TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

DATE: JUNE 18, 1973

A. BASIC TRAINING INDEX

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 3, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

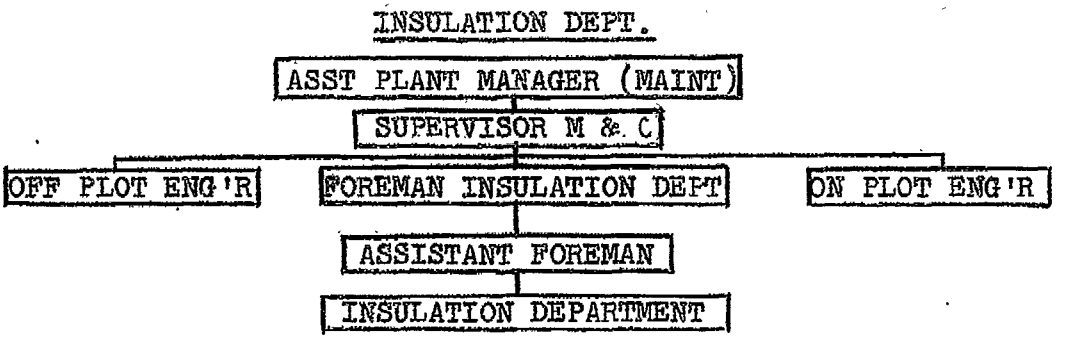
ITEM NO. A-1 SUBJECT: DEPARTMENTAL ORGANIZATION

The Insulation Department is one of several departments of Puget Sound Plant which comes under the jurisdiction of the Assistant Plant Manager (Maintenance).

The Supervisor - Maintenance is in charge of the planning, scheduling and execution of work involving all the maintenance departments in the plant including the Insulation Department.

The foreman of the insulating department is in direct supervision of the personnel of the department and is responsible for the selection and assignment of craftsman and trainees in accordance with the requirements of the daily work schedules. He is also responsible for the follow up of work performance to assure proper application of craft skills and quality workmanship.

The Insulation Foreman directly supervises the work of insulators, assigned to respective units, coordinates the work and cooperates with the various operating departments in accomplishing scheduled work.



TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)
ITEM NO.: A-2

DATE: JUNE 18, 1973

SUBJECT: RELATIONSHIP OF DEPARTMENT TO REFINERY OPERATIONS

The purpose of a refinery is to process crude oil and convert it into highly refined and saleable petroleum products, as economically and safely as possible, while maintaining high standards of quality which assure continued confidence of the buying public.

Each operating unit and department is designed, constructed and operated with the objective of providing a continuing supply of quality-controlled petroleum products for a highly competitive market. Maintaining each unit in a safe, operable condition requires the knowledge and skills of many people and crafts. New techniques, materials, tools and methods are constantly being developed which require increasing knowledge, skill and training in order to take advantage of these developments and remain competitive.

Since the Insulator's work may involve other crafts, or affect several operating departments, it is essential that he closely coordinate his work and cooperate with others in order to do a safe, workmanlike job. It can thus be seen that the Insulation Department plays an important part in relation to both the maintenance and operation of refinery equipment. As equipment or procedures are changed the Insulator may find it necessary to adapt himself to the use of new methods, new tools and undergo re-training. However, the Insulation Department still bears a continuing responsibility and relationship to operations of the refinery which contribute substantially to the maintenance of the safety, economy and continuity of the refinery productive capacity.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 3, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-3 SUBJECT: DEPARTMENT STANDARDS AND WORKING RULES

1. When you cannot report for work as scheduled, and on time, give your Craft Supervisor or the Night Foreman on duty as much advance notice as possible. If you are unable to call, have someone call for you.

2. Request for time off should be handled with your Craft Supervisor as far in advance as possible.

3. When you have been absent for any reason such as sickness, accident, vacation, etc., call your Craft Supervisor as far in advance as possible before returning to work so he can arrange schedules and advise you when to report for duty.

4. In case of change of address, notify your Craft Supervisor of new address and telephone number.

5. When you have finished a job, go at once to your next assignment, if known; otherwise, contact your supervisor. Do not loiter or loaf between jobs.

6. It is an Insulator's responsibility to see that his job progresses in a safe working manner, keep his helpers lined up and working, and to know where his helpers are at all times.

7. It is an Insulator's duty to make sure all necessary materials, equipment and tools are transported to his assigned job.

8. Instruct his helpers of proper tool handling and work procedures on the job.

9. Request work permits when required to do a job, such as entering and burning lights in vessels or towers, etc. (Read permits and follow special instruction written on permit.)

10. In an oil refinery, we must eliminate all possible causes of fire. Smoking is permitted, therefore, only in certain clearly marked areas and at specified times. People who cannot observe this very important safety rule just don't belong in an oil refinery. For the safety of everyone, this rule is rigidly enforced.

11. Insulators will be furnished the tools necessary to perform their specific duties. It is the responsibility of each Insulator to make sure that the tools he uses, or returns for the use of others, are in safe working condition. Replacement of broken or damaged tools will be handled by the Main Tool Room.

12. The plant telephone system is primarily for the transaction of Company business. Personal calls ordinarily should not be made during working hours. You are expected to use good judgment in this respect. Please use the phones for personal business only when absolutely necessary.

13. It is an Insulator's responsibility to train and instruct a Craft Helper or Trainee in the methods and procedures of his trade whenever so assigned by his supervisor.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-4 SUBJECT: DEPARTMENTAL SAFETY PRACTICES
a. Location of Equipment
b. Use of Equipment

The purpose of this section is to assemble in one place the more important and pertinent safety information applicable to the work of the Insulators. In general, all of the Regulations, Procedures and Practices and information contained herein should be studied carefully by every craftsman and trainee and practiced constantly.

b. REGULATIONS

The following regulations MUST be observed:

(1) No tank, vessel, tower, drum or other enclosed space is to be entered until a SAFETY WORK PERMIT has been issued authorizing entry.

(2) No electric hand power tools, such as Skillsaw, or electric drill can be used which could be a source of ignition for any flammable materials, unless and until a HOT WORK PERMIT, Form R-241, (pink form) has been issued in proper form by the operating department involved and properly countersigned by an authorized operating supervisor.

(3) Standing instructions for issuing both Hot Work and Safety Work Permits must be reviewed by each Insulator and trainee.

(4) CAUTION - Always read the PERMIT - be sure you understand the precautions which must be observed - note the time period it covers - be sure it describes or identifies the line, vessel or equipment to be worked on - note the requirements for use of personal protective equipment - be sure the condition of the line, vessel or surrounding area is specified - and obey all the precautions written on the permit. WHEN IN DOUBT, CONSULT YOUR FOREMAN.

(5) Do not open or close valves on lines, vessels and operating equipment (except valves at utility stations - air, steam and water). Only Operators on the particular unit or area are permitted to operate valves.

(6) Hard hats must be worn on the job. Goggles must be used whenever a hazard to the eyes may be encountered. For example: Chipping, breaking concrete, working where dust and rust is blowing around, grinding, etc. Protective clothing (impervious suits) and other protective equipment must be worn when specified on HOT or SAFETY WORK PERMITS, when instructed to do so by the Foreman in charge of the work.

(7) When work is performed on pipe lines connected to equipment or lines in service and there is any danger of oil or other products escaping from an open end, or open-end valve, the valve flange or open end of the line should be (blinded) off or plugged.

(8) When using buckets to raise or lower tools, equipment and material to top of towers or vessels, remove bail and replace with a heavy gauge wire or small cable.

(9) If working in a trench with straight up and down walls over 4 ft. deep, shoring should be installed to prevent cave-ins of dirt.

(10) Before operating on air tugger, cable and spool should be inspected for tangles in cable on spool and broken strands in cable. Caution: When pulling scaffold from towers with tugger, tugger operator on ground and Insulator working inside of tower will be equipped with a two-way telephone system.

(11) Hearing protection must be worn in zoned off areas indicating that hearing protection is required.

c. PROCEDURES

The procedures outlined herein should be followed whenever performing the work described.

(1) When working near pumps or vessels handling TEL (Tetraethyl Lead) the current rules and regulations of the supplier (Dupont) shall be followed, therefore, consult your foreman and secure properly prepared SAFETY WORK PERMIT.

(2) Working on Scaffolds: After building a scaffold, Insulator should check the following to assure safety:

(a) Supports should be solidly set on level surface or properly blocked.

(b) Cross braces should be firmly attached.

(c) Guard rails should be provided.

(d) Decking boards should be free of splits and checks (boards should be at least 2" x 10" lumber at least as good as select structural)

(e) Decking boards should extend one foot beyond working ledger.

(f) Decking boards should overhang the bearing ledger at each end at least 12". Where overhang exceeds 12", Tubelox bars are to be clamped to posts on top of scaffold planks at each end to prevent tilting.

(g) Decking boards must be free of oil and grease and kept free at all times.

(h) Ladders should be installed in best position for climbing and exit.

(i) While building scaffold, check all exits possible, in case a quick descent has to be made.

d. PRACTICES

The following practices are considered as precautionary in nature and it is recommended they be observed.

(1) Avoid walking on pipe lines whenever possible. Major jobs of work should not be done while standing on lines or fittings.

(2) Avoid walking on asbestos or transite roofs, on defective roofs, and on insulated lines.

(3) Keep clear of suspended loads wherever and whenever hoisting is being done.

(4) When lifting make full use of the leg muscles, keep the back as nearly upright as possible and avoid twisting while lifting. Get help with heavy loads.

(5) When working with or around welding operations secure and use safety glasses (goggles) with dark lenses. These may be obtained from the Tool Room. Never look directly at electric or acetylene welding rays. Reflection of electric or off light colored (aluminum) surfaces can cause flash burns.

(6) All excavations of any kind in any area where employes are likely to walk must be either refilled, covered, fenced or roped off, and warning flashers used at night.

(7) Leather gloves should be worn at all times when building scaffold.

TEXACO INC.

PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 3, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-5 SUBJECT: DEPARTMENT AND PLANT FIRE PROTECTION
a. Fire Prevention Practices
b. Location of Fire Equipment
c. Use of Fire Equipment

Fire protection and fire fighting are the concern of each and every individual at Puget Sound Plant. All employes, exclusive of women, are subject to fire fighting duty as required, whether or not directly attached to the Fire and Emergency Organization. Accordingly, supervisors assigned a copy of this manual are responsible for keeping all personnel under their supervision informed in regard to their individual roles.

I. HOW TO REPORT A FIRE OR EMERGENCY

To report a fire or other emergency there are simple rules which should be followed:

1. REMAIN CALM - DO NOT PANIC

You have certain vital functions to perform - functions which must be carried out promptly and effectively - functions which call for clear thinking and sound judgment.

2. SIZE UP THE SITUATION QUICKLY

Is the fire small enough to handle alone - or will help be needed? Spot the nearest fire extinguishing equipment - weigh the possibilities of personal injury

3. TAKE ACTION

(a) Extinguish Fire
If you can handle it alone - SAFELY! or

(b) Give Alarm
If the fire is too large to handle without help - even if necessary to leave location to do so.

TAKE NO CHANCES OF LETTING FIRE GAIN SERIOUS HEADWAY BEFORE GIVING ALARM.

4. GIVING THE ALARM

Call the Boiler House immediately by telephone (242) giving:

1. Your name
2. Location of fire and department: Have this information repeated back.
3. Nature of fire - seriousness.

Mobile radio equipment may be used if telephone is not convenient and would cause delay in sounding alarm. In this case, call the Gate or the Garage who in turn will relay the call to the Boiler House. However, it is preferable to call the Boiler House direct.

REMAIN CALM - HAVE PERSON RECEIVING CALL REPEAT INFORMATION BACK - BE SURE HE CLEARLY KNOWS LOCATION.

II. FIRE AND EMERGENCY SIGNALS

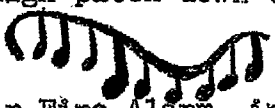
REGULAR FIRE ALARM: One wildcat cycle followed by number of short blasts to indicate zone number. Repeat wildcat cycle and zone signal one time, as follows:

ZONE NO.

1	1 Wildcat	(pause 10 sec.)	1 short blast Repeat wildcat and zone	(pause 10 sec.)
2	1 Wildcat	(pause 10 sec.)	2 short blasts Repeat wildcat and zone	(pause 10 sec.)
3	1 Wildcat	(pause 10 sec.)	3 short blasts Repeat wildcat and zone	(pause 10 sec.)
4	1 Wildcat	(pause 10 sec.)	4 short blasts Repeat wildcat and zone	(pause 10 sec.)
5	1 Wildcat	(pause 10 sec.)	5 short blasts Repeat wildcat and zone	(pause 10 sec.)

Responsibility: When Regular Fire Alarm Sounds, all personnel assigned to the Fire and Emergency Organization who are on duty are required to report to their respective assignments. The only exceptions would be in the case of scheduled fire drills when individual members may be excused by authority of the Fire Chief (Assistant Plant Manager) only. Persons temporarily on "limited duty" due to physical condition will be considered as temporarily relieved from fire fighting duties. Off duty employes are not required to report unless called out, except that Supervisors on Call Out Lists should not necessarily wait to be called.

The term "wildcat" or "wildcat cycle" refers to the variable pitch feature of the wildcat fire whistle, sounding the whistle through its range from high pitch down to low pitch and back to high pitch again. The high pitch is used for zone signals.



Fire Drill: Same as Regular Fire Alarm, including repeat.

Recall: One long blast of the high pitch. "Recall" to be sounded only when authorized by person acting as Fire Chief, Assistant Fire Chief, Fire Marshal or Acting Fire Marshal. Person calling the "recall" to the Boiler House should identify this authority.

GENERAL ALARM: 10 continuous wildcat cycles (approximately two minutes.)

"General Alarm" to be sounded only when authorized by person acting as Fire Chief, Assistant Fire Chief, Fire Marshal, or Acting Fire Marshal. Person calling a General Alarm" to the Boiler House should identify this authority.

Responsibility: When General Alarm is sounded, all available employes except women are required to report as outlined in SECTION XVII - General Alarm - of the Plant Fire Manual. Off duty employes should report on hearing the alarm or on being called.

UNIT EMERGENCY ALARM: Series of short blasts (approximately 10), of air whistle on unit concerned.

Fire whistle will be tested each Friday noon immediately following the regular plant noon whistle. Test will consist of sounding one wildcat cycle.

If wildcat fire whistle is inoperative, the plant shift whistle will be used. Signals will be the same as above, substituting one long blast for each wildcat cycle.

Hourly employes reporting in response to General Alarm or Call Out Should punch in as usual at the Main Gate.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 3, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM A-6 SUBJECT: DEPARTMENT AND PLANT HOUSEKEEPING

A. DEFINITION

The term "housekeeping" is generally used throughout the petroleum industry and refers to the continuous maintenance of clean, neat and orderly condition within a refinery. Lack of good housekeeping practices contributes to safety, fire and health hazards detrimental to all employes.

B. RESPONSIBILITY

It is the responsibility of each supervisor and employe in the Insulation Department to maintain the department and assigned work areas in conformance with the "Refinery Housekeeping Practices".

C. INSULATION DEPARTMENT PRACTICES

In addition to the general practices applicable to every employe in the refinery there are a number of "Housekeeping Practices" which are emphasized here and which must be observed by everyone in the Insulation Department.

1. All roadways, passageways, aisles, stairways, platforms, etc., shall be kept free of unnecessary tools, materials and debris. Clean up after every job.

2. Oil or chemically damaged scaffold decking boards should be promptly removed from service and tagged for destruction in order to prevent re-use.

3. Any oil or chemical spilled on stairways, platforms, scaffold decking, walkways and similar areas where persons must work or walk should be cleaned up immediately and Super-Dri or sand applied to prevent slips and falls.

4. Waste material should not be allowed to accumulate but should be cleaned up and arrangements made to keep it hauled away. Salvageable materials should be neatly piled until they can be hauled to the plant salvage area.

5. Never block access to fire fighting equipment with equipment or materials.

6. If it is necessary to leave job before clean up can be completed, advise the Insulator Foreman so arrangements can be made to reschedule clean up.

It is the responsibility of every Insulator, after a job to leave the work site in a clean, orderly and safe condition unless specifically directed otherwise.

7. All tools and equipment should be cleaned and returned to their proper storage area. Broken tools should be tagged and sent to main tool room for repair.

8. Area around power saws and all machinery is to be kept free of pieces of lumber, sawdust and bent nails to prevent tripping or stumbling. After cutting lumber, Insulators are to pick up any scrap pieces and place them on scrap pile.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 3, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-7 SUBJECT: CARE AND PURPOSE OF SHOP EQUIPMENT

A. PURPOSE

1. Band Saw - is used for various angle cuts for insulation ells.
2. Pexto Shears - used for cutting aluminum jacketing.
3. Rollers - used for rolling jacketing for various size lines.

B. CARE

1. Band Saw - the blades should be kept sharp, motor oiled, bearing greased and table should be kept clean.
2. Shears - bearings greased, monthly.
3. Roller - bearings greased, monthly.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-8 SUBJECT: TYPES AND PURPOSE OF INSULATING MATERIALS

A. TYPES

1. Calcium Sillicate
2. 85% Magnesia
3. Foam Glass
4. Foam Plastic
5. Fiberglas
6. Mineral Wool
7. Kaowool
8. Finish Cements
9. Metal Lath
10. Wire mesh
11. Aluminum Jacketing
12. Wire
13. Metal Screen
14. Weatherproof Coating
15. Insulation Sealer
16. Heat Transfer Cement

B. DESCRIPTION AND PURPOSE

1. Calcium Sillicate Insulation is a light weight, molded material, manufactured by reviting a blend of special inorganic ingredients, reinforced with selected long fibers under suitable condition of heat and water, then is chemically converted into a strong hard material.

   The low thermal conductivity of this product makes it ideal high temperature insulation for piping, ducts and equipment recommended for temperature from 600°F to 1350°F.

2. 85% Magnesia is composed of hydrated basic carbonate of magnesia bonded with asbestos fiber and molded into both pipe and block form for a high insulating valve. Recommended for temperature up to 600° F.

3. Foam Glass insulation is a rigid, light weight material containing millions of individual hermetically sealed cells. Because of its inorganic nature it will not deteriorate. It also is resistant to acids. Recommended for temperatures up to 300°F.

4. Foam Plastic is a flexible foam plastic material in pipe covering form, used on cooling and heating lines. This insulation is used to prevent heat gain, condensation and frost formation on cold temperature lines. It also prevents heat loss for liquid heating and dual temperature piping. The flexibility of this insulation makes it very good for copper lines that are curved. Recommended for temperatures from 40°F to 220°F.

5. Fiberglas is a low-density resilient, blanket-type thermal and acoustical insulation made of long, extremely fine, flame blown glass fibers, bonded with thermosetting phenolic resin. Fiberglas is used for piping and duct insulation for temperature up to 300°F.

6. Mineral Wool is composed of high temperature spun mineral fibers and an inorganic binder. Recommended for temperatures up to 2000°F.

7. Kaowool - This material is an alumina silica ceramic that can be used for temperatures up to 3200°F. It comes in rolls 24" X 24' long and from 1/2" to 2" thick. It can be removed and used again. Due to its high melting point and high cost, Kaowool is used only in heaters and for annealing welds.

8. Finish Cement - OC 30 - This cement is made of the same material as calcium silicate. It is a one coat application that will not shrink or crack. Recommended for temperatures up to 1350°F.

9. Metal lath is expanded metal sheeting. It is used to support and reinforce insulating cements and refractories. It is used primarily for boxing in instruments and refractories inside heaters.

10. Wire mesh, or "chicken wire", used in insulation is woven galvanized wire in one inch mesh, generally 19 or 20 gauge, on large equipment such as vessels, tank breechings, stacks, on large diameter piping where block, segmental on blanket type insulation has been applied, a layer of wire mesh netting is usually applied, to provide a firm light weight reinforcement that will follow and support insulation on a contoured or flat surface, and also used for binding weather-proofing to the vessel.

11. Aluminum jacketing is used for covering insulated lines and vessles, for weather protection. It comes in rolls of various sizes and thicknesses, corrugated, with or without a polycraft vapor barrier.

12. Wire - The purpose of wire is to permanently attach insulating materials in various forms, to piping and equipment. The gauge, or thickness, of wire used depends on the size of material or load which the wire or group of wires will be required to support. For most insulation materials #16 gauge galvanized wire is satisfactory.

13. Metal Screws - Metal screws are used for fastening aluminum jacketing to lines and vessels. The type used at PSP are 1/2" x #12 cadmium plated, pan head, self tapping metal screws.

14. Weatherproof Coating - Foster H.I. Mastic #90-07 is used to weatherproof ells and various shaped insulation jobs. H.I. Mastic is an asphalt emulsion weathercoat and water vapor "breather" for thermal insulation in hot service.

15. Insulation Sealer - Insulation sealer is designed for dual temperautre service with foamglas, styrofoam and other rigid foam insulation. Effective as a vapor barrier in joints and between courses of vapor barrier insulations, also used as a bedding compound between metal and insulation, performing as a cushion and providing additional adhesive strength to the insulation and corrosion protection to the metal. The type used at PSP is Foster 30-46 insulation sealer, suitable for temp - 50° to 200°F and can be applied at temperature as low as 15°F.

16. Heat Transfer Cement - Thermon is a non-metallic plastic compound with highly efficient heat transfer properties. It is supplied in a ready to use paste form for application over either conventional steam traced or electrical resistance systems. When cured to a cement like hardness, thermon bonds itself to the coils and the equipment, forming an unbroken thermal convertion. Utilizing the entire surface of tracer tubing or electric heating cable, thermon conducts the heat to the surface to be heated or away from the surface to be cooled. Thermon can be installed by either hand trowel or by air operated equipment.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 3, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-9 SUBJECT: PROCEDURE FOR OBTAINING TOOLS, MATERIALS AND EQUIPMENT

A. TOOLS

1. Each Insulator is issued the basic tools needed to perform his duties.

2. Tools needed but not issued, can be obtained from the tool room (located in machine shop or from the insulation foreman.) *Footnote

B. Equipment
Equipment needed for the job, can be obtained from the warehouse or recovery yard.

C. Material
1. Each Insulator is authorized to order material from the Storehouse. Before calling for material, compile a list giving the name size and weight, type of material and a charge * to which the material is to be credited.
*Charge - Estimate number, bill of material number casualty claim number, or unit where used.

2. Insulation can be obtained from the insulation warehouse located upstairs in #1 Warehouse.

* Basic Tools Issued:
1. Pruning Saw
2. End nippers
3. 4" Screw driver
4. Awl
5. 12' tape rule
6. 6" fish knife
7. 2-6" pointing trowel
8. Small tin snips
9. Rubber palm

TEXACO INC.

PUGET SOUND PLANT

TRAINING DETAILS

DATE: APRIL 3,1973

DEPARTMENT: INSULATION

CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-10 SUBJECT: TYPE OF WEATHERCOATING

1. Asphalt Emulsion - See On-The-Job Training Item B-19.
2. Aluminum Jacketing - See On-The-Job Training Item B-19.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-11 SUBJECT: DEPARTMENTAL STANDARDS OF CRAFTSMANSHIP

An insulator as directed, performs on his own responsibility all types of insulation work necessary to install, repair, and maintain equipment in the Shop or in the field.

May direct the work of others assigned to the job. Cooperates with others in the performance of duties assigned.

Performs customary rigging incidental to the work of his department.

Observe safety instructions applicable to to work performed, and adherence to general safety instructions applicable to all plant employes. Also, while actively directing others, is responsible for their adherence to such safety instructions.

May be required to instruct or train employes or others in the work of his craft.

Should have the ability to understand verbal and written orders and issue instructions accurately and clearly for their proper execution.

Requires a general knowledge of company standards, requirements, specifications, and common practices for insulator work in order to perform duties and jobs in a standard manner. This would include the proper use of Safeway scaffold, insulating, brick laying, cementing, applying refractory and a multitude of common practices that are standard to Texaco and Puget Sound Plant. This refers to knowledge gained only through experience and might enable an insulator to perform a job without benefit of prints.

Requires a general knowledge of condition under which equipment operates and plant location of such equipment.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-12 SUBJECT: LOCATION AND USE OF UTILITIES

USE:

(1) A utility is a form of energy used to get work done. At Puget Sound Plant, utilities include steam, electric power, service water and compressed air. These utilities amount to approximately 40% of the total cost to operate the plant.

(2) An Insulator uses these utilities almost every working day. Compressed air is used for pneumatic tools, sandblasting and guniting equipment. An Insulator uses electric power for light to work inside towers, vessels and for operating some types of portable power equipment.

CAUTION: ALWAYS USE A 32 VOLT LIGHT WITH VAPOR PROOF COVER WHEN WORKING IN TOWERS OR VESSELS.

(3) It is each Insulator's duty to see that utilities are not wasted.

LOCATION:

(1) In every operating unit and designated spots throughout the refinery, utility stations are mounted on stanchions. In most cases, service water, air and steam are mounted together. Steam lines are insulated to prevent personnel from burning their hands. Water lines are usually 1-1/2" pipe and are marked with a sign "Service Water - Do Not Drink". Air and water lines will have a Chicago fitting attached. Electricity is mounted separately, 440 volt tie-ins are also provided for electric welding machines. Utilities are also mounted in all of the working shops.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-13 SUBJECT: PROCEDURES FOR OBTAINING AND USING PERMITS

A. PERMITS

Before any electric hand power tool can be used on a field job or before entering a heater, tower or vessel to build scaffolding, a Safety or Hot Work Permit (which ever the job requires) must be obtained.

B. SCHEDULED DOWN PERIODS

1. A permit list is turned in to operations each afternoon by a down period supervisor for the work permits required the next day. (Note: This does not preclude the craftsman calling to his supervisor's attention that a permit may be required on a specific job.)

2. If a work assignment arises during the shift that requires a permit, and the permit has not been issued, the Insulator should contact the Supervisor in charge and advise him accordingly.

3. A permit board is usually set up during the unit down period and Operators will post the permits on this board. All requirements noted on the permits should be carefully followed.

C. OPERATING UNITS

The Stillman should be contacted for permits to work on units in operation. Explain the work to be performed and the equipment that is to be worked on. Conditions on permits must be followed.

D. TANK FARMS

The Operating Supervisor in charge should be contacted and advised of work to be performed. If equipment or material is required, a Hot Work Permit should be requested for Transportation to enter firewalls around tank in order to make material delivery.

NOTE: All permits should be posted in open sight for inspection.

SAFETY WORK PERMIT

FORM R-24?-A (1-59) IN BKS.

(This DOES NOT Permit Burning, Welding or Other Hot Work)

This Will Permit _____ (Craft, Department or Person)

To: ☐ Unhead ☐ Enter ☐ Disconnect ☐ Work On ☐ Remove or Replace ☐ _____ (Specify Other Work)

Type of Equipment _____ (Vessel, tank, line, pump, compressor, manifold, etc.)

Location: _____ (Unit, Area, Building, etc.)

From _____ A.M. P.M. 19__ To _____ A.M. P.M. 19__

Condition: ☐ Empty ☐ Blinded Off ☐ Steamed ☐ Line Disconnected ☐ Drains Open ☐ _____ (Specify Other)

Safety Precautions: _____ (Specify: Man on guard, Wet down shell or roof,

spark-proof tools, vapor-proof lights, protective clothing & equipment,

canister mask, airline hose mask and blower, and other similar precautions).

Gas Free _____ (Yes or No)

Gas Test Taken _____ A.M. P.M. (Time)

Taken By _____ (Person Making Test)

Signed: _____ (Foreman or Operator)

Poison Gas _____ (Yes or No)

Gas Test Taken _____ A.M. P.M. (Time)

Taken By _____ (Person Making Test)

Countersigned: _____ (Authorized Personnel)

HOT WORK PERMIT

FORM R-241 (7-59) 1500 BKS.

This Will Permit _____ (Craft or Dept.)

To _____ (Burn—Weld—Light Fires—Sandblast—Break Concrete—Grind—Chip—Operate Internal Combustion Engine, Etc.)

At _____ Location: Unit—Vessel—Building—Tank—Area—Etc.)

From _____ (Time) A.M. P.M. _____ (Date) 19__ To _____ (Time) A.M. P.M. _____ (Date) 19__

Conditions and Limitations: _____ (Specify all special requirements such as: Fireguard—Fire Equipment—Wet down area, etc.—Cover sewer, Ditch or Drain,

Personal Protective Equipment—Other special precautions.)

Gas Free _____ (yes or no)

Gas Test Taken _____ A.M. P.M. (Time)

Taken By _____ (Person Making Test)

Signed _____ (Foreman or Operator)

Poison Gas _____ (yes or no)

Gas Test Taken _____ A.M. P.M. (Time)

Taken By _____ (Person Making Test)

Countersigned _____ (Authorized Personnel)

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. A-14 SUBJECT: READ, INTERPRET, AND WORK FROM BLUEPRINTS, SKETCHES AND BILLS OF MATERIAL

Refer to Job Training Manual on Blueprint Reading for Craftsmen located in the foreman's office and to the following copy of a Bill of Material.

BILL OF MATERIAL

REFINING DEPARTMENT

Form R-415-E

28

B. M. No. 1737

EST. TITLE GENERAL - REPLACE PLANT ENTRANCE SIGNS

EST. NO. ~~ESP~~ EC - 4168 MADE BY RCP

LOCATION PSP CHECKED BY DFM DATE 8-13-71 SHEET NO. 1 / 2

ITEM NO.	QUAN. AND UNIT	DESCRIPTION	DWG. NO.	MARK	FURNISHED BY
1		SCOPE:			
2		PLANT FORCES REPLACE EXIST PLANT ENTRANCE			
3		SIGNS @ INTERSECTIONS OF W. MARCHES POINT RD/			
4		S. TEXACO ROAD & "C" ST/S. TEXACO ROAD PER			
5		DWG 50-764-Y, EXCEPT;			
6		1. SIGNS WILL BE FURNISHED AND INSTALLED BY			
7		OTHERS ON POSTS INSTALLED BY TEXACO. POSTS			
8		TO BE READY FOR USE BY 8-27-71.			
9		2. PLANTINGS TO BE FURNISHED & PLANTED BY			
10		LAWN MAINT CONTRACTOR W/CHARGES TO PSP			
11		MW-352.			
12		ALL OTHER WORK BY PLANT FORCES TO BE COM-			
13		PLETED AS MANPOWER & MATLS PERMIT.			
14		R L KIRKPATRICK RLK			
15					
16		MATERIALS: (ALL BY 8-27-71)			
17	2	DIRECTIONAL SIGNS - PER DWG 50-758-Y			-LL-123973
18	2	POLES - 12" MIN DIA X 20' LONG - WESTERN RED			---AHB
19		CEDAR, PEELED & CLEAN, UNTREATED (AVAILABLE			
20		FROM MAC GILLIS & GIBBS @ CONWAY, WASH).			
21	4	"DITTO" X 14' LONG			
22	6	"DITTO" X 5' LONG			
23	2	GAL. - "VERITHANE", CLEAR, GLOSSY			
24					
25	(DFM DRW	WWC JWA KWE RLK) AOS(2*) AHB(2) GDJ CEL(3*) DFS(2*) ENG(2)			
26					

WA-TEX 001554

BILL OF MATERIAL

REFINING DEPARTMENT

Form R-415-E

29

B. M. No. 1737

EST. TITLE

EST. NO.

LOCATION

MADE BY

CHECKED BY

DATE

SHEET NO. 2 / 2

ITEM NO.	QUAN. AND UNIT	DESCRIPTION	DWG. NO.	MARK	FURNISHED BY
1	12	DRIFT PINS - 3/4" Ø X 2' LONG A-36			AHB
2	2	PIPE - 4" SCH 40 A53 X 7'-8"			
3	2	DITTO X 9'-8"			
4	2	PLATE - 1/2" X 4" Ø A36			
5	4	CORR FIBERGLASS - 4 OZ X 26" X 10' GREEN			
6	4	DITTO X 12'			
7	4	SONOTUBE FORM - 12" Ø X 6'			
8	20'	WIRE MESH - 2 X 2 X 12 GA STL X 2'-6"			
9	3/4	YD - 3000 PSI CONCRETE			DFS
10	2 YD	SHALE - PIT RUN			AHB
11	5 YD	PLANTING SOIL			
12	2 YD	BEAUTY BARK			
13	30	JUNIPER TAMS - FURNISHED BY MR. R. HALLENBECK			
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					

DEPARTMENT: INSULATION

CLASSIFICATION INSULATOR (TRAINEE)

ITEM NO. A-15 SUBJECT: MEASURING AND LAYOUT METHODS

A. MEASURING

1. Principle of Insulation measurement will be for pipe insulation.

2. The greater majority of Insulation job in a refinery will normally be replacing insulation on existing lines.

B. LAYOUT METHODS

1. Determine the size of pipe or vessel to be covered by using a square and level.

   The inside angle of the square is placed against the pipe and the top leg leveled. One point on the center is located under the scale at a distance from the inside angle of the square, equal to 1/2 the outside diameter (OD) of the pipe. This will give the size of insulation required.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-1 SUBJECT: PROCEDURES FOR OBTAINING AND TRANSPORTING TOOLS AND EQUIPMENT

1. Tools will be in the Insulator Shop tool room or upstairs in the shop. If additional tools are needed you can get them from main tool room in the Machine Shop. You must sign a charge out slip, do the job and return the tool to the tool room.

2. Equipment may be located in the following areas.

   Warehouses 1, 3 or 4 and north of 6th Street between "B" and "C" St. in storage area.

3. Storehouse: Each Insulator is authorized to order and receive material from the storehouse.

4. Methods of Transporting: Call trucking department giving type of material or equipment to be hauled where equipment or material is located, and where it is to be hauled. Also state type of trucking equipment that is needed.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-2 SUBJECT: PROCEDURES FOR HOISTING TOOLS AND EQUIPMENT

A. AIR DRIVEN HOIST

The insulators use air tuggers to hoist tools and materials needed for covering of lines and vessels upon towers, vessels, structures, etc.

Before operating, the tugger should be inspected:

(1) Check cable for frayed places, kinks or loops. Be sure cable is not overlapping itself on the drum. If strands are broken, cable should be replaced. Do Not Take a Chance With a Frayed Cable as it could cause a serious accident. If cable is tangled or looped on the spool, run cable out and respool it keeping tension on the cable so it will be spooled evenly. Always keep cable neatly wound on the spool.

(2) Check oil in the gear box.

(3) Check spool drum brake.

The tugger must be firmly anchored to a dead man or some other solid support where operator can see all of the lift.

NOTE: Never anchor tugger or snatch blocks to operating lines.

Always place the tugger so the cable will unwind from the top of the drum. If pull is from the bottom of the drum, a heavy pull on the cable will have a tendency to lift the tugger and control could be lost causing an accident.

After tugger is secured, pull the cable to the top of the tower with a rope and install the cable in a snatch block hung on the overhead trolley. As an extra safety precaution, the snatch block should be wired closed so it cannot be pulled from trolley.

A snatch block is also installed on the cable at the bottom of the tower directly in front of the tugger no higher than the top of the tugger spool.

NOTE: It may be necessary to use more than one snatch block at the bottom to clear obstructions. First block must be installed as directed above.

A rope or tail-line must be tied to the cable end. It is used to pull the loadless cable to the ground and to keep loads from hitting anything on the way up or down.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-3 SUBJECT: PROTECTION OF MATERIALS AND EQUIPMENT

When material and equipment is left out in the weather, protect them by covering with a tarp or vis queen.

TEXACO INC.

PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-4 SUBJECT: CLEAN UP OF SHOP AND WORK AREAS

1. The shop should be kept clean at all times.

2. The job site should be kept clean and cleaned up at the end of each day.

3. In addition all housekeeping practices should be followed, according to the General Housekeeping practices Ist in Basic Training in this manual.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-5 SUBJECT: PROCEDURES FOR ERECTING SCAFFOLDS AND LADDERS

The Insulat r at PSP are required to build scaffolds up to 2 sections high.

1. First obtain the scaffolding needed for the job.
   a. One section, consists of the following:

      2 - end frames - 6'4" high and 3' high section
      2 - cross braces
      5 - scaffold planks
      4 - hand rail post
      4 - side hand rails
      2 - end hand rails

If more than one section is required, it will require 4 connecting pins per section 2 to assemble. Connect the braces to the end frame, by sliding the end of the brace, over the pins on the frame, lay the planks on top of frames. Put the hand rail post on top of frames and connect the hand rails to the past with a wing nut.

If more than one section is needed connect the two frames together with the pins inserted in the top hole of lower frames to the bottom leg of the next frame.

If half sections are required, the braces will have to be shorter; half section braces are generally colored orange.

EXHIBIT - See Department Foreman

Ladders

When erecting a ladder, the bottom of the ladder, should be 1 foot from the place for every 4' in height.

Securely tie off ladder at the top.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-6 SUBJECT: PROCEDURES FOR REMOVING OLD INSULATION

A. PIPE INSULATION

When removing pipe insulation, first remove the jacketing by removing the screws. Cut the wires with end nippers while holding the insulation from falling. When finished, move insulation to storage, and clean up area.

B. ALL OTHER TYPES OF INSULATION

When removing insulation from pumps, meters, orifice flanger, etc. Use hatchet to knock off the old insulation, being careful not to mar the piece of equipment that the insulation is being removed from. Clean up area when finished.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-7 SUBJECT: SALVAGE OF INSULATION MATERIAL

When removing insulation from lines and vessels, try to salvage as much insulation as possible and move to storage.

TEXACO INC.

PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-8 SUBJECT: PROCEDURES FOR MIXING INSULATION CEMENT a. Hand Mix b. Machine Mix

A. HAND MIX

Hand mix is used, when only a small amount of cement is required. Mix the cement by pouring the amount required in a bucket and adding enough water to make a firm enough consistency that will hold its shape and will not slump.

B. MACHINE MIX

Machine mix is used when a large amount of cement is required to do the job. Pour the contents of a sack into the mixer and add enough water to make a firm enough consistency that will hold its shape and will not slump.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-9 SUBJECT: PROCEDURES FOR CUTTING MATERIALS

Refer to Item B-17, this Manual.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-10 SUBJECT: PROCEDURES FOR OPERATING THE TAR POT

Refer to operating Instruction Manual in the Yard Foreman's office.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-11 SUBJECT: CLEANING AND PREPARING SURFACES FOR INSULATION

Refer to Item B-17 of this Manual.

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION

CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-12 SUBJECT: PROCEDURES FOR OPERATION SPACE HEATERS

Refer to operating Instruction Manual located in Yard Foreman's Office.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-13 SUBJECT: PROCEDURES FOR PREPARING INSULATION FOR APPLICATION

a. Calcium Silicate
b. Cork
c. Plastic
d. Block
e. Monolithic
f. Fiberglass
g. Acid Proof Cement
h. Mineral Wool
i. Hair Felt

Refer to Section B-16 On-The-Job Training

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 4, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-14 SUBJECT: PROCEDURES FOR OPERATING SAWS
a. Band
b. Bricksaw

Band Saw

(a) Use - Puget Sound Plant's 20" band saw is fully enclosed in a welded steel cabinet and is equipped with miter gage and rip fence complete with guide rails for accurate work. Use of correct blades makes it an efficient unit for ripping, re-sawing and for cutting wood, insulation, plastics, aluminum, manganese and other non-ferrous metals.

(b) Description - Standard blade length of this band saw is 141 inches. Maximum blade width is 1 inch. All adjustments necessary for proper centering, guiding and tensioning of blades are provided. Blades of various widths from 3/16 to 1 inch wide are available. The table tilts 45 degrees to the right and 12 degrees to the left.

Maximum height of cut is 13 1/4 inches with clearance of 5 inches between the blade and upper frame. The full throat width, however, is 19 3/4 inches for cuts up to a height capacity of 12 1/8 inches. These clearance, location of mounting holes and other dimensions are shown in Fig. 2.

On this machine the slot for removing the blade is at the side of the table. This patented feature permits the use of widely spaced trunnions for greater rigidity of the tilting table, and avoids interference with the front rip fence bar, screw feed or other attachment which may be used.

The blade guides are fully and independently adjustable for blade width and thickness to permit the exact settings required for accurate work and long blade life. The lower guides are within 1 inch of the table surface. Thus the blade is supported close to the work, reducing blade breakage. Convenient adjusting screws permit each setting to be made separately. The front blade guard rides with the upper guides, protecting the Operator in all cutting positions.

Other features presented in this band saw are the convenient blade tracking adjustment, blade tension control with indicator, aluminum wheels with tensioned removable rubber tires which have been ground to uniform thickness, the foot brake and dust spout. Sealed ball bearings are used for both wheel shafts and for supporting the blade, thus reducing lubrication requirements to a minimum.

The correct motor speed with 60-cycle or DC power is 1725 rpm, which will run the blade at 4500 feet per minute.

(c) Lubrication - The upper and lower wheel shafts are supported in sealed ball bearings. The same type of bearing is used back of the band saw blade to take the thrust developed when cutting. These bearings need no lubrication throughout their life.

Oil the sliding ways of the upper wheel bracket, the trunnions, the adjusting screws and other movable parts occasionally to keep them in free operating condition.

Do not lubricate the saw blade. Keep the blade contact surfaces of the guide blocks and the support bearings clean and free from oil.

(d) Adjustments - The controls and adjustments described below are important for accuracy and convenience in various operations. Follow these directions for best results:

(i) Blade Tension - For accurate work and maximum blade life it is important that the blade be centered on the wheels. When the adjustment has been properly made, the blade will "track"; that is, it will run steadily in the same line. If the blade weaves across the crown of the wheels, cutting will not be uniform and blade breakage will be increased.

Both the upper and lower blade guides and the support bearings must be moved back to clear the blade entirely while the tracking adjustment is being made.

Alignment of the blade on the wheels is accomplished by tilting the upper wheel slightly with respect to the lower. The upper wheel shaft housing is pivoted. Its direction is controlled by the hand knob C which is the upper knob in Fig. 3.

Having brought the blade to correct tension, turn the upper wheel clockwise by hand. If the blade creeps forward, tighten the knob slightly to tilt the wheel toward the rear, thus centering the blade. Loosen the knob if the blade creeps toward the rear. Spin the wheel and check again. When it is certain that the blade will not run off the wheels, start the motor and make any final minor adjustment which may be necessary at operating speed.

Never begin the tracking adjustment while the machine is running; at high speed the blade may run off almost instantly, injuring the blade or operator. Adjust the hand knob only a small fraction of a turn at a time, as very little tilt of the upper wheel is required to draw the blade across the rim of the wheel.

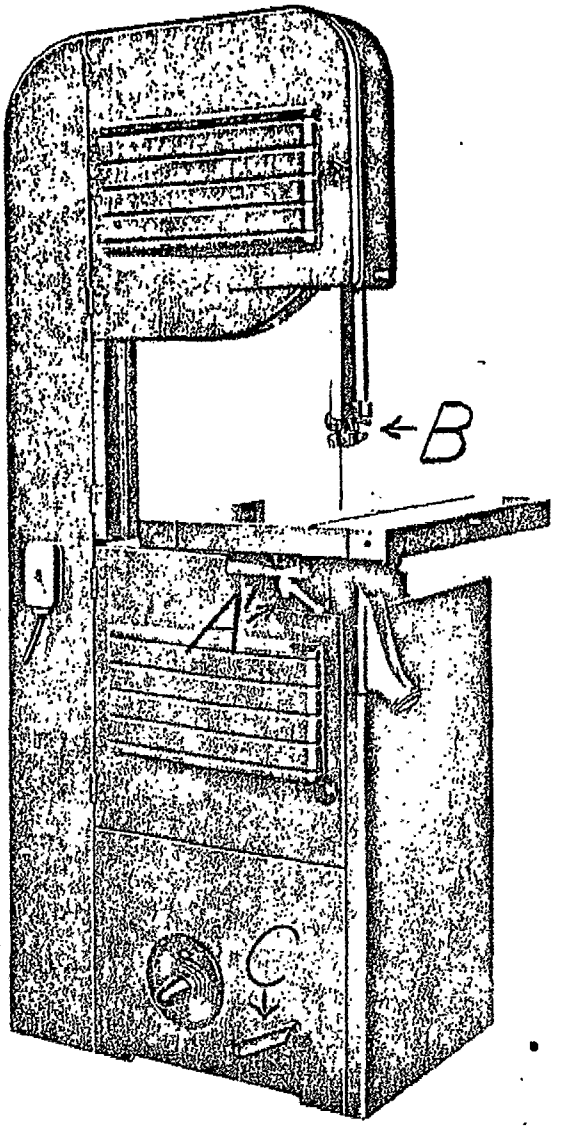


Fig. 1. 20" Wood Cutting Band Saw.

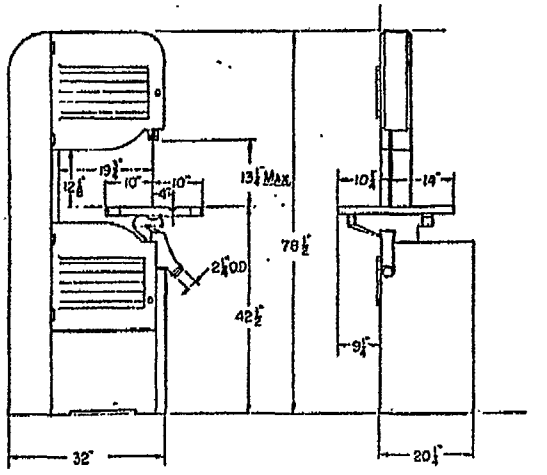


Fig 2. Dimensions of 20" Band Saw.

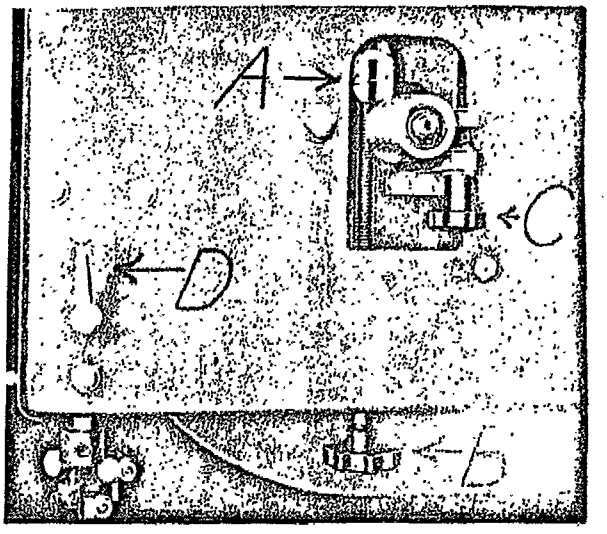


Fig. 3 Rear of Upper Cabinet, Showing Tension and Tracking Adjustments.

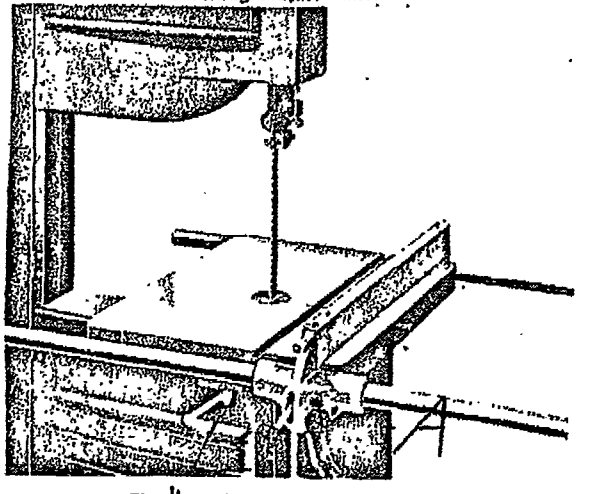


Fig. 4 7' Rip Fence Mounted on Table.

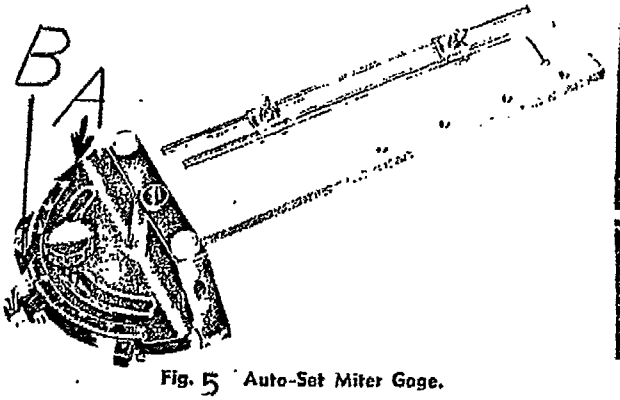


Fig. 5 Auto-Set Miter Gage.

Each blade has its own tendencies, especially after welding or brazing. The blade centering adjustment must therefore be repeated whenever a new or repaired blade is installed, regardless of previous adjustments.

(ii) Table - The table will tilt up to an angle 45° to the right and 12° to the left. Table tilt locking lever and table angle indicator are located under front of table.

(iii) Guides -

Upper guide steadies the saw. It should be set just above stock being worked. Upper guide locking lever is located behind upper wheel case.

Lower guide is below table.

(iv) Rip fence - Knob A locks fence in place. Knob B drives gears to move fence right or left. To make accurate cuts use tape to measure between fence and blade.

(v) Meter gauge - See figure 5. Knob A locks fence in place. Indicator B shows angle of fence.

(e) Operation - Before starting the machine, see that all adjustments have been properly made. Turn the wheels by hand as a final check. Close the cabinet doors before starting the motor.

Keep the upper blade guides and guard down as close to the work as possible, for maximum protection to the Operator as well as best support for the blade.

Move the stock steadily against the blade and no faster than required for easy cutting. Do not force the work; light contact will permit closely following the cutting line and prevents excessive friction, heating and case-hardening of the blade at its back edge.

A sharp blade of the correct type for the work will cut easily without much pressure.

Use the foot brake to stop the wheels after shutting off the power. This is a safety precaution which will prevent injury to the Operator and others who might not notice the blade running idle after work has been completed. It is also useful if the work becomes jammed and when a blade breaks.

(i) Straight cuts - Use the widest blade available for straight cuts, in order to have the greatest possible support for the teeth which do the work. Keep the blades which have closer tooth spacing for fine work, always using the coarse blades for resawing and other rough cuts.

(ii) When cutting curves, turn the stock carefully so that blade may follow the line without being twisted. Clearance for the blade in the saw kerf is provided by the set of the teeth. Wider tooth set and less blade width permits the cutting of sharper curves. The narrow blades should therefore be reserved for curve cutting. Remember wider blades are used for straight cuts and narrower blades are used for cutting curves.

If the curve is so abrupt that it is necessary to back up and cut a new kerf, a narrower blade or one with wider tooth set should be used. However, the cut is usually rougher when the teeth are set wider.

When backing out of the work in order to change the cut, or for any other reason, be careful to avoid pulling the blade off of the wheels. It is generally easier and safer to turn the stock and saw out through the waste material, rather than try to withdraw the stock from the blade.

(f) Blades - Band saw blades are subjected to heavy strains when cutting. Long service can be obtained only by selecting the correct blade for the work, and by carefully adjusting and operating the machine. Blades should be of the correct thickness and temper for use on 20-inch wheels.

A sharp blade will cut effectively under moderate pressure and uniform feed. When excessive pressure is required, the blade should be sharpened, as continued use is harmful to the blade in addition to taking extra time. Sharpening and setting a saw blade requires skill; those who lack equipment and experience should send the blades to a competent sawyer for sharpening.

Broken blades may be welded or brazed. Care should be taken to preserve tooth spacing, to keep the blade straight, and to remove welding flash at the joint. It is not economical to weld a blade which has become case-hardened, as it will soon break elsewhere.

Standard blades furnished for this machine are 141 inches long. The adjustment of the upper wheel bracket will accomodate blades up to a maximum length of 142 1/2 inches and to a minimum length of 139 inches. Thus standard blades may be shortened 2 inches by successive repair.

Excessive blade breakage may be due to a number of causes. In some cases it is unavoidable because of stresses which come upon the blade in the work. More generally, it is due to lack of care or judgment on the part of the Operator in making the adjustments. Common causes of blade breakage are:

(i) Faulty alignment or adjustment of guides.

(ii) Force or twisting the blade around a curve or very short radius.

(iii) Feeding too fast.

(iv) Insufficient tooth set or dull teeth.

(v) Excessive blade tension.

(vi) Upper guide set too high above the work.

(vii) Improperly finished or lumpy braze or weld.

(viii) Wrong blade for the work being done.

(g) Safety Precautions

(i) Adjust guide to suit work to be done.

(ii) Keep hands away from saw blade while it is in motion.

(iii) Prevent overcrowding of the saw by feeding stock to fast.

(iv) When operating saw and a nicking sound develops at each revolution of the blade, "STOP IT", and examine the blade carefully as it will have either a bent tooth or is cracking.

(v) Keep all guards in place.

Before cutting be sure you have the proper specification Eveready blade, whether it be Diamond, Tuffie Break-Resistant or Xtra-Cut Abrasive. If in doubt, consult the blade recommendation chart on the inside of the rear cover or see your Eveready distributor.

How to Mount Blade

Be sure blade shaft collars are free of grit or dirt before mounting blade on arbor shaft. Tightening blade against an uneven surface can cause fracture of an Abrasive blade, or cause blade to run out of alignment causing excessive blade wear.

When tightening nut against outside blade shaft collar be sure to tighten enough to hold the blade firmly without slipping, but do not overtighten - excessive tightening can cause fracture of Abrasive blades.

NOTE: Blade shaft nut has left hand threads. TURN COUNTER CLOCKWISE TO TIGHTEN. Tap nut lightly with hammer or equivalent.

How to Adjust The Height Of the Cutting Head

The Eveready crank raises or lowers the cutting head to any desired position. No secondary adjustment is necessary.

When the foot pedal is depressed, the patented blade pressure equalizer spring automatically takes over. (See section on "Step" cutting with Abrasive blades). To lock out blade pressure equalizer spring when "Step" cutting with Diamond blades, tighten wing nut on top of spring until the spring is compressed solid.

When the foot pedal is not depressed the blade pressure equalizer spring is locked out automatically. Use this position for "Jam" cutting with diamond blades (See Page following)

How To Use "Step" Cutting With Abrasive Blades

Use "Step" cutting without exception when cutting Wet or Dry with Abrasive blades. ("Jam" cutting which is discussed and illustrated in the section below, is to be used only with some Diamond blades for Wet Cutting).

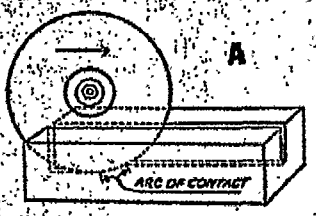
Hold material firmly against Backstop on Conveyor Cart. Be certain material does not slip or rock during cutting operation as this will bind blade causing excessive wear and fracture.

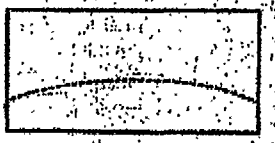
Move Conveyor Cart forward near the blade, and press down on the Foot-Pedal until blade is lowered to a point where it will lightly contact top of the material. Then start "Step" cutting - which means passing the material beneath the blade with RAPID, (50 to 60 strokes per minute) full length strokes, taking a shallow cut

(approximately 1/8" deep) on the forward, and ALSO on the backward stroke. Complete each RAPID stroke backward and forward by passing the material beyond the center of the blade before starting the reverse movement of the cart. The harder the material, the more rapid the forward and backward strokes.

"Step" Cutting, as can be seen in Sketch A lessens the area of the blade circumference in contact with the material, keeping the blade cool, running free, and cutting at peak efficiency. Don't get the impression "Step" Cutting means slow cutting - actually it is 6 times faster than trying to "force" the cut by strong - arming the material through the blade. Forcing the blade through with a deep cut causes a longer area of the blade circumference to be in contact with the material, causing excessive friction heat to be generated causing blade to "smear" or "load" with fused material particles and lose its sharp cutting surface. (NOTE: If improper operation should cause an Abrasive blade to "smear" make several cuts through a soft brick to "dress" it back to good cutting performance).

Due to the automatic pressure control provided by the Blade Pressure Equalizer Spring, Operator will find the blade "Rolling" as it passes through the material on both forward and backward strokes - making the cut slightly lower at each end, and slightly higher in the center as shown in Sketch B. With the cuts slightly lower at each end, masonry particles are freely and cleanly ejected from the cut, and there is free access of air or water into cut to keep blade cool and at peak efficiency.





How To Use "Jam" Cutting or (Fixed Cutting) and "Step" Cutting with Diamond Blades.

For "Jam" Cutting or Fixed Cutting adjust cutting head to proper height and do not step on foot pedal. Push the material through the blade in one pass. Jam Cutting should be used only with Diamond blades.

"Step" Cutting with Diamond blades is done by locking out the blade pressure equalizer spring (See Page 5) and applying pressure with the foot pedal. Unlike "Step" Cutting with Abrasive blades, "Step" Cutting with Diamond blades requires only a few passes through the material.

In cutting, hold the material firmly with both hands against the Conveyor Cart backstop. If the material is allowed to slip, resulting seizure of the blade may bend the Diamond blade center or cause a rim section to be twisted off.

Do hot force the material or bump into the blade. When nearing completion of the cut retard and slightly hold back the conveyor cart. If this is not done the material may be pulled into the blade so fast that excessive pressure on the rim may cause warping or twisting of the rim section.

When a new Diamond blade is broken in make the first few cuts slowly until the blade cuts free and easily.

When the blade is cutting freely and easily USE IT! As long as it continues to cut satisfactory do not dress the diamond blade or remove it from the blade shaft.

After continuous cutting of extremely hard and dense materials, the blade may slow down and it may be necessary to "dress" the cutting edge. To do this:

1. Use a rapid "Step" Cutting method for a few cuts - push material back and forth under the blade while it is cutting down. Or - if this is not sufficient:

2. Make one or two cuts in a soft brick or light weight block.

However, "dressing" should be done as seldom as possible - too much "dressing" reduces blade life.

NEVER USE DIAMOND BLADES DRY.

How to Use your BrikSawMatic Masonry Saw for Dry Cutting

1. Use proper blade for dry cutting.

2. Remove water curtain.

3. Disconnect electric water pump.

4. Use "Step" cutting.

How to Use your BrikSawMatic Masonry Saw for Wet Cutting

1. Fill pan with water to within 1/2" of top.

2. Install water curtain.

3. Be sure that water pump is plugged to connection to Masonry saw motor. (It will start when the main switch is turned on). This applies only to single phase models. In case of three phase motors provide a separate supply of 115 volts single phase for the pump.

It is not necessary to prime pump.

Be sure that water covers bottom flange of pump at all times. Do not let sludge and dirt get deep enough in the pan to block the pump inlet.

Use "Step" Cutting with Abrasive blades as described on Page proceeding.

Use "Jam" Cutting with Diamond blades as described on page proceeding.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-15 SUBJECT: PROCEDURES FOR CUTTING, PREPARING AND APPLYING MATERIALS
a. Roofing paper
b. Muslin and canvas
c. Wire mesh
CUT, PREPARE AND APPLY
d. Metal lath
e. Aluminum jacketing

A. ROOFING PAPER

When using roofing paper for weatherproofing cover, the joints should be overlapped at 2" minimum. The overlap on horizontal lines should be towards the underneath side of the line fastened by galvanized wire approximately 2" from each end and one in the center.

B. MUSLIN AND CANVAS

Muslin and canvas covering are used inside building. They are applied by using a wheat paste to fasten them to insulation. The paste is also used for sizing.

C. WIRE MESH

Wire mesh both secures the insulation under it and forms a good bond for master applied over it. The mesh should be applied around the vessel, and the joint and end should be wired together with 18 gauge galvanized wire. The mesh should fit firmly to the insulation. If the vessel does not have tie wires. To hold the mesh firmly, use staples to hold the mesh down, by driving staples into the insulation.

D. METAL LATH

Metal lath is expanded metal sheeting. It is used to support and reinforce insulating cements and refractories. Metal lath is used by the insulators to fabricate irregular size boxes for orifice meters and leads, and various other types of equipment that require uneven shapes. The lath is fastened securely to the piece of equipment by wire and pins with all loose ends fastened securely by wire.

E. ALUMINUM JACKETING

Aluminum jacketing comes in 100' rolls 36" wide. It ranges from .006 inches to .040 inches in thickness. It is obtainable in either smooth or corrugated form and with or without a vapor barrier. The advantage of using aluminum jacketing, other than another type of covering is its easy application and little maintenance necessary.

We use two different gauges here at PSP. .010 gauge is used for covering small line and .016 gauge is used for covering larger line and some vessels.

On all horizontal lines the lap should be towards the underneath side of the line to protect it from wind and rain. The lap should be about 2" on ends and on the overlap and fastened by 1/2 x 12 cadmium sheet metal screen every 6 inches or less.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-16 SUBJECT: LAYOUT WORK

The layout of the job, depends on 2 factors; the amount of material needed and type of material required.

1. The amount of material needed. This is figured in square feet on flat or curved surfaces. In measuring pipe, only the length has to be measured.

   (a) Piping - figure the length of pipe estimate the amount of valves and fittings to be covered.

   (b) Measuring areas - An insulator must be sure to figure the areas of all surfaces on pieces of equipment that are to be insulated.

      (1) To find the area of a square or retangular surface, use the formula: length times width = area (square feet).

      (2) To find the surface area of cylindrical equipment like large pipe, exchangers, or even tanks, figure the area of the sides, and the area of the ends on top.

      To find the area of the sides of cylinder shapes use the formula:

      Circumference x length = (square feet).
      To find the circumference, either measure it or figure it from the diameter using the factor 3.14, which applies to any calculation involving circles.

      Diameter times 3.14 = circumference. To find the area of a circle, like an exchanger head or tank roof, use the 3.14 factor - the radius (radius is 1/2 the diameter) times radius times 3.14 = area.

2. The coverage and type of material required:

   (a) For example, 100 pounds of high temperature insulating cement will cover 50 square feet, one inch thick.

   (b) 85% magnesia cement: 50 pounds covers approximately 29 square feet, 1" thick.

(c) All-Purpose Cement: 100 pounds covers 20 square feet 1" thick.

(d) Weatherproof Cement: Foster Hi Mastic 15 gallons will cover 100 square feet 1/4" thick.

(e) Wire: 10 pounds of 16 gauge wire will be enough to secure a layer of one-inch thick pipe covering as follows:

240' of 2" Pipe
180' of 4" Pipe
140' of 6" Pipe
120' of 8" Pipe

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-17 SUBJECT: PROCEDURES FOR APPLYING INSULATION
a. Lines
b. Pumps
c. Valves and Fittings
d. Vessels (outside)
e. Vessels (inside)
f. Heaters and Exchangers

a. PIPE STRAIGHT RUNS

Pipe straight runs can be insulated using either sectional or segmental insulation.

(1) Sectional - Pipe insulation, molded of 85% magnesia, asbestos, calcium silicate, or high temperature insulation, is made in two halves (sectional), and is performed to fit piping of many sizes. Sectional pipe insulations are molded in 3 foot lengths in the following thicknesses: 1" ("Standard thick"), 1-½", 2" ("Double standard thick"), 2-½, and also in double layers (1" or 1-½" layers), to fit standard pipe sizes. The terms "Standard thick" and "Double standard thick" apply to 85% magnesia pipe insulation. Pipe insulation is furnished in sectional form with muslin jackets glued on.

(2) Segmental - Segmental covering is also performed for specific larger sizes of pipe. Instead of being made in halves, it is made in narrower pieces, so that 3 or more pieces are needed to surround the pipe. Large size pipe covering is made this way for economical packing, and for ease of handling during installation. Segmental insulation does not come with a muslin covering. Equal segments are supplied about 5" wide along the inner arc. Odd width segments, where necessary, are furnished in the proper width to complete the circumference of the particular pipe size. Smaller pipe sizes are furnished sectional. Larger pipe sizes are fabricated from segments.

(3) Single Layer - Single layer covering, or the first layer, is fastened to the piping with wire loops. Each section or segment should be butted tight against the next section to avoid heat loss through the cracks or seam.

Any voids or cracks that are caused by breakage or rough handling, along with joints and seams, should be filled with a mud or cement made of the same material as the covering.

On flanged piping, the covering should stop far enough short of the flange that the flange bolts may be removed without damaging the insulation. The insulation should be cut to a 45° bevel at these points to facilitate opening the flanges and still getting the insulation close to the flange.

(4) Double or Multiple Layer - Multiple layers are applied when extra thickness is needed to prevent heat loss. Each layer is secured with wire loops before the next layer is applied. Joints or seams are staggered between layers, so that there will be no heat loss through cracks that extend straight from the surface of the pipe to the outside of the insulation.

To stagger the joints, apply the first layer of covering with the 36" lengths of covering. Then cut a 36" section in two and start the second layer with an 18" length. This will put the first joint of the second layer over the solid part of the first layer. Continuing the second layer with full 36" pieces will then automatically stagger all the joints.

(5) Different Materials for Different Layers - Under high temperature insulation, two layers may be made up of different insulating materials. In high temperature work, the first layer of pipe covering may be an expensive material of good resistance to heat, but not very high insulating value. If such a first layer will bring the temperature at the outside surface of the insulation down to 600° or less, then subsequent layers should be of a material like 85% magnesia which has better insulating value and is safe to use on temperatures below 600°.

(6) Wiring - Soft wire loops are fastened around sectional or performed pipe insulation to hold the insulation in place. 18 gauge wire may be used for pipes up to 1½ inches in diameter with insulation not over 1 inch thick. 16 gauge wire is used to hold coverings on pipes that are as large as 12 inches in diameter. 14 gauge wire should be used on larger pipes, and for securing segmental and block insulation to valves, vessels, and other large equipment.

At least 3 loops are applied on each 36 inch long section, on 12 inch centers. For short sections, loops are placed 2 or 3 inches from each end, with additional loops on 12 inch centers if the sections are over a foot and a half long.

For long runs of pipe covering, it is efficient to cut enough wire loops in advance to secure a large part of the covering. These wires should be cut 5 or 6 inches longer than the circumference of the insulation. They may be hung from the insulator's belt, or draped over the line that is being insulated.

An alternate method is to use wire from small coils located along the job in positions where they will not snag while being uncoiled. In this method the end of the wire is brought around the insulation before the wire is cut.

While the loop is being applied, the covering must be held firmly in place. With large diameter sections it may be necessary to have a helper hold the sections in place, or to use spring tension bands which are readily attached and are removed after the loops are secured.

To apply wire loops, place the wire around the two halves of insulation and hold the ends either in both hands or with one hand and the pliers. Twist one or two turns, making the twist snug against the covering. Do final tightening with the pliers,

making sure that both strands of the wire wind around each other to form a corkscrew spiral. (If only one strand makes a spiral and the other stays straight, the loop will be weakened and will probably break.) When all the slack is twisted out, clip the wire ends off to about 3/4 inch. Bend the twist down to lie alongside the wire loop. Hammer the twist into the insulation with the pliers so that no part protrudes from the covering.

b. PIPE ELLS

(1) Sectional or Segmental - Sectional or segmental insulation is applied to 90° ells and bends by cutting mitres from pieces of the straight pipe covering. Mitres are wedge-shaped short pieces as shown in Fig. 1. Mitred pieces should start at the beginning of the curve on bent piping, at the flange on a flanged ell, or just covering the weld on a weld ell. The pieces are butted tightly against each other until the whole bend is insulated.

To cut mitres, hold the section of covering level, with the seams at the sides. This position of the section and the seams will make cutting easiest and most accurate.

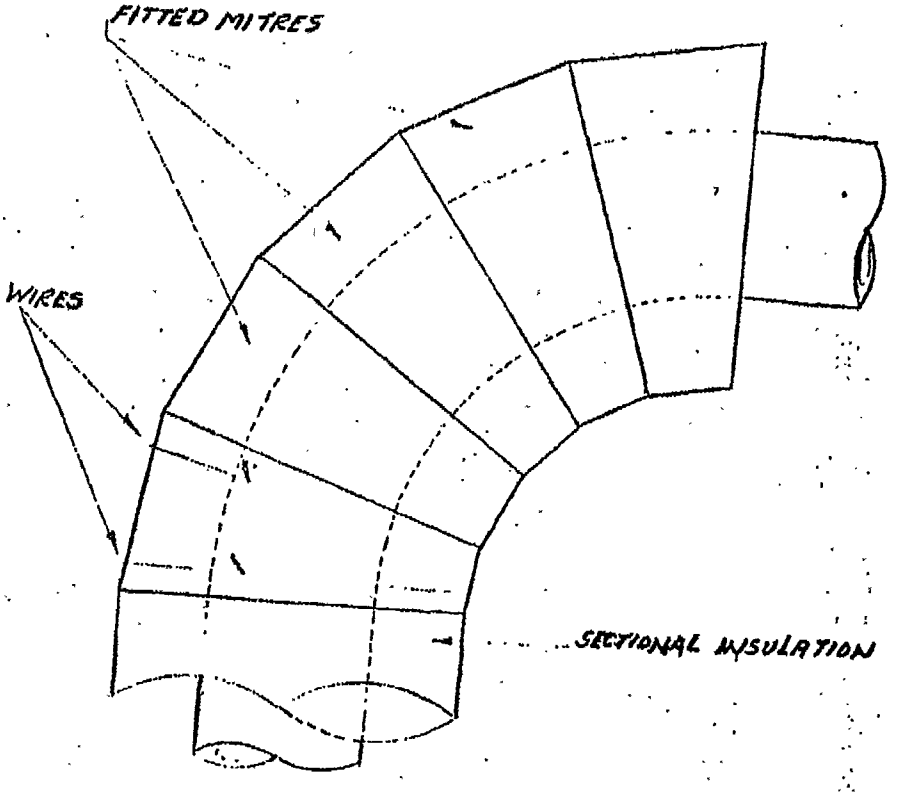


Fig. 1 Mitred Insulation on a Weld Ell

Keep the cut pairs, or halves, together to assure good fit. To keep them together, as well as to aid in cutting, leave the muslin on, or hold the section firmly closed with a couple of wire loops.

Use a sharp saw. Keeping saws sharp makes insulating work easier, cleaner, and quicker. Cut straight down through the section, so that the small edge of the mitre is at the near or far side of the section, not at the top or bottom of it. Cutting at about a 30° angle with the section gives the approximate taper needed.

Each mitre should be installed as it is cut. As each mitred pair is applied to the pipe, the insulator should observe whether a slightly larger or smaller angle should be used for the next mitre he cuts.

NOTE: If a mitre has been cut, and does not fit very well, it should be saved. It might fit elsewhere as the job progresses.

A rule of thumb in mitre cutting may be used in work on pipe up to 10 inches in diameter with covering up to 2 inches thick: Cut mitres about 3 inches wide on the outside and 1-1/4" wide at the inside. Five mitres are usually enough for a 90° ell. To cut more and thinner mitres might give closer fit, but is usually not worth the time expended. To cut more accurate mitres, consult Table A for long radius ells, and Table B for short radius ells.

Cracks or openings up to an inch wide between mitres should not be removed by re-cutting mitres, since the whole job will be covered with cement. Experience will reduce the number of poor fitting mitres.

Apply mitres to an ell at the lowest point first, if the ell is not horizontal. Butt the first mitre tight against the end of the straight section (unless the ell is flanged), with the narrow part of the mitre in the inside or throat of the bend.

Fasten the mitre snugly with a wire loop. If the mitres are large, they should each have 2 wire loops, one loop an inch from each edge of the mitre. Large diameter mitres can be held in place with temporary tension springs until the wire loops are secure.

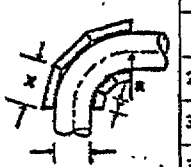
(2) Small Piping - On ells or bends for small piping (3 inches or less in diameter), insulation cement is usually applied instead of mitred sections. In such cases, the cement used must have the same insulating value as the insulation used on the rest of the piping. The cement should be applied to the same thickness as the adjacent insulation.

MITERED SEGMENT DIMENSIONS

TABLE A

PIPE SIZE	NOMINAL THICKNESS OF INSULATION 1" X	N	Y	1½" X	N	Y	2" X	N	Y	2½" X	N	Y	3" X	N	Y
3	2⅞	4	¾	3	4	½	4¾	3	⅜	4⅝	3	⅛			
3½	3⅛	4	1	3⅜	4	¾	3½	4	⅛	3¾	4	⅜	5¼	3	¼
4	2⅜	6	¾	2½	6	⅝	2¾	6	½	2⅞	6	⅜	4½	4	¼
4½	2⅝	6	⅞	2¾	6	¾	2⅞	6	⅝	3	6	½	3⅛	6	⅜
5	3	6	1	3⅛	6	⅞	3¼	6	¾	3⅜	6	⅝	3½	6	⅜
6	3½	6	1¼	3⅝	6	1⅛	3¾	6	1	3⅞	6	⅞	4	6	¾
7				4⅛	6	1⅜	4¼	6	1¼	4⅜	6	1⅛	4½	6	⅞
8				3½	8	1¼	3⅝	8	1⅛	3¾	8	1	3¾	8	⅞
9				3⅞	8	1⅜	4	8	1¼	4⅛	8	1¼	4¼	8	1⅛
10				4¼	8	1⅝	4⅜	8	1½	4½	8	1⅜	4⅝	8	1¼
11				4¾	8	1¾	4¾	8	1⅝	4⅞	8	1⅝	5	8	1½
12				5⅛	8	2	5⅛	8	1⅞	5¼	8	1¾	5⅜	8	1⅝
14				5¾	8	2½	5⅞	8	2⅜	6	8	2¼	6⅛	8	2⅛
15				6⅛	8	2⅝	6¼	8	2⅝	6⅜	8	2½	6½	8	2⅜
16				6½	8	2⅞	6⅝	8	2¾	6¾	8	2⅝	6⅞	8	2⅝
17				7	8	3	7	8	3	7⅛	8	2⅞	7¼	8	2¾
18				7⅜	8	3¼	7⅜	8	3⅛	7½	8	3	7⅝	8	3
19				7¾	8	3½	7⅞	8	3⅜	7⅞	8	3¼	8	8	3⅛
20				8⅛	8	3⅝	8¼	8	3½	8⅜	8	3½	8⅜	8	3⅜
21				8½	8	3⅞	8⅝	8	3¾	8¾	8	3⅝	8⅞	8	3½
22				8⅞	8	4	9	8	4	9⅛	8	3⅞	9¼	8	3¾
23				9¼	8	4¼	9⅜	8	4⅛	9½	8	4	9⅝	8	4
24				7¾	10	3½	7⅞	10	3½	7⅞	10	3⅜	8	10	3¼

This thickness not manufactured in size 7" or larger.



N=NUMBER OF SEGMENTS

FOR LONG RADIUS WELD ELBOWS R=1½D

FOR SHORT RADIUS WELD ELBOWS R=D

TABLE B

PIPE SIZE	NOMINAL THICKNESS OF INSULATION 1" X	N	Y	1½" X	N	Y	2" X	N	Y	2½" X	N	Y	3" X	N	Y
3															
3½	2½	4	¼	5⅜	2	⅛									
4	3¼	3	¼	6⅛	2	⅛									
4½	3	4	½	3¼	4	¼	6⅞	2	⅛						
5	3½	4	½	3⅝	4	¼	7⅜	2	⅛						
6	2⅝	6	½	2¾	6	⅜	4⅜	4	¼	9¼	2	⅛			
7				3¼	6	½	3⅜	6	¼	5¼	4	¼			
8				3⅝	6	⅝	3¾	6	½	3⅞	6	¼	8⅛	3	¼
9				3	8	½	3⅛	8	⅜	3¼	8	¼	4⅛	6	¼
10				3⅜	8	⅝	3⅜	8	½	3½	8	⅜	3⅝	8	¼
11				3⅝	8	¾	3¾	8	⅝	3¾	8	½	3⅞	8	⅜
12				3⅞	8	¾	4	8	¾	4⅛	8	⅝	4¼	8	½
14				4⅜	8	1⅛	4½	8	1	4⅝	8	⅞	4¾	8	¾
15				4¾	8	1¼	4¾	8	1⅛	4⅞	8	1	5	8	⅞
16				5	8	1¼	5⅛	8	1¼	5⅛	8	1⅛	5¼	8	1
17				5¼	8	1⅜	5⅜	8	1¼	5½	8	1¼	5⅝	8	1⅛
18				5⅝	8	1½	5⅝	8	1⅜	5¾	8	1¼	5⅞	8	1¼
19				5⅞	8	1⅝	6	8	1½	6	8	1⅜	6⅛	8	1¼
20				6⅛	8	1⅝	6¼	8	1⅝	6⅜	8	1½	6½	8	1⅜
21				6½	8	1¾	6½	8	1⅝	6⅝	8	1⅝	6¾	8	1½
22				6¾	8	1⅞	6⅞	8	1¾	7	8	1⅝	7	8	1⅝
23				7	8	2	7⅛	8	1⅞	7¼	8	1¾	7⅜	8	1⅝
24				7⅜	8	2⅛	7⅜	8	2	7½	8	1⅞	7⅝	8	1¾

This thickness not manufactured in size 7" or larger.

DIMENSIONS TO NEAREST 1/8" FOR FIELD USE ONLY.

c. INSULATING CEMENTS

(1) General - Insulating cements are used for filling and smoothing block or preformed insulation, and for insulating odd shapes.

The pointing trowel is used most often with insulating cements, but for large area jobs either the bullnose or broad trowel may be used.

The cement that is to be applied should be mixed with water to a firm enough consistency that it will hold its shape and not slump.

Insulating cements shrink as much as 20% when they dry. This tends to cause cracking. Also, when the cement dries from the outside in, there is a tendency for it to crack and curl away from the equipment. These difficulties are reduced when cements are applied to bare fittings and equipment that are hot or warm at the time the cement is applied. Heat in the equipment causes the adhesive binders in the cement to adhere more firmly to it. The hot surface also causes the cement to dry from the inside out, eliminating the likelihood of "curling".

When insulating cements are used to fill cracks and voids in solid insulation, the cement should be applied and smoothed out quickly. This is necessary because the moisture in the cement is absorbed by the solid insulation, making the cement unworkable in a short time.

For large areas, like vessels, drums, towers, and ducts, that are covered with block or segmental insulation, wire mesh should be applied to serve as an anchor for the cement. 19 or 20 gauge galvanized 1 inch mesh wire should be fastened securely over the whole insulated surface before the cement is applied.

Because cements tend to shrink and crack, it is better to apply two 3/4 inch layers than one 1½ inch layer. After one thin layer has been applied and allowed to dry thoroughly, surface cracks should be filled and the surface scored with the edge of the trowel to promote adhesion of the next layer. If the cement is to be more than 1½ inches thick, a layer of wire mesh or expanded metal lath should be applied over every 1½ inches of cement.

The irregular shape of such equipment as pumps, turbines, and valves makes it necessary to use cements for the entire thickness of the insulation. Small scraps of solid insulation may be embedded in the cement to add bulk and to hasten drying. This method was discussed in Item B-1b (2) (See figure 2). Figure 3 shows the same technique where sectional insulation is stopped at a pipe hanger.

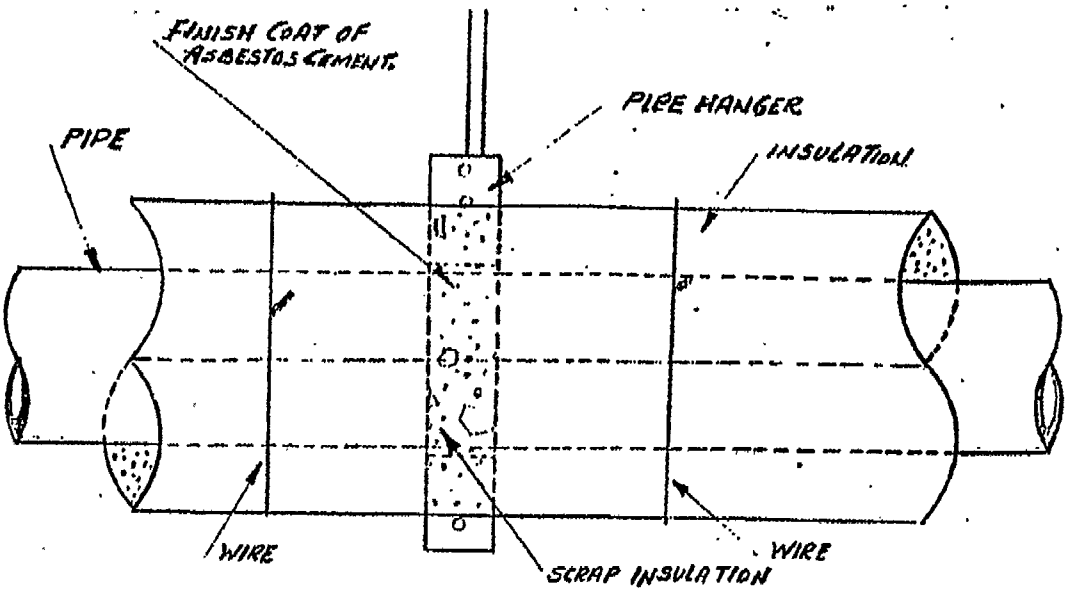


Figure No. 3

Each layer of cement should be dry before the next layer is applied. If the second layer is applied too soon, the whole mass may soften and fall off. When the job must be completed before the first layer has dried fully, a few wraps of asbestos or jute twine may be used to hold the first layer together.

The final coat of cement should be troweled smooth. The smooth surface is especially important when it is the foundation for such finish coatings as paint, weatherproofing cement or aluminum jacketing.

(2) Applying Acid Proof Insulating Cement - When applying acid proof cement, first clean the hexsteel or floor-steel lining. Chip off slag or excess weld metal. Clean off oil, grease, and dirt with steam or hot water. Let dry thoroughly.

Do not prepare more cement than can be applied in 20 or 30 minutes, as it sets up quickly. Place the sodium silicate solution in the mixing container. Gradually add the dry cement and stir thoroughly. Stir until the mixture is free from any dry or unmixed cement. Continue adding powder to form a thick heavy mortar. If the mortar will very slowly slide off the face of a trowel that is turned on its side, the mortar is thick enough. The mix should be about one 50 pound bag of cement to one 2 1/2 gallon can of sodium silicate. Never add any water to this mix.

NOTE: When a large amount of cement is to be mixed, it is helpful to use a 5 x 5 inch blade steel mixing paddle mounted in a low speed drill. This will make mixing easy in a bucket of 14 quart capacity.

Apply the cement with a 6 inch pointing trowel. Start at the center of each area and work toward the edges. This helps to eliminate air pockets or voids under the cement.

Apply the full thickness of cement in one coat. Never try to apply a second layer. Firmly press the mix into each opening of the hexsteel or grating. Be sure each opening is completely filled, flush with the surface of the grating. Do not apply any cement above the surface of the grating. The grating and the cement should be smooth and flush.

NOTE: If any excess of cement is allowed to overlay the steel, it will eventually flake off in hard chips.

NOTE: Once the mortar is applied, do not go over it. The mortar sets quickly, and trying to rework it will cause it to stick to the trowel and be dragged out of shape.

After the mortar has become stiff, but not completely hard, brush the surface lightly with sodium silicate solution. Use a trowel to smooth the surface to a glazed finish, and to push back sags in the grating.

d. PUMPS AND FLANGED VALVES

(1) Pumps - Pump bodies are usually insulated with cements rather than block or preformed insulation. This is because of the irregular shape of the equipment, and because pump castings usually have no securement anchors for the wires needed to hold block insulation in place.

Have some heat in the pump, if possible. Cements applied to warm or hot equipment stick better and crack and curl less than on cold metal. The heat also reduces the drying time between application.

Make the cement a little thicker or dryer than cement that is applied over solid insulation, as metal does not absorb moisture from the wet cement. The less water in the cement, the quicker it dries and the less it shrinks.

Apply cement to pump body by hand, applying it in the form of small balls to cover the surface. Do not let the balls exceed 3/4 inch thickness after they are pressed into position. Small pieces of scrap insulation may be embedded in this layer. Cover entire pump this way, but do not cover flanges, the area next to flanges, areas near studs that may need to be removed, drain plugs, or manufacturer's tags with important information. Where there are flanges, measure the length of the bolts and stop the

insulation that distance from the flange.

After the rough spotting of insulation is done, let the cement dry before applying more layers. Trowel on the next layer of cement. Do not let the total thickness of cement on the pump exceed 1½ inches in this step.

If the pump requires more than 1½ inches of insulation, fit and embed wire mesh into the surface of this troweled coat, and let the cement dry thoroughly. Build up required thickness in 3/4 inch layers, letting each one dry before applying the next.

Apply wire mesh on every 1½ inch thickness.

Use Portland cement in the final layer of cement.

NOTE: If pump is outdoors, apply a ½ inch layer weatherproofing cement instead of the Portland cement mixture.

Insulate flanges after all layers have been applied to the pump body. By insulating the pump completely, before the flanges, the flange insulation overlaps the pump covering and can later be torn off as necessary without damaging the unit of insulation on the pump body.

Cover the flange with small lumps of cement, and finish the same as the body of the pump.

If possible to use block or segmental insulation on flanges, fit and apply block on the outside circumference of the flange 1/2 inch less in thickness than the covering on the pump body.

Have the flange covering extend at least 2 inches over the adjacent covering of the pump casting or piping.

After block is wired in place, trowel on the required cement layers to smooth finish.

Apply aluminum jacket, if required.

(2) Flanged Valves

(a) Insulating End Flanges and Body - Use sectional or segmental insulation the size of the flanges, if available, or use block insulation. Cut the sections, segments, or blocks to a length that will extend over both end flanges, plus a distance to overlap the adjacent pipe insulation. Make the length of the overlap equal to the thickness of the insulation, but never less than 2 inches.

When using sectional insulation, have the 2 seams parallel to the valve stem. That way an equal amount will have to be cut away from each half for fitting around the bonnet, and a better fit will be made. If overlap lies against pipe

covering, apply wire loops an inch from the end of the valve covering. If there is a space between the pipe covering and the overlap, place temporary loops around the flange area. Fill in the space between the pipe covering and flange covering with insulating cement and let dry.

Tighten and secure the insulation with loops an inch from the end of the overlap. See figure 4.

NOTE: If block insulation is used, score it to make it conform as closely as possible to the flanges and valve body.

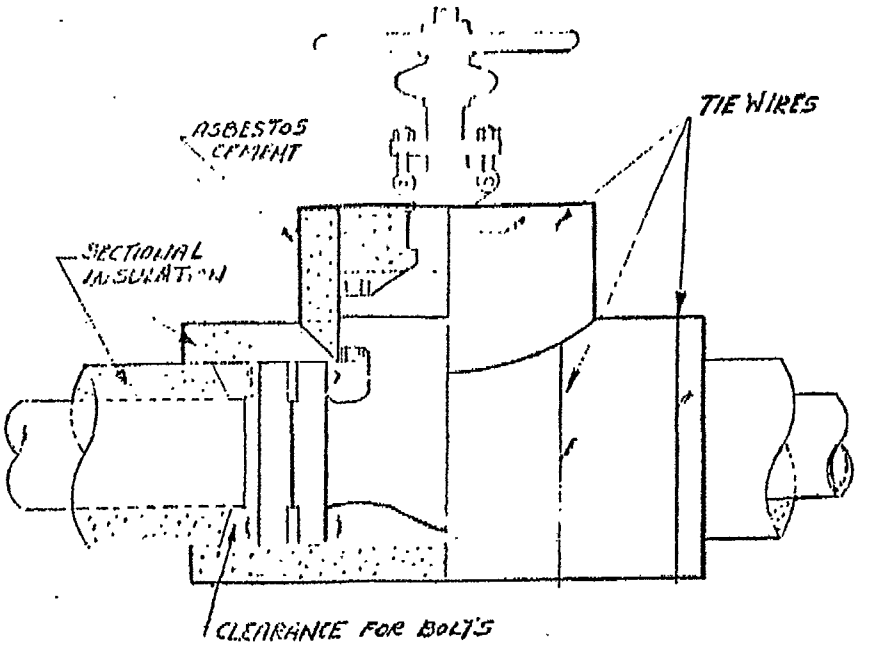


Figure No. 4

(b) Insulating Bonnet Flange and Bonnet - Fit with pre-formed insulation for the size of the flange, or use scored block insulation. Bonnet flanges are usually the same size as the end flanges.

Use tension springs to hold pieces in place during cutting and fitting.

Cut insulation to fit tightly over the curve of the insulation on the flange body.

Let insulation extend above flange studs a distance equal to the thickness of the insulation, but do not let it extend above packing gland.

Hold insulation in place temporarily with a hand-tight wire loop around the bonnet flange, and another loose loop near the top and bottom.

Fill the space between the insulation and the bonnet with small pieces of scrap insulation and cement. Let dry.

Tighten and secure wire loops.

Fill voids and cracks with insulating cement.

Apply a rough coat of insulating cement on entire valve covering, not over 1/4 inch thick.

Let dry and follow with specified finish coat.

e. EXCHANGERS AND VESSELS

(1) Block Insulation - Block insulation is used mostly on large vessels, drums, ducts, and on piping that is over 12 inches in diameter.

Block insulation is made with straight flat surfaces and it comes in several dimensions. In refinery work, the most common size is 36 inches long, 6 inches wide, and 1, 1½, 2, or 2½ inches thick.

Blocks for curved surfaces should be cut, mitred, or scored and bent, to fit snugly. Tension springs or heavy rubber strips around the vessel or pipe are used to hold blocks in place until the whole surface is covered. The last block inserted should fit very loosely, so that when the wire loop is tightened it will be able to pull all the blocks snug up against the vessel. When all the blocks are in position, they are secured by wire bands or loops on 9 or 12 inch centers, as specified.

When multiple layers are required, the joints of successive layers are staggered. To do this the first round of block alternates between full length and half length blocks. The first layer is then continued with all 36 inch high lengths. The second layer is started the same way, with alternate full and half lengths, but the blocks are centered over the seams in the first layer.

(a) Insulating Drum and Vessel Heads - The ends of an exchanger, vessel, or drum are insulated the same as the sides of the equipment. The main problem with exchanger heads, etc., is securement of the insulation.

Supports for securement wires are installed in the form of small lugs, clips or wire rings. These are welded to the vessel, and wires are attached to them to hold the blocks in position against the surface. The wires are criss-crossed or laced over the blocks to hold them in place.

(i) Drum Heads - For boiler drum heads, securement lugs are welded on 12 inch centers over the entire head.

A ring of 9 gauge wire is tack welded around the manway. It should be tacked about 3 inches out from the outside diameter of the manway.

Securement wires are attached to the lugs and to the ring.

Since drum heads are slightly convex, the best fitting of blocks is accomplished by scoring the blocks crosswise so they will bend easily. Applying fibrous insulation adhesive to the blocks will give temporary securement and make fitting easier.

After all block is secured with the wires that run from the lugs and wire ring, hairpin wires are applied if mesh is going to be put on the insulation.

Voids are filled with scrap and cement. The entire surface is cement coated and wire mesh is applied.

Where mesh is cut away for the manway, the edges of the mesh are secured with tie-wires from the wire ring. Sharp edges of mesh are hammered down with staples.

Mesh at the edge of the drum head is cut to conform to the circumference of the drum, and is laced or wired to the mesh on the side of the drum.

(ii) Exchanger Heads - Flat exchanger heads have a row of bolts around the edge. The area of the bolts is usually not insulated.

NOTE: Convex heads are insulated with cements, covered with wire mesh, and secured by a wire loop around the base of the installation.

When a flat exchanger head is to be insulated, a wire loop or ring is tack welded around the head, $1\frac{1}{2}$ inches inside the studs. The loop is tacked down about every 5 inches. Tie wires are attached to the loop on about 6 inch centers. Enough tie wire should be attached to secure the required number of layers of blocks.

(2) Roll Insulation - Exchangers and vessels can sometimes be insulated with roll (blanket) insulation: Regular fiber glass insulation for equipment up to 250°F., and fiber glass T.W.F. thermal wool for equipment up to 1000°F. These products come in rolls 4 feet wide and up to 520 inches long.

To insulate an exchanger with fiber glass, wrap the insulation around the exchanger with the ends at the top, over lapping 3 inches. Making sure the insulation is pulled snug against the metal, tie on with jute twine; tie twine 2 inches in from edges, and then about every 9 inches along the entire length of the exchanger.

NOTE: The twine must not be tight enough to make deep grooves or creases in the insulation as that compresses it and reduces its insulating value.

After exchanger is completed covered with the fiber glass, wire mesh is applied. Cut the wire mesh 3 inches shorter than the circumference of the exchanger. Using 48 gauge galvanized wire, saw ends together pulling the wire mesh tight. Apply the next section of wire mesh leaving 3 inches between the edges of the sections. Sew the edges together using 48 gauge galvanized wire.

After all wire mesh has been put on, apply one coat of the specified insulating cement. After the cement is dry, apply a coat of weatherproofing mastic.

f. BREECHINGS

For the outside of breechings, have studs, clips, or 9 gauge annealed impaling wires welded on staggered centers as follows:

Vertical sides	18 inch centers
Top	24 inch centers
Bottom	12 inch centers

For the inside of breechings

Vertical sides	18 inch centers
Top	12 inch centers
Floor	24 inch centers

If impaling wires are not used, attach the needed number of lacing wires to the clips.

Apply block or blanket insulation to side, top, and bottom. Hold block in place temporarily with fibrous adhesives. If lacing wires are used, secure each layer of block or blanket as it is applied.

If impaling wires are used, let them protrude through all layers of insulation. Press the insulation firmly down around the impaling wires, and with pliers bend the wires at the surface of insulation. Bend wires to a right angle so they lie flat against the insulation. Bend two out of every three wires, leaving the remaining wires to secure the wire mesh and insulation at the same time.

NOTE: An alternate method is to bend all impaling wires against the insulation. Mesh is then secured with short lengths of lacing wire that are passed under the bent impaling wires before cements are applied.

Fill voids and apply a rough coat of insulating cement. Let dry.

Apply and secure wire mesh, lacing all adjoining seams together.

NOTE: On the inside of breechings, floor and overhead mesh is installed separately from wall mesh. The mesh is then laced together.

On the outside of breechings, apply a $\frac{1}{4}$ inch wet coat of waterproofing cement over the mesh.

On the inside of breechings, apply a $1\frac{1}{2}$ inch layer of semi-refractory insulating cement. This will protect the blocks from abrasion due to erosive particles passing through the breeching. Follow manufacturer's instructions for mixing semi-refractory cements. Be sure to trowel the surface smooth.

g. COLD INSULATION

Cold lines that are likely to sweat should be out of service while being insulated, if possible. This is to keep the line from being cold enough to attract moisture which might then be trapped inside the insulation and damage it. Whether a cold line is in use or not, it should be wiped dry before the Foamglas (or Styrofoam) is applied. The cold system should not be put into operation until the whole insulating job is completed, including its vapor barrier and outside coverings.

(1) Applying Foamglas - Foamglas can be used on equipment getting as cold as -450°F. Apply the Foamglas to the clean surface of the pipe. Butter the joints with a permanent mastic type sealer (Foster Foam Seal). Making sure the joints are tightly butted, secure the insulation with metal bands on 9 inch centers. In multi-layer applications where temperature of piping is below the recommended range of the sealer, seal only the outer layer.

(2) Applying the Vapor Barrier - Since it is essential to keep moisture out of the Foamglas insulation, and since cold lines attract moisture, it is necessary to apply a vapor barrier over the insulation. In the refinery, we use a fiber impregnated asphalt cutback called Pittcote 300c as a vapor barrier.

Insulation shall first be tack coated with Pittcote using about 2 gallons per 100 sq. ft. Into this, a layer of asphalt impregnated glass cloth shall be embedded over-lapping all ends. Then another coating of about 4 gallons per 100 square feet of Pittcote is applied. Aluminum jacketing is then applied over the insulation (See item B-1h(2)).

(3) Fitting Insulation - Fitting insulation shall be applied in the same manner as adjacent pipe insulation with sufficient bands to hold it in place. Where it is impractical to finish fittings the same as adjoining pipe insulation, fittings may be finished with glass fabric and Pittcote and then painted to match the jacket covering.

DIMENSIONS FOR MITERED SEGMENTS FOR SHORT RADIUS ELLS BASED ON PABCO PIPE INSULATION ACTUAL THICKNESS

Nominal Insulation Thicknesses

Pipe Size	1"				1½"				2"				2½"			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
3"	3	3 1/32	1/8	2.22	—	—	—	—	—	—	—	—	—	—	—	—
3½"	3	3 5/16	1/8	2.00	—	—	—	—	—	—	—	—	—	—	—	—
4"	3	3 15/16	3/16	1.66	2	6½	1/8	1.66	—	—	—	—	—	—	—	—
4½"	4	3 3/4	3/32	1.50	3	4 23/32	3/16	1.50	—	—	—	—	—	—	—	—
5"	4	3½	1/16	1.33	4	3 29/32	1/4	1.33	3	5 9/32	1/16	1.33	—	—	—	—
6"	6	2 29/32	1/16	1.11	6	2 29/32	5/16	1.11	4	4½	1/4	1.11	3	6 3/8	1/16	1.11
7"	—	—	—	—	6	3¼	7/16	1.00	6	3 3/8	5/16	1.00	4	5 5/8	1/4	1.00
8"	—	—	—	—	6	3 29/32	9/16	.88	6	3 11/16	7/16	.88	6	3 31/32	1/4	.88
9"	—	—	—	—	8	3½	½	.75	8	3½	3/8	.75	8	3¼	5/16	.75
10"	—	—	—	—	8	3 3/8	17/32	.66	8	3 15/32	½	.66	8	3 1/16	13/32	.66
11"	—	—	—	—	8	3 5/8	9/16	.66	8	3¾	17/32	.66	8	3 11/16	½	.66
12"	—	—	—	—	8	3 15/16	9/16	.58	8	4 1/32	9/16	.58	8	4 1/8	17/32	.58
14"	—	—	—	—	8	4 7/16	13/16	.50	8	4 9/16	11/16	.50	8	4 11/16	5/8	.50
16"	—	—	—	—	8	5	1¼	.41	8	5 1/16	13/16	.41	8	5 1/16	1 1/8	.41
18"	—	—	—	—	8	5 5/8	1½	.33	8	5 11/16	1 3/8	.33	8	5 3/4	1¼	.33
20"	—	—	—	—	8	6 1/8	1 5/8	.28	8	6¼	1 5/8	.28	8	6 3/8	1½	.28
22"	—	—	—	—	8	6¾	1 7/8	.28	8	6 7/8	1¾	.28	8	7	1 5/8	.28
24"	—	—	—	—	8	7 3/8	2 1/8	.25	8	7 3/8	2	.25	8	7½	1 7/8	.25

Pipe Size	3"				3½"				4"				4½"				5"			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
8"	8	8 5/16	1 1/2	.88	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9"	6	4 15/32	1/4	.75	6	4 5/8	3/32	.75	—	—	—	—	—	—	—	—	—	—	—	—
10"	8	3 31/32	3/32	.66	8	3¾	3/32	.66	8	3 7/8	1/8	.66	—	—	—	—	—	—	—	—
11"	8	3 31/32	3/8	.66	8	4	3/32	.66	8	4 1/8	3/16	.66	8	4 7/32	1/8	.66	—	—	—	—
12"	8	4 7/32	½	.58	8	4 1/16	1 3/32	.58	8	4 1/8	3/16	.58	8	4 17/32	3/16	.58	8	4 5/8	1/8	.58
14"	8	4 13/16	11/16	.50	8	4 15/16	1 1/16	.50	8	5 1/16	3/16	.50	8	5 5/16	7/16	.50	—	—	—	—
16"	8	5 1/4	1	.41	8	5 5/16	1 1/16	.41	—	—	—	—	—	—	—	—	—	—	—	—
18"	8	5 7/8	1¼	.37																
20"	8	6½	1 3/8	.29																
22"	8	7	1 5/8	.29																
24"	8	7 5/8	1¾	.20																

A = Number of Miters

B = Greater Dimension of outside face of pipe insulation

C = Lesser or throat dimension on outside face of pipe insulation

D = Number of short radius ells available from a linear foot of pipe insulation, based on alternating the cuts and allowing for saw kerf and waste

Dimensions are to nearest 1/32"

TEXACO INC.
PUGET SOUND PLANT
TRAINING DETAILS

DATE: APRIL 5, 1973

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-18 SUBJECT: PROCEDURES FOR PAINTING INSULATING COVERING

Refer to Item B-19 Paragraph 'C'.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-19 SUBJECT: PROCEDURES FOR APPLYING EROSION AND CORROSION PROTECTION TO INSULATION
a. Acid proof cements
b. Refractory cements
c. Weatherproofing

A. Acid Proof Cement - refer to item 19 Acid Proof Cement

B. Refactory Cements - refer to Carpenter Manual Item 26.

C. Weatherproofing

Since insulating cements soften when wet, it is necessary to protect insulation against moisture when it is outdoors or subject to getting wet. Normal exposure to the weather is controlled by weatherproofing cements and aluminum jacketing.

H.I. Mastic - the only type of weatherproofing cement used in the plant is an asphalt emulsion called H.I. Mastic #90-07. The mastic is applied to ells and fittings where it is impractical to apply aluminum jacketing.

The mastic is applied to the cement surface and then wrapped with a fiberglass bandage, another layer of mastic is applied about 1/4" thick and then smoothed down with a wet paint brush.

Before applying the mastic be sure that the insulation cement is dry.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-20 SUBJECT: PROCEDURES FOR CONCRETE FINISHING

Refer to Carpenter's Manual Item B-8.

DEPARTMENT: INSULATION
CLASSIFICATION: INSULATOR (TRAINEE)

ITEM NO. B-21 SUBJECT: PROCEDURES FOR REPAIRING FURNACES

a. GLOSSARY OF TERMS COMMONLY USED IN THE REFRACTORIES INDUSTRY

(1) Abrasion - The wearing away of a material at its surface through the cutting action of solids. Refractories are often subjected to the abrasive action of moving charges (such as lumps of lime in a vertical lime kiln), dust laden gases, or tools used for charging or cleaning.

(2) Batter - A slope of the face of a wall, usually causing a diminution of thickness as the wall ascends; the angle at which a face of a wall slopes from the vertical.

(3) British Thermal Unit - The amount of heat required to raise the temperature of one pound of water one degree fahrenheit.

(4) Calcination - An industrial heat treatment to which many rocks or mineral substances are subjected, mainly for the purpose of effecting dissociation, and driving off some constituent in the form of a gas. A familiar example is the calcination of limestone which in the process, loses weight and is converted into lime, through loss of carbon dioxide. Clays are calcined not only for the purpose of driving off combined water, but also to effect shrinkage.

(5) Cold Set - The hardening or "setting" of a mortar material which takes place merely upon drying. Bonding mortars containing agents which give them greater strength after drying than is obtainable with a clay or other refractory base alone are said to be cold setting.

(6) Corbel - An arrangement of brick in a wall in which each course of brick projects beyond the course immediately below it.

(7) Corrosion - Gradual wearing away of a solid body through chemical action, as the rusting of iron. Corrosion of furnace linings through chemical attack by gases, slags, coal ash, or other fluxes, occurs in many types of furnace practice.

(8) Course - A layer or row of brick as built into a furnace structure.

(9) Density - The mass of a unit volume of a substance. It is usually expressed either in grams per cubic centimeter, or in pounds per cubic foot.

(10) Devitrification - The change in a solid body from a glassy state to a crystalline condition.

(11) Erosion - Wearing away of a solid through abrasion or corrosion, or through removal of loosened particles by the action of a moving gas, liquid or solid. In furnace practice, the blowing away by the furnace gases, or washing away by a slag or molten bath, of loosened particles of refractory material from the lining, is called erosion. The sand blast action of dust-laden gases moving at high velocity is an example of erosion caused by abrasion. The washing away of grog particles from a brick by a molten slag, after the bond of the brick has been weakened by chemical attack, illustrates erosion resulting from corrosion.

(12) Fusion - A state of fluidity or flowing, in consequence of heat; the softening of a solid body, either through heat alone or through heat and the action of a flux, to such a degree that it will no longer support its own weight, but will slump or flow. Also the union or blending of materials, such as metals, upon melting, with the formation of alloys.

(13) Fusion Point - The temperature at which fusion takes place. Most refractory materials have no definite fusion point, as they soften gradually over a relatively wide range of temperatures.

(14) Grog - Non-plastic material, frequently precalcined, added to a brick or mortar batch to reduce shrinkage in drying and firing.

(15) Header and Header Course - A header is a brick laid with its length perpendicular to the face of a wall. A header course is a course of brick laid in this manner.

(16) Jamb - An upright structural member forming the side of an opening in a furnace wall.

(17) Lintel - A one-piece horizontal structural member spanning an opening in a furnace wall and usually supporting a superstructure.

(18) Mortar (Refractory) - A finely ground refractory material which becomes plastic when mixed with water, and is suitable for use in laying refractory brick.

(19) Nine-Inch Equivalent - A brick volume equal to that of a standard 9" x 4 ½" x 2½" straight brick; the unit of measurement of brick quantities in the refractories industry.

(20) Spalling - The loss of fragments (spalls) from the face of a refractory structure, through cracking and rupture, with exposure of inner portions of the original refractory mass.

(21) Stretcher - A brick laid on flat with its length parallel to the face of the wall.

b. CONSTRUCTION BRICK MORTAR

The amounts of the ingredients used in brick mortar can be varied depending on the job being performed. For brickwork in non-bearing walls with average loads and exposure, use 1 volume of Portland cement, 1 volume of hydrated lime, and 5 volumes of loose mortar sand.

For bearing walls or walls requiring extra strength, use 1 volume of Portland cement, ¼ volume of line, and 3 volumes of sand.

Place the sand in the mortar box. Spread the cement and lime evenly over the sand. Turn the material over with a square shovel until the mix has an even uniform color. Add a little water, and hoe the mixture. Add just enough water to mix the mortar into a workable plastic mass. Mix the mortar thoroughly to make a smooth mortar. Extra stirring will improve the consistency of the mortar without the addition of water.

NOTE: Do not mix more mortar at one time than can be used before it stiffens. If stiffening mortar can not be restored to workable consistency without adding water, it must be discarded.

c. CONSTRUCTION BRICKWORK REPAIR

When making brickwork repairs, the area to be repaired must be cleared of old mortar. Scratch out any loose mortar from the joints. Wet the area with a wet stiff brush, at the same time brushing out any powdered mortar.

Mix mortar of 1 part cement, 1 part lime, and 6 parts sand, with just enough water to make the mixture workable.

Slice off a small amount of mortar with a pointing trowel.

First into the vertical joints and then into the horizontal joints, strike or press the mortar into place with the edge of the trowel, pressing with a downward and then outward motion.

When the mortar has become firm, strike the joints again to compress the mortar, using the same pattern: first the vertical joints, then the horizontal joints. At the same time, press the trowel into the surface of the joint to make it slightly concave..

d. THERMAL MORTARS

(1) Fire Clay - Fire clay can sometimes be used when the temperatures involved are not too great, and when resistance to abrasion is not an important consideration.

Put some water into a mixing through or pan. Pour in dry clay at the edge of the pan or the end of the through, stirring it into the water. Add clay, and stir out any lumps, until a heavy troweling texture is obtained.

If leftover clay mixture is to be used in the next few days, pour a thin layer of water over the top of the mixture. When ready to use it, pour off the water and remix. If the mixture is too thin, add more dry clay and stir. If the need for clay is known a day in advance, mix an extra firm batch of the mortar cover with water, and let stand overnight. This practice makes the mortar smoother and more adhesive.

(2) Ganister - Ganister is a mortar made by mixing ground fire brick with fire clay in order to give the clay more body. It is used for patch work in furnaces.

Mix with water to a heavy putty-like consistency. Use just enough water to permit the mix to be troweled or rammed into the voids.

NOTE: Excessive water will result in excessive shrinkage of the mortar as it dries.

(3) Fire Brick and Insulating Fire Brick Mortar - In the refinery, two kinds of fire brick mortar are commonly used. These are Babcock and Wilcox Mulset, and H.W. Harwaco Bond. These mortars are essentially the same material as the brick, but finely ground. They are mixed with water until a troweling consistency is obtained.

NOTE: Portland cement, lime, and other additives should not be used in thermal mortars as they reduce the mortar's resistance to abrasion, heat, slag, and corrosion.

e. REFRACTORY CASTABLES

(1) General - There are many kinds of refractory castables used in the refinery depending on the particular job to be done (See Item A-10d (5)). These castables come in dry form and are mixed with water to the proper consistency. They can be applied by either gunning or troweling.

The material should be thoroughly dry mixed before adding water to ensure a uniform distribution of the ingredients. After the proper amount of water has been added, thorough mixing should again be carried out because the initial dry strength of the refractory depends on the action of water with the hydraulic binder. Over-mixing should be avoided as it affects the strength and characteristics of the castable.

The mortar box or concrete mixer should be carefully cleaned of old concrete and any foreign material. It should be wetted down to prevent loss of moisture from the mix. Do not prepare too large of a batch at one time. Generally, the maximum amount should be one that can be applied within 1/2 hour after mixing.

In certain lines, boilers, furnaces, vessels and any place where there is a need for high insulating value along with resistance to abrasion, a dense castable is sometimes applied over a layer of insulating castable. The insulating material is applied approximately 1½ inches thick before hex metal or expanded metal lath is welded to studs which have been attached to the metal surface. Then the dense castable is troweled or gunned into the hex metal or other reinforcement material that is used. The dense castable is applied flush with the top of the hex metal. Any material that is above the hex metal will flake off during the operation of the equipment.

f. PLASTIC REFRACTORIES

Plastic Refractories are refractory materials prepared in a stiff plastic condition of the proper consistency for use without further preparation. Various grades are supplied commercially, corresponding in compositon to high-duty and superduty fireclay brick, high-alumina brick, and chrome brick. Most grades of plastic refractories are supplied in both heat-setting and air-setting forms. They are applied to form monolithic or joint-free furnace linings in new construction, or to repair existing refractory masonry.

Plastic refractories are generally rammed on with the use of a pneumatic hammer, although in certain applications they are pounded into position using a mallet. In some applications, such as arches, rigid forms must be used to achieve the deisred contour. In patch work, the surface should be cleaned thoroughly before the plastic refractory is applied. Because of the many types of plastic refractories available, manufacturer's specifications should be referred to for application details.

g. STANDARD REFRACTORY BRICK SHAPES

The following brick shapes have been generally adopted by fire-brick manufacturers as standard shapes for brick which are molded to size and cannot be machined easily. They are used either alone or in combination as shown in the tables.

However, since insulating fire brick are readily machined to exact dimensions, it is common practice to furnish them "tailer-made" to fit any specified arch or curved wall and also eliminates the necessity for handling a number of different shapes. In the event that standard shapes are desired, the following tables give sizes and combinations of standard shapes to turn circles of various diameters.

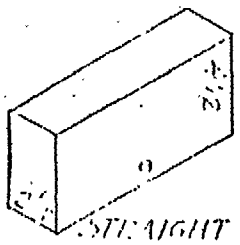
Number of 9" Straight Brick per Sq. Ft.

Thickness of Wall	Number of Brick
2¼ Inches	3.6
4½ "	6.3
9 "	12.3

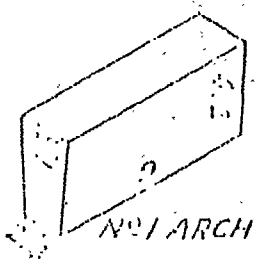
No. of 9" Straight Brick per sq. ft. 17.07

9" Straight Brick--2½" Series

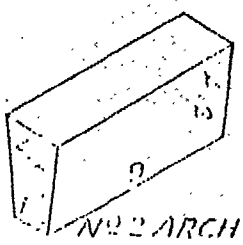
To calculate number of 9" Straight Brick needed for walls of other thicknesses, use multiples of the figures given in the table at the left. These same quantities can be used on curved walls by using the outside dimensions of the walls.



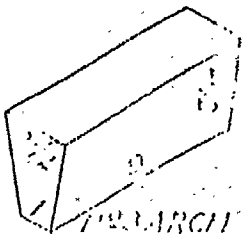
STRAIGHT
9"x2½"x4½"



9"x(4½"-2⅛")x(2½"-2⅛")



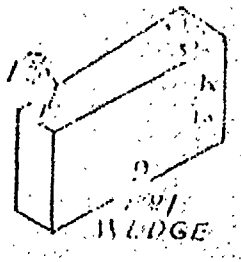
9"x4½"x(2½"-1⅜")



9"x4½"x(3½"-1")

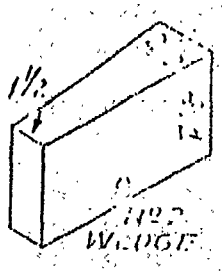
9" Arch Brick--2½" Series

Inside Diameter	Number Required: No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	Total	Inside Diameter	Number Required: No. 3 Arch	No. 2 Arch	No. 1 Arch	Straight	% Waste
0 ft. 0 in.	19				19	7 ft. 6 in.			56	11	
1 ft. 0 in.	12	15			27	8 ft. 0 in.			76	57	
1 ft. 6 in.	4	20			24	8 ft. 6 in.					
1 ft. 9 in.		21				9 ft. 0 in.			26		
2 ft. 0 in.		14	8		22	9 ft. 6 in.			56		
2 ft. 6 in.		26	23		49	10 ft. 0 in.			76	17	
3 ft. 0 in.		19	38		57	10 ft. 6 in.			56		
3 ft. 6 in.		11	52		63	11 ft. 0 in.			76		
4 ft. 0 in.		4	63		67	11 ft. 6 in.					
4 ft. 6 in.			76	1	77	12 ft. 0 in.			75	117	
5 ft. 0 in.			76	11	87	12 ft. 6 in.			56		
5 ft. 6 in.			76	19		13 ft. 0 in.			76		
6 ft. 0 in.			76	32	108	13 ft. 6 in.			75		
6 ft. 6 in.			76	34	110	14 ft. 0 in.			76		
7 ft. 0 in.			76	41	117	14 ft. 6 in.			76	171	



No. 1 Wedge
9"x4½"x(2½"–1⅝")

No. 2 Wedge
9"x4½"x(2½"–1⅝")

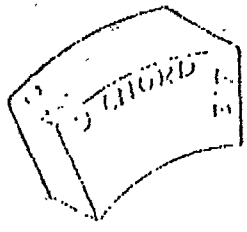


9" Wedge Brick (3⅜" Series)

Diameter	Number Required: No. 2 Wedge	No. 1 Wedge	Straight	Total
2 ft. 3 in.	57			57
2 ft. 6 in.	49	11		60
3 ft. 0 in.	38	30		68
3 ft. 6 in.	26	50		76
4 ft. 0 in.	12	71		83
4 ft. 6 in.		91		91
5 ft. 0 in.		91	8	99
5 ft. 6 in.		91	15	106
6 ft. 0 in.		91	23	114
6 ft. 6 in.		91	30	121
7 ft. 0 in.		91	38	129
7 ft. 6 in.		91	45	136
8 ft. 0 in.		91	53	144
8 ft. 6 in.		91	60	151
9 ft. 0 in.		91	68	159
9 ft. 6 in.		91	76	167
10 ft. 0 in.		91	83	174
10 ft. 6 in.		91	91	182
11 ft. 0 in.		91	98	189
11 ft. 6 in.		91	106	197
12 ft. 0 in.		91	113	204
12 ft. 6 in.		91	121	212
13 ft. 0 in.		91	129	220
13 ft. 6 in.		91	136	227

Inside Diameter	Number Required: No. 2 Wedge	No. 1 Wedge	Straight	Total
14 ft. 0 in.		91	144	235
14 ft. 6 in.		91	151	242
15 ft. 0 in.		91	159	250
15 ft. 6 in.		91	166	257
16 ft. 0 in.		91	174	265
16 ft. 6 in.		91	181	272
17 ft. 0 in.		91	189	280
17 ft. 6 in.		91	196	287
18 ft. 0 in.		91	204	295
18 ft. 6 in.		91	211	302
19 ft. 0 in.		91	219	310
19 ft. 6 in.		91	227	317
20 ft. 0 in.		91	234	325
20 ft. 6 in.		91	242	333
21 ft. 0 in.		91	249	340
21 ft. 6 in.		91	257	348
22 ft. 0 in.		91	264	355
22 ft. 6 in.		91	272	363
23 ft. 0 in.		91	279	370
23 ft. 6 in.		91	287	378
24 ft. 0 in.		91	294	385
24 ft. 6 in.		91	302	393
25 ft. 0 in.		91	309	400

The above table may be used also for 9" x 6⅜" x 2⅝" Wedges and Straights.

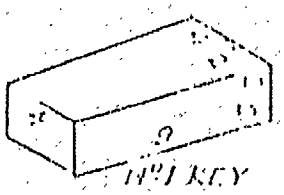


Circle
9"x4½"x2½"

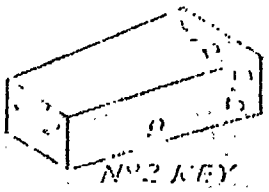
9" Circle Brick
(Table can be used for both 3⅜" and 3" Series)

Diameter	22" Circle	21" Circle	20" Circle	19" Circle	18" Circle	Total
2 ft. 0 in.	12					12
2 ft. 3 in.	9	4				13
2 ft. 6 in.	6	5				11
2 ft. 9 in.	3	12				15
3 ft. 0 in.		14				14
3 ft. 3 in.		11	6			17
3 ft. 6 in.		7	11			18
3 ft. 9 in.		3	16			19
4 ft. 0 in.			20			20
4 ft. 3 in.			11	7		18
4 ft. 6 in.			9	14		23
4 ft. 9 in.			4	19		23

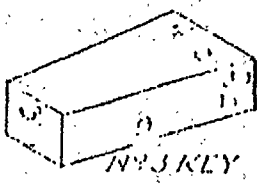
Inside Diameter	Number Required: 22" Circle	21" Circle	20" Circle	19" Circle	18" Circle	Total
5 ft. 3 in.	21	8				29
5 ft. 6 in.	11	16				27
5 ft. 9 in.	7	24				31
6 ft. 0 in.		32				32
6 ft. 3 in.		23	11			34
6 ft. 6 in.		14	21			35
6 ft. 9 in.		5	31			36
7 ft. 0 in.			37			37
7 ft. 3 in.				13		13
7 ft. 6 in.			18	21		39
7 ft. 9 in.			10	30		40
8 ft. 0 in.				41		41



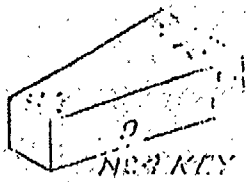
9"x(4½"—1")x2½"



9"x(4½"—2½")x2½"



9"x(4½"—3")x2½"



9"x(4½"—3½")x2½"

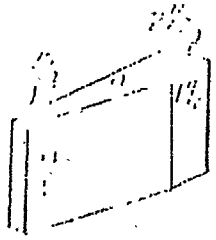
9" Key Brick (Table can be used for 2½" and 3" Series)

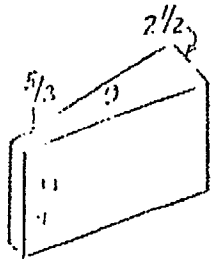
Inside Diameter	Number Required					
	No. 4 Key	No. 3 Key	No. 2 Key	No. 1 Key	Stretcher	Total
1 ft. 6 in.	25					25
2 ft. 0 in.	16	13				29
2 ft. 6 in.	9	25				34
3 ft. 0 in.		34				34
3 ft. 6 in.		29	13			42
4 ft. 0 in.		21	25			46
4 ft. 6 in.		12	38			50
5 ft. 0 in.		5	50			55
5 ft. 6 in.			50			57
6 ft. 0 in.			46	4		59
6 ft. 6 in.			42	13		64
7 ft. 0 in.			36	21		67
7 ft. 6 in.			30	29		71
8 ft. 0 in.			28	38		76
8 ft. 6 in.			24	46		80
9 ft. 0 in.			20	55		85
9 ft. 6 in.			16	63		89
10 ft. 0 in.			11	71		92
10 ft. 6 in.			17	80		97
11 ft. 0 in.			13	88		101
11 ft. 6 in.			9	96		105
12 ft. 0 in.			4	105		109
12 ft. 6 in.				113		113
13 ft. 0 in.				113	4	117
13 ft. 6 in.				113	9	122
				113	13	126

Inside Diameter	Number Required					
	No. 4 Key	No. 3 Key	No. 2 Key	No. 1 Key	Stretcher	Total
14 ft. 0 in.				113	17	130
14 ft. 6 in.				113	21	134
15 ft. 0 in.				113	25	138
15 ft. 6 in.				113	29	142
16 ft. 6 in.				113	33	146
16 ft. 6 in.				113	37	150
17 ft. 0 in.				113	42	155
17 ft. 6 in.				113	46	159
18 ft. 0 in.				113	50	163
18 ft. 6 in.				113	54	167
19 ft. 0 in.				113	58	171
19 ft. 6 in.				113	63	176
20 ft. 0 in.				113	67	180
20 ft. 6 in.				113	71	184
21 ft. 0 in.				113	75	188
21 ft. 6 in.				113	79	192
22 ft. 0 in.				113	84	197
22 ft. 6 in.				113	88	201
23 ft. 0 in.				113	92	205
23 ft. 6 in.				113	96	209
24 ft. 0 in.				113	101	214
24 ft. 6 in.				113	105	218
25 ft. 0 in.				113	109	222
25 ft. 6 in.				113	113	226
26 ft. 0 in.				113	117	230

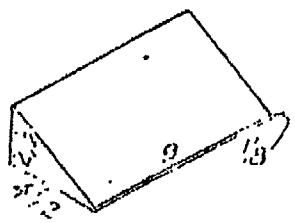
OTHER STANDARD BRICK SHAPES - 9" Series

No. 2 Neck
9"x4½"x1½"x(2½"—5/8")

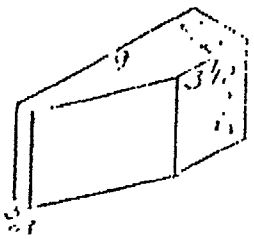




No. 3 Neck
9"x4½"x(2½"—5/8")

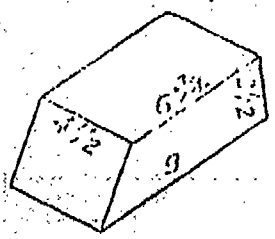


Feather Edge
9"x4½"x(2½"—½")

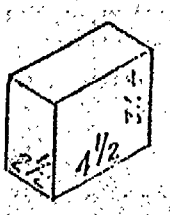


No. 1 Neck
9"x4½"x3½"x2½"x5/8"

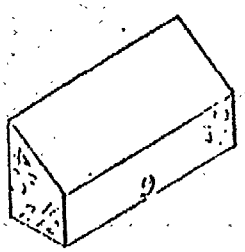
Other Standard Brick Shapes--2" Series--Continued:



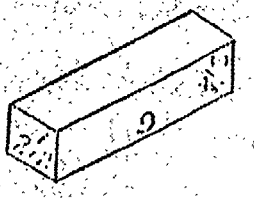
End Skew
9"x6¾"(4½"-2½")x2½"



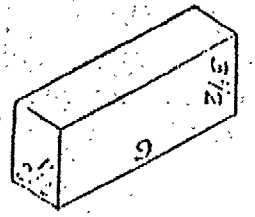
Bat
4½"x4½"x2½"



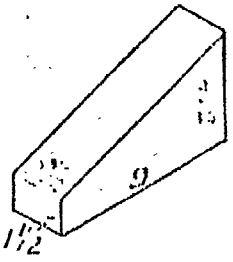
Side Skew
9"x(4½"-2¼")x2½"



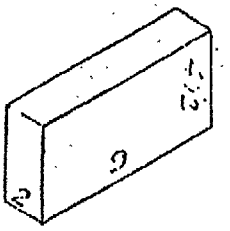
Spap
9"x2¼"x2½"



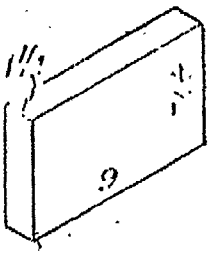
Small 9"
9"x3½"x2½"



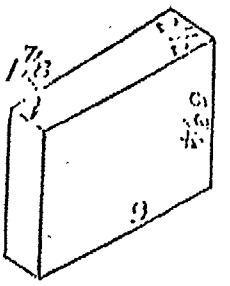
Edge Skew
9"x(4½"-1½")x2½"



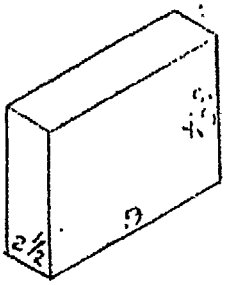
2" Brick
9"x4½"x2"



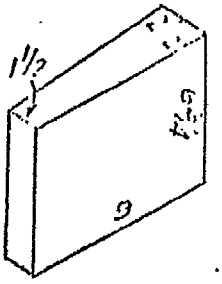
Split
9"x4½"x1¼"



Large 9" No. 1 Wedge
9"x6¾"x(2½"-1⅞")



Large 9" Straight
9"x6¾"x2½"



Large 9" No. 2 Wedge
9"x6¾"x(2½"-1½")

h. REFRACTORY BRICK STRAIGHT WALL CONSTRUCTION

(1) Courses - There are several types of courses, or continuous level ranges, that can be used in straight wall construction. Among these are:

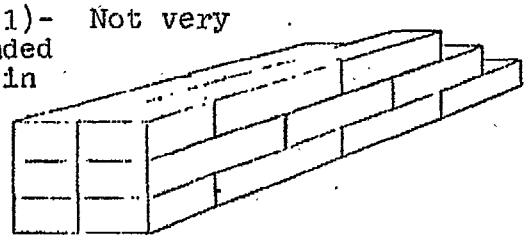
(a) Stretcher Courses - Long dimension of brick is parallel to face of wall. This construction is desirable in that fewer joints are exposed.

(b) Header Courses - Long dimension of brick is perpendicular to face of wall so that less area of each brick is exposed with the result that the brick are less subject to spalling and falling out in service.

(c) Other Types of Courses - As it is desirable to confine the loading on the largest face of a brick, other types of courses are seldom used in straight refractory walls

(2) Types of Construction - Courses can be arranged to form many different types of wall constructions. Among the more common are the following:

(a) All Stretchers (See Fig. 1)- Not very rigid and is not recommended except for walls under 3 feet in height, or walls having other means of support such as suspended walls or veneer courses between a heavier wall and exterior casing.

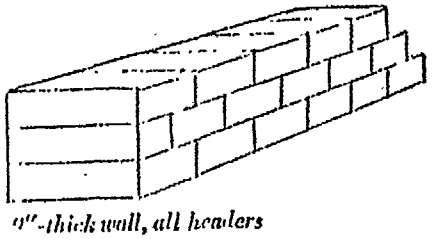


9"-thick wall, all stretchers

Figure No. 1

Even for walls under 3 feet high other types of construction are preferable.

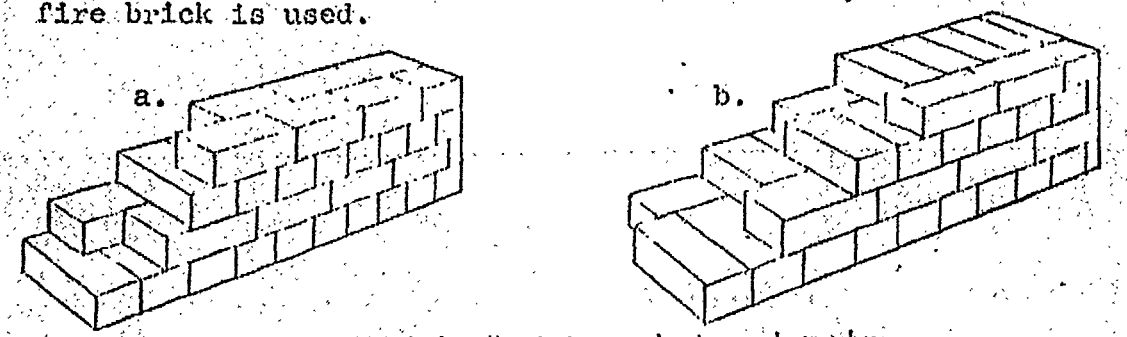
(b) All Headers (See Fig. 2) - Many 9"-thick insulating fire brick walls are built of all-header courses. This is especially true of bell-type annealing furnaces. Advantages are a reasonably stable wall with the back side of all brick under comparatively low temperatures. Hence, a preferred construction for walls operating near their temperature limit



9"-thick wall, all headers

Figure No. 2

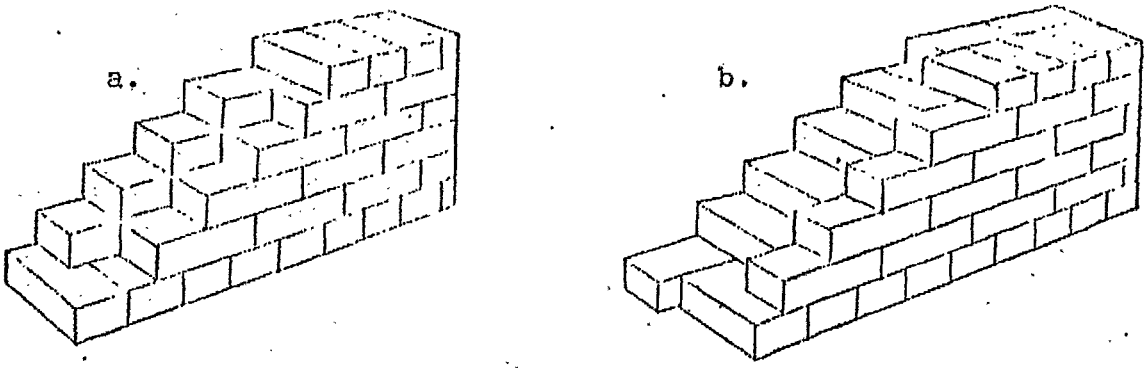
(c) Alternate Headers and Stretchers (See Fig. 3, a & b) - Walls of both 9" and 13-1/2" thicknesses constructed of alternate headers and stretchers make a very stable wall and is considered "good practice." Walls of this type are most common in mill-furnace construction, especially where dense fire brick is used.



9" and 13½"-thick walls of alternate headers and stretchers

Figure No. 3

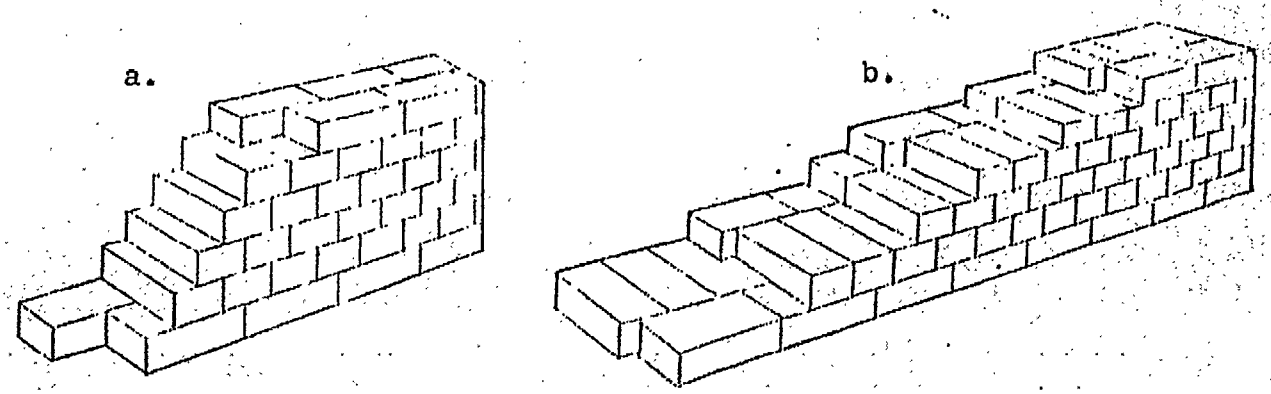
(d) Walls Mainly of Stretcher Courses (See Fig. 4, a & b) - This type of wall is extensively used where the brick are subjected to slagging or other erosive action. The advantage of this type is that the exterior face can be repaired by applying a 4-1/2"-skin wall tied into the remaining brick work.



Walls Mainly of Stretcher Courses

Figure No. 4

(e) Walls Mainly of Header Courses (See Fig. 5, a & b) - This type of wall possesses many of the advantages of one constructed entirely of headers, but sacrifices the advantages of the all-header wall on a minimum number of courses in order to obtain greater rigidity. This wall is usually laid with three to four header courses to each stretcher course.



Walls Mainly of Header Courses

Figure No. 5

NOTE: The most common construction where insulating fire brick is used are those consisting of all headers or of alternate header and stretcher courses. These constructions are recommended unless other factors influence the type of wall used.

(3) Permissible Unsupported Height - Unsupported wall 4-1/2" thick, should be no higher than 3 feet. Unsupported wall 9" thick, tied in by combinations of header and stretcher courses, can be used up to 8 feet heights; 13-1/2" walls under same conditions are suitable up to 12 feet heights.

(4) Veneer Courses of Insulating Brick - A large proportion of modern furnace walls are constructed of exposed linings of fire brick or insulating fire brick with "back ups" of lower-temperature, insulating brick or block. Typical examples of such construction are:

Exposed	Back Up
9" Insulating Fire Brick or Fire Brick	with 4 1/2 Insulating Brick or Block.
13 1/2" Insulating Fire Brick or Fire Brick	with 3" Insulating Brick or Block.

1. CUTTING BRICK

(1) General - It is usually impossible or at least impractical to predetermine all of the brick sizes required for a piece of equipment. Consequently, it is normally necessary to cut some brick to size in the field. Some places where cutting is necessary are for the last course in an arch or wall, at the end of an arch or wall and around openings such as burners.

The amount of cutting is normally not great, particularly where the furnace has been laid out completely and materials ordered accurately. However, occasionally it may be necessary to do a great amount of cutting in the field. An example would be where it is desired to cut arch or wedge brick from straight brick carried in stock.

Insulating fire brick can easily be cut without special tools. This is in contrast to dense fire brick which must be chipped to size or cut with abrasive wheels. The cut edges of insulating fire brick are even and the size is accurate. When fire brick are chipped to size the edges are rough and the size is inaccurate to a degree, dependent upon the operator's skill.

(2) Tools for Cutting Brick - Several different tools can be used for cutting brick. The more common are as follows:

(a) Pruning Saws - For the average job where a small amount of cutting is involved, a pruning saw is the best tool to cut insulating fire brick. Ordinary carpenters' or key-hole saws can be used if a pruning saw is not available. The pruning saw has an advantage over the other hand saws in that the arrangement of the teeth will eliminate any tendency for the saw to clog. These saws will cut through the brick very easily.

(b) Hand Saws - Hand saws will be most satisfactory for the majority of the jobs. For accurate cuts, be sure the saw is sharpened properly.

(c) Masonry Saw - For cutting brick in quantity lots, it is usually easiest to use the masonry saw. This saw is especially designed for cutting masonry products. The cutting is done by a rotating abrasive disc. The bricks to be cut are placed on a movable table and pushed against the disc.

(d) Circular Saws - An ordinary circular saw can be converted to cut insulating fire brick by substituting a steel-centered abrasive blade for the steel blade. This type of blade should not, however, be used on extra high speed equipment or mounted on an unstable mandrel. Such use, where the blade would be subject to excessive vibration, might result in explosion of the blade and injury to the workman.

(e) Other - When it is desired to reduce the dimension of an insulating fire brick only slightly, or smooth up a rough saw cut, the brick may be rubbed to accurate dimensions against coarse abrasive paper or cloth, a rough file or a rough fire brick.

j. LAYING REFRACTORY BRICK

(1) General - The joints between insulating brick or insulating fire brick should be just as thin as possible. The ideal

is to have the brick in physical contact at the high points with only the irregularities filled with cement. The most common practice is to lay these types of brick with so called dipped joints. In laying brick in this manner, the cement or mortar is thinned to a creamy consistency and the brick dipped into this slurry before being placed in the wall. It is very difficult to apply cement placed in the wall. It is very difficult to apply cement to insulating brick sufficiently thin with a trowel. The practice is discouraged, as it requires a degree of skill that is mastered by only a very few.

(2) Insulating Fire Brick - Insulating fire brick are difficult to lay because they tend rapidly to absorb the water out of cements and mortars. The brick should, therefore, be placed into position as rapidly as possible after dipping. With the mortar box near the work, this can and should be almost a continuous motion.

To slow up the rate of absorption by insulating fire brick, they are sometimes dipped in a very thin cement solution or water (the former preferred) just before dipping them into the layering mixture. The disadvantage of this is that it greatly increases the time for drying out the finished furnace.

(3) Laying the Brick - While the brick can be laid by several different methods, the most common practice (after dipping in cement or mortar) is to place them in the wall one to three inches from their final location, then rapidly slide them into place. After this, it is best to tap the brick lightly with a mallet or hammer on the top end or side to firmly bed it in place. With insulating brick and insulating fire brick it is imperative that this whole operation be done rapidly before the brick absorbs the water out of the cement.

A good share of the insulating fire brick and insulating brick used today are laid dry. For certain conditions, this is the preferred manner of laying these brick and can be considered good practice. Laying brick dry offers an advantage in that it permits expansion to be taken up at the individual brick joints, whereas when mortar or cement is used all expansion must be taken up at expansion joints.

k. EXPANSION JOINTS

(1) General - In the construction of any equipment it is necessary to consider expansion of the refractories. In most straight walls the refractory can expand freely vertically but horizontal expansion must be provided for. This expansion may be taken care of by expansion joints or by laying the brick loose or dry. The most common practice, however, is to use expansion joints.

It is preferable to use a larger number of small expansion joints rather than a few large joints. For example, it is better to use three $\frac{1}{4}$" wide joints than one 3/4" joint although common practice varies between these two extremes. The smaller joints result in less loss due to radiation than a smaller

number of large joints and greatly restrict the total distance that it is necessary for any part of the wall to move during expansion or contraction. This latter factor is especially important in walls with a large number of openings.

NOTE: In all cases where expansion is provided for with definite expansion joints, care should be taken to see that a joint is located close to and on each side of all corners.

(2) Constructing Expansion Joints- It is difficult to lay up a brick wall leaving open spaces for expansion joints. Therefore, it is customary to insert a material in the expansion space which can be removed after the wall is built or which will burn out after the furnace is fired. Materials commonly used are insulating board or corrugated paper. Wood is commonly used for this purpose with dense fire brick but should not be used with insulating fire brick unless removed manually as the steep temperature gradient through these brick may result in the wood in the rear portion of the wall not burning out completely.

(3) Vertical Expansion of Stacks and Furnaces - As most boiler and furnace stacks operate at comparatively low temperatures and have relatively little expansion, it is customary to depend on the cushioning together of the brick and expansion of the shell to take care of the expansion. The vertical expansion merely results in the wall moving in that direction.

On stacks operating at high temperature, pit furnaces, blast furnace stoves, etc., the brick are either laid-up loose to provide for expansion or Superex or some other cushioning materials are used no other provision is necessary since the cushioning materials will compress sufficiently to take up the circumferential expansion. Again, vertical expansion results in the wall moving vertically.