

1. Never stand or walk under a crane load. Obey the man handling the load from the floor;

Follow You

We Can Furnish Goggles, But Not Eyes

ST0014108

listen for the crane horn or other signalling device. When entering a shop floor, over which there is a crane, look for the crane—determine its location before crossing the floor.

The responsibility of carrying a load safely is placed upon the crane operator. You must hook your load to his satisfaction at all times.

2. Riding a load handled by a crane or riding crane chains or slings is strictly prohibited with the exception of crews working on steel erection.

3. The practice of moving oxygen or acetylene cylinders, by means of cradling one or more cylinders in the crane chain, is strictly prohibited. Gas cylinders are not to be hoisted or lifted, under any circumstances, by crane except in specially constructed holder.

4. Certain men are designated as crane operators. No one other than these operators are to operate a crane except in case of emergency and with the permission of the Shop Superintendent.

5. Do not leave a load hanging or hooked on. Make sure that everyone is out from under load, lower and place load, unhook immediately and hook up chain or remove sling. See that hook or chain is hoisted above head level immediately after unhooking.

6. After finishing any repair work, make sure that all tools and materials are removed from crane or track.

7. No employee is allowed to work under a suspended load without same being blocked in such a manner that any failure of crane or part would not allow load to fall on him.

ELEVATORS

1. In case any elevator equipment is found out of repair, the Machine Shop Office must be notified at once. Do not try to repair the elevator yourself.

2. All elevator gates are to be in a closed position—except at the level at which the elevator

A Good Safety Record is a Fine Recommendation

ST0014109

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ommendation

car is standing. If the gates do not close auto-
matically, do not consider that as an excuse for
leaving them up.

3. Do not allow material, rubbish, stock, etc.,
to accumulate near elevator gates. The space
directly in front of the elevator shaft must be
kept clear at all times.

4. When doing any repair work on elevators
of any type—close and lock, or tag, the main
switch.

5. The following definite rules apply to the
use of the various man elevators in the plant:

- (a) When you step onto the elevator—grasp
the handle with one or both hands and
face the belt.
- (b) When shutting the elevator off, after reach-
ing your floor, make sure that no one is
riding the elevator at the time.
- (c) No material or tools are to be carried on
the elevator which cannot be easily and
safely handled with one hand. No hand
tool or material over 18 inches in length
is to be carried.
- (d) The practice of placing tools, tool boxes,
or material of any kind on the elevator
steps—to be carried to a higher or lower
level—is strictly prohibited.
- (e) Report to your foreman, or the Safety De-
partment, any hazardous conditions around
the elevator landings.

LADDERS

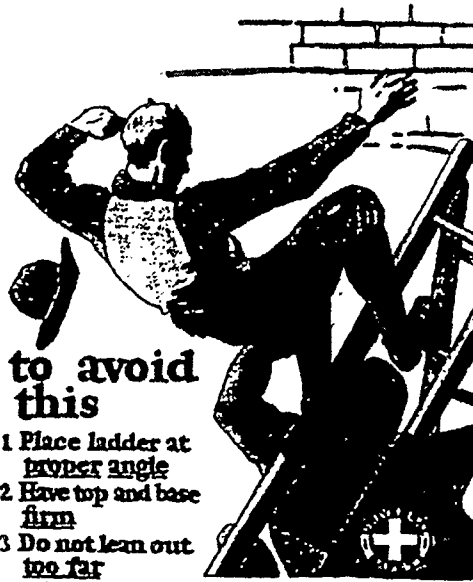
1. Never use a ladder which is defective in any
respect, such as with broken or split side rails or
rungs. The tool room is equipped to renew broken
rungs with rung replacers.

2. In placing ladders—the best angle at which
to lean the ladder is that in which the horizontal
distance from the foot of the ladder to the base
of the wall or beam against which the ladder is
resting is one-quarter of the length of the ladder.

Think How Much Suffering First Aid Prevents

ST0014110

LADDERS



to avoid
this

- 1 Place ladder at proper angle
- 2 Have top and base firm
- 3 Do not lean out too far

NATIONAL SAFETY COUNCIL

3. When a ladder is left standing over night, tie up the top of the ladder.

4. Never place a ladder on a slippery floor unless the base of the ladder is securely anchored so it cannot slip, or unless somebody is holding the ladder at the bottom.

5. Use caution when carrying boxes, tools, chainfalls, or other material in your hands when climbing or descending a ladder. Use a rope, or crane, with excessive loads so that both hands will be free to grasp the ladder.

6. Never descend a ladder while facing outward.

7. Be careful when carrying ladders in aisles, through doorways, or around blind corners. Always carry it with the end ahead of you elevated high enough to clear a man's head in case you should meet some one unexpectedly.

Keep Fit By Keeping Clean

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WELDING EQUIPMENT

1. Never look at an electric arc with the naked eye. When observing or working near arc welding operations—the eyes must be protected from direct exposure.

2. Heavy canvas (or metal) screens must be used to afford protection to all others from electric welding wherever possible, particularly when welding is being done in the shop.

3. When welding wherever there is the least chance of causing a fire, keep a fire extinguisher within reach. Welders are required to have a quart hand extinguisher as a part of their equipment.

4. Gas motor driven portable generators or air compressors must not be located inside buildings. The exhaust vapors are extremely dangerous and these machines must be operated out of doors.

5. Never allow oil or grease in any form to come into contact with part of the oxy-acetylene welding equipment. An explosion may occur if you violate this rule.

6. Use extreme care in handling gas cylinders. Do not drop tanks over steps, off of trucks or platforms.

7. Keep cylinders away from salt and other corrosive chemicals and fumes.

8. Carrying or lifting tanks by crane or hoist is absolutely forbidden, unless a sling or cradle constructed for this purpose is used—see Cranes—3. page 22.

9. Put nothing on top of tanks—you may damage the safety plug or regulator, or interfere with the quick closing of the valve. Valves must be closed when cylinders are not being used.

10. Cylinders must be secured to prevent their being knocked over while in use.

11. All cylinders should be protected against excessive rise of temperature. On storing cylinders in the open—see that they are protected against extremes of weather.

Report Every Injury

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12. Foremen and welders should study thoroughly the more detailed "Safety Precautions for Arc and Acetylene Welders."

13. The Boiler Shop is equipped to service and repair all acetylene welding equipment. Worn and defective gauges, regulators, etc., must be turned in for repair.

ELECTRICAL EQUIPMENT

1. There is no line of work where it is more necessary to be always on the alert for danger. Do not take chances.

2. Do not fail to report any electrical trouble whatsoever, or any apparently dangerous installations, to your foreman.

3. Employees not authorized are forbidden to work or tamper with any electrical wire or equipment.

4. Treat all circuits, so far as possible, as if they are alive, even though you believe them dead.

5. In handling live or control parts on circuits such as are exposed on switches, switchboards, etc., use only one hand if possible. When closing a switch, close it solidly and abruptly. This will greatly reduce the chance of the switch "arcing".

6. Electric wires which seem to be unused or are hanging free are sometimes charged and are dangerous. Report them but do not touch them.

7. When opening a switch, in order to shut down a machine for maintenance or repair work, the switch must be properly tagged with a warning or do not start sign. When the work is done get the proper authority to start the equipment.

8. Get the voltage off the line—in case of any electrical fire. Open the switch or circuit breaker, or call the power house to have the switch opened on that line.

9. In case of fire on or near electrical equipment, do not use water to extinguish the fire. Proper extinguishing units of C-O-Two or Pyrene are located near all large electrical machines.

Foot Note—Remove Nails from Boards

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10. In case of severe electrical shock—remove the person from the source of current immediately and call the ambulance and First Aid at once.

(a) Use a dry coat, dry rope, a dry stick or board or any other dry non-conductor to move either the victim or the wire, so as to break the electrical contact.

(b) If the victim is conducting the current to ground and is convulsively clutching the live conductor, it may be easier to shut off the current by lifting him than by leaving him on the ground and trying to break his grasp.

(c) Open the nearest switch if that is the quickest way to break the circuit.

11. Accidental electric shock usually does not kill at once, but may only stun the victim and for awhile stop his breathing. Under these circumstances artificial respiration is recommended immediately.

FIRE PROTECTION

1. In case of fire—call the Dow operator and report the fire, giving building name and number and location of fire. In cases of fires after regular working hours, the watchman will notify all production and service men directly affected by the fire.

2. Learn the location and proper use of the fire fighting equipment in your department.

(a) Do not use water where extinguishers are provided.

(b) Never hang up an extinguisher. If you have used one or see one which is not on a hook, notify the Pipe Shop at once.

(c) Use extreme caution in fighting hot fires in closed rooms or badly ventilated areas. Toxic products of combustion often provide a serious hazard.

3. The plant fire department is under the supervision of the Pipe Shop. All maintenance of fire fighting equipment, automatic sprinkler systems,

Safety and Efficiency Go Hand in Hand

ST0014114



NATIONAL SAFETY COUNCIL

fire hydrants, and fire hose is taken care of by that department. Notify the Pipe Shop at once if any of the above equipment is not in perfect working order.

4. Never pile any material on any floor beyond its load limit or to a height within less than eighteen inches of the level of any sprinkler head.

5. Except in times of immediate use, aiseways, passages, stairways and elevator approaches must be kept clear; a closed passage might result in the loss of an entire plant. There must be unrestricted passage to all fire hose and fire protection equipment at all times.

6. Keep the places around you clean. Put all oily waste, rubbish, or papers in the covered containers provided for that purpose.

7. Do not work on any electrical apparatus or wiring unless it is part of your work.

Double Your Caution in Rain, Snow or Sleet

ST0014115

8. Some plants of The Dow Chemical Company are a definite fire hazard because of the materials handled. These particular plants are prominently posted with signs prohibiting smoking and the carrying of matches while in or around the buildings and requiring the personal O. K. of the plant superintendent before doing any welding in or around the plant—look for these notices and obey them to the letter.

9. When doing any welding—use extreme caution in lighting the torch and make sure that the hot slag will not fall where there is danger of its igniting inflammable material. Welders are required to have a hand extinguisher as a part of their equipment.

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LABORATORY SAFETY

The importance of safe practices in all laboratory work or handling of chemicals cannot be overemphasized. While the previous sections of this booklet apply to laboratory workers as well as to others, the following instructions must be kept particularly in mind. Your laboratory director or supervisor is aware of the importance of safety and will welcome your suggestions.

GENERAL—HANDLING CHEMICALS

1. Keep all bottles labeled. Serious accidents have resulted from neglecting this simple precaution.

2. Know the materials with which you are working so that you are able to handle them properly and caution others in their use.

3. Deposit waste chemicals in crocks or jars provided for the purpose. These waste jars must be emptied daily.

4. IN THE CASE OF A CHEMICAL BURN—IMMEDIATE FLUSHING WITH WATER IS THE BEST EMERGENCY TREATMENT.

5. Keep goggles or a face shield on hand and use them on any hazardous operation. Remember, it is YOUR eyesight which is being protected and accidents usually happen when least expected.

6. Aisleways and approaches to apparatus and fire equipment must be kept clear so that quick exit is unhampered.

7. Guard your apparatus with suitable glass or metal shields so that those nearby are safe. Men working near one another on different projects are not aware of what each may be doing.

8. Read carefully the specific safety instructions for your particular laboratory. Each man must realize his individual responsibility for the safety of himself and others.

A safety minded person is a valuable asset to plant and community

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SAFETY EQUIPMENT

1. Each worker must become familiar with the location and proper use of standard laboratory safety equipment. This equipment includes:

- A. Fire hoses, sand pails and chemical fire extinguishers.
- B. Fire blankets and fire showers.
- C. Gas masks and dust respirators.
- D. Eye and face protection—goggles and face shields.
- E. Protective clothing—rubber gloves, sleeves, aprons, etc.
- F. Safety shields—shatter-proof wired glass and steel shields.

Make sure you understand the relationship between your job and the available equipment before you begin work. Your immediate superior or the Safety Department will be glad to answer any questions you may have.

FLAMMABLE LIQUIDS

1. Low boiling flammable liquids should be heated with steam whenever possible.

2. Extreme care must be used when distilling flammable liquids. Look over any nearby equipment for open flames, electric heaters or open relays, any of which may provide a source of ignition for flammable vapors.

3. Flammable liquids must be stored in a safe location in metal containers except when small quantities are to be used immediately. Regulation safety cans are available for this purpose.

4. Be careful to avoid static electricity in pumping or transferring flammable liquids. Metal tanks, lines or other equipment should be grounded before use. In transferring flammable liquids, both containers should be grounded either by contact or through the use of battery clips and a short length of cable.

Don't let familiarity with your job make you forget safety

ST0014118

PRESSURE EQUIPMENT

1. When working with pressure apparatus, make sure of the temperature and pressure for which the equipment has been designed.

2. Always work with a safety factor of at least two over hydraulic tests made on pressure equipment. Under unusual conditions a greater safety factor may be necessary and the choice of equipment must rest upon an individual who has had such authority delegated to him. Be certain the strength has not changed due to corrosion or high temperature use since the last hydraulic test.

3. Conform to recommendations in the use of frangible disc safeties.

4. Make sure you are not exceeding allowable working pressures on the pipe and fittings being used.

5. The volume of a pressure vessel must be considered carefully in relation to the volume and possible expansion of the material with which you may be working. In general a pressure bomb should not be filled to more than six-tenths of its capacity. High temperature operation will reduce this figure.

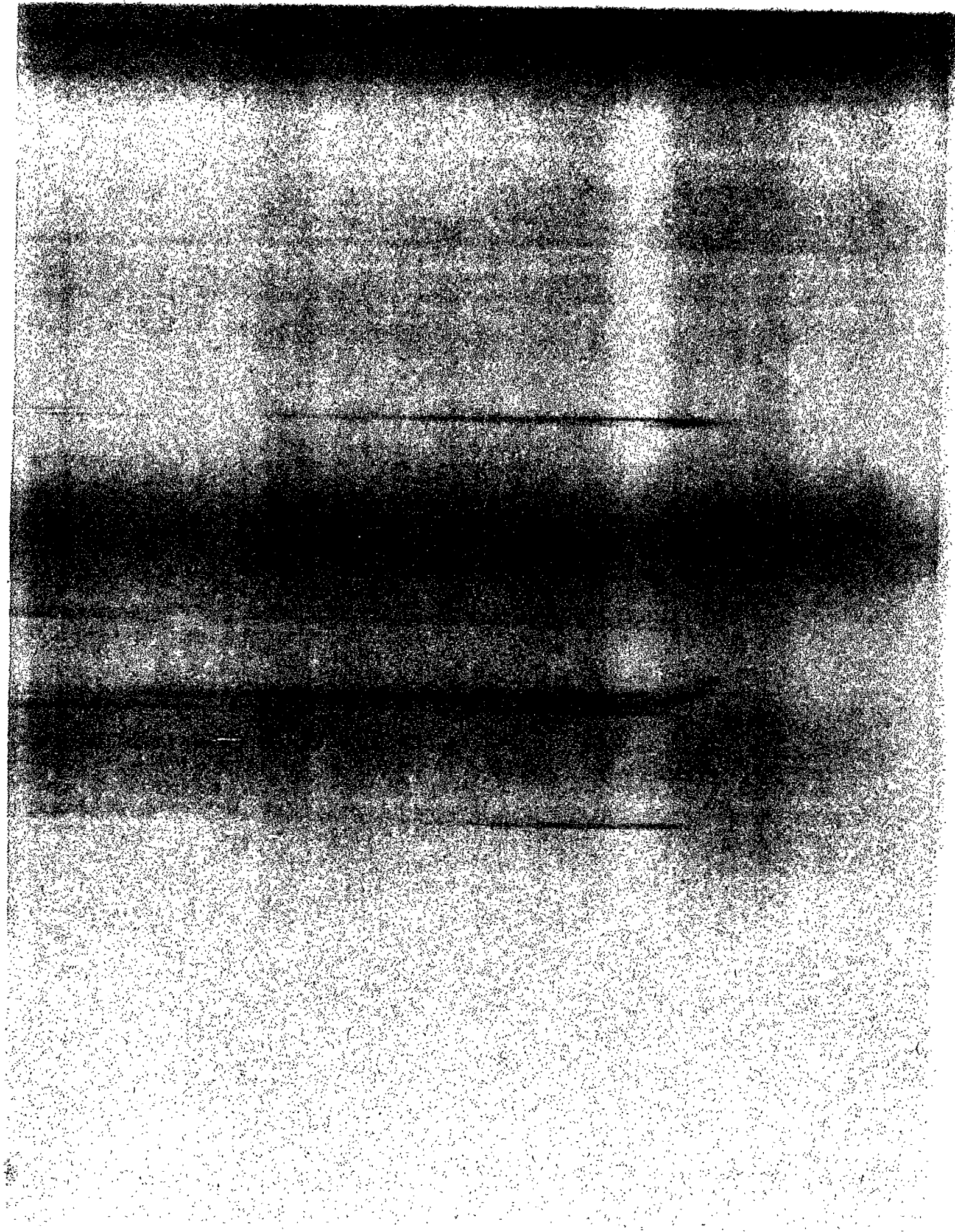
6. When opening pressure equipment, do not remove any nuts or bolts on the closure before first loosening all closure fastenings. Make sure the closure is free, releasing any pressure, before removing any bolts or nuts completely.

7. NEVER ATTEMPT TO REMOVE OR BLOW OUT EQUIPMENT OR PIPING WITHOUT FIRST BEING POSITIVE THAT ALL INTERNAL PRESSURE HAS BEEN RELIEVED OR THAT YOUR FACE AND EYES HAVE BEEN ADEQUATELY PROTECTED. DO NOT DEPEND UPON GAUGE READINGS TO INDICATE LACK OF PRESSURE.

NEGLECT OF THIS SIMPLE PRECAUTION IS THE GREATEST SINGLE CAUSE OF CHEMICAL ACCIDENTS. IF THE ACCIDENT RESULTS IN PERSONAL INJURY YOU ARE THE ONE TO BLAME AND THE ONE TO SUFFER.

Your job is only as safe as you make it

ST0014119



OFFICE COPY

Biochemical Research Department

THE DOW CHEMICAL COMPANY

5601

Subject: INDUSTRIAL HYGIENE SURVEY
OF VARIOUS OPERATIONS AT
THE CHLORINE CELLS, BLDGS:
261, 196, 137, 295, 236,
270, 303, 207.

File T34.21-21-3(E)
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Work by H. Hoyle
E. J. Schneider

to:

Dev. Sec.
4-30-51

E. J. Schneider
4/10/51

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Att: H. H. Gay, M. D., Bldg. 256
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OF
THE DOW CHEMICAL COMPANY

SUMMARY AND CONCLUSIONS

1. Significant amounts of chlorine, sufficient to cause inflammation and swelling of the respiratory system from short periods of exposure, were found in areas where men were working on and among the chlorine cell series.

2. Men working in these areas have been getting by without severe exposure by using respirators, however, it must be kept in mind that excessive amounts of chlorine above the maximum allowable concentration of 1 p.p.m. for an eight-hour exposure do exist among the cell series.

3. No excessive amounts of chlorine were found in the making of bleach solution at the cell brine plant, 303 building.

4. Excessive concentrations of chlorine occurred in the loading of ton cylinders with liquid chlorine when the delivery line became plugged and insufficient time was taken to purge the connecting lines to the cylinder before removing them.

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PLAINTIFF'S EXHIBIT

DOW-2904

5. No excessive amounts of chlorine were found during the normal loading of cylinders and no odor of chlorine was noticed during normal operations to purge, test and load tank cars.

6. Excessive amounts of chlorine and sulfuric acid were found while dumping the sulfuric acid drying tower to the sewer.

7. No excessive amounts of alkali dust were found among the chlorine cell series.

8. No significant amounts of mercury vapor were found at the discharge of the vacuum pumps for the mercury arc rectifiers.

9. Excessive amounts of pitch dust must be considered to exist, since men who are working at the pitch grinding operation do become photo-sensitized and must limit their outdoor activities.

10. Large amounts of graphite dust were found during the loading of plates into the buckets to be impregnated with phenol formaldehyde resin solution. Since the loading operation involves only an hour or so, the exposure to the graphite dust can not be considered excessive.

11. The graphite dust concentrations found in the machine shop were well within the limits for an inert dust.

12. The worker using the band-saw was found to be exposed to more fine dust than workers at the other machines, possibly because there was no spot exhaust ventilation provided.

13. No excessive amounts of formaldehyde or phenol vapors were found during the making of the phenol formaldehyde resin or during the various drumming operations.

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14. The millions of particles per cubic foot of air of asbestos was found to run higher than the maximum allowable concentration of 5 for an eight-hour exposure for the handling of dry asbestos in covering the cell diaphragms. Since the exposure occurs only eighteen times a day for a short period with a total exposure of less than two hours, the amounts of asbestos found cannot be considered excessive.

CHLORINE

I. Significance of Chlorine Exposure

1. For many years a gas concentration of 1 p.p.m. (by volume) has been used as a standard for evaluating workmens' exposures. Recently there has been some expression of opinion that 2 or 3 p.p.m. could be tolerated up to 8 hours daily without adverse effect. Gas concentrations much above 3 p.p.m. unquestionably produce irritation (tissue injury) to the eyes, nose, and throat; concentrations above 10 p.p.m. may cause serious effects on single relatively short exposures. Beginning at about 3 p.p.m. chlorine causes unmistakable pain in the eyes, nose and throat to which very little tolerance develops. This painful action serves as an excellent warning of the presence of harmful concentrations of gas. There appears to be no evidence of chronic effects from repeated exposures at concentrations of less than 2-3 p.p.m. (concentrations having no immediate acute effects). Repeated exposures above 2-3 p.p.m., however, may maintain an irritation of the eyes and respiratory passages, produce an erosion of the teeth, and possibly a nonspecific debility.

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2. To a large extent the data of Table I, II, III, and IV merely give numerical expression to what has been apparent by sensory perception and experience, that excessive gas concentrations are encountered rather frequently if not routinely. Considering the nature of the operations and that much chlorine comes from unpreventable or accidental leaks, it may not be practical to reduce these concentrations of chlorine. Accordingly, it is necessary to emphasize the need for proper respiratory protection, the training of workmen, and the provisions for handling leaks. The results emphasize the desirability of medical examinations to assure the workmen are receiving adequate personal protection. If the men show no evidence of injury that is persistent or frequent, then our principal additional recommendation is that every opportunity to lessen chlorine contamination be utilized.

II. Observation and Presentation of Data

1. The odor of chlorine was ever present throughout the cell buildings and from time to time it was noticed that the men were required to use their respirators in order to go about their work.

2. Air samples were collected at several locations and on different days. The results of the air analyses are collected in Table I and II and can be compared with the accepted maximum allowable concentration of 1 p.p.m. for an eight-hour exposure.

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TABLE I

Vapor Concentration of Chlorine Found
Among the Cell Series in Building 137

Location		p.p.m. (by Volume)		
			and	
1. Center aisle between series 45 and 46	(10-4-49)	1.44	cloudy/raining	
2. Center aisle between series 41 and 42	(10-4-49)	0.72	" " "	
3. Center aisle between series 37 and 38	(10-4-49)	0.31	" " "	
4. Center aisle between series 33 and 34	(10-4-49)	0.31	" " "	
5. Between series 45 and 47	(10-4-49)	0.31	" " "	
6. Between series 41 and 43	(10-4-49)	2.16	" " "	
7. On top series 43	(10-5-49)	1.13	cool and clear	
8. Between series 46 and 48	(10-5-49)	6.80	" " "	
9. Between series 42 and 44	(10-5-49)	4.00	" " "	
10. On top series 46	(10-5-49)	3.30	" " "	
11. Between series 35 and 37	(10-5-49)	1.44	" " "	
12. On top series 35	(10-5-49)	1.44	" " "	
13. Between series 31 and 32	(10-5-49)	2.16	" " "	
14. Between series 38 and 40	(10-5-49)	1.13	" " "	
15. On top series 36	(10-5-49)	1.13	" " "	
16. Between series 32 and 34	(10-5-49)	0.31	" " "	
17. Near compressors	(10-5-49)	0.31	" " "	
18. Center aisle near 13,14,15,16,17,18 series		0.31	" " "	
19. On top series 39 repairing leak	(10-6-49)	2.16	cloudy and /raining	
20. Near two mechanics repairing compressor	(10-4-49)	4.40	" " "	
21. On top series 46 (when back pressure operator added water)	(10-6-49)	7.30	" " "	
22. Between series 15 and 17	(10-6-49)	0.72	" " "	
23. On top series 15	(10-6-49)	0.31	" " "	
24. Between series 16 and 18	(10-6-49)	1.44	" " "	
25. On top series 16	(10-6-49)	0.72	" " "	
26. On top series 36 repairing leak	(11-18-49)	3.29	cool and clear	

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TABLE II

Vapor Concentration of Chlorine Found
Among the Chlorine Cell Series in
Building 295

Location		p.p.m. (by Volume)
1. Between series 93 and 95	(11-18-49)	0.36 clear and cool
2. Between series 92 and 94	(11-18-49)	0.36 " " "
3. Between series 93 and 95 and on top	(11-18-49)	0.72 " " "
4. On top series 103	(11-18-49)	1.53 " " "
5. On top series 104	(11-30-49)	1.13 " " "
6. On top series 110	(11-30-49)	0.36 " " "
7. On top series 109	(11-30-49)	4.4 " " "
8. On top series 103	(11-30-49)	3.6 " " "
9. On top series 101 (men setting it up)	(11-30-49)	14.8, 9.4 " "
10. On top series 99	(11-30-49)	11.5 " " "
11. On top series 98	(11-30-49)	10.8 " " "
12. Center aisle near series 92, 93, 94, 95	(11-30-49)	2.56 " " "

3. In the chlorinating of the cell caustic for bleaching solution at the cell brine plant no irritating or excessive amounts of chlorine escaped during the normal operation.

The results of air analyses collected during the preparation of the bleaching solution are shown in Table III

TABLE III

Vapor Concentrations of Chlorine Found in the
Making of Bleach Solution, Building # 303

Location	p.p.m. Chlorine (by Volume)
1. Platform near tank for making bleach solution. In the fumes at the start of bubbling chlorine through the sodium hydroxide	1.1
2. In the fumes after one-half hour of bubbling	1.1
3. In the fumes after one-hour of bubbling and finishing batch up	1.1

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4. The possibility of exposure to chlorine vapors during the loading of tank cars and cylinders was investigated, sensory perception usually being employed as a measure of exposure. If a good vacuum was pulled on the tank car and the connecting lines purged, there was little chance for exposure when removing the valves and testing the car for moisture. With properly repaired valves and tight connections, there was no exposure during loading.

5. In the loading of cylinders, an inside job, there was more chance for exposure to chlorine. During one visit the delivery line for the liquid chlorine became plugged. In removing the connecting lines, insufficient time was allowed for purging and excessive amounts of chlorine were found to exist.

6. During normal operation of the filling of the cylinders no excessive amounts of chlorine were found. The results of air analyses taken during the loading operation of ton cylinders are collected in Table IV.

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Table IV

Vapor Concentrations of Chlorine Found During the Filling
of Ton Cylinders of Liquid Chlorine, Bldg. 270 (11/15/50)

Location	p.p.m. (by volume)
1. Breathing zone of operator as he disconnected purge lines from empty ton cylinder	3.12
2. Breathing zone of operator as he disconnects lines from full ton cylinder of liquid chlorine (line became plugged and insufficient time was allowed for purging)	8.2

7. In the operation of changing the drying towers in the cell buildings, high enough concentrations of chlorine and sulfuric acid were encountered to saturate a respirator.

Table V shows the concentrations of chlorine found during this operation.

SULFURIC ACID (PLUS CHLORINE)

I. Significance of Sulfuric Acid Exposure

1. Sulfuric acid fume or mist has an acute irritating action not too different from that of chlorine. The problem presented by this mixture is practically the same as that presented by chlorine alone. The exposure is short and the concentrations sufficiently low that no great hazard is presented by the operation. It is one that occurs regularly, however, the one can question whether or not it is really necessary.

II. Observation and Presentation of Data

1. The odor of sulfuric acid fumes was masked by the chlorine. Air analyses during the operation showed the presence of considerable acid fumes, however, the exposure was of short duration.

2. The results of the air analyses are collected in Table V and can be compared with the maximum allowable concentration of 0.25 p.p.m. for an eight-hour exposure.

(Table V - page 9)

ST006746

Table V

Concentrations of Chlorine and Sulfuric Acid Fumes
Found During the Emptying of a Drying Tower to the
Sewer, Building 137

<u>Location</u>	<u>p.p.m. Cl_2</u> <u>(by volume)</u>	<u>p.p.m. H_2SO_4</u> <u>(by volume)</u>
1. Operators breathing zone as he opens valve to release sulfuric acid from tower to sewer (first series of towers)	3.3 (5 min.)	5.7 (5 min.)
2. Area near sewer after the tower was dumped (first series of towers)	1.3	2.3
3. Operators breathing zone as he opens valve to release sulfuric acid from tower to sewer (second series of towers)	13.8 (5 min.)	3.9 (5 min.)
4. Area near sewer after the tower was dumped (second series of towers)	2.9	2.1

ALKALI DUST (PROBABLY SODIUM CARBONATE)

I. Observations and Presentation of Data

1. No maximum allowable concentration has been established for alkali, however, based on plant experience, no significant amounts of sodium hydroxide were found.

2. The presence of finely dispersed titratable alkali was checked by air analyses among the various cell series and the results are collected in Table VI.

Table VI

Dust Concentration of Sodium Hydroxide Found
Among the Chlorine Cells Series in Buildings
137 and 295

<u>Location</u>	<u>Bldg. 137</u>	<u>Mgs./cu. meter</u> <u>as NaOH</u>
1. On top of series 47	(10-6-49)	same as blank
2. Between series 45 and 47	(10-6-49)	"
3. Between series 41 and 43	(10-6-49)	"
4. Between series 50 and 48	(10-6-49)	"
5. Between series 42 and 44	(10-6-49)	"
6. Between series 14 and 16	(11-18-49)	2.44
7. Between series 34 and 36	(11-18-49)	2.44
8. Between series 15 and 17	(11-18-49)	2.18

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Table VI (cont'd)
Blag. 295

9. Between series 92 and 94	(11-18-49)	1.95
10. Between series 95 and 97	(11-18-49)	0.66
11. Between series 109 and 111	(11-18-49)	0.80
12. Between series 104 and 106	(11-18-49)	1.14

MERCURY

I. Observations and Presentation of Data

1. Air is constantly being evacuated from the mercury arc rectifiers and discharged into the rectifier room. The possibility of some mercury vapor being given off was checked by sampling at the outlets of the vacuum pumps. The results of the air analyses are collected in Table VII and can be compared with the maximum allowable concentration of 0.1 mg./cu. meter. These concentrations of mercury have no significance whatever.

Table VII

Vapor Concentrations of Mercury found in the
Rectifier Room, Building 137 (11-13-50)

<u>Location</u>	<u>Conc. Hg. Vapor (by volume)</u>
1. Directly beneath the outlet of the low pressure vacuum pump for G-2 skid of mercury arc rectifiers	<0.006 mgs./cu. meter
2. Directly beneath the outlet of the low pressure vacuum pump for G-1 skid of mercury arc rectifiers	<0.005 mgs./cu. meter
3. Directly beneath the outlet of the low pressure vacuum pump for H-2 skid of mercury arc rectifiers	<0.006 mgs./cu. meter
4. General air sample taken between skids G-1 and H-2. Circulating air shut off for winter conditions	<0.006 mgs./ cu. meter

ST006748

PITCH

I. Significance of Pitch Exposure

1. Coal tar pitch from many different sources has produced a variety of effects in the skin: photosensitivity; acne and other dermatosis; pigmentations and growths, some of which are benign, others malignant. It is said that about half of the cancers attributable to occupational exposures are due to pitch. The heavier fractions and tars of some petroleums and of shale oil have similar actions. One obtains the impression from published information that the rather heavy exposures among pitch workers cause a high incidence of skin injuries.

2. It is apparent that the men handling pitch in the chlorine cells come in direct contact with the material, resulting in prolonged and repeated contacts upon some portions of the body. The data in Table VIII indicate a moderately dirty atmosphere.

3. The data in Table IX represent counts of small particles, roughly of particle size 0.1 to 5 microns which may be inhaled. This data indicates that relatively small amounts of pitch dust are being inhaled. Since the literature contains no reference to toxic effects attributable to inhalation, we are not greatly concerned about inhalation of pitch dust.

4. Excessive skin contact with pitch dust is to be controlled by arrangement and design of the process to eliminate manual handling and dispersion of dust, by personal protection of workmen, and measures to assure a high degree of personal cleanliness. The clothing and bath requirements on these jobs have been indicated. It is recommended that the men working directly with pitch be given medical examinations at regular intervals.

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II. Observations and Presentation of Data

1. Several exhaust hoods had been installed to control the dust exposure when grinding pitch. The men working on the pitch grinding equipment, however, through known experiences, are apparently exposed to amounts of pitch sufficient to cause photosensitivity.

2. The results of air analyses taken in the worker's breathing zone and in the work area during various operations encountered in pitch grinding are collected in Table VIII.

Table VIII

Dust Concentrations of Pitch Found During the Grinding and Handling Operations in Preparation of Making Cell Cement - Building 196

<u>Location</u>	<u>Conc. Mgs./cu. meter</u>
1. Breathing zone of worker as he opens metal drum of pitch tar and breaks up the contents	63
2. Breathing zone of worker as he shovels broken pieces of pitch into the grinder and dumps buckets of pitch into mills	306
3. Breathing zone of worker as he rakes pulverized pitch from the cyclone and shovels it into the buckets	94
4. Breathing zone of worker as he sweeps area after grinding and filling buckets	453
5. Breathing zone of worker as he operates the cable hoist to dump bucket of pulverized pitch into hopper for the mixer	209,249

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3. The results of dust counts taken in the general area and during the various pitch grinding operations are shown in Table IX.

(Table IX - page 13)

Table IX

Dust Concentrations Found During the Various Pitch
grinding operations and in the General Area

<u>Location (Breathing zone samples taken whenever possible)</u>	<u>m. p. c. f. (average of several counts)</u>
1. Shaking out broken pitch from metal drum	5
2. Breaking up lumps	7
3. Shoveling broken up pitch into grinder	8
4. Dumping buckets of ground pitch to mills	5
5. Sweeping up area where pitch is ground.	7
6. Raking out pulverized pitch	5
7. Filling buckets with pulverized pitch	5
8. Sweeping area where buckets are filled	2
9. Dumping bucket to mixer	5
10. Gen. atmosphere near foreman's desk	5
11. Area in front of small mixer while dumping cement to the small mixer with pitch	4
12. Area in front of small mixer while dumping the pitch cement mix	4
13. Area in front of small mixer with men working on poured casting	5
14. Area of building where men are working to prepare the cell forms	5

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GRAPHITE DUST

I. Significance of Graphite Dust Exposures

1. There are a few reports of lung injury (pneumoconiosis) among persons working with graphite. Nearly all reports have dealt with natural graphite containing an appreciable amount of other minerals so that it is not definite that graphite dust alone has an adverse effect.

2. It is apparent that considerable amounts of graphite are dispersed in the air, but the counts of particles susceptible to inhalation fail to indicate any exposures that are questionable. If workmen were regularly and uniformly exposed to counts of more than 50,000,000 particles per cubic foot, correction would be called for.

II. Observations and Presentation of Data

1. A dusty atmosphere was created when a worker used an air hose to remove the loose graphite from the plates before loading. There was still sufficient loose graphite remaining on the plates to make the loading of them very dusty.

2. The results of air analyses made during the loading operations are shown in Table X.

Table X

Dust Concentrations of Graphite Found During the Loading of Plates into the Buckets in Preparation for Pregnatina with P.F., Elda. 261

<u>Location</u>	<u>Dust Conc. : Mg./cu. meter</u>
1. Breathing zone of worker blowing loose graphite off a stack of plates with an air hose (room closed up for winter conditions)	2260
2. Breathing zones of two workers as they load a bucket with graphite plates	2870

3. Several dust counts were taken during the plate loading and in the general atmosphere. The results of these counts are shown in Table XI. These values can be compared with the maximum allowable concentration of 50 m.p.c.f. for an inert dust.

4. Several dust counts were taken in the machine shop, both during the operation of the machines and in the general atmosphere through the area. The results of these counts are shown in Table XI also.

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Table XI

Dust Concentrations of Graphite Found
During the Loading of Plates and Various
Operations in the Machine Shop.

Treating Room

Location (Sample taken in the breathing zone of worker whenever possible)	m.p.c.f. (aver- age of several counts)
1. Blowing the loose graphite off the plates before loading them	50
2. General atmosphere in the room after blowing	35
3. Filling the plates into the buckets	50
4. General atmosphere of the treating room after finishing the loading of the plates	10 min. 20.1 15 min. 28.3 20 min. 35.2 30 min. 30.8 45 min. 41.0
5. General atmosphere in the treating room in the morning when the plates are unloaded	2.0

Machine Shop

6. General atmosphere in the machine shop early in the morning before work is started	7
7. Cutting corners off of boards at band saw	20
8. Running plates through bevel machine	8
9. Near new machine for grooving boards	10
10. Near old machine for grooving boards	9
11. Placing boards in machines	8
12. Removing boards from machines	9
13. Where operator sits after loading machines	10
14. Blowing small area from machines so board is locked in	11
15. Blowing machine off for cleaning	10
16. Sweeping up area around machines	8

(Table cont'd on page 16)

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Table XI -(cont'd)

17. General atmosphere near foreman's desk	8
18. General atmosphere near crib	5
19. General atmosphere other end of shop	5
20. General atmosphere office area	4
21. Janitor sweeping floor	5

FORMALDEHYDE

I. Significance of Formaldehyde Exposures

1. None of the exposures measured during normal operation were excessive.

II. Observations and Presentation of Data

1. In the making of the phenol formaldehyde resin, the odor of formaldehyde was noticed throughout the room, however, only during the blowing of the mixing tank was there evidence of eye irritation.

2. In all cases where air analyses were made, the concentration of formaldehyde found was below the maximum allowable concentration of 5 p.p.m. The results of air analyses are collected in Table XII.

PHENOL

I. Significance of Phenol Exposures

1. None of the exposures measured during normal operation were excessive.

II. Observations and Presentation of Data

1. Very little odor of phenol was noticed during the various operations of making phenol formaldehyde resin. The results of the air analyses can be compared with the concentration of 10 p.p.m. phenol found through past company experience to be an acceptable limit.

2. Table XII also shows the results of air analyses for phenol concentration.

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Table XII

Vapor Concentrations of Formaldehyde and Phenol
Found During Various Operations of the Phenol
Formaldehyde Resin Process, Building 236

<u>Location (Winter conditions - doors and windows closed)</u>	<u>P.P.m. Formaldehyde (by volume)</u>	<u>P.P.m. Phenol (by volume)</u>
1. General air sample taken in front of reactor and near operator's desk (reactor up to temp.)	1.0	0.40
2. From an elevated platform between the reactor and mixing tank (reactor up to temp.)	1.0	0.87
3. Next to the mixing tank and oper- ator's desk	0.44	
4. Near the mixing tank as phenol was blown in from trailer outside		0.69
5. Near the mixing tank as formaldehyde was pumped in from storage tank	1.27	
6. Near the mixing tank as air was blown to mix contents	2.6, 2.6	1.04
7. Near the mixing tank and operator's desk after blowing had stopped	4.0	
8. Near the vacuum still (operating) in the area where operator spends considerable time making insulating plugs	1.5	1.19
9. Breathing zone of operator filling 100 gal. drum with evaporated P.F. solution	2.9	1.11
10. Breathing zone of operator filling four 50-gal. drums with neutralized and evaporated P.F. solution for the Texas Division	2.4	0.87
11. Operators breathing zone filling six 50 gal. drums of formaldehyde for interplant use. (work done outside on cold, windy day)	.60	

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ASBESTOS

I. Observations and Presentation of Data

1. The handling of dry asbestos in making up a slurry of caustic, water and asbestos does offer an exposure to finely divided particles of asbestos.

2. The results of dust counts taken in the breathing zone of a worker as he weighs, dumps, and stirs the asbestos into the slurry are shown in Table XIII. These values can be compared with the maximum allowable concentration of 5 m.p.c.f. for an eight-hour exposure. None of the exposures measured during normal operation were excessive since the duration of exposure is short.

Table XIII

Dust Concentrations Found During the Handling of
Dry Asbestos in the Covering of Cell Diaphragms

<u>Location (samples taken in worker's breathing zone)</u>	<u>m.p.c.f. (average of several counts)</u>
1. Dumping bag of weighed asbestos (48 lbs.) to slurry tank	8
2. Stirring and mixing the asbestos with water	10
3. Weighing out a bag of asbestos	5

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