129-16a

PESTICIDES ENGINEERING CONTROL TECHNOLOGY ASSESSMENT SURVEY

Plant J-1

Rohm-Haas, Inc.
Philadelphia, PA

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(NIOSH Contract 210-77-0093)

This report is intended to describe effective applications of control technology which may be of general use to the pesticide manufacturing and formulating industry It is not intended to describe all aspects of control programs in this plant

PLANT OVERVIEW

Plant J-1 produces a family of pesticides which are finely divided powders The plant is located within a larger facility which has many other chemical operations and a complete complement of mechanical, engineering, analytical, industrial hygiene, and other technical and utility services The plant itself is housed in several older buildings,and the three basic types of operations (wet processing, dry processing, and packaging) are housed in separate buildings Basic unit operations employed in the process are' batch chemical reaction, solids dissolving, filtration, drying, transport of solids, liquids, and slurries, solids cooling and blending and packaging The process requires storage and handling of several hazardous or toxic compounds Environmental controls include wet scrubbing for gases, wet scrubbing for particulates, liquid seal transfer and storage, and baghouse filtration for particulate collection Raw materials are either solids or liquids (both volatile organic compounds and inorganic compounds) Most raw materials are received by rail and are transferred to silos (solids) or tanks (liquids)

The plant operations and transfer of hazardous materials are performed only by the most senior operators in the plant The entry level jobs are packaging and utility (cleanup). Detailed procedures for the handling of the materials (i.e., tank car unloading procedures) are published as plant SOP's, and are strictly followed

The product is packaged in 3#, 5#, 25# and 50# bags and in 250#

fiber drums No product is sold in bulk bins The principal product has a relatively low toxicity (LD_{50} = ~5000–8000 mg/kg) although some starting materials and intermediates are more toxic (LD_{50} = ~300 mg/kg) Dust explosions and thermal decomposition of the product are concerns, and control of the oxygen content in the process equipment is of primary importance

The plant operations are autonomous to a large extent, although corporate headquarters provides direction and support Industrial hygiene activities are carried on both locally and from corporate headquarters Likewise, design engineering may be performed locally, with review and approval at corporate headquarters for those projects above a certain dollar limit Larger projects will be wholly designed at corporate headquarters

The medical program is directed by the Corporate Medical Director, but the administration of the program and all medical care are the responsibility of the plant medical department Examination and initial care for any job related conditions are given by the plant Pre-employment exams are required of all employees These exams include

- Occupational history
- Health history
- Physical examination
- Visual acuity testing
- Audio-metric testing
- Pulmonary function tests
- Haematological analysis (SMA-26)
- Urinalysis
- Electro-cardiogram

The plant physician takes medical histories and performs examinations and evaluates testing performed by nurses All employees are offered a physical examination annually Employees over 40 years of age receive a complete physical examination, those under 40 years receive the complete examination bi-annually with the electrocardiogram and physician conference omitted from the examination in the alternating year. Additional tests are offered to employees who work near carcinogens, materials which inhibit cholinesterase and those which affect hemoglobin In these cases, preassignment monitoring is conducted to establish a baseline for each employee Record keeping is rendered more effective because of company policy that all first aid or medical care rendered in plant must be performed in the dispensary or reported to the dispensary. This insures that all injuries and illnesses are documented. Medical records are kept indefinitely Posting and labeling are carried out throughout the plant

I

PROCESS. Powder packaging

PROBLEM Supply local exhaust ventilation

SOLUTION Company-designed system

Three powder-packaging lines are used to package the final product The powder is < 2-3 µm (max) and the company has set an operating TLV of 1 mg/m^3 Each of the lines contains several packing machines which are under local exhaust ventilation control, with a total requirement of ~12,000 CFM. Figure I-1 shows the general layout of the system. Several important general design features are evident

- Use of air-actuated dampers ("Blast Gates")

  The system consists of several sub-systems with air flow limited by several dampers to those packing machines actually in use The gates are closed and opened by air pistons actuated by P/E interlocks with the packing machine under control The exhaust system is designed to provide adequate velocities when all equipment is in operation Details of the gates are shown in Figures I-2, and I-3

- Cleanout doors

  The end of each line (A-D in Figure I-1) has a cleanout door The doors serve two purposes

  1. Access for cleanout during shutdown
  2. "Air sweep" cleanout during operations The door is shown in Figure 1-4

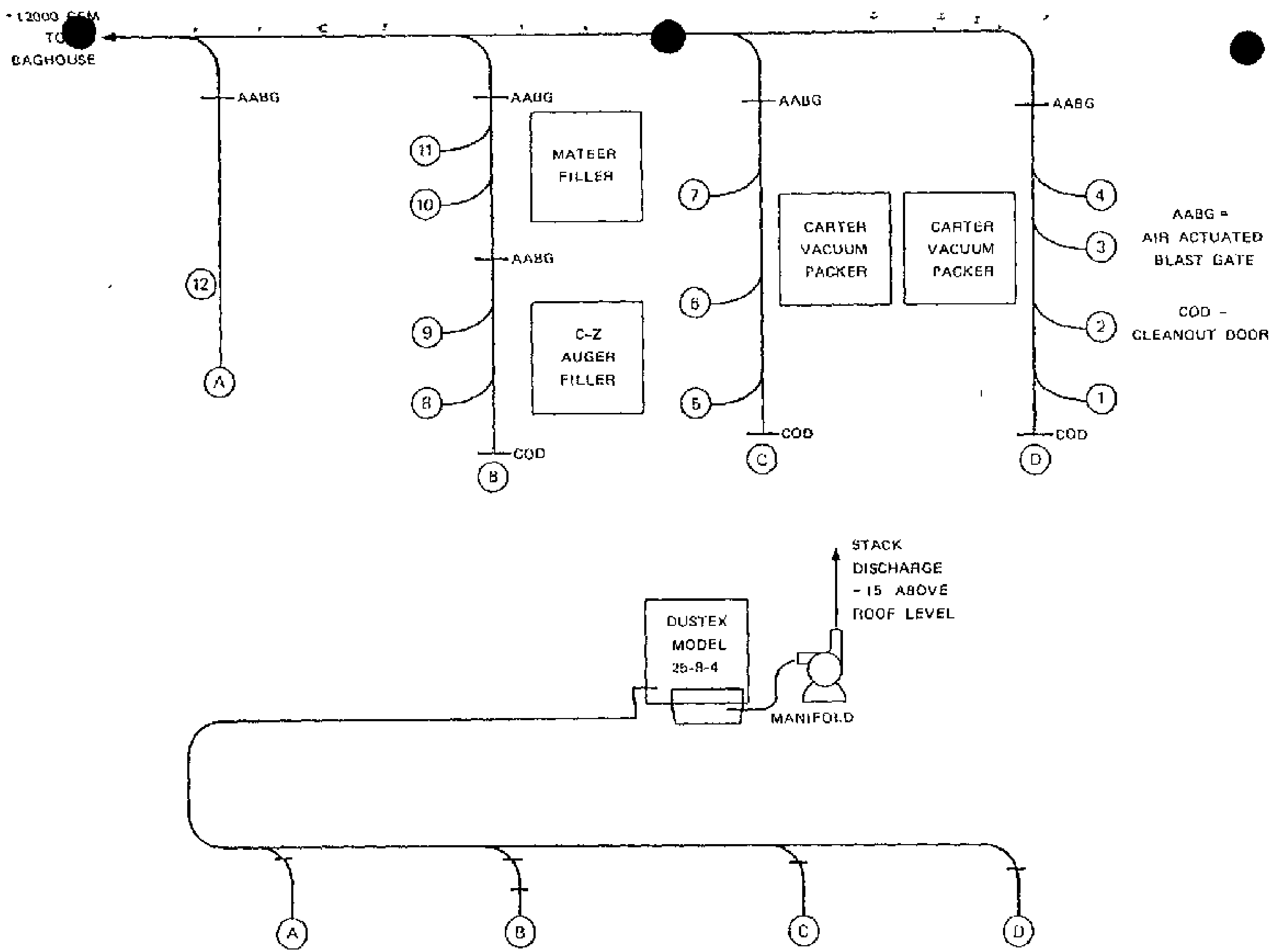


FIGURE 1-1 POWDER PACKAGING SYSTEM

Figure I-2
Air-Actuated Dampers

Figure I-3

Air-Actuated Knife Valves - Flange Detail

Figure I-4
Clean Out Doors

- Transport velocity

  Each duct is sized so as to maintain a transport velocity of >4000 FPM Opening the cleanout doors produces an air sweep through the main branch ducts of ~8000 FPM

- Construction details

  1 Ducts are constructed to be generally in accordance with National Board of Fire Underwriters Std #91 for dust removal exhaust systems
  2. Elbow radii are 2 duct diameters minimum
  3. Welds are ground smooth internally
  4. Company engineering standards are followed
  5 Flexible ducts are Flexaust® type CWY.

PROCESS General Plant Operations

PROBLEM Personal Protection

SOLUTION Corporate SOP

The pesticide production and packaging operations are governed by the same company regulations as the rest of the plant. These regulations are given in Appendix II-A (attached). In addition, some of the specific items (with prices/costs) are listed in Table II-1. Entry points to pesticide production buildings have well identified cases containing either MSA all-service gas masks (now being phased out) or Scott Air-Pak Supplied-Air respirators. The regulations are intended to be equivalent to ANSI Z-33.

Beards are not allowed for workers in areas where respirarors are required Butyl rubber gloves are generally used where permeability of skin-toxic agents is a serious concern; Playtex® gloves are used where short-term exposures (such as in maintenance) are expected.

All production employees are given an annual allowance for purchase of clothing Employees with potential for contact with hazardous materials are given clean clothes daily which are laundered on plant site Depending upon the potential for contact, the type hazard involved, and the toxicity level of the material, the clothing mav be outer wear only (coveralls, or the shirt and pants), or complete change including underwear, socks, etc. The operators working in the packout of the pesticide powders, the pilot plant, and other areas where hazardous materials are present are required to shower before leaving the plant at the end of the shift. The garments are issued to individuals and are identified with the employee's clock number.

All employees are furnished two lockers A change facility for 60 men equipped with a cleanroom/dirty room/shower room and lockers was recently installed in a nearby location for $175,000. The cost of installing shower facilities for 60 men was estimated at $125,000 (exclusive of the utilities, as hot water)

All garments from pesticide operations are laundered using commercial laundry procedures

- Disposal of garments to laundry bins in locker room
- Tagging by work area (to facilitate sorting and return)
- Separation of laundry according to department, garments from different departments are **not** laundered together.
- Pre-soaking
- Washing with commercial detergent
- Adherence to standard operating procedures for laundry worker's safety

The plant has recently evaluated the cost and effectiveness of disposable protective garments which are issued to visitors who enter the plant They have selected DuPont Tyvek® garments because of several considerations (not necessarily in order of importance)

- Cost
- Impermeability
- Ruggedness
- Worker acceptance.

Tyvek® garments, however, are not used in the pesticide area

TABLE II-1

PERSONAL PROTECTIVE EQUIPMENT AND COSTS
USED IN PLANT J-1

Item	Model/Description	Supplier	Cost
Respirator	3M disposable dust #8710	3M Company, St. Paul, Minn 55101	0.55 ea*
	Willson #1221 (half face w/	Willson Prod.Div ESB, Inc	12 27 ea
	replacement cartridges)	Reading, PA 19603	1 78 to 2 05 ea
Rain Suit	Disposable clear plastic	Pransky Co., Phila., PA	3.00/set
Monogoggle	Model 214	American Allsafe Co., Buffalo, NY 19113	2.96 ea
	AO - plano		3 29 ea
	- prescription, plain	AO Corp , Safety Prod. Div.,	10 70 ea
	- prescription, bifocal	Putnam, CT 06260	18 45 ea
Hard Hats	Gray - #454722	MSA, Pittsburgh, PA 15208	7 05 ea
	Gaddy for monogoggle #200 BG	Encon Div., Valley Co ,	1 52
	Bump - White #455160 (not used in manufacturing production - used in shipping, etc)	Houston, TX 77001	3.95 ea
Gloves	12" black rubber gauntlet #928-SR	Stauffer Mfg. Co ,	11 55/doz
	Blue Playtex®	Red Hill, PA 18076	0 37 per
	Vinyl coated cotton (used primarily in transportation) #20-115	Edmont-Wilson, Coshocton, OH 03812	31 10/doz
Clothing	company allowance to all employees**		$30/yr + 25%
	coveralls		11.50 per
	nylon pile jacket		13 50 ea
	shorts, t-shirts, socks		1.25 ea
	towels		1 75 ea
	shoes		$18/pr

*Items so marked are list prices all others are company purchase prices

**Prior to giving cash gave 2 shirts and 2 pairs trousers for year. Employee is given an allowance expected to give a net of $30 after IRS deductions, i e., averages $40-42 total

III

PROCESS: General Plant Operations

PROBLEM: 1 Tank Entry (confined space)

2. Maintenance Safety

SOLUTION General Plant SOP's (see attached)

The plant has a rigidly enforced procedure for entry into a confined space. This procedure is attached (Appendix III-A) Similarly, safety procedures for maintenance work in hazardous areas are enforced throughout the plant in both pesticide and non-pesticide operations (Appendix III-B). Figure III is a copy of the safety permit required for work in confined or otherwise hazardous areas.

F-1178 Rev 3/71

Figure III

PLANT J-1 SAFETY PERMIT

cc Worker (pink copy)
Foreman (white copy)

For Work Involving Any source of ignition that could result in an accident or fire
Internal inspection of equipment and work inside of vessels & confined areas
Exposure to toxic or corrosive material, oxygen deficiency etc

After the work has been scheduled and before workers are due to arrive, every thing should be ready to start the work and the form should be completed. If the worker has any question about the safety of this job he should consult with the department foreman, worker's foreman or Safety Department. This permit is good only for the job and time listed. Follow instructions in Safety Manual.

Job Description & Hazardous Conditions Involved.
Burn
Weld
Electric Tools
Chip
Other (Indicate)

COMPLETE CHECK OF CONDITIONS MUST BE MADE IMMEDIATELY PRIOR TO START OF WORK.
Foreman to check all items

	CHECK	Yes	No Need
1 Has equipment been properly cleaned?			
2 Has equipment been properly drained?			
3 Have all lines to equipment been broken, properly blanked off and/or valves closed?			
4 Has working area been properly protected against spreading or falling sparks as well as flashes?			
5 Has water, nitrogen or CO_2 been added to maximum volume possible for safety?			
6 Has equipment venting into building been blanked, disconnected or shut down?			
7 Have operations been stopped on equipment that should be shut down?			
8 Has electrical power been disconnected (fuses removed, switches tagged and locked open)?			
9 Have all personnel affected by this job been informed?			
10 Has the transfer of hazardous materials within the work area been stopped?			
11 Have arrangements been made for proper ventilation by foreman and/or mechanics?			
12 Should area be tested for flammable or explosive vapors and/or oxygen deficiency?			
13 Should the work be done outside of the department?			
14 Is it safe to proceed with work?			
15 Should job be rechecked? When?			
16 Has area been tested with Explosimeter and found safe?			
17 Special precautions, (check below if required)			

Personnel Protection
Rescue kit ☐ Stand by man ☐ Wristlets ☐ Safety belt ☐
Other ☐

Eye Protection
Acid goggles ☐, Monogoggles ☐, Face shield ☐
Other ☐

Respiratory Protection
Gasmask ☐ Respirator ☐ Fresh-air mask ☐ Other

Protective Clothing
Rubber hat & coat ☐ Rubber pants ☐ Boots ☐, Rubber gloves ☐
Hard hat ☐ Other

Area protection
Tarpaulins ☐ Asbestos blankets ☐ Welders shields ☐, Running water ☐
Fire watch ☐ Fire extinguisher ☐ Other

MECHANICAL DEPARTMENT

A. Requested Permit .. am pm
B. Received Permit .. am pm
C. Started Work .. am pm
D. Stopped Work .. am pm
E. Job Finished .. am pm
Remarks

SAFETY DEPARTMENT

1 Recheck Requested .. am pm
2 Inspector Sent To Recheck Job .. am pm
3 Inspector Arrived At Job .. am pm
4 Job Not Ready (check one) .. am pm
(a) Men not on job
(b) Permit not ready
(c) Conditions not o.k.
(d) Other
Remarks

REMARKS

Worker must notify foreman immediately upon completion of job

Permission granted for work to .... Pay # .... Date .... From .... a.m. p.m. To .... a.m. p.m.
Building No .... Floor .... Unit ....

Dept. Foreman Date Hour a.m. p.m. Rechecked by Date Hour a.m. p.m.

DEPARTMENT FOREMAN MUST NOT GIVE WORKER HIS COPY OF PERMIT UNTIL IMMEDIATELY PRIOR TO START OF WORK

IV

PROCESS. Reactor vessel

PROBLEM: Contamination control

SOLUTION Simple stainless steel sheathing over top

Reactor vessels are insulated with thermal insulation In order to prevent contamination of the insulation, as well as to prevent abrasion of the insulation, a stainless steel skirt/top was installed. The sheathing can be easily wiped off and removed for any vessel repairs (Figures IV-A and IV-B). The sheathing for some vessels is constructed of Kydex.®

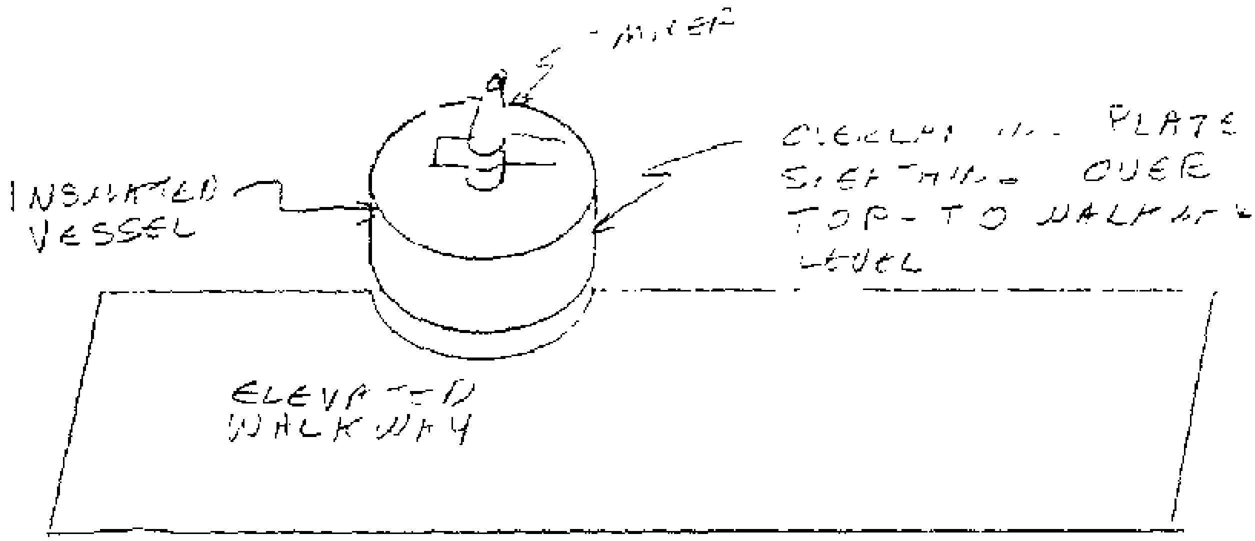


Figure IV-A

Sheathing Over Vessel

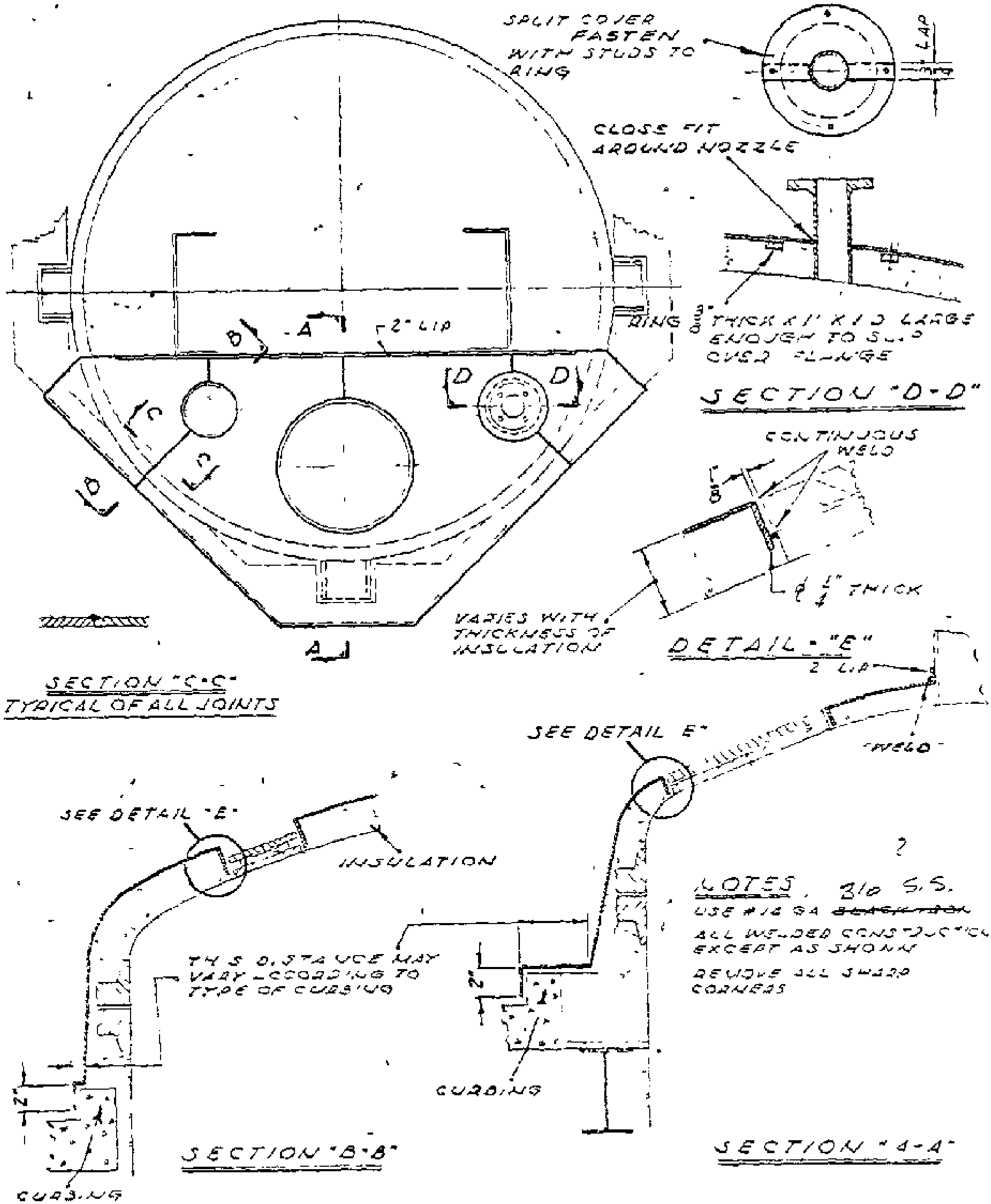


Figure IV-B

Metal Bibs for Kettles

V

PROCESS. Pesticide production & packaging

PROBLEM. Industrial hygiene monitoring data recording

SOLUTION Field data sheets and computer entry forms

Plant J-I has an active I.H program Recently they have begun to enter employee health data, employment history and exposure history into a computerized system to permit study of exposures and responses. Figures V-1 to V-3 are the forms required to enter the I.H. data Figure V-1 is a field data sheet used before Figures V-2 and V-3 were developed, and which is still used by some company industrial hygienists. Figures V-2 and V-3 are on opposite sides of the same sheet. Figure V-3 is the computer entry data sheet Codes for chemicals, jobs, operations, etc. are included.

Figure V-1

AIR MONITORING DATA SHEET

Plant J-1

Submit copy to
Employee Health & Safety
Department — Home Office

Plant ______________________ Conducted by ______________________

	Sample No				
SAMPLE IDENTIFICATION AND LOCATION	Date Sample Taken				
	Contaminant				
	Process				
	Building/Outdoors				
	Area Within Building				
	Operation Monitored				
	Unusual Conditions Observed During Monitoring Period				
SAMPLE TYPE	Personal/Area				
EMPLOYEE IDENTIFICATION	Employee Name				
	Social Security No				
	Job Title & Code No				
	Protective Equipment Worn by Employee				
SAMPLING EQUIPMENT	Instrument (Make & Serial No.)				
	Collection Device (Filter, Impinger, etc.)				
SAMPLE TIME	Start (24-hour Clock)				
	Stop (24-hour Clock)				
	Total (minutes)				
SAMPLE RATE	Start				
	Stop				
SAMPLE VOLUME	Temperature, °C				
	Pressure, mm Hg				
	Total Volume (liters)				
SAMPLE ANALYSIS	Laboratory				
	Date				
	Analytical Method				
	Test Result				

Use reverse side if needed

FORM 11011 REV 3/77

Figure V-2

EMPLOYEE EXPOSURE MONITORING REPORT – Part II

LOCATION NAME	PRODUCT NAME	NON-PRODUCTION FUNCTION	JOB NAME	SAMPLING CONDUCTED BY

	A	B	C	D	E
SAMPLE NO					
SAMPLE DATE					
OPERATION					
SPECIFIC LOCATION OF SAMPLE					
EMPLOYEE					
INSTRUMENT					
COLLECTOR					
START TIME					
STOP TIME					
TOTAL (min)					
START RATE					
STOP RATE					
TEMP °C					
PRES mmHg					
VOL LITERS					
LABORATORY					
ANAL DATE					
ANAL REF					
AGENT & RESULT					
COMMENTS & UNUSUAL CONDITIONS	DO NOT USE COLUMN "A" FOR COMPANION DATA				

FORM 3249 REV 3/78 (BACK)

Figure V-3

EMPLOYEE EXPOSURE MONITORING REPORT - Part I

LOCATION CODE	DEPARTMENT NAME	DEPT. CODE	GENERIC NAME	GENERIC CODE	PRODUCT CODE
LOCAL JOB NAME		HRIS JOB CODE	BUILDING/AREA NAME		BLDG./AREA CODE

	A	B	C	D	E
AGENT	NAME CODE	NAME CODE	NAME CODE	NAME CODE	NAME CODE
DATE	MO. / DAY / YEAR	MO. / DAY / YEAR	MO. / DAY / YEAR	MO. / DAY / YEAR	MO. / DAY / YEAR
SEQUENCE NO.					
OPERATION					
METHOD	PERSON [P] AREA [A] ESTIMATE [E]	PERSON [P] AREA [A] ESTIMATE [E]	PERSON [P] AREA [A] ESTIMATE [E]	PERSON [P] AREA [A] ESTIMATE [E]	PERSON [P] AREA [A] ESTIMATE [E]
PROTECTION	YES [Y] NO [N] UNKNOWN [U]	YES [Y] NO [N] UNKNOWN [U]	YES [Y] NO [N] UNKNOWN [U]	YES [Y] NO [N] UNKNOWN [U]	YES [Y] NO [N] UNKNOWN [U]
BASE	NUMBER OF COMPANION SAMPLES				
COMPANIONS	COMPLETE COLUMNS B TO E ONLY IF THE ENTRY FOR BASE IS MORE THAN ONE	DATE FROM COLUMN A SEQUENCE NO. FROM COLUMN A	DATE FROM COLUMN A SEQUENCE NO. FROM COLUMN A	DATE FROM COLUMN A SEQUENCE NO. FROM COLUMN A	DATE FROM COLUMN A SEQUENCE NO. FROM COLUMN A
TYPE	TWA [T] STEL [S]	TWA [T] STEL [S]	TWA [T] STEL [S]	TWA [T] STEL [S]	TWA [T] STEL [S]
UNITS	U/M L [<] G [>]	U/M L [<] G [>]	U/M L [<] G [>]	U/M L [<] G [>]	U/M L [<] G [>]
VALUE					
STANDARD					

KINDS OF SAMPLES

1. REGULAR
2. BASE (CALCULATED)
3. COMPANION
4. ESTIMATE

INSTRUCTIONS

1. SEQ # INCREASES FROM COL. A TO E BY UNITS OF ONE
2. COL. A TO E OF PART II ARE CONTINUATION OF COL. A TO E OF PART I
3. REGULAR SAMPLES - BASE AND COMPANIONS ARE NOT APPLICABLE
4. BASE SAMPLES - COL. A ONLY
   a. NUMBER OF COMPANIONS GREATER THAN ONE
   b. OPERATION - ENTER CALC.
   c. METHOD [P] OR [A] ONLY
   d. TYPE [T] ONLY
5. COMPANION SAMPLES - COL. B, C, D, E ONLY
   a. AS MANY COLUMNS AS IN BASE ENTRY
   b. ENTER DATE FROM COL. A
   c. ENTER SEQ. # FROM COL. A
   d. TYPE [S] ONLY
6. ESTIMATE SAMPLES
   a. METHOD [E] ONLY
   b. TYPE [T] ONLY

FORM 8219 REV. 4/78 (FRONT)

VI

PROCESS: Reaction and storage of process chemicals

PROBLEM: Escape of volatile materials

SOLUTION: Ventilation of vessels

One of the process chemicals is highly volatile To prevent escape of this material, local exhaust ventilation is applied to process vessels The vessels are equipped with hinged access hatches as shown in Figure VI-1.

Some of the vessels are vigorously agitated, so ventilation rates are maintained to give a minimum face velocity of 100 CFM/SF open area Because of gradual duct obstruction, initial ventilation rates are substantially greater. Figure VI-1 shows details and face velocities as measured in the plant. Figure VI-2 shows points where area samples were taken to evaluate potential exposures, and Table VI-1 shows the sample results, with ventilation on and off

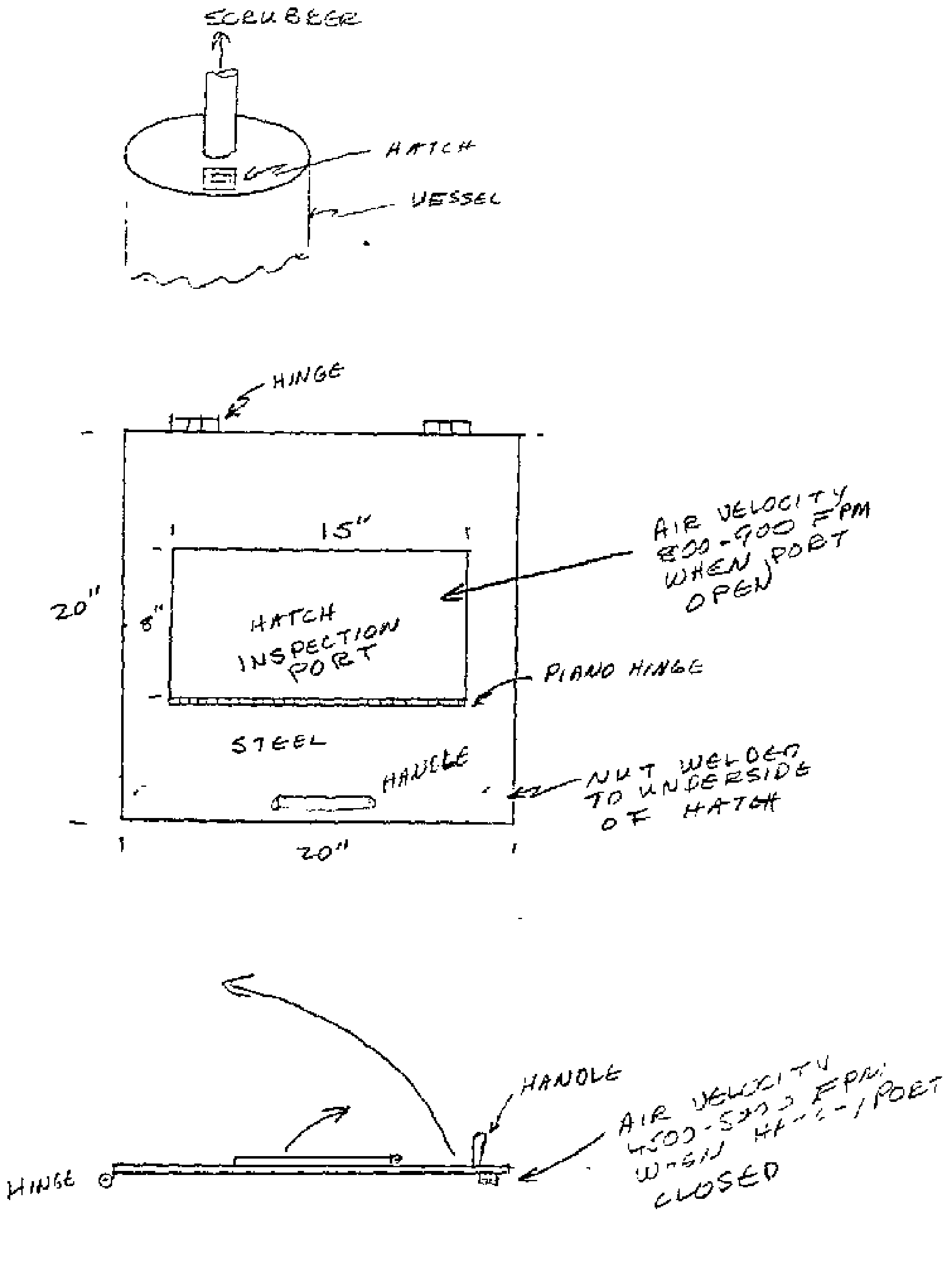


Figure VI-1

Vessel Ventilation - Details and Face Velocities

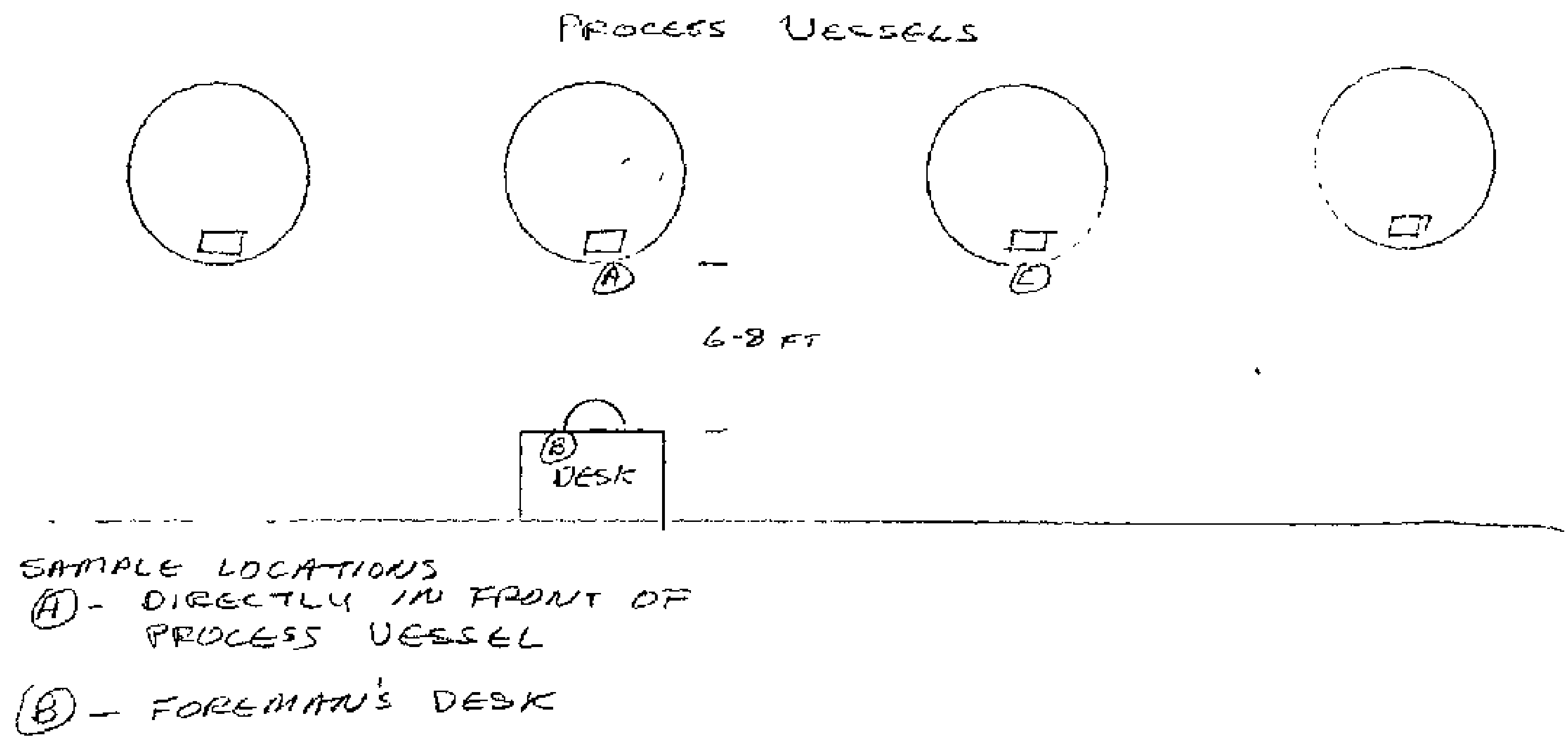


Figure VI-2

Effectiveness of Vessel Ventilation - Sample Locations

Table VI-1

MEASUREMENTS OF SOLVENT A IN PROCESS AREA

SAMPLE LOCATION*	OPERATION	VENTILATION	CONCENTRATION SOLVENT A (ppm $^v/v$)
A	Reaction/Agit.	Off	68.7
B	"	"	1.5
B	"	"	<0.1
A	"	On	0.1
C	"	"	1.0
B	Charging Vessel	"	0.4
B	"	"	<0.1
B	"	"	1.4

*See Figure VI-2

VII

PROCESS: Product drying

PROBLEM: Surveillance of process

SOLUTION Remotely controlled closed circuit TV system

One of the process steps requires drying of an intermediate product which is temperature-sensitive. Conventional temperature sensors were inadequate because of special (proprietary) product/process characteristics. A closed circuit TV system, with the monitor in the control room, was installed to permit continuous monitoring of the process. This reduced operator exposure by reducing direct visual inspection of the process.

VIII

PROCESS Charging powder to process

PROBLEM: Skin/eye irritation

SOLUTION: Specially designed hood

One of the process additives is an irritating powder (flake) In order to prevent skin/eye irritation during the charging of 50 lb. bags, a special charging hood was developed Details of the hood are shown in Figures VIII-1 to VIII-8. Measurements of powder in air during charging process showed breathing zone area air concentrations as follows:

0.24 mg/m^3

0.25 mg/m^3

0.17 mg/m^3

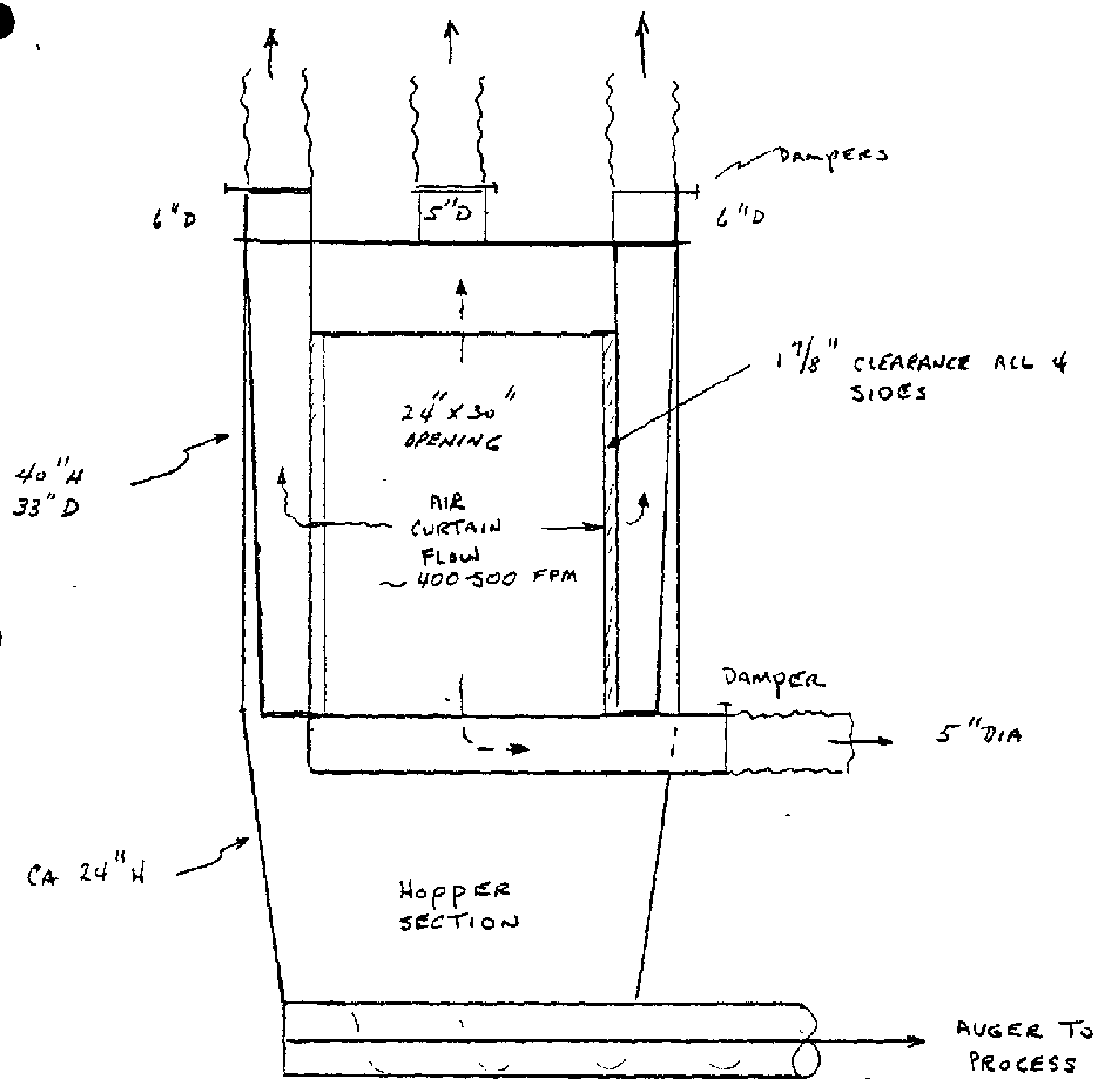
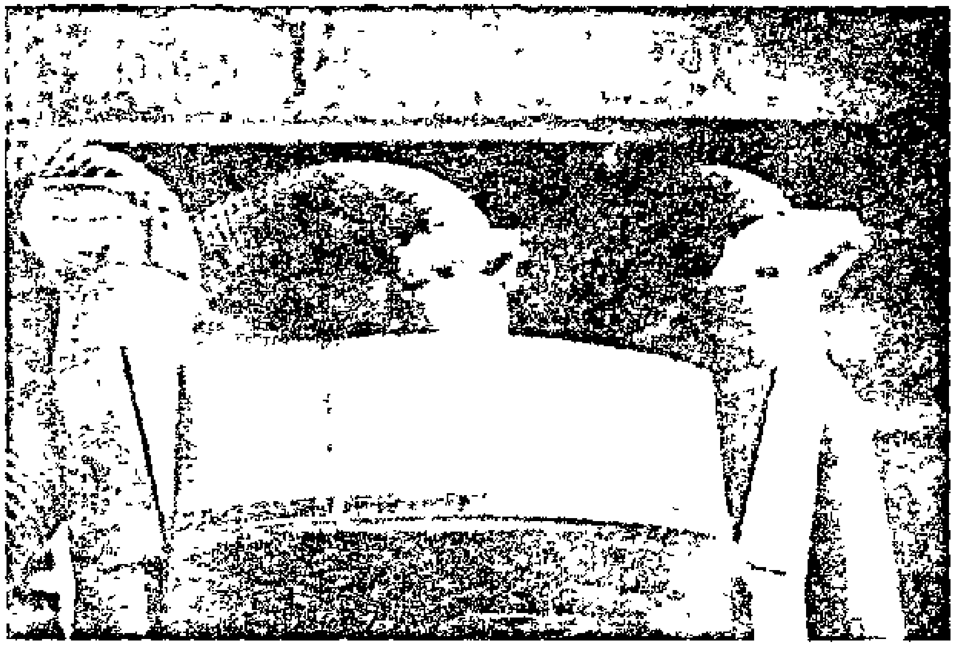


FIGURE VIII-I

DUMPING HOOD WITH AIR SLOTS ON ALL 4 SIDES OF ENTRANCE



Top air vents from slots

Figure VIII-2

SPECIALLY DESIGNED DUMPING HOOD

Bottom of entrance and bin below

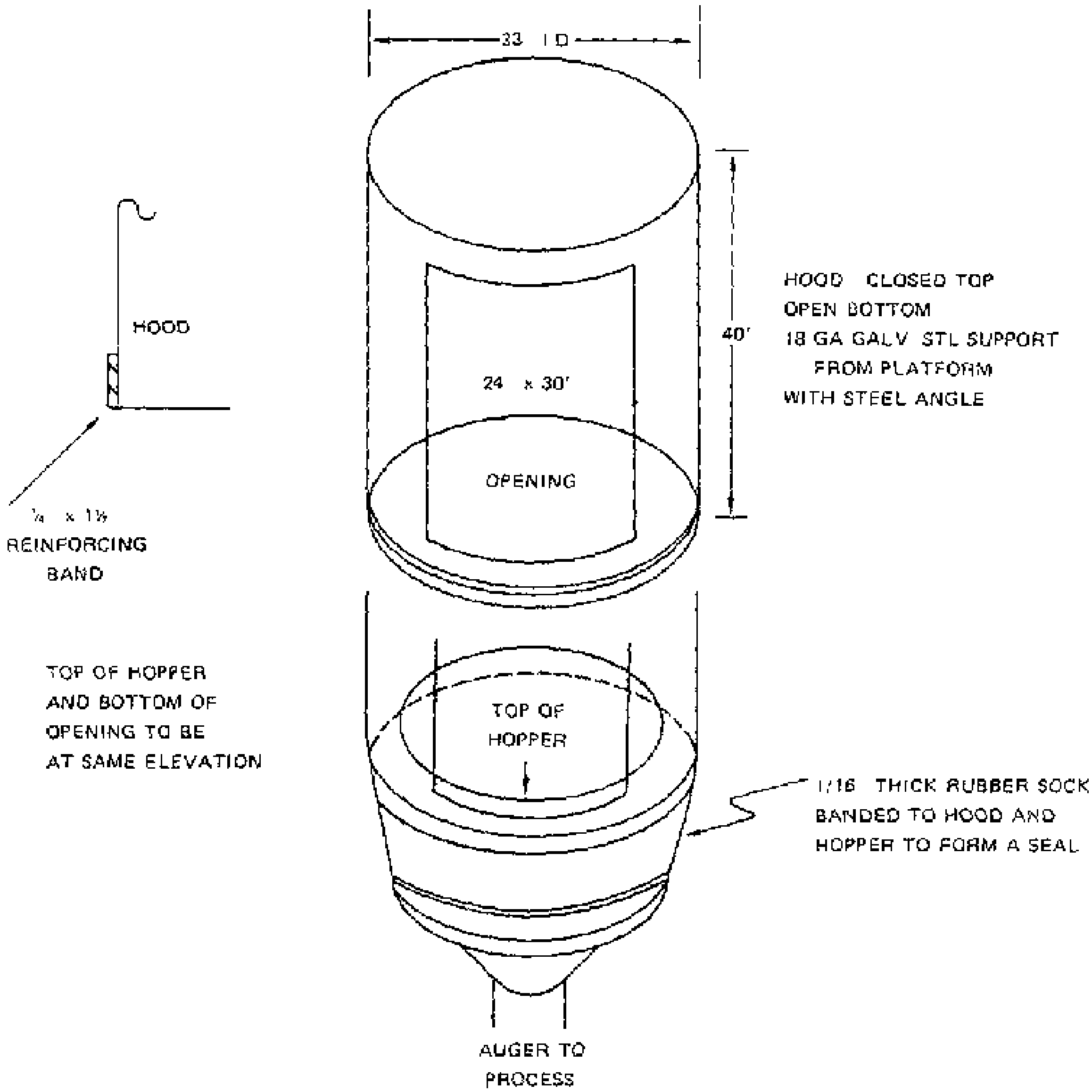


FIGURE VIII-3

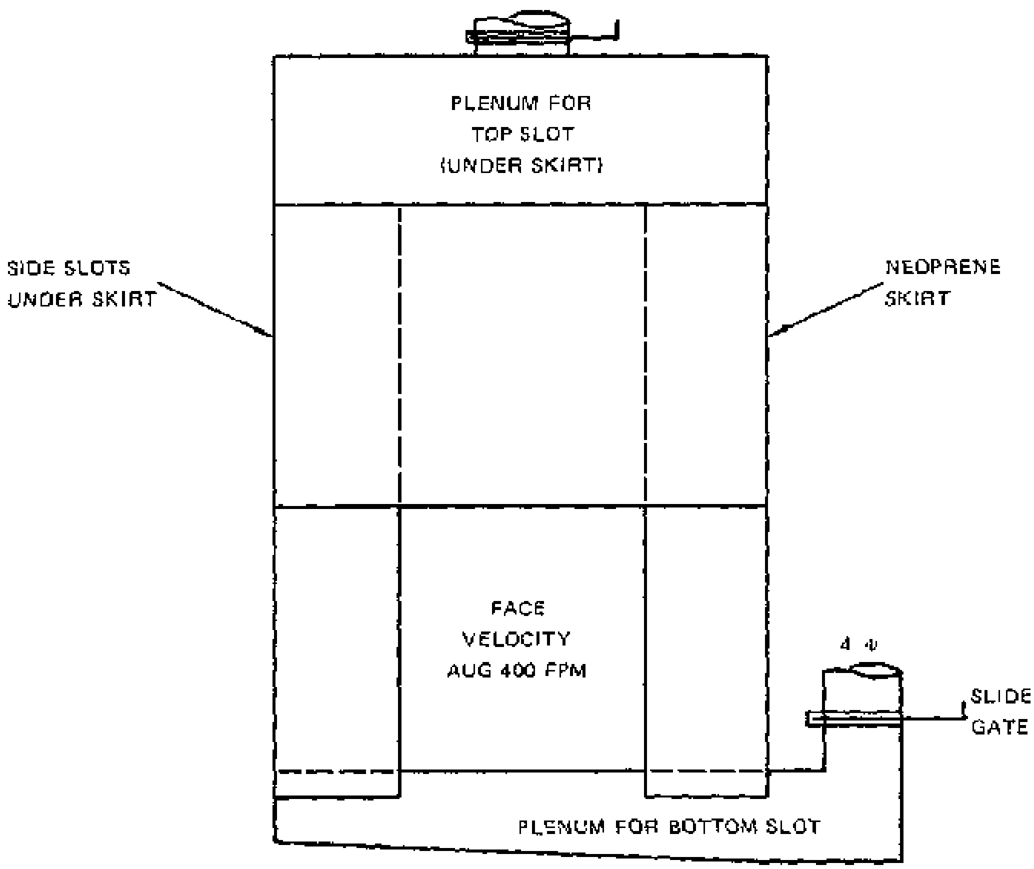
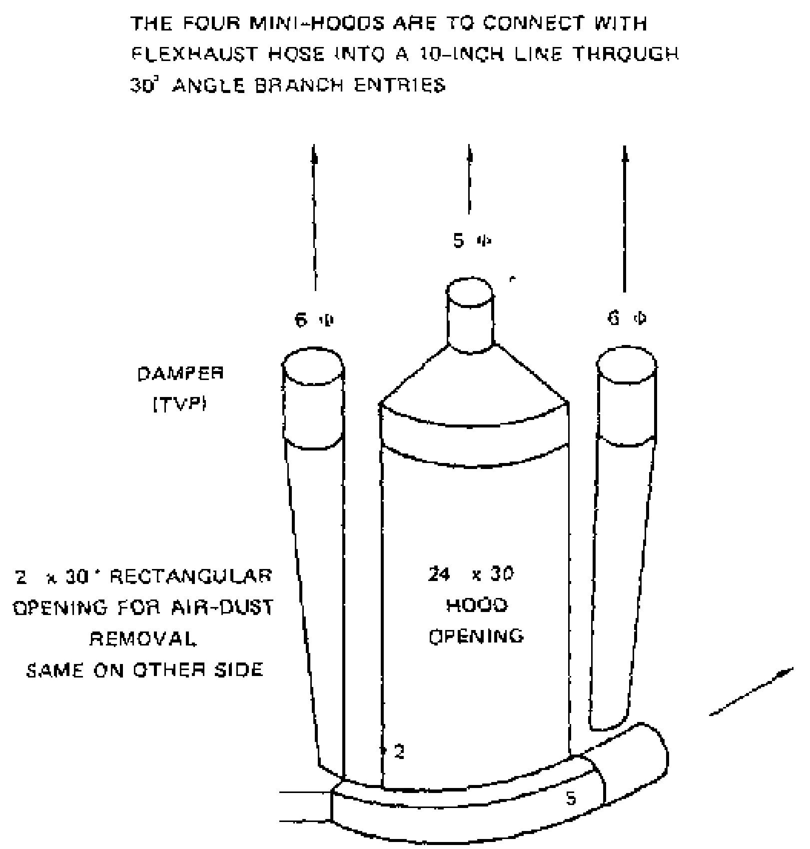
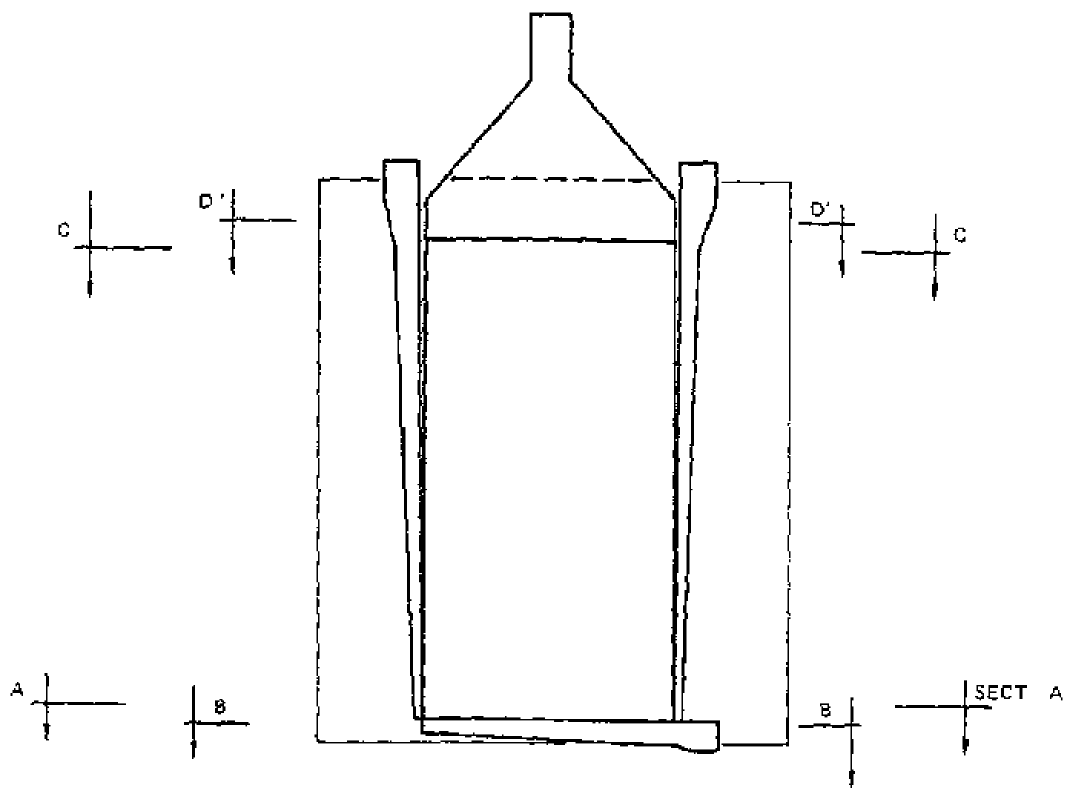


FIGURE VIII-4



NOTE All four above units to be mounted on hood around the 24 x 30 opening

FIGURE VIII-5



NOTE Refer to Figure VIII-6 for sections

FIGURE VIII-6

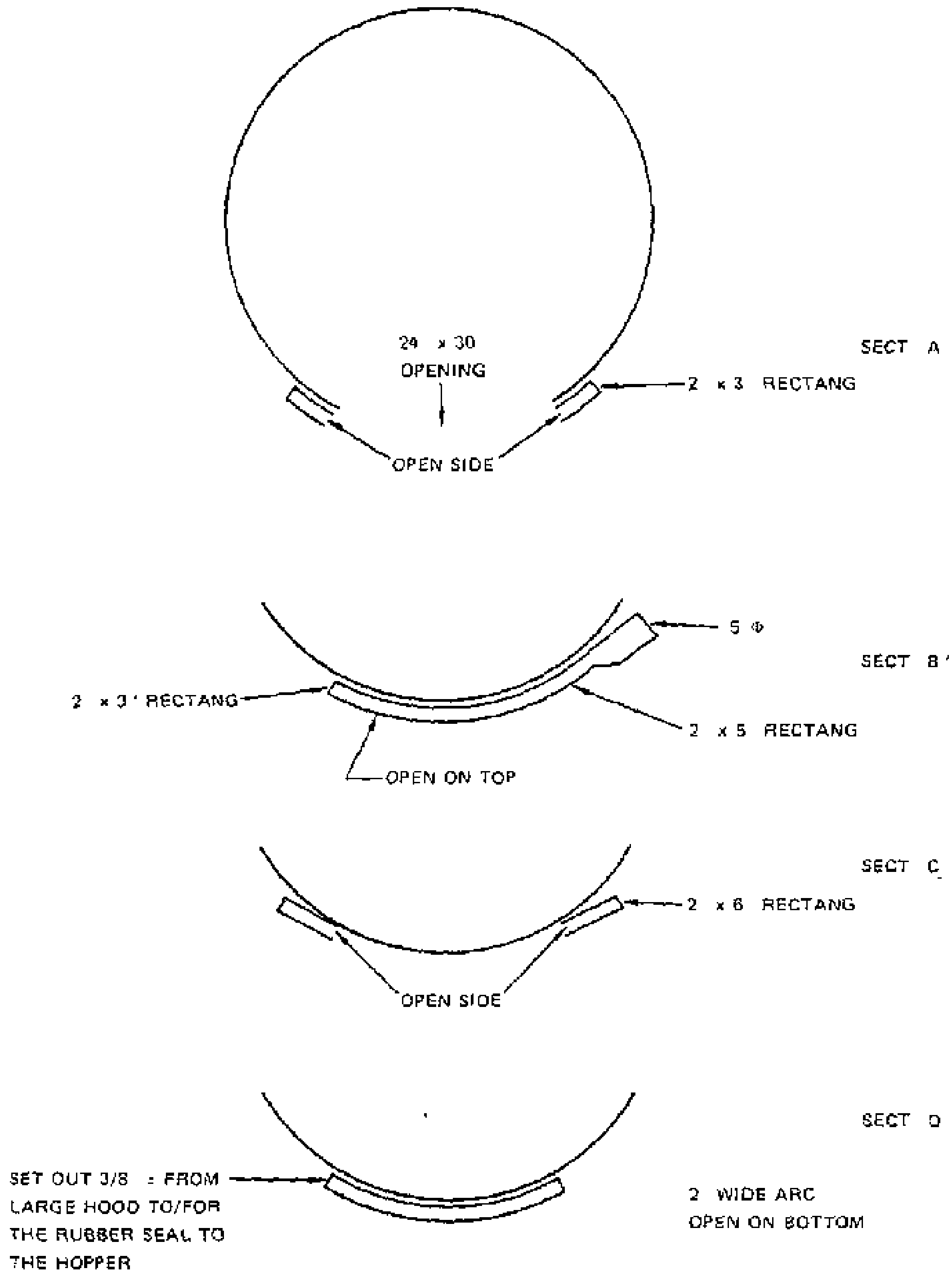


FIGURE VIII-7

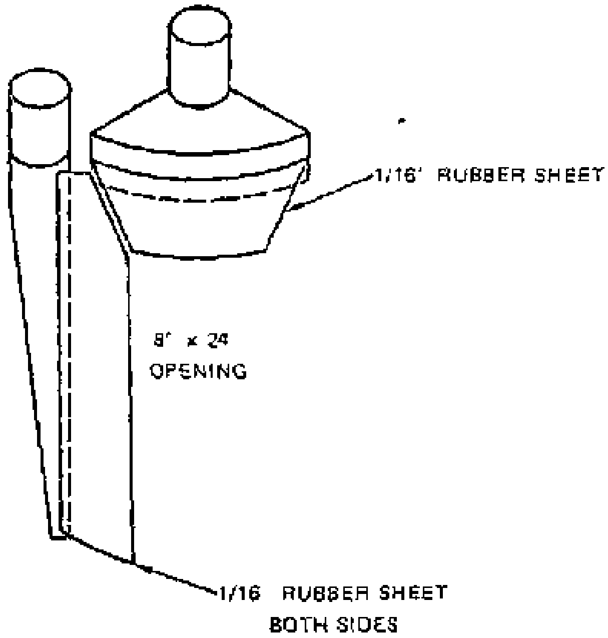


FIGURE VIII-8

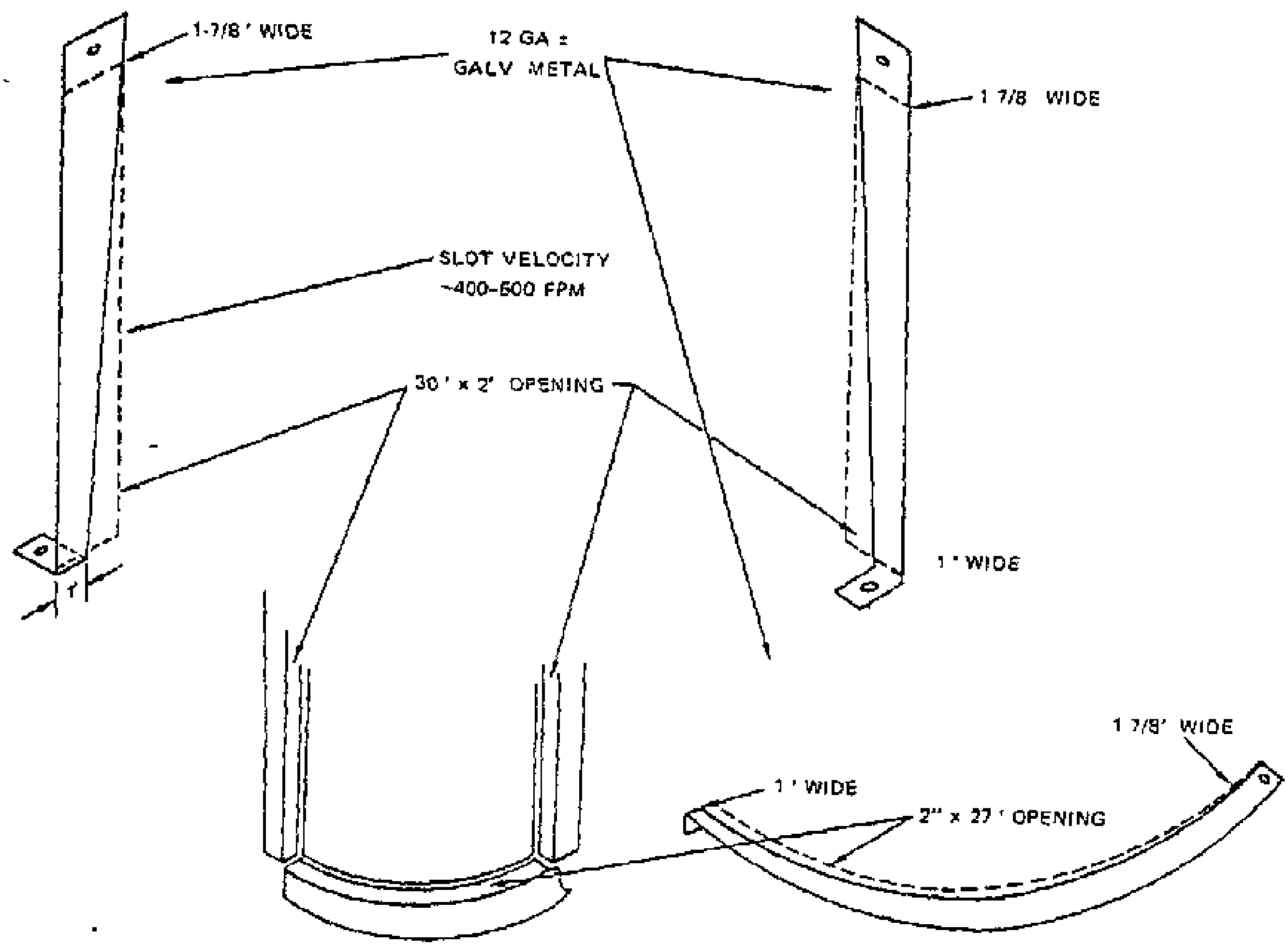


FIGURE VIII-9

IX

PROCESS. Quality control sampling

PROBLEM: Preventing exposures during sampling

SOLUTION: Glove box for sampling

In Figure IX-1 is shown a Q.C. sampling glove box used for sampling highly toxic materials. The box is used as follows

1. The sample line is opened and run to waste for two minutes.

2. The water spray, which floods the entire inner surface of the box, is turned on for 2 minutes.

3. A 16 oz. jar is placed in the box through the sliding lid. The operator wears butyl rubber gauntlets which prevent skin contact with the box.

4. Using the gloves in the side of the box, the operator opens and moves the sample jar under the sample line.

5. The sample is taken.

6. The line is closed.

7. The jar is closed (using the gloves) and moved under the lid.

8. The water spray is turned on for 2 minutes.

9 The lid is opened, the sample jar removed and wiped off, and the lid closed.

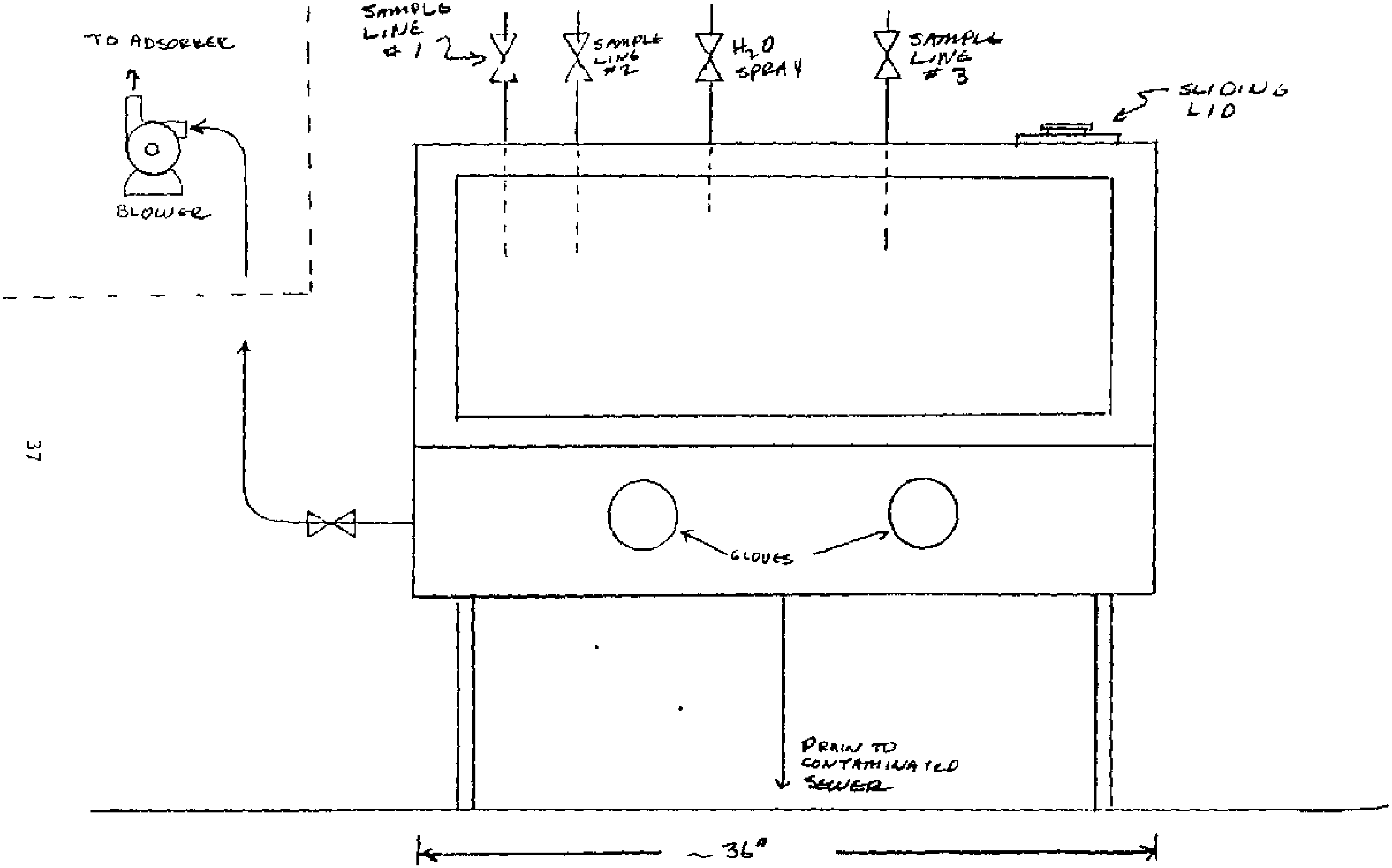


Figure IX-1
Q.C. Sampling Glove Box

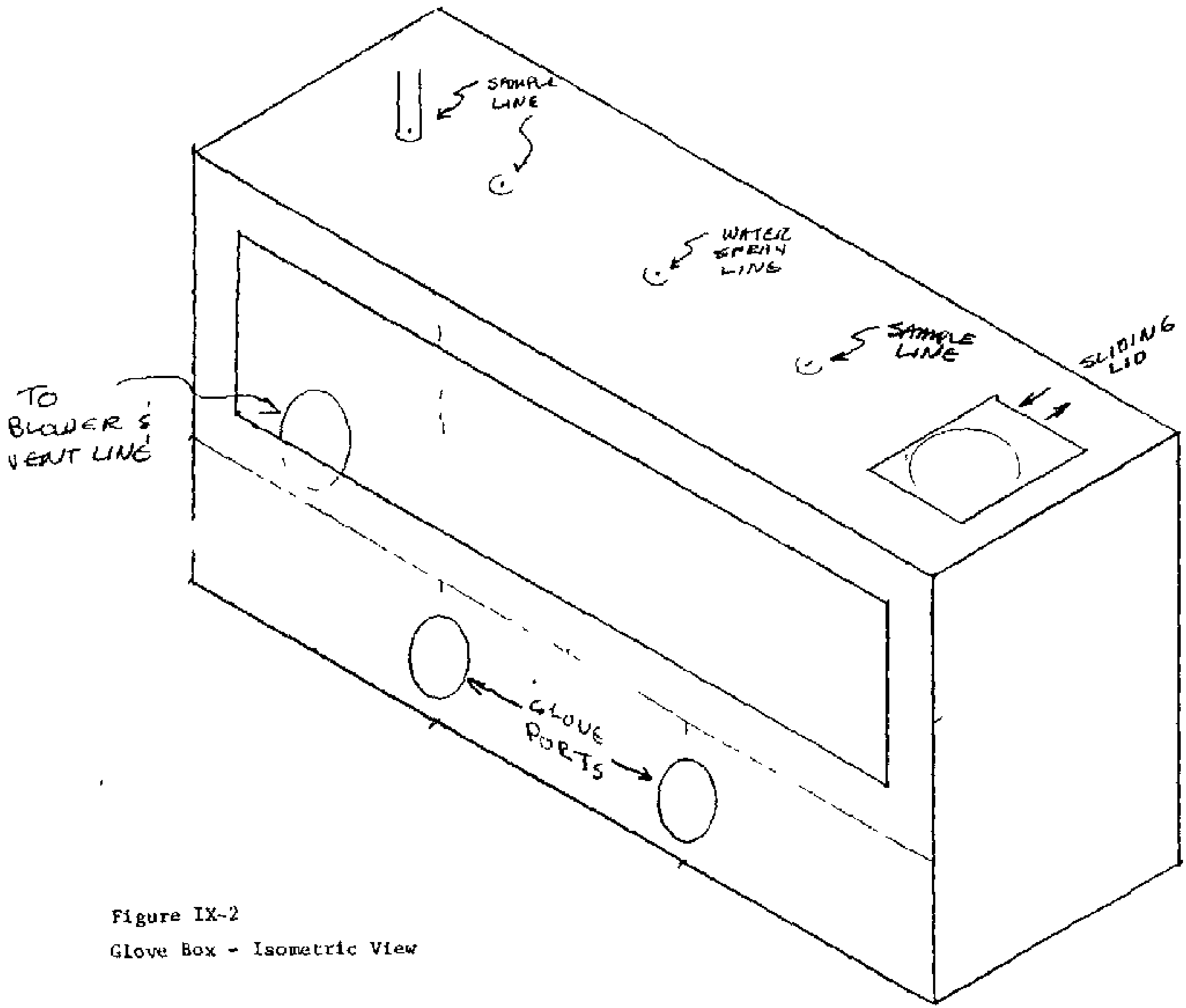


Figure IX-2

Glove Box - Isometric View

X

PROCESS. Open top bag filling

PROBLEM: Dust emissions from tops of bags after filling

SOLUTION: Side-draft slot, and canopy-slot hoods along conveyor line.

As the filled bags from the Mateer bag-filler travel down the line to be closed after filling, dust may be emitted from the top of the bag. Figure X-1 is a plan view, and Figure X-2 is the elevation of the ventilation system. Details are also shown in Figures X-3 to X-6

The table below shows the flows measured at the various hoods in this line.

Hood#		FPM	CFM
#2 New bagging Line			
A	Exhaust vent at bag filler	$\bar{v}$=3400	Q=42
	1 standing hood behind conveyor	$\bar{v}$=1683	Q=640
	2. standing hood behind conveyor	$\bar{v}$=1017	Q=401
	3 standing hood behind conveyor	$\bar{v}$=2842	Q=471
B	Hood around brush sweeping conveyor	not measurable	
	4 canopy hood over bagging line conveyor	$\bar{v}$=663	Q=317
	5. standing hood behind conveyor	$\bar{v}$=3800*	Q=518
	6. standing hood behind conveyor	$\bar{v}$=1615	Q=179
C	Nozzle at mouth of bag sealer	$\bar{v}$=2300	Q=69

* measured in duct, not at hood face.

This line was not operating during the SRI visit, so exposure data were not available. Because of overlap of jobs, TWA measurements by the company include all jobs in the packout room, not this line exclusively, indicated exposures are less than 3 mg/m^3 A highly toxic contaminant is found in the product; exposures to this contaminant are less than 20 $\mu g/m^3$.

The conveyor brush (Figure X-6) has not been effective in this application, because the dust handled is very fine and adheres to the rough surface of the belt. It is shown here because the company has had good experience in reducing general floor contamination in other operations where coarser materials are handled.

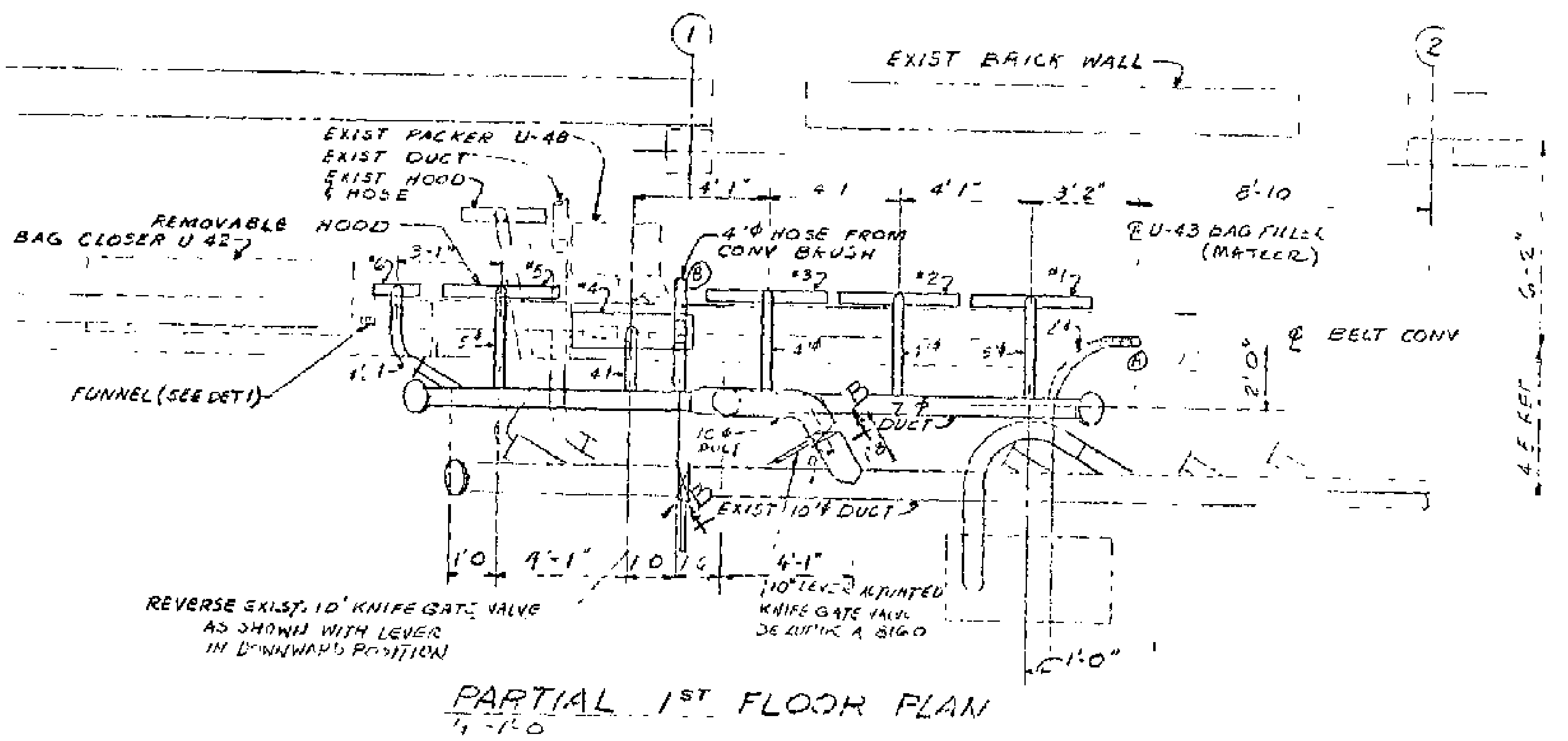
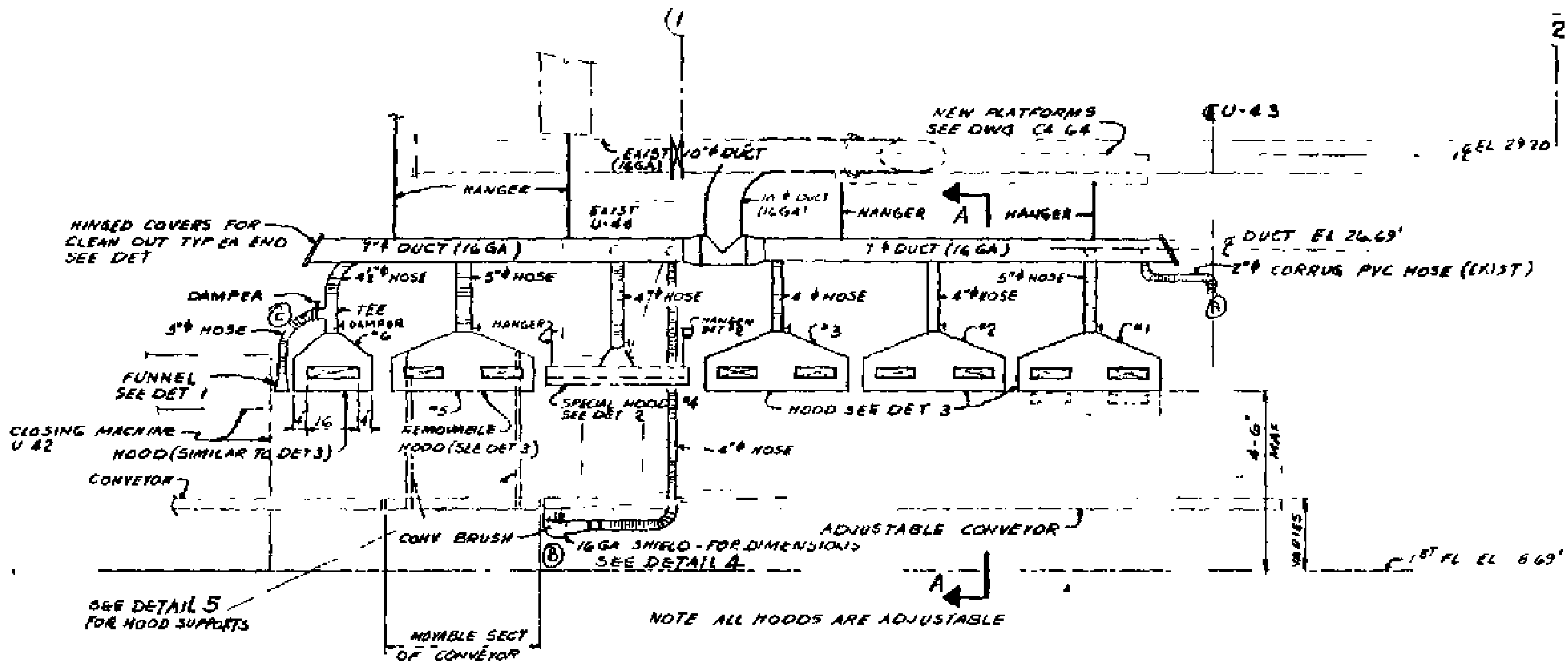


Figure X-1

Bag-Filling Ventilation System



ELEVATION
3/8" = 1'-0

Figure X-2

Bag-Filling Ventilation System

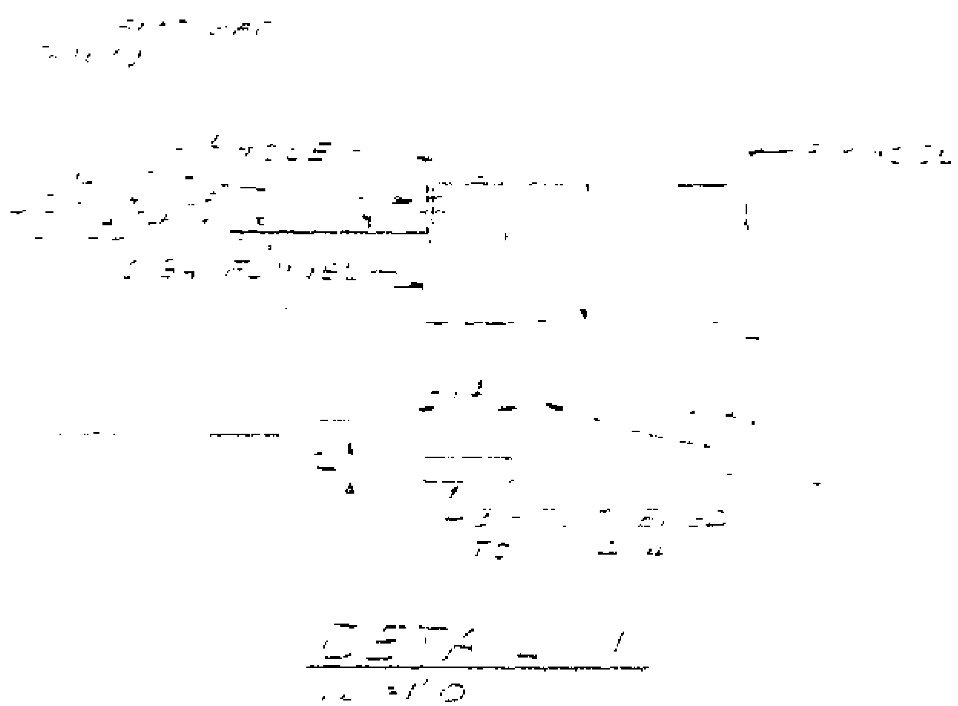


Figure X-3

Bag-Filling Ventilation System

Figure X-4
Bag-Filling Ventilation System

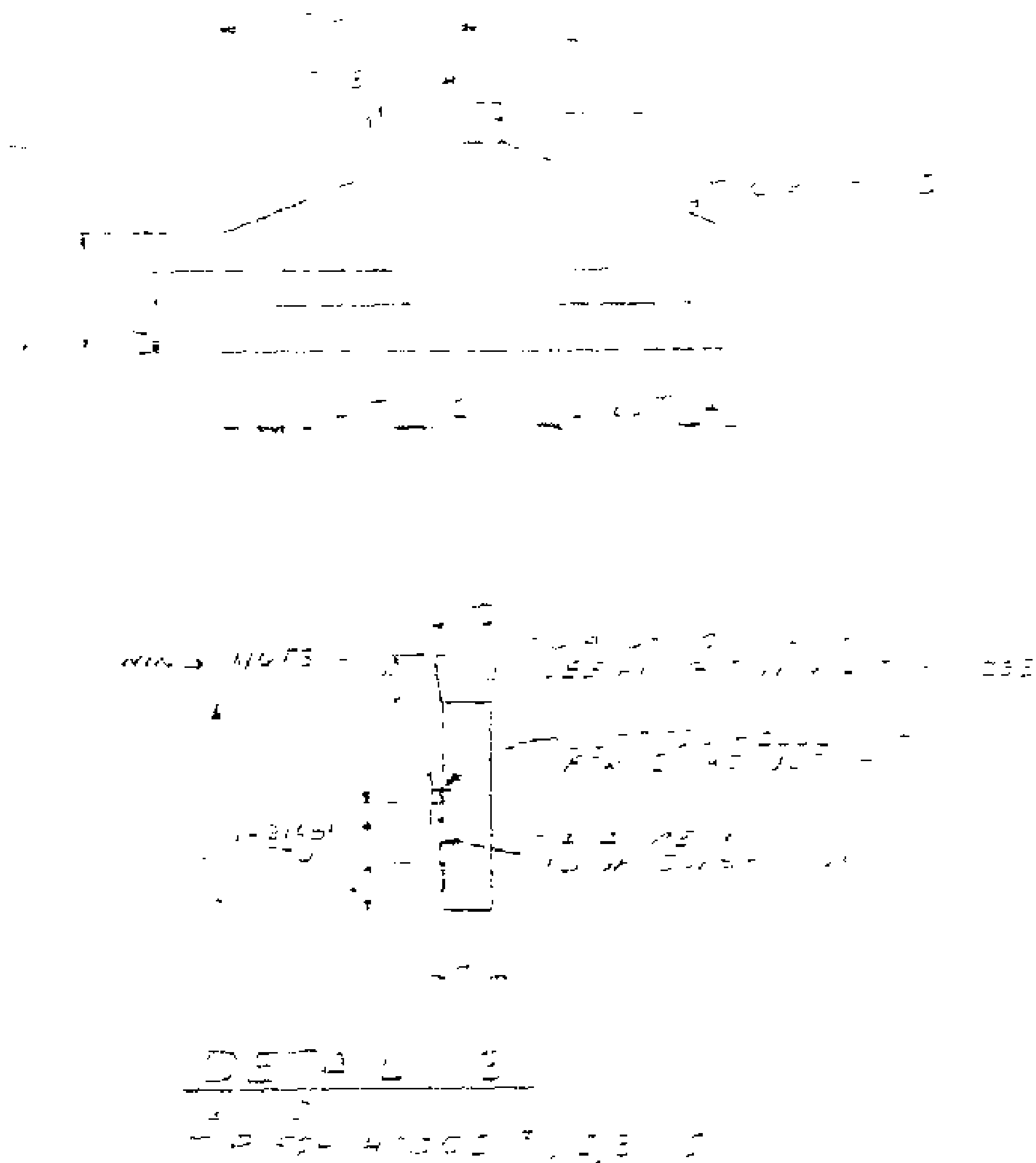


Figure X-5

Bag-Filling Ventilation System

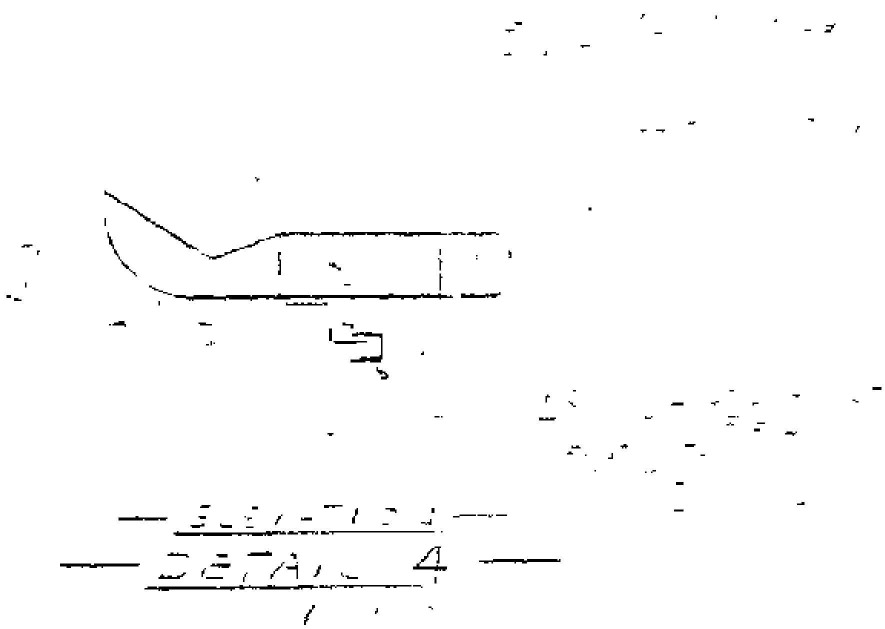


Figure X-6
Bag-Filling Ventilation System

XI

PROCESS. General plant operations

PROBLEM: Asbestos-containing insulation

SOLUTION. Replacement with non-asbestos-containing substitutes

Asbestos has been completely replaced (or is being replaced) throughout the plant. Suitable replacements have been found for all applications.

XII

PROCESS: Drum filling

PROBLEM: Dust exposure control

SOLUTION. Local exhaust ventilation

Two Carter Vacuum Pack Drum Fillers are used to fill fiber drums. To prevent airborne dust exposures during topping off and covering the drum (level pack), a series of hoods is provided. A plan view of the system is shown in Figure XII-1. Figures XII-2A through XII-2C show details of construction for the original hoods, 7-9, while Figures XII-3 to XII-5 show the slots on the bottom of the hoods and measured air flow rates during the SRI visit. Slot velocities and total flows measured by the company are shown below.

#2 Vacuum Packer	Avg. Slot Vel. ft/min	Flow in ft^3/min
K- HOOD #		
4- Rectangular shaped canopy type hood over conveyor line after scale	$\bar{v}$=1925	Q=1210
5- Rectangular shaped double cone canopy hood before scale	$\bar{v}$=1878	Q=1850
6- "C" shaped canopy hood at vacuum packing unit	$\bar{v}$=2000	Q=1400
#3 Vacuum Packer		
7. Rectangular shaped double cone canopy type hood over conveyor after scale	$\bar{v}$=523	Q=288
8 Rectangular shaped double cone canopy type hood over conveyor before scale	$\bar{v}$=2535	Q=1743
9. "C" shaped canopy type hood over conveyor in front of vacuum packer	$\bar{v}$= 2430	Q=1312

Operator personal breathing zone exposures were measured during this operation (TWA-near full shift measurements), using filters with or without cyclones (conventional personal dust sampling). The results were:

Respirable Dust (mg/m^3)		Total Dust (mg/m^3)	
All	Active Ingredients "A"	All	Active Ingredients "A"
0.46	0.26	1.81	1.61
0.78	0.18	1.32	0.47
0.62	0.36	1.77	1.39
0.43	0 07	1.19	0.78

It should be noted that the dust should be nearly all "respirable". It may be that static charging of the nylon cyclone is giving artifically high collection.

One problem with the hoods was noted. The screens in the slots were somewhat clogged with collected dust, thus reducing air flow. A simple brushing removed enough dust to improve air velocity (from 400 to 1400 FPM in one case). Removal of the screens might be appropriate, although they were installed to prevent entrainment of papers, rags, gloves, etc., which might clog the system.

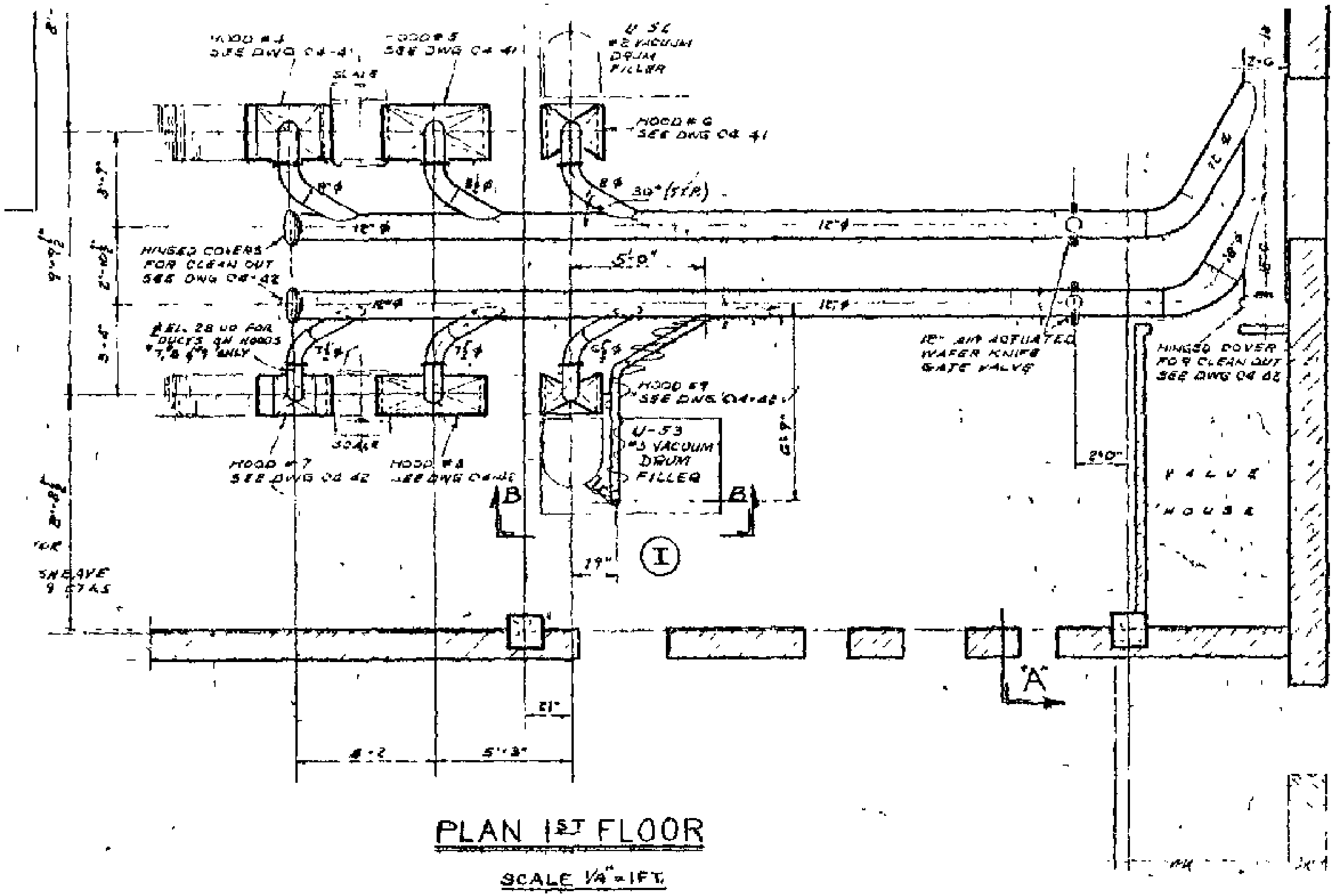


Figure XII-1

Drum Packaging Line

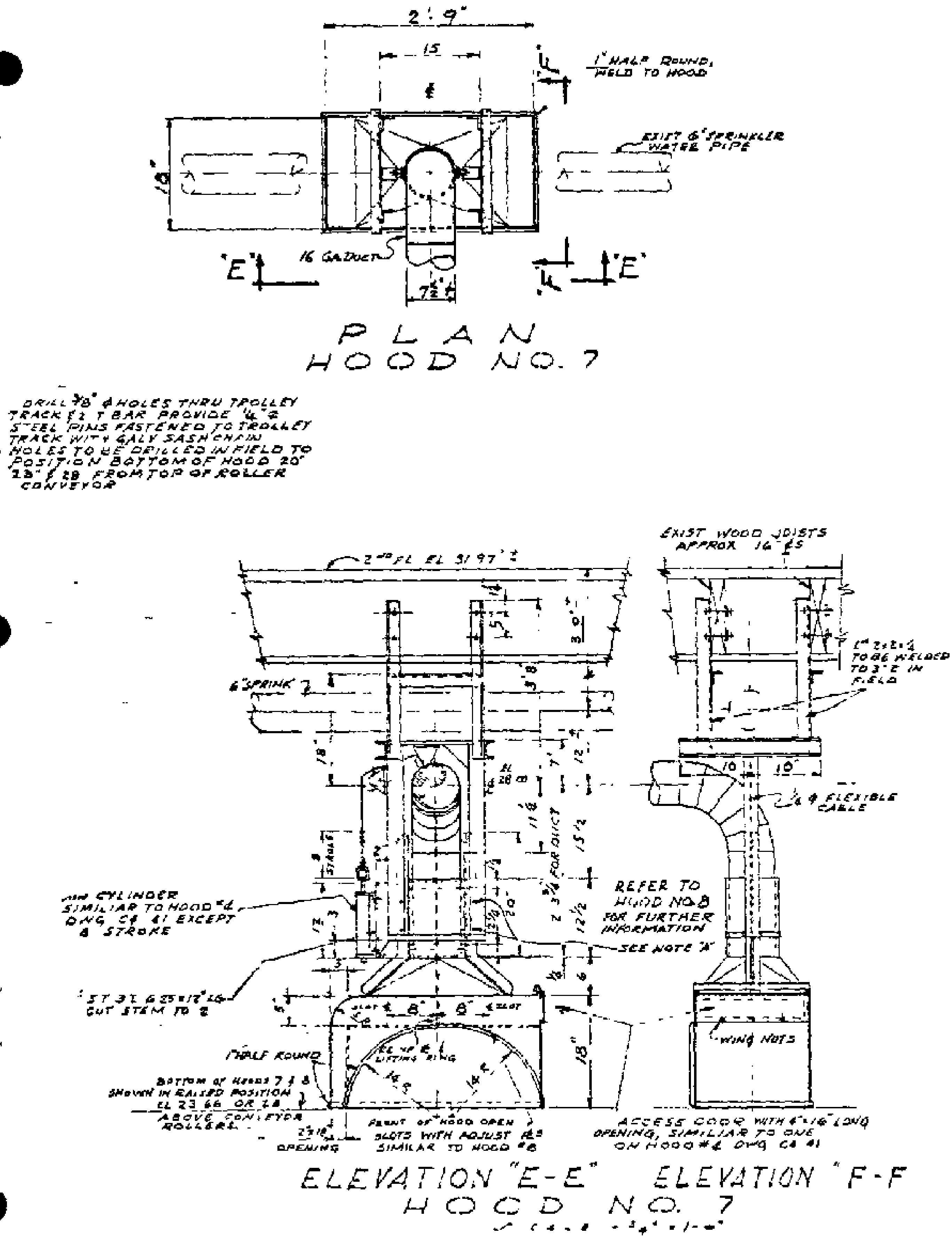
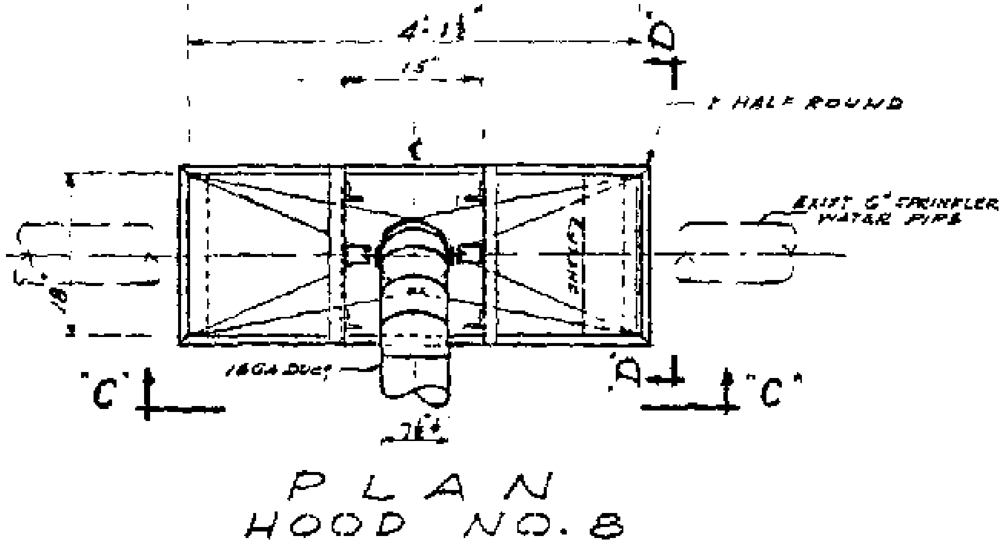


Figure XII-2A   Detail of Hood No. 7



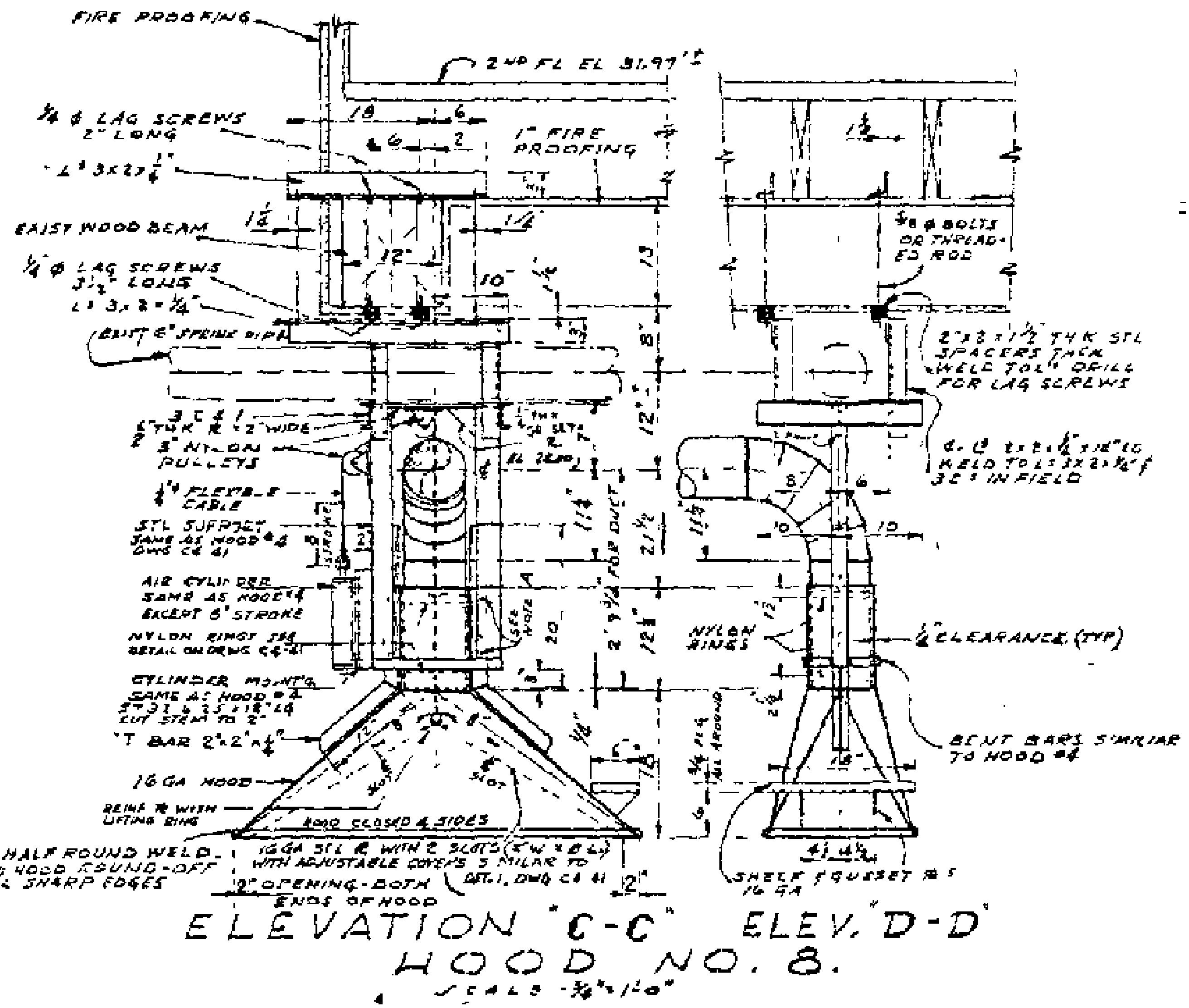
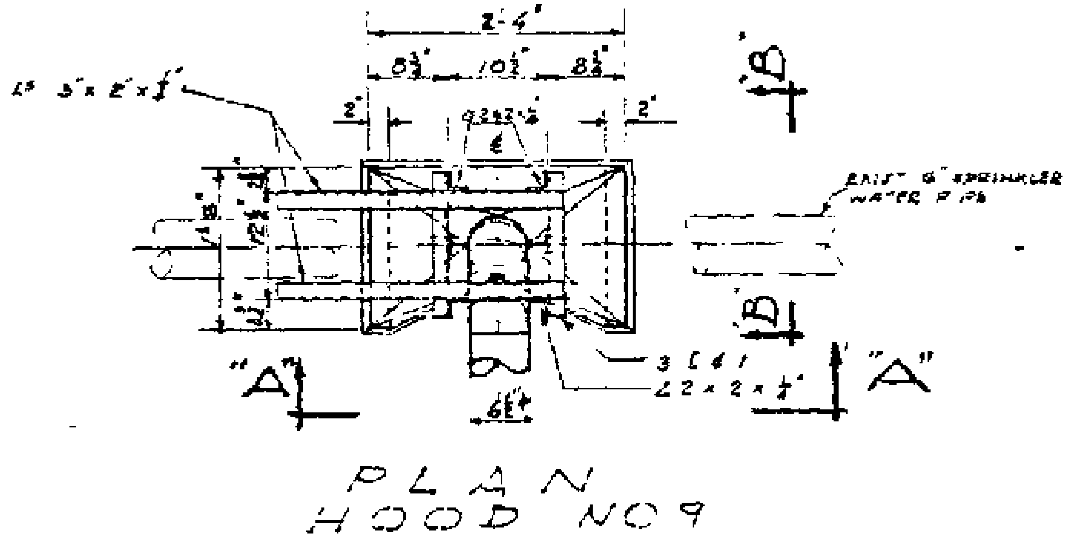


Figure XII-2B   Detail of Hood No. 8



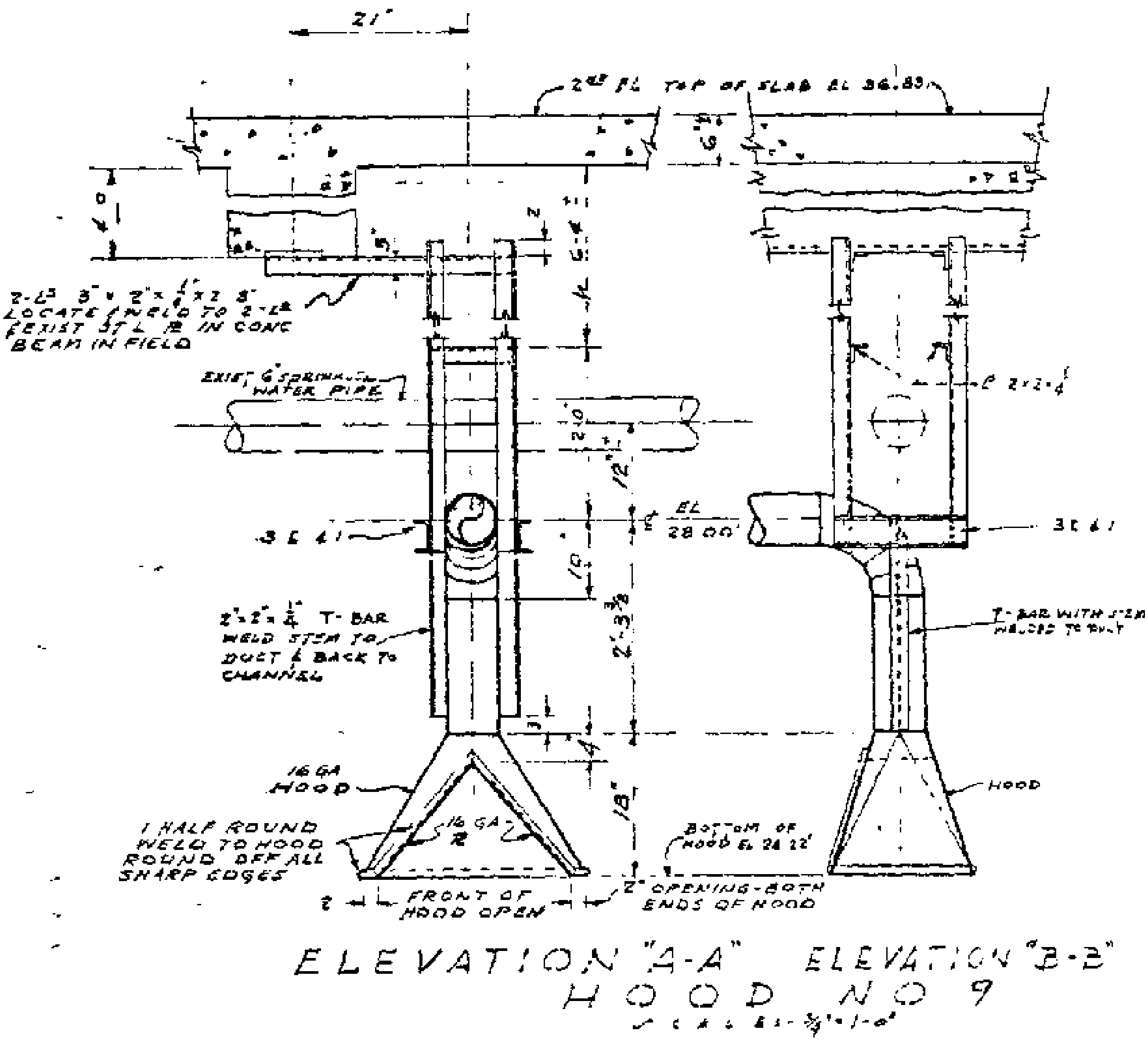


Figure XII-2C   Detail of Hood No 9

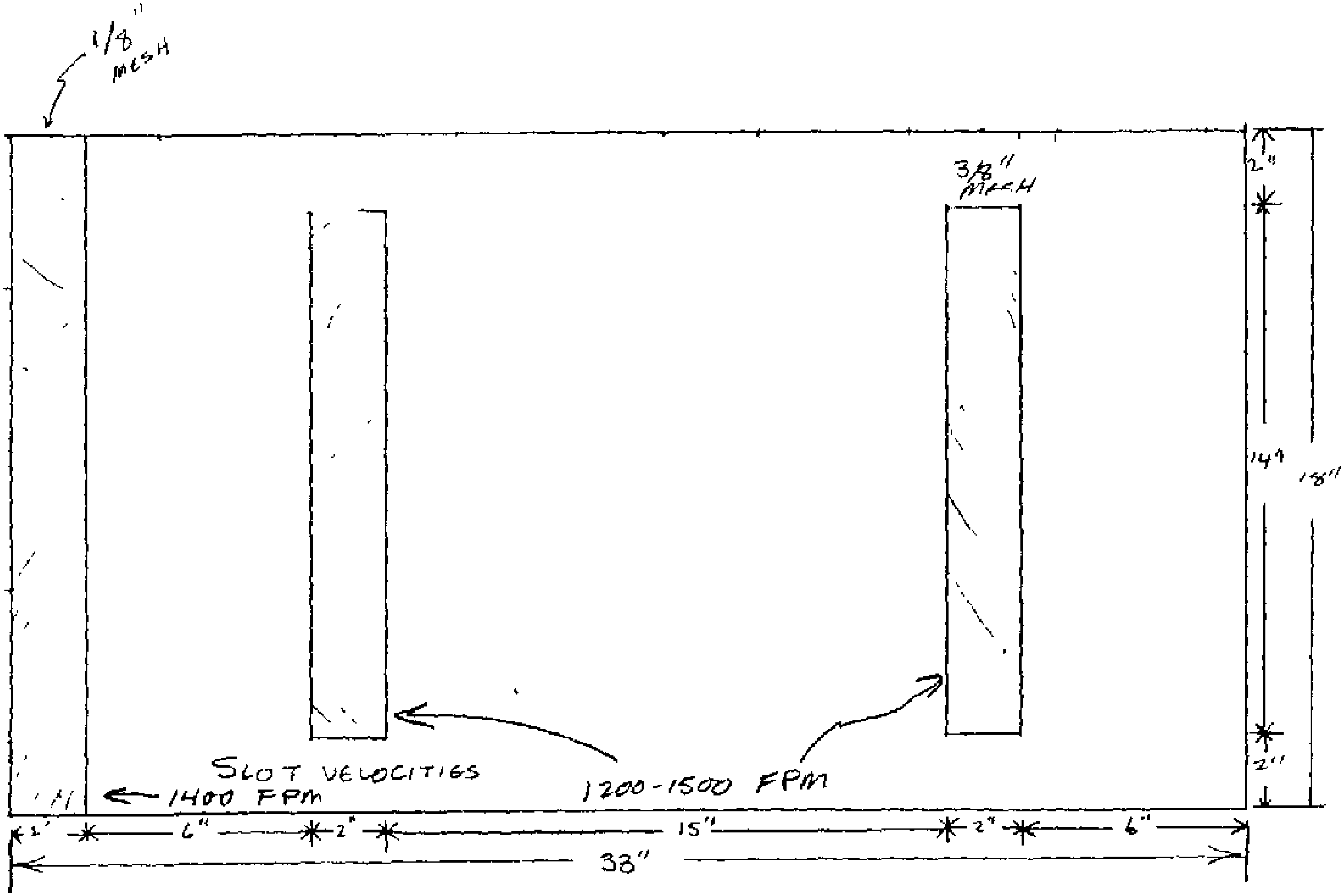


Figure XII-3

Plan View of Underside of Hood #7

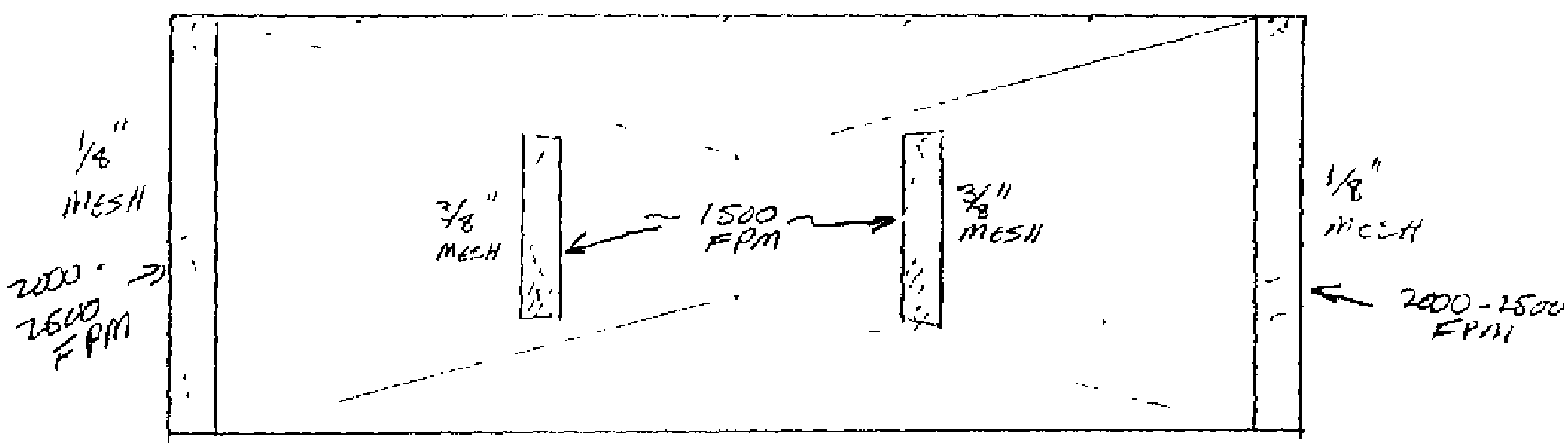


FIGURE XII-4

PLAN VIEW OF UNDERSIDE OF HOOD #8

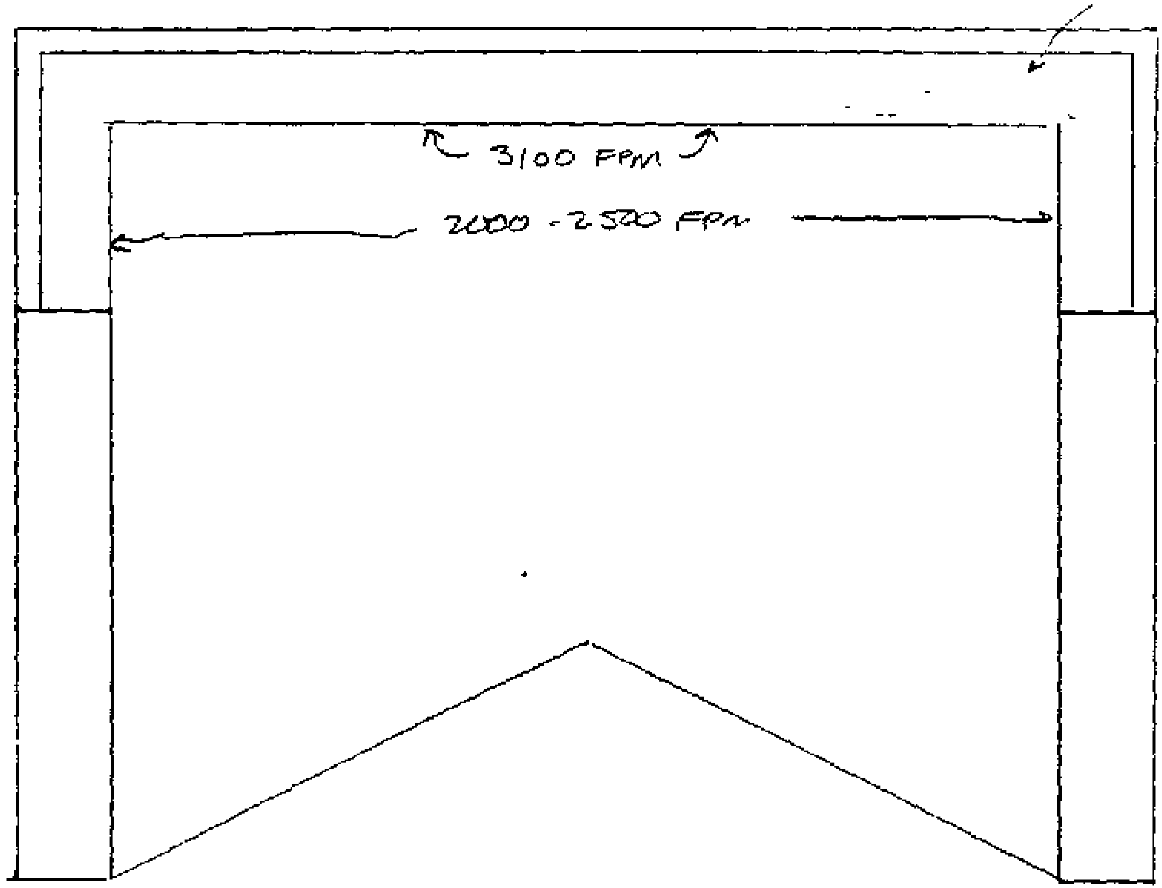


FIGURE XII-5

PLAN VIEW OF UNDERSIDE OF HOOD #9

XIII

PROCESS: Packaging operations

PROBLEM: Dust from operations

SOLUTION: Install baghouse filter in ventilation air system

To capture pesticide dust which is removed from the packaging operation by the ventilation system, a Dustex Model 25-8-4 baghouse filter was installed. The unit operates with an air flow of about 8500 SCFM and reduces emissions to 0.006 lb/hr. The air flow is supplied by a Buffalo Forge Company, Type MW, size 55 heavy duty industrial exhaust blower. It is rated at 12000 CFM at 16" static pressure at 1452 RPM and employs a 1750 RPM, 50 HP motor. There is a 36" diameter exhaust stack 10' above the roof level.

The Dustex Collector unit is a Model 25-8-4, four compartment "Inductaire" fabric bag filter unit with reverse pulse air. The collected dust is conveyed to a 55 gallon open top drum (which is changed daily) by a screw conveyor. The unit has an explosion door and the bags are removable from the top. The unit is located inside a building in a large room on the top floor with some other process equipment. The plant reports that the unit performs well and requires little maintenance. Bags are changed twice a year as a preventive maintenance measure. The unit has been in operation since 1964 and no unusual problems have been reported.

The air for pulsing the bags is supplied by a compressed air source (house air) at 25 SCFM at 90-105 psig. A drawing of the system is presented as Figure XIII-1.

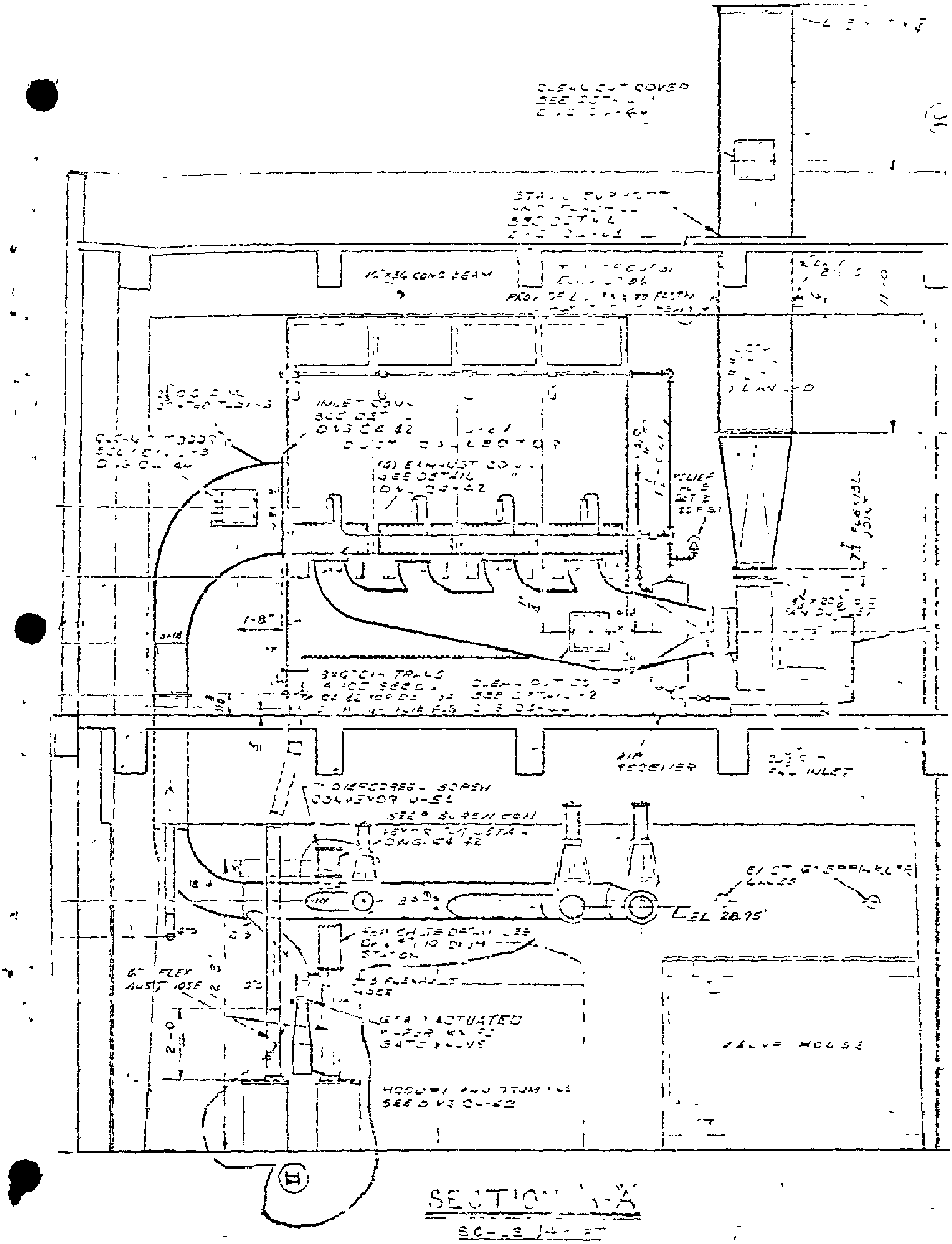


Figure XIII-1

XIV

PROCESS Spray drying

PROBLEM: Recovery of fine pesticide product from exhaust air stream

SOLUTION: Installation of cyclones and a Peabody wet impingement plate scrubber to collect particulates

A large (18' diameter) spray dryer is used to spray dry a pesticide product. The product from the spray dryer is then further processed in other units. Some of the product from the spray dryer is collected in the internal cone cyclone of the spray dryer and transported to the next unit. However, about 20% of the product is entrained in the dryer air exhaust stream and must be recovered for both economic and environmental reasons. A combination of cyclones and a wet scrubber are used to capture the particles as shown in Figure XIV-1.

The 8 cyclone collectors are 31 1/2 inch diameter by 8' 11 5/8" long Approximately 225 lb/hr (a fraction of the total product of the spray drying operations) are processed by the cyclones. The cyclones are approximately 85% efficient, recovering about 192 lb/hr of product. The remaining 33 lb/hr of product which passes through the cyclones is fed to the Peabody scrubber. The dirty exhaust air from the cyclone is pulled through an American Blower exhaust air fan into a 6' diameter x 16'6" high Peabody water impingement scrubber The scrubber can be operated with one or two impingement trays, each perforated with 3/16" diameter holes. The flow of water along the plates is channelled by special vertical fins welded to the top of each plate which parallel the rows of holes. The scrubber also contains a bank of 6 auxiliary deluge nozzles fed from a fire hose as well as the original bank of spray nozzles fed by a recirculation pump and used to clean the underside of the impingement plate. One arrangement of the scrubber internals is shown in Figure XIV-2. The single impingement tray configuration shown in Figure XIV-2 is presently used for some product grades The scrubber slurry is recycled to the spray dryer via the additives tank. Other grades require additional scrubbing so the two impingement tray configuration utilizing the auxiliary deluge nozzles is normally used. The scrubbed effluent air is exhausted to the atmosphere through a 2'6" diameter stack 83 ft. above ground level.

Scrubber Specifications

Peabody Scrubber, 12,000 CFM gas volume, 170°F to 190°F inlet 120°F dew point, 29 mol. wt. Two Stage Scrubber, 7.5" W.C. pressure drop, 6' dia., 11 ga. 304 SS construction. Two impingement baffle plate stages and humidifying stages. 2'6" OD gas discharge from fan, U-18, and vent through Stack, U-19. 450-gallon bottom sump.

Operating Data

The Peabody scrubber is approximately 85% efficient when operating on the product which is exhausted from the cyclones. The following data were supplied by the plant:

Scrubber Inlet lb/hr	Scrubber Outlet lb/hr
37.7	4 8
18.5	2.8

For purposes of an Air Pollution Control permit, the unit is described as reducing emission to 5#/Hr.

Overall Efficiency- the combination scrubber and cyclone system is over 99% efficient in collecting product dust from the spray drying operation.

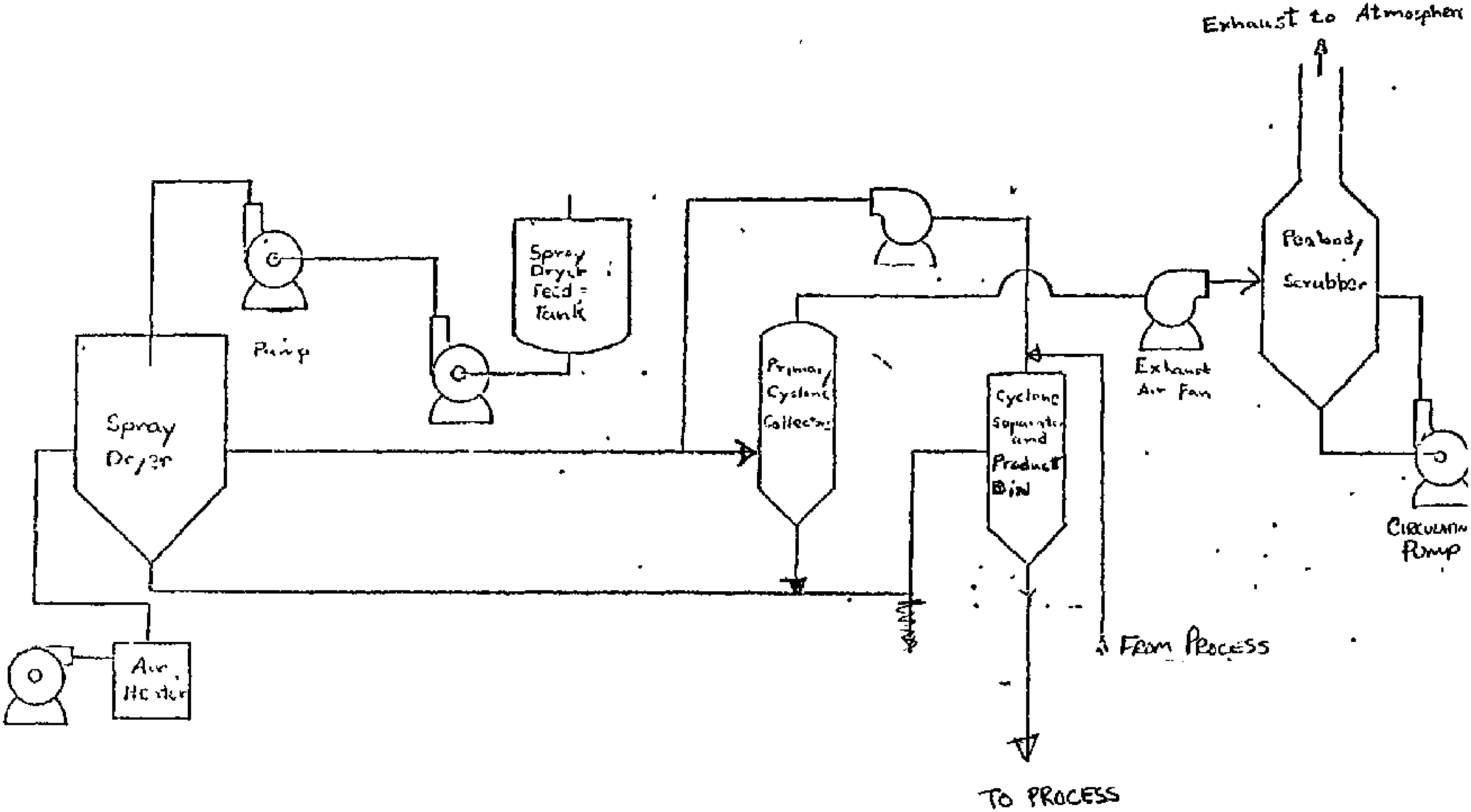


Figure XIV-1

Spray Drying Equipment

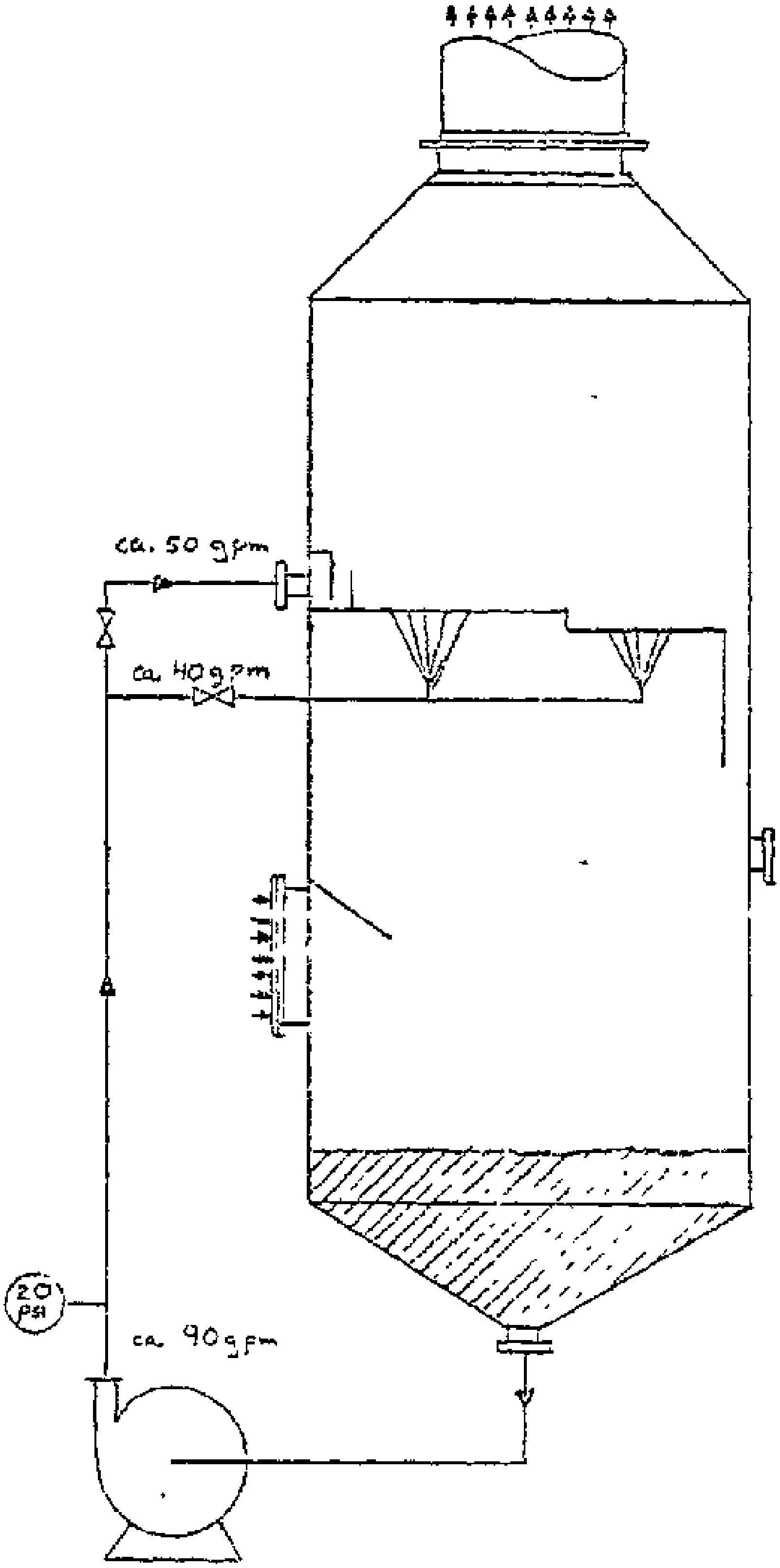


Figure XIV-2

Peabody Scrubber

XV

PROCESS Chemical reaction

PROBLEM: H_2S by-product gas venting

SOLUTION: Vent through caustic scrubber

A chemical reaction produces by-product hydrogen sulfide (H_2S) gas. Concentration in the vent gas from the reactor are too high to vent directly to the atmosphere due to the odor problem and the toxicity of H_2S. A packed-bed wet scrubber (Figure XV-1) was installed to capture the H_2S. Sodium hydroxide solution (caustic) at a concentration of 10-20% is circulated through the scrubber. A list of important instruments and equipment is presented in Table XV-1 Trouble-shooting and preventive maintenance procedures are presented in Table XV-2.

Operational Data

The plant supplied some historical test data on the operational performance of this caustic scrubber which is reported in Table XV-3.

Operating Cost Data and Materials and Energy Consumption

Approximate cost of the scrubber unit in 1971 was $68,000. Approximate cost in 1979 is $280,000. Operating costs were estimated to be about $9.00 per day including operating labor in 1971. This included consumption of about 200 lb/day of 50% sodium hydroxide (caustic) solution, $3.50 per day for electricity, and $2 50 per day for operating labor. In 1979, a rough estimate of these costs are

caustic 300 lb x $.15/lb -	$45.00
electricity	7.00
labor	7.00
	$59.00 per day

This cost does not include amortization of capital cost or maintenance cost.

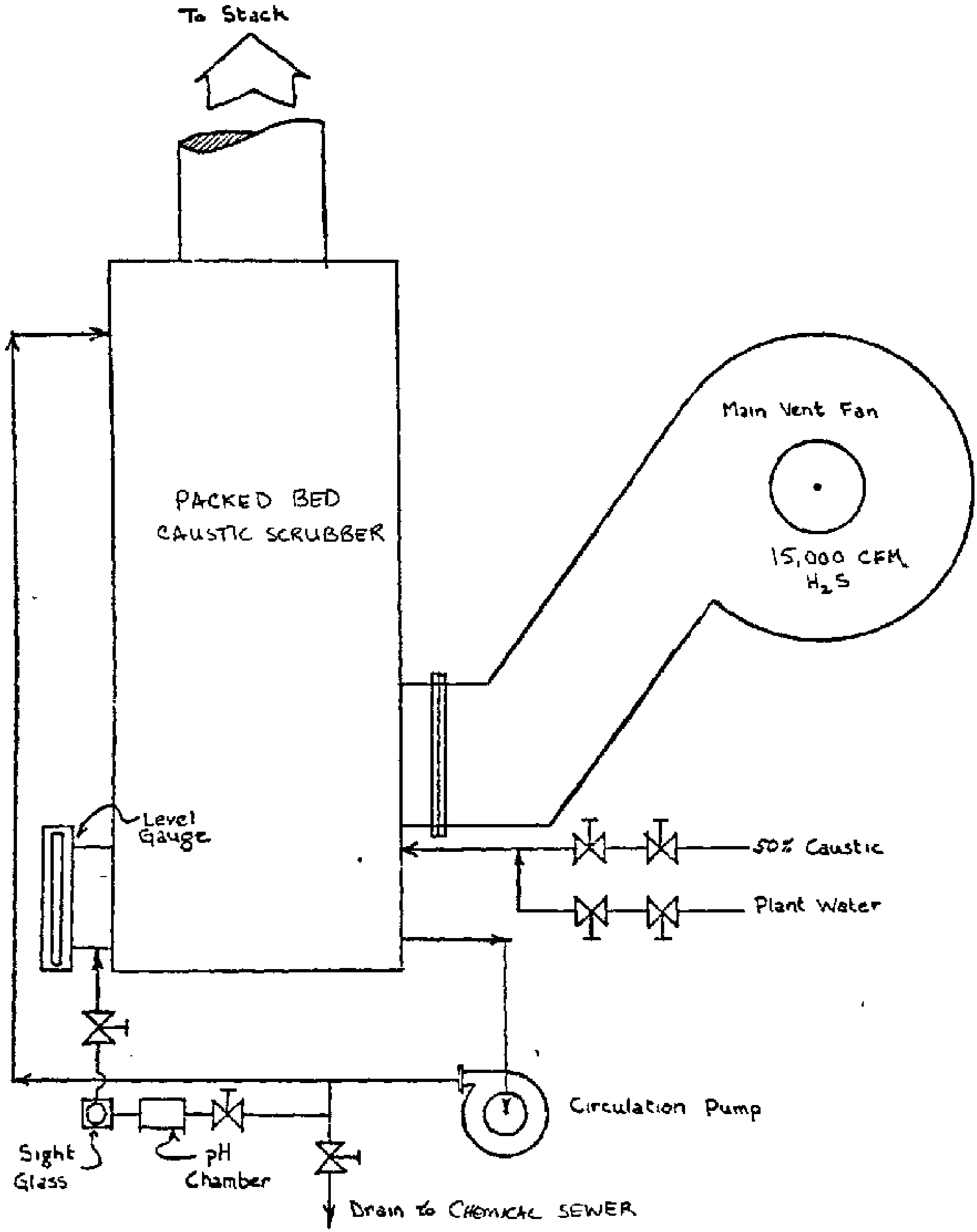

To Stack
Main Vent Fan
15,000 CFM
H_2S
PACKED BED
CAUSTIC SCRUBBER
Level
Gauge
50% Caustic
Plant Water
Circulation Pump
Sight
Glass
pH
Chamber
Drain to CHEMICAL SEWER

Figure XV-1

Table XV-1

SCRUBBER SYSTEM - EQUIPMENT

Instrumentation - pH Flow Chamber, Transmitter Analyser, Recorder and Alarm System

pH Flow Chamber

Beckman #190302 pH electrode flow chamber, type 316 Stainless Steel, with a #19505 high pH glass electrode and a #19033 Lazaran reference electrode.

Transmitter Analyser

Universal Interloc In. Model 1000U transmitter analyser and Model 2000020 F.E.T. solid state preamplifier.

Recorder

Fischer & Porter Co. Model #51-4202BL02 electronic recorder for 4 to 20 ma DC input signal with 4 to 14 linear chart and scale (Chart #212C212).

Alarm System

Rochester Instrument Systems Model ET-214D single voltage/current alarm for 4 to 20 ma DC input signal
Russel & Stoll Co. Cat. #SAEP-2 explosion-proof Unilarm.

Equipment - Scrubber Equipment

Scrubber Solution Circulating Pump

Down Bros. type PH-230, 2 x 3 - 8-1/2 cast iron centrifugal pump rated at 125 gpm @ 40 ft. head in 20% NaOH service, 5 HP, 1750 RPM, explosion-proof motor, Crane type 9 mechanical seal with high alumina insert and special carbon rotating face and seal face flushing connection in stuffing box.

Ductwork and 125 Ft. High by 4 Ft. Diameter Stack (Existing)

Johns-Manville Transite Vent Duct 30" diameter.
United Sheet Metal Co. Miscellaneous type 304 Stainless Steel ductwork.

13,000 cfm Ventilation Fan

New York Blower Co. #307RB General Purpose Fan, with 1800 RPM, 20 HP explosion-proof motor.
Rating: 13,000 cfm @ 6" S P., 125°F, 1520 RPM wheel rotation.

Packed Column Caustic Scrubber

Norton Co., 6 ft. dia. x 182-1/8 in. overall height polypropylene scrubber overwrapped with FRP with a recirculating bottom reservoir section of 300 gallons, ladder-type distributor, packed with 190 ft.^{3} of 2 in. polypropylene Intalox saddles.

Table XV-2

Troubleshooting and Preventive Maintenance

pH Instruments

If the pH Indicator-Recorder is not operating—

1. Check the pH sample line to be sure there is circulation through the pH flow chamber.

2. Check the Uniloc Indicator to be sure the switch on the cover is turned to the "OPERATE" position.

3. Check the power supply to the instruments.

4. Check pH flow chamber electrodes with standard buffer solution (pH = 10).

Scrubber Solution Circulating Pump

If the pump will not run --

1. Check electrical circuit and fuses.

2. Check pump coupling to motor and draft bearings.

3. Open pump casing and check impeller.

If the pump stuffing box leaks and the mechanical seal on this pump needs replacement, use a Crane type 9 mechanical seal with high alumina insert and special carbon rotating face. See Dean Pumps Inc., Dwg. SK-1453.

Periodic lubrication of bearings is required.

Ductwork and Stack

The Stainless Steel ductwork is type 304 and can be repaired by welding.

13,000 cfm Ventilation Fan

If the fan will not operate or is noisy in operation--

1. Check the electrical circuit and fuses.

2. Inspect the drive belts and pulleys.

3. Check the bearings on the fan shaft.

4. Inspect the fan wheel for any buildup of solids. Also inspect the connection of the wheel to the shaft.

Periodic lubrication of bearings is required.

Packed Column Scrubber

If any leaks in the scrubber develop--

1. Repair the polypropylene liner by welding using a hot air gun at 300-350°F and polypropylene welding rod.

2. The FRP overlay can be repaired using Atlac #382 resin and fiberglass cloth as necessary.

All operating and maintenance manuals have been previously issued to the Mechanical Department. Copies should be available from the job file and the equipment description files.

Table XV-3

Performance Test Data - Caustic Scrubber

H_2S inlet concentration	125 ppm
H_2S outlet concentration	<1 ppm
Scrubber pressure drop	2 1/4 - 2 3/4" H_2O
Fan pressure drop	7" H_2O
Caustic circulating pump pressure	15-20 psig
Air inlet temperature	65-90^{o}F
Relative humidity	25-85% (seasonal range)
Scrubber solution temperature	60-85^{o}F
PH	11-14
Air flow rate	15,000 CFM*

* exceeds design of 13,000 CFM

XVI

PROCESS. Plant operations - solids handling - general

PROBLEM: Dust spills in operating area

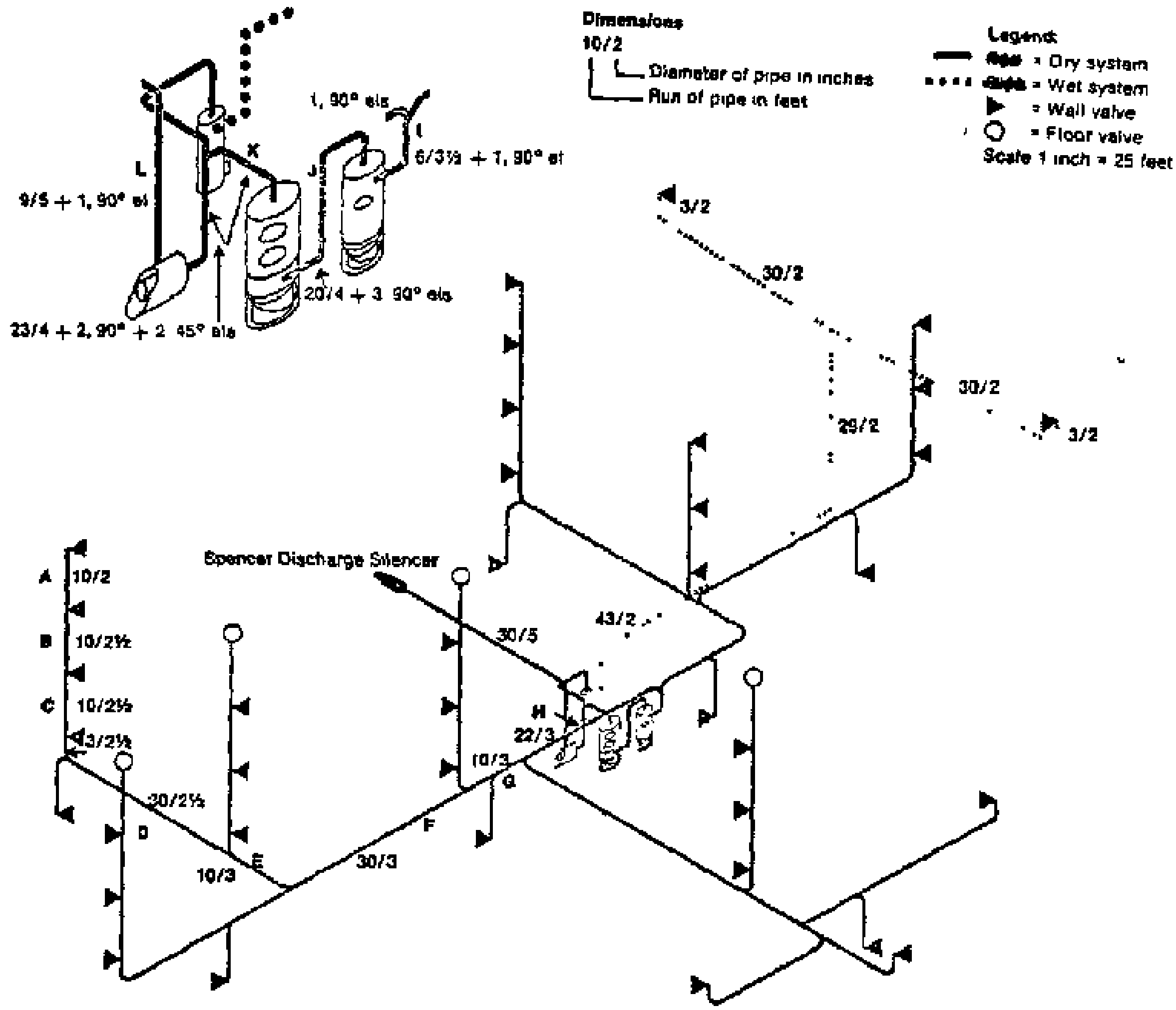
SOLUTION. Frequent cleanup with Spencer House Vacuum Cleaning System.

Due to the normal problem of handling, transporting and packaging a very fine (2 micron particle size) powder, there are spills of powder on the floors and equipment. To encourage quick cleanup of powder spills and good housekeeping, a central vacuum cleaning system was installed with vacuum heads and outlets in all areas where powder is handled. The unit is a Spencer Vacuum Producer which is rated at 240 CFM at 7" Hg. The vacuum intake pressure is 7" Hg. and the exhaust is atmospheric pressure (14.7 psi). The unit is 6' high with a 3'2" x 2'9" filter. A 30" cyclone-hopper is used in the system (volume 13.75 cubic feet) and a 36" baghouse filter with a bag area of 127 sq.ft. The vacuum producer employs a 10 Hp motor operating at 3500 rpm.

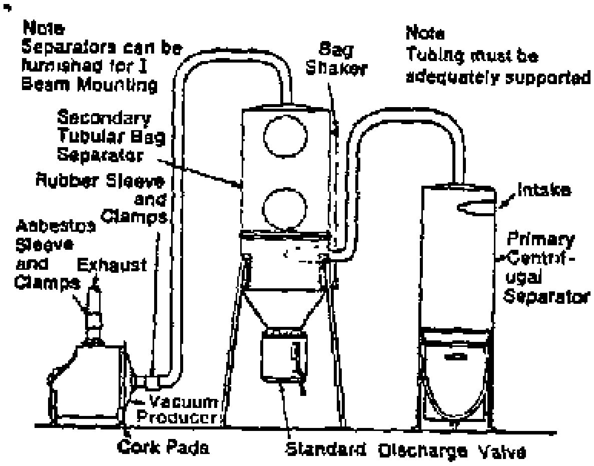
We observed that the unit produced good suction and apparently could easily pick up the powder. The reported emissions from the vacuum system are considered negligible ($<$.01 lb/hr).

The problems associated with vacuum systems are operator and equipment dependent. The lack of specific tools for cleaning crevices, corners, and other difficult to reach places is a major problem; tools are frequently lost and not replaced. Operators must be cognizant of the proper use and storage of tools and must be quick to use the system when the necessity arises The mere presence of the system does not guarantee efficient clean up; it requires operator action to make it effective.

Details of each installation will vary, and must be carefully considered for each individual case, but a general "typical" layout is shown in Figure XVI-1.



Typical Unit Installation



XVII

PROCESS: Unloading inorganic salt from hopper cars and preparing a clear solution

PROBLEM: Presence of contaminants in salt and toxicity of metal component (TLV = 5-10 mg/m^3)

Solution: Filtered vacuum pneumatic unloading systems

A pneumatic vacuum systems unloads salt to a storage bin which vents through a small filter. The salt is pneumatically transported from the bin to an elevated baghouse recovery filter. Salt drops via a rotary valve into the dissolving tank. The operator adds a small excess of salt and then adds sufficient water to meet specific gravity and concentration specifications. The process is shown in Figure XVII-1.

During the adding of solids, displaced air and salt dust are captured in a rotoclone blower-scrubber. The solution is filtered on a pre-coated plate and frame press. Air samples taken around the dissolving tank showed the following values:

0.07 mg of metal in salt/m^3
0.12 mg of metal in salt/m^3
0.33 mg of metal in salt/m^3
0.58 mg of metal in salt/m^3.

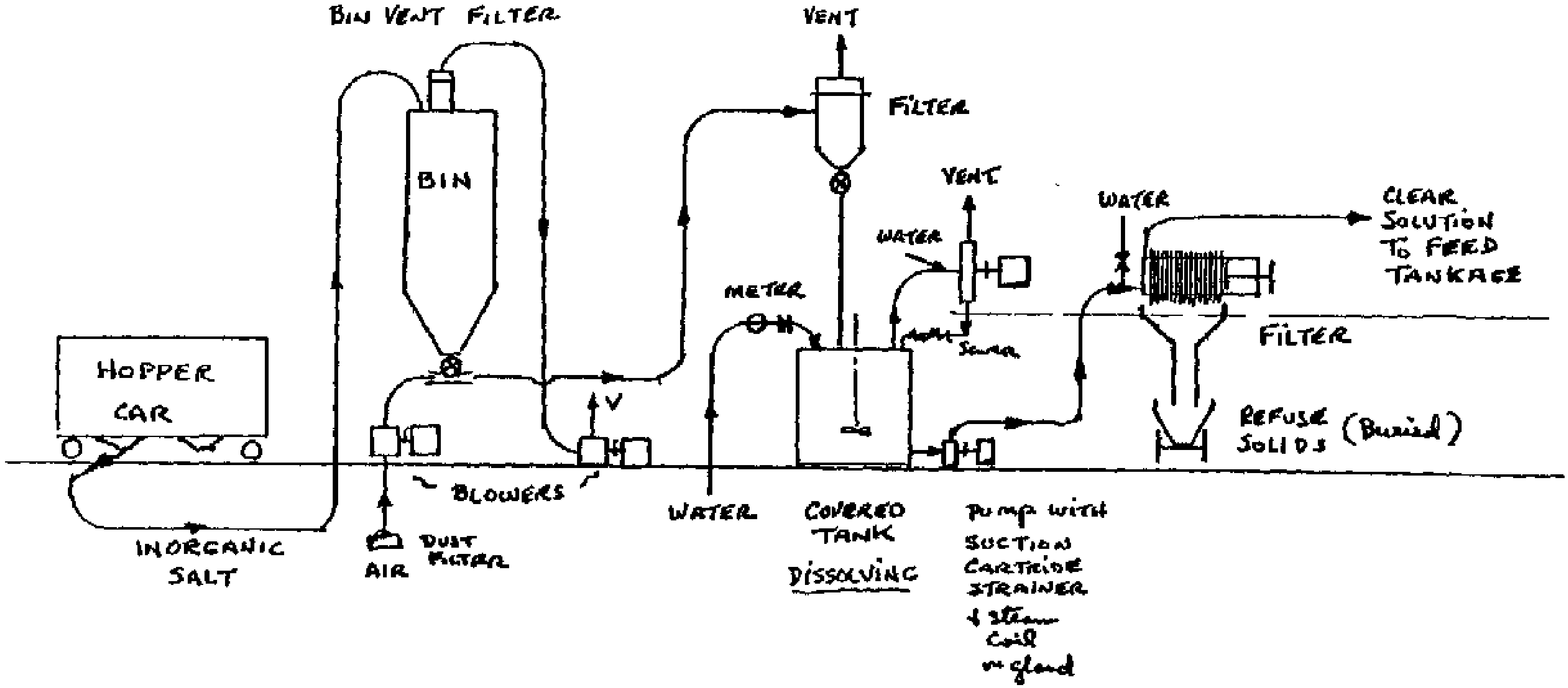


Figure XVII-1

Inorganic Salt Receiving and Unloading and Solution Preparation

XVIII

PROCESS: Packaging fine(< 3 micron) pesticide powder

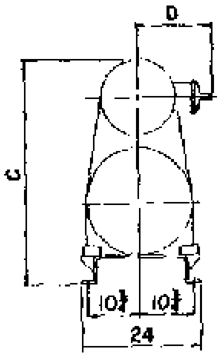
PROBLEM: To obtain adequate density in the final packaging

SOLUTION: A densifier with the following mechanical specifications is used.

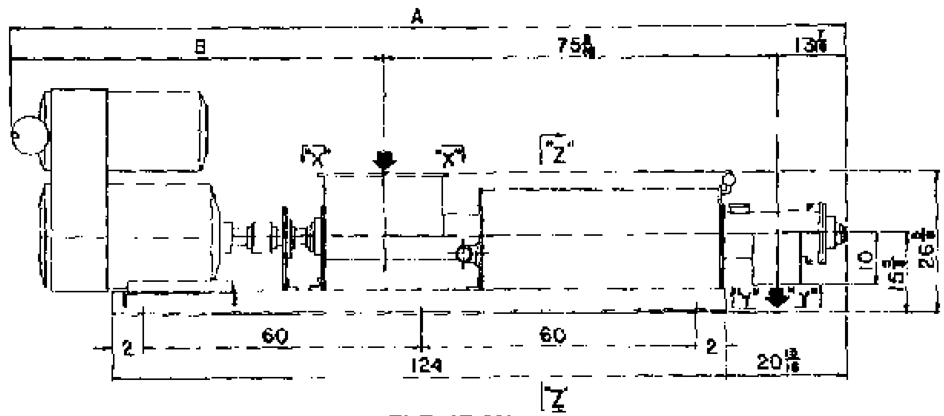
<u>Garivac Densifier - Unit No. 44</u> CARMAN INDUSTRIES

Garivac Densifier, Type GVA 150. Pipe screw with double shell, jacket subdivided, removable filter, vacuum connection, 304 SS construction 21 to 150 RPM, .60 to 3.7 CFM of material, 10 HP, 230/460 V, 3 Ph., 1800 RPM, explosion-proof motor. See also Figures XVIII-1 and XVIII-2.

This installation also smooths out the packaging operation making for fewer problems with powder spills and emissions.



END VIEW



ELEVATION

SCHEDULE											
SIZE	HP	CFM	RPM	WGT	A	B	C	D	E	F	G
6	5	044-459	16-164	1694	148	59	33¼	10¼	6¼	8	11¼
	7.5	067-686	24-245	1846	151¼	62¾	34¾	10¼			
	10	0.81-644	29-230	2071	155¼	66¾	37⅟₁₆	13¼			
8	10	177-1401	29-230	2163	156⅟₁₆	67⅟₁₆	37⅟₁₆	13¼	8¼	11¼	14¼
	15	177-1401	29-230	2163	156⅟₁₆	67⅛	37⅛	13⅜			
	20	214-142	368-233	2878	164⅛	75⅟₁₆	43⅟₁₆	14¼			

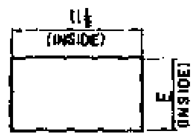
NOTES

(1) STAINLESS STEEL CONSTRUCTION AVAILABLE

(2) TEMPERATURE LIMITATIONS 250°F

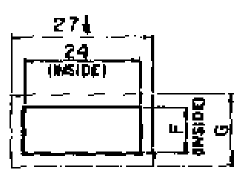
(3) ALL STANDARD MOTORS ARE TEFC (EXPLOSION PROOF ENCLOSURES AVAILABLE CLASS I, GROUP D OR CLASS II, GROUP E,F,G)

(4) ALL DIMENSIONS ARE IN INCHES



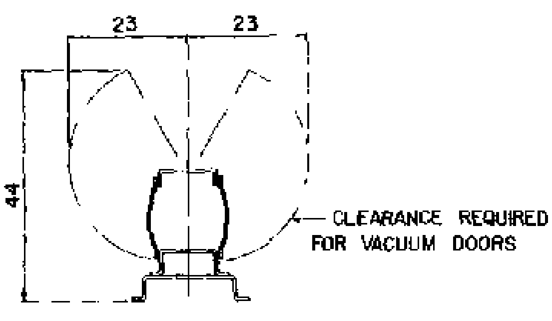
VIEW "Y-Y"

OUTLET SIZE



VIEW "X-X"

INLET SIZE



SECTION "Z-Z"

THIS DRAWING IS FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION

CARMAN DENSIFIER

DIMENSION SHEET 8000

REV 1 11-1-79

(812) 282 7527

1005 W RIVERSIDE DR. JEFFERSONVILLE IND

SPECIALIST IN GRANULAR & BULK SOLID MATERIAL HANDLING EQUIPMENT

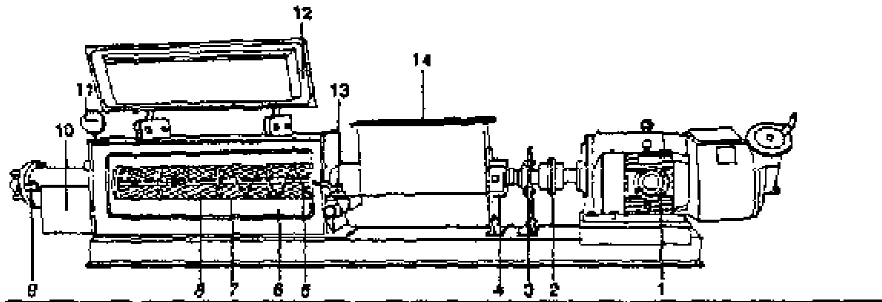
The Carman Densifier

The Standard Carman Densifier consists of a continuously welded auger and auger tube sectioned, with flanges The vacuum chamber consists of a filter cartridge (inner wall) and an outer shell fitted with a vacuum exhaust manifold A vacuum gauge is also provided Hinged doors facilitate access to the filter media for maintenance and inspection All surfaces that contact the product are in carbon steel The Standard Carman Densifier is furnished as a complete unit ready to operate when fitted with the proper vacuum pump

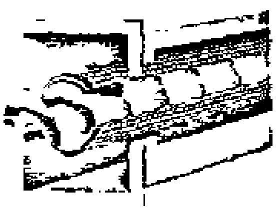
The Standard unit includes a totally enclosed motor and variable speed auger drive with speed adjustment ratio of 10 to 1 The Densifier can be modified to meet specific requirements Other types of drives, such as explosion proof, can be furnished Stainless steel construction is also available and can be furnished to meet sanitary standards. Vacuum pumps engineered for the Carman Densifier, are available

With the Carman Densifier the increase of densification that is achieved, within the limits of the particular material processed, can be controlled Variation in the finished density is relative to the speed of the auger drive and to the regulation of the vacuum exhausted from the densifier vacuum chamber

Volumetric flow required to maintain the performance of packaging, filling, extruding, pelletizing or other equipment in line with the Carman Densifier is easily achieved If desired, Carman engineering can be put to work to incorporate one or more of the Carman Vibrating Hoppers, Feeders or Conveyors into a complete material handling-densification system.



1 Motor Drive
2 Coupling
3 Bearing Support
4 Packing Gland
5 Auger
6 Vacuum Chamber
7 Strainer Basket
8 Outer Housing
9 Quick Disconnect Clamps
10. Discharge Ass y
11 Vacuum Gauge
12. Hinged Access Door
13 Two-Way Solenoid Valve (to reverse air flow)
14 Feed Hopper



Unique Filter Media

The unique densification method afforded the Carman Densifier is made possible by the design of the filter media. Extensive tests have shown that materials with particle size of less than one micron can be successfully densified The filter media allows air to pass through it but denies passage to any solid particle.

The filter media is easily cleaned by reversing the air flow through the exhaust manifold The total absence of mechanical pressure throughout the system eliminates particle degradation to the materials being processed

Increase in Densification Table

material tested	particle size in microns	weight ahead of densifier (PCF)	weight after densifier (PCF)	increase of densification by percentage
Copper based fungicide	1 to 3	18.1	45.0	148
Copper & sulphur based fungicide	1 to 4	17.5	37.5	114
Herbicides	10 to 15	18.1	39.4	117
Organic fungicides	1 to 20	20.0	45.6	128
Organic fungicides	1 to 8	11.9	41.2	245
Half white flour	2 to 150	20.6	35.6	72
Organic dyes	1 to 10	8.1	11.9	50
Precipitate silicate	1 to 10	28.1	39.9	42
Antiseptic powder	3 to 5	13.7	25	82
Vitamin intermediate product	5 to 10	11.9	18.4	60
Calcium product	50 to 100	10.0	16.9	70
Polyurethane powder	40 to 60	22.7	29.8	30
Silicic acid	1 to 50	14.4	41	187

Maintenance

The Carman Densifier is engineered and designed to require a minimum of maintenance Operation is extremely simple The complete system is designed and fabricated for dust free performance, yet the design allows excellent accessibility to all interior surfaces for cleaning purposes. Easy removal of all interior parts allows thorough cleaning of those surfaces where product contamination might occur

Your Product

To best determine the degree of densification possible for any material, Carman maintains complete test facilities. Your Carman agent will be glad to work with you and set up a testing schedule for your material Hundreds of materials have been tested in Carman Industries laboratories

In addition to the Carman Densifier, Carman Industries, Inc. manufactures a standard line of vibrating hoppers, feeders, conveyors and mixers. If it should be determined through laboratory testing that standard equipment is not the answer to your material handling problem, qualified material handling engineers are available to design or modify equipment for your application

For a review of the entire product line, ask for Carman's General Bulletin.

Carman®
Industries, Inc.
1005 W Riverside Drive
Jeffersonville Ind 47130
(812) 282-7527
Specialists in Bulk Materials Handling

XIX

PROCESS Kettle production of an aqueous pesticide solution

PROBLEM: Avoiding ignition of a toxic ingredient with a low flash point

SOLUTION: A kettle with a water-jacketed stirrer packing gland chamber

To avoid ignition of the toxic ingredient (TLV = 1 ppm), a kettle with a water-jacketed stirrer packing gland chamber is used; the system, including a supplementary water bath, is shown in Figure XIX-1. In addition to these precautions, a nitrogen atmosphere is maintained in the kettle.

The kettle operator maintains visual surveillance over the kettle stirrer gland; any vapor leakage is easily detected.

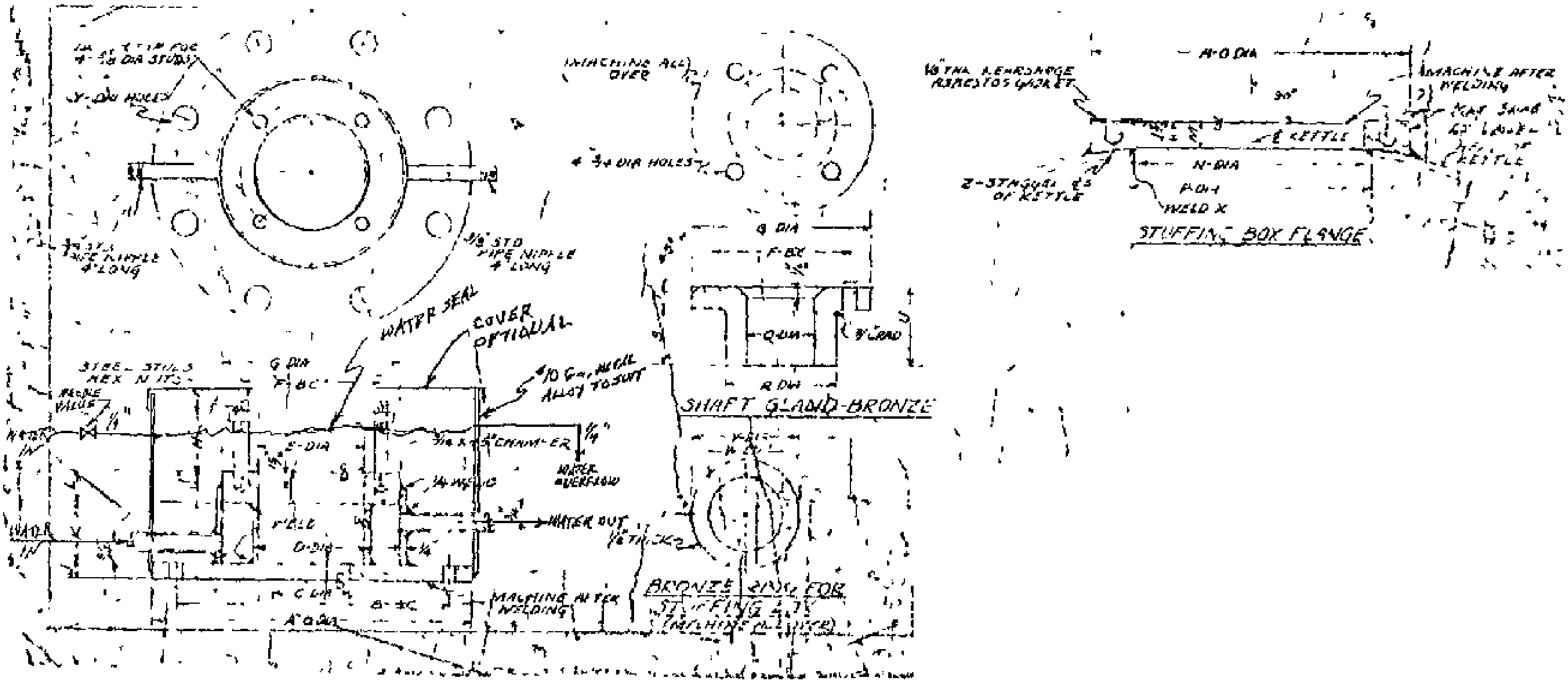


Figure XIX-1

WATER JACKETED STIRRER PACKING GLAND CHAMBER

XX

PROCESS: Pesticide manufacture-pumping concentrated aqueous slurry mixture

PROBLEM: Avoiding crystals or solids in gland packing on rotary pump shafts

SOLUTION: Purging packing gland with hot condensate

The plant solved the above problem by connecting a bare copper tubing coil from a steam line to a lantern ring between packing rings on the pump gland. Hot condensate kept the gland warm and flushed/dissolved potential crystals Water is compatible with the process at this point. See Figure XX-1.

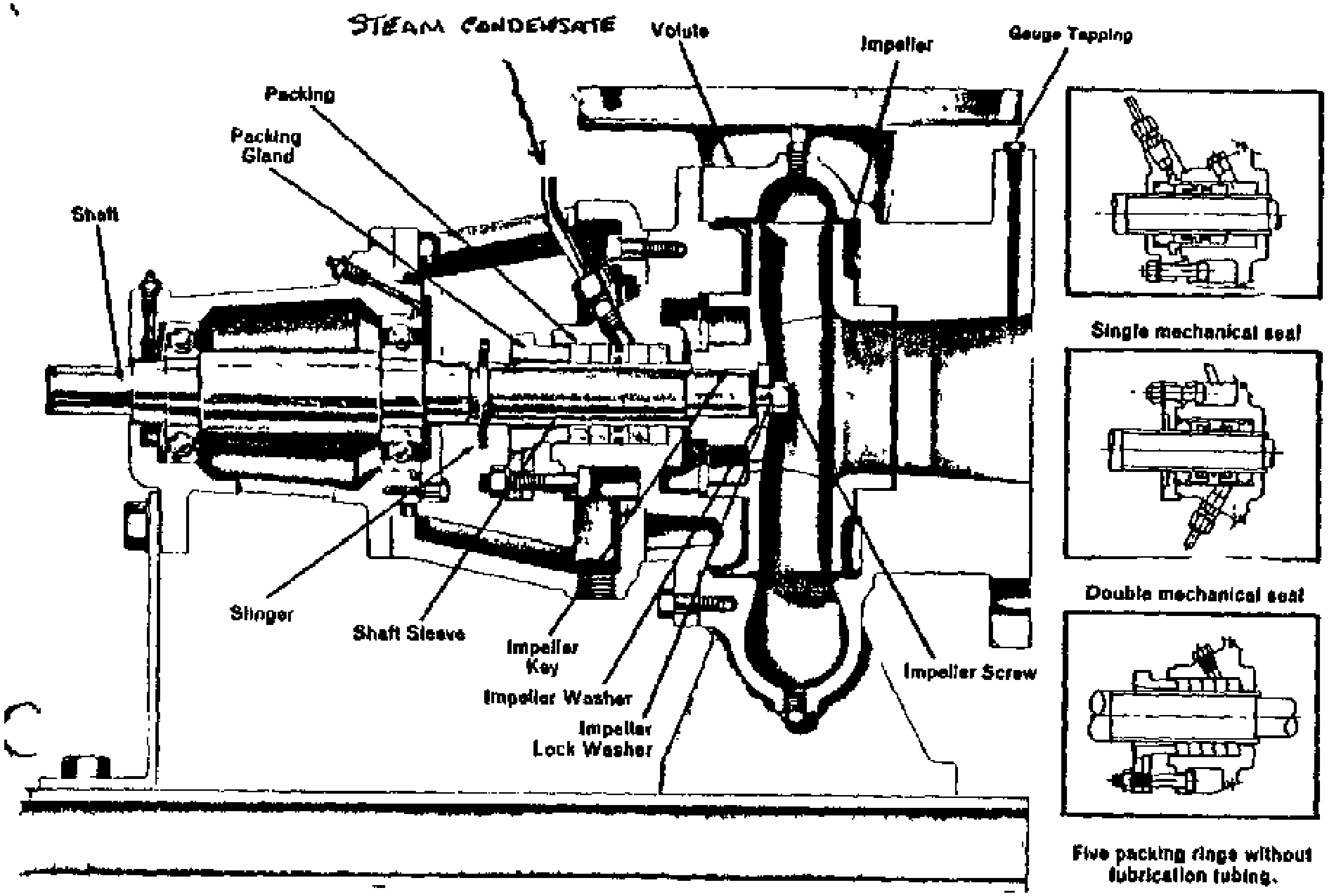


Figure XX-1

PURGING PACKING GLAND WITH HOT CONDENSATE

XXI

PROCESS. Cooling of powdered pesticide formulation for safe handling and safe packaged inventory

PROBLEM: The powder is heat sensitive and has an exothermic decomposition liberating a material with a low ignition temperature and a NIOSH TLV recommendation of 1 PPM.

SOLUTION: Plant J-1 installed a hollow flight, 2 tier, water-jacketed, screw conveyor-cooler to cool the product powder to 124°F or lower.

Mechanical Specifications

Holo-Flite 2 tier cooling conveyor. Type D2D16206: 16" diameter screws, 6" pitch, 20 ft. base length. 478 sq.ft screw cooling surface, 304 stainless steel screws, steel jacket. Working Pressure: Jacket - 15 psig, Trough- Atmospheric. Rating: Screws - 40 psig. Jacket - 15 psig. 3 HP, 220 V, 3 Ph., explosion-proof motor with 3.1 varidrive for screw speed of 3 to 9 rpm. Design Conditions: Rate - 7000 #/hr. of powder 23 lbs./cu.ft., at 179°F initial, 124°F final, Specific Heat: 0.23 Btu/Lb.-°F. Cooling Water: 84°F initial, 89°F final. Shipping weight: 15,200 lbs. Supplier: Western Precipitation (Div. of Joy Mfg Co.) Figures XXI-1 through XXI-4 show mechanical details.

The cooler is maintained under a very slight, nitrogen atmosphere, holding oxygen below 8%. Gland leakage is very minor Performance meets the plant's full expectations. Gland or cover leakage is minor

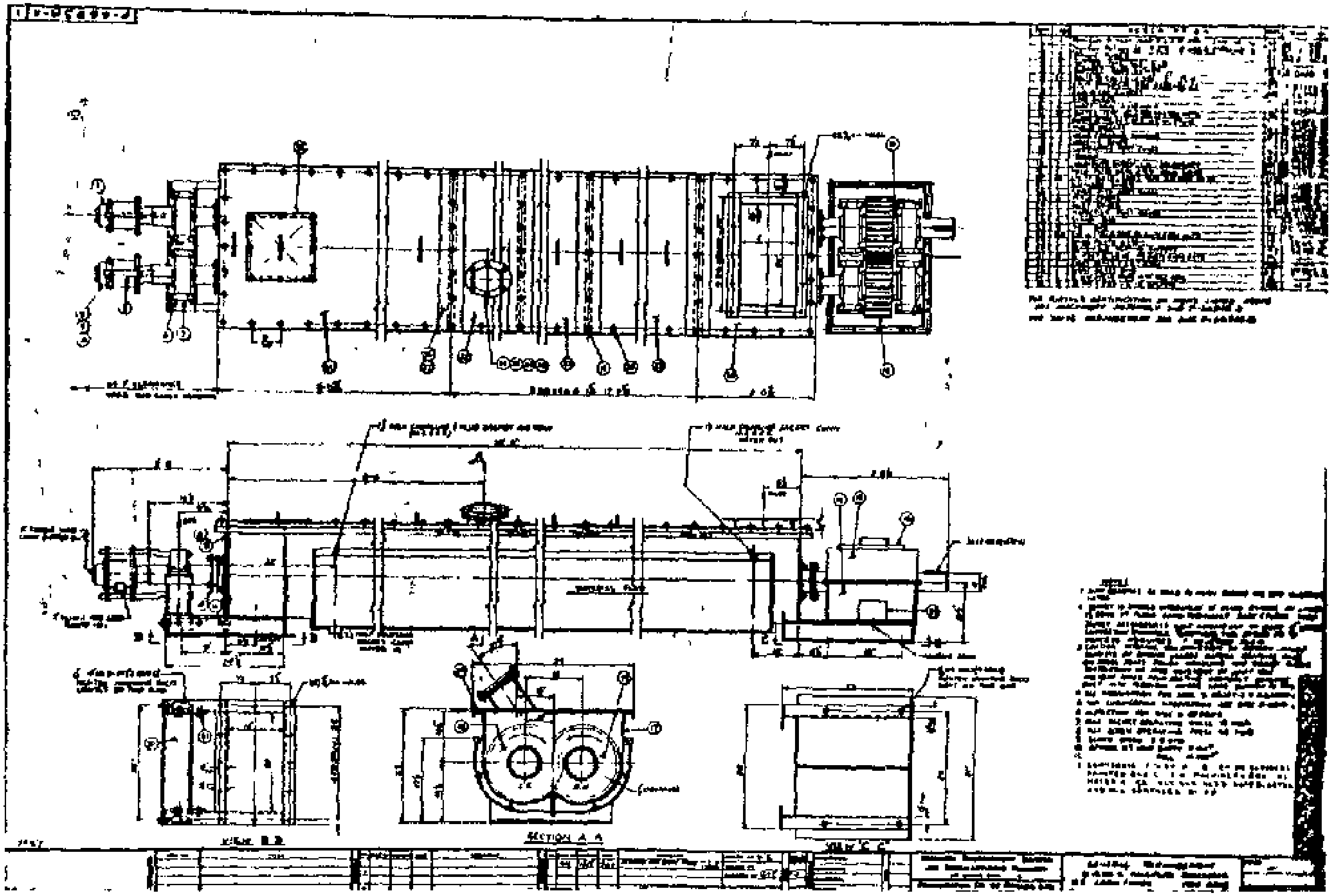


Figure XXI-1

DETAILS OF HOLO-FLITE 2-TIER COOLING CONVEYOR

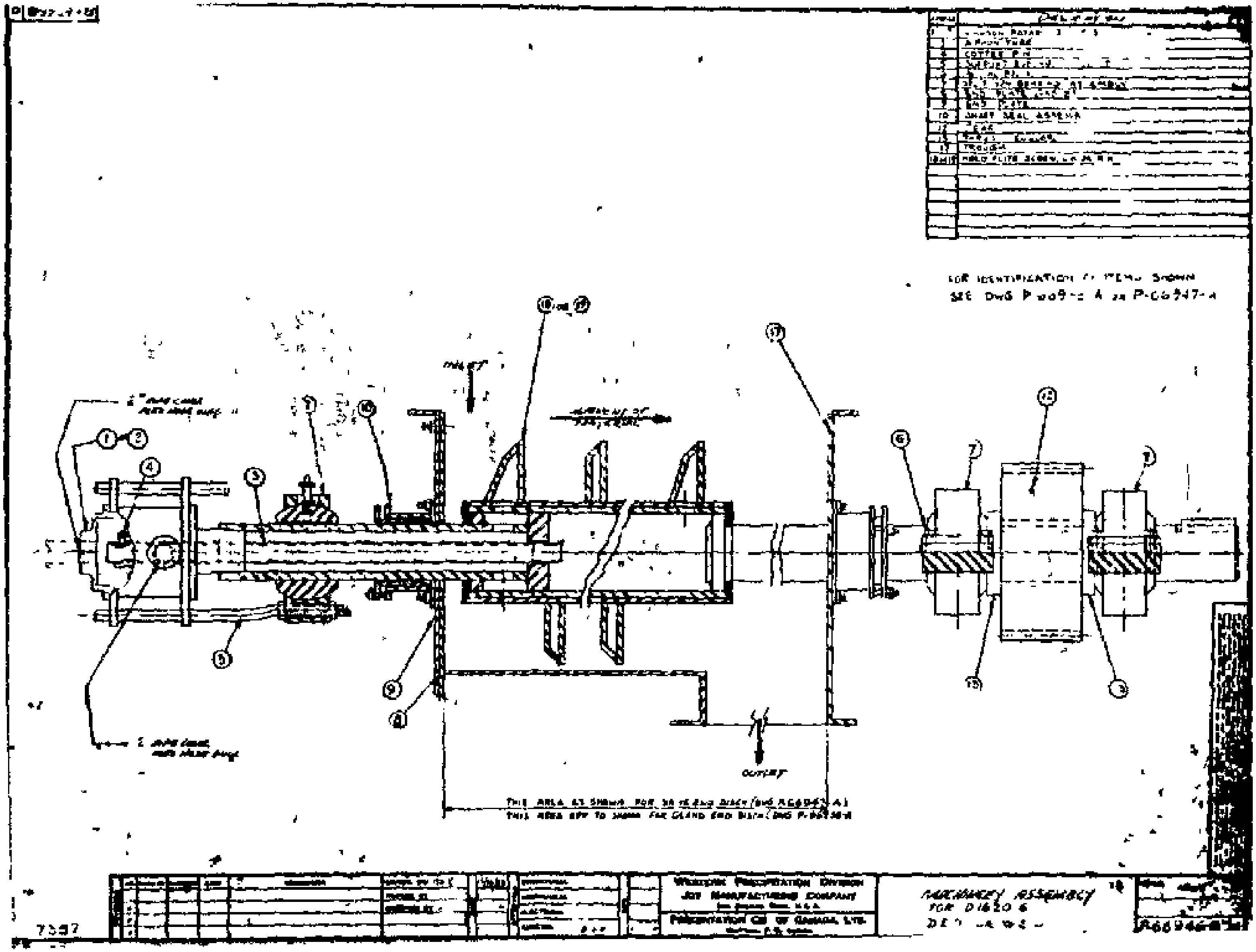


Figure XXI-2

DETAILS OF HOLO-FLITE 2-TIER COOLING CONVEYOR

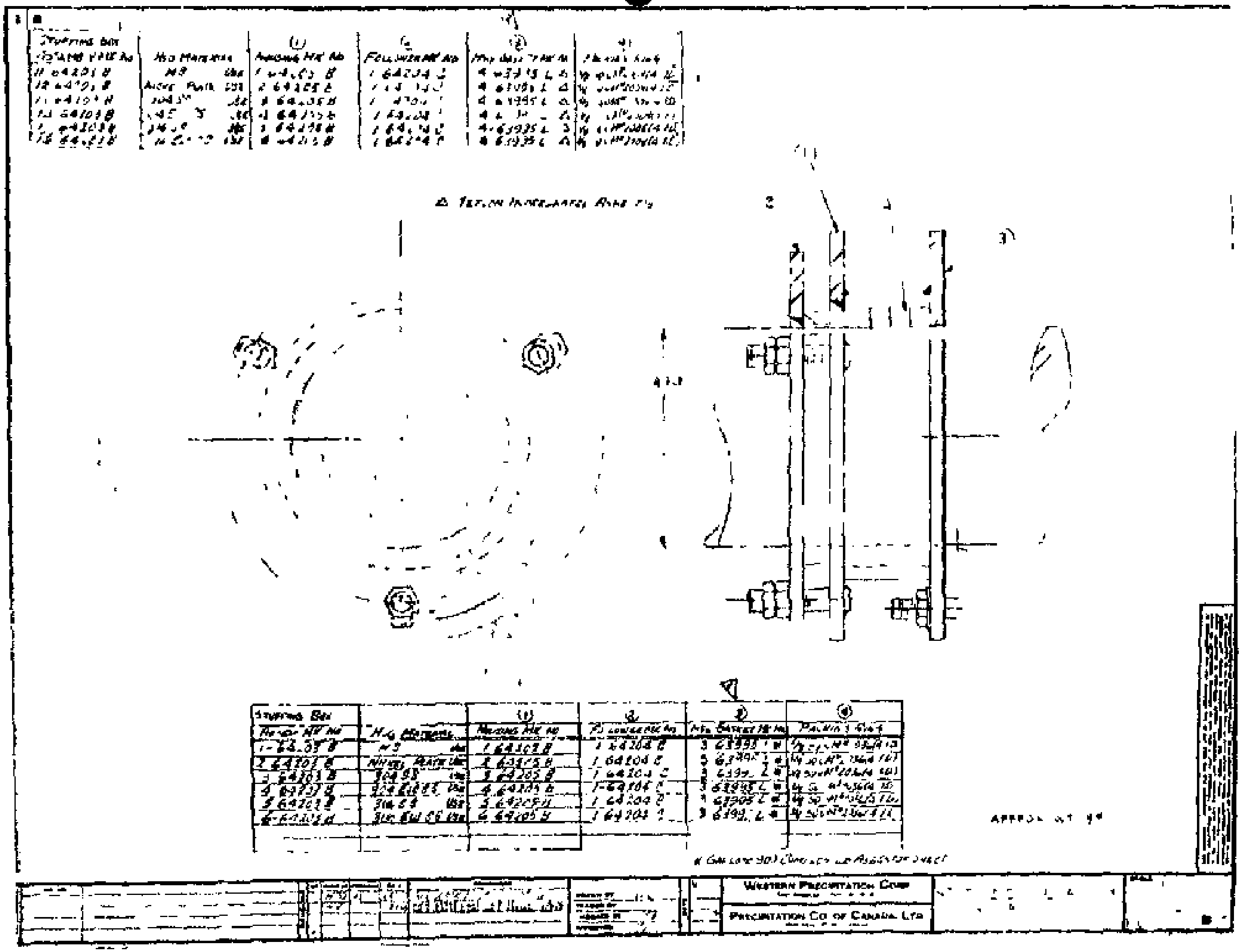


Figure XXI-3

DETAILS OF HOLO-FLITE 2-TIER COOLING CONVEYOR

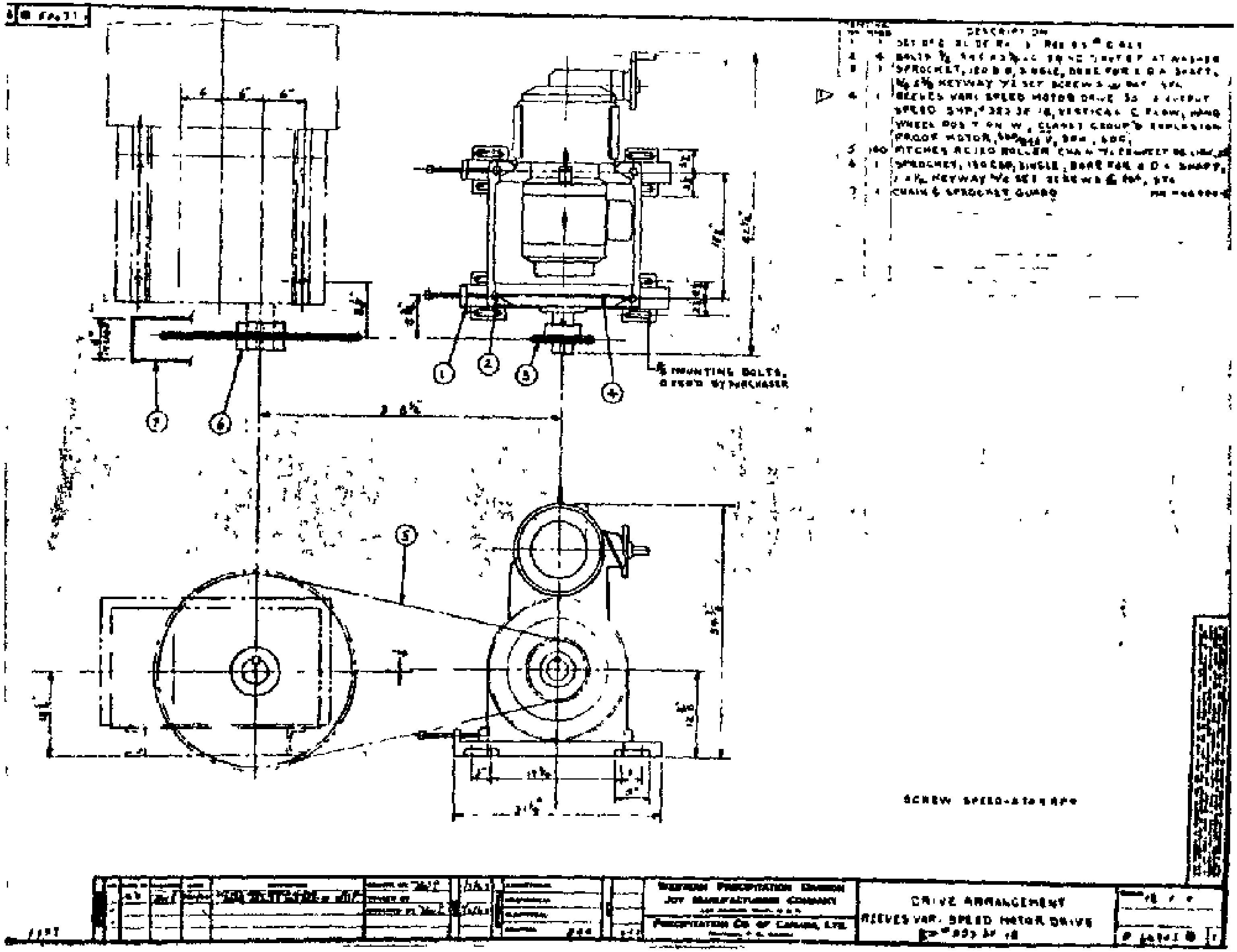


Figure XXI-4

DETAILS OF HOLO-FLITE 2-TIER COOLING CONVEYOR

XXII

PROCESS: Unloading, storing and transferring Solvent A from tank cars to plant storage and operating vessels.

PROBLEM: Solvent A is dangerous because of its flammability and toxicity

SOLUTION. Solvent A is stored and transferred under water using very rigid operating procedures

SOLVENT A

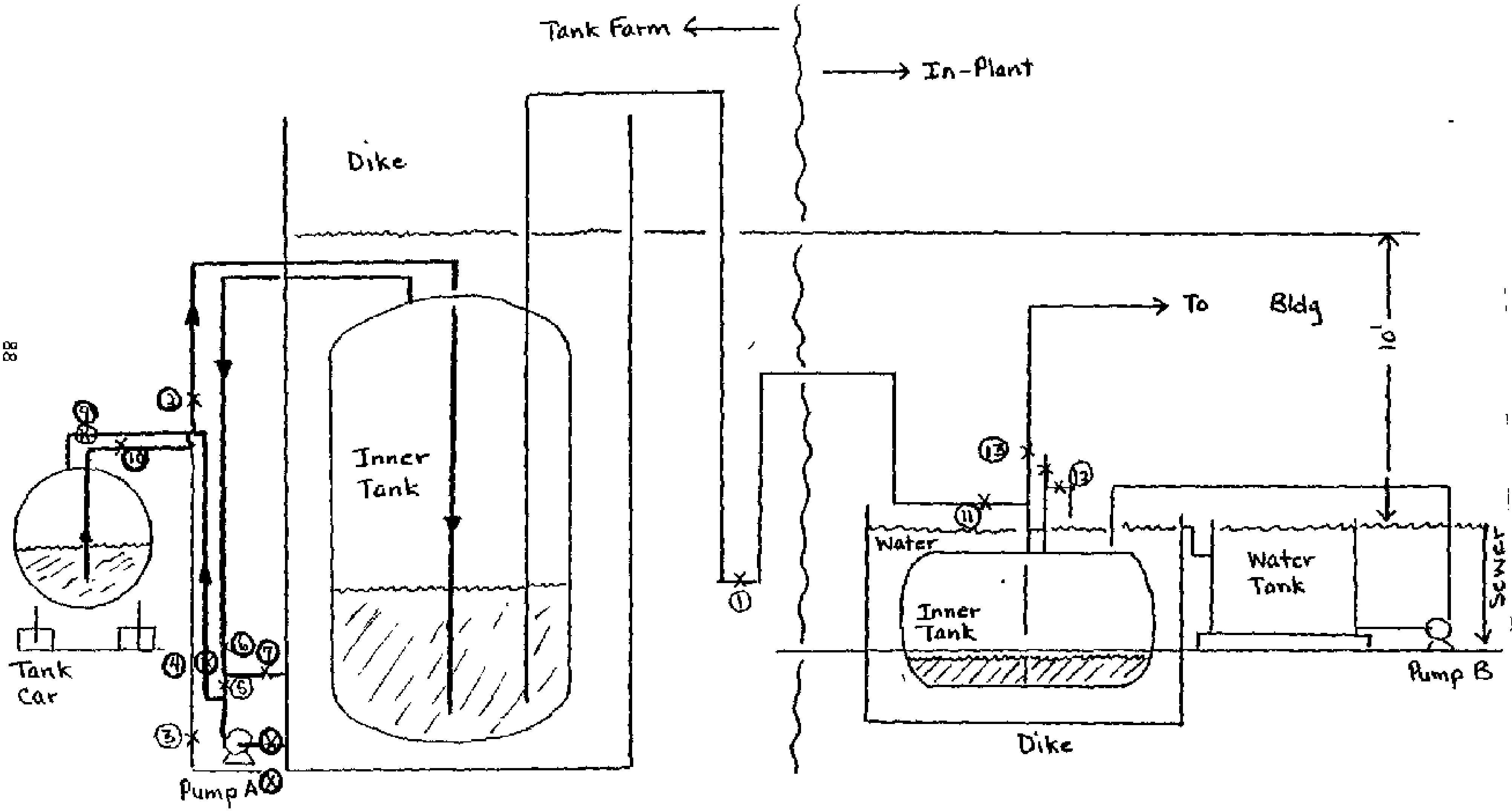
flash point	< 0 F
ignition temperature	<240 C
explosive limits	1% - 50%
vapor pressure	>10 mm at 50 F
TLV	<50 ppm (NIOSH recommends 1 ppm)
eye contact causes burns	

The attached flow diagrams show the arrangement of an incoming tank car, the filled storage tank, an in-plant storage tank, pumps, outer water tanks, and lines and valves to be aligned..

In each of the operating modes, the operator must follow a rigid checklist of valve and pump alignments to be checked by the shift foreman. Figure XXII-1 shows the arrangement of valves for unloading a tank car into the field storage tank 81 Figure XXII-2 shows the alignment for removing the water from the tank car to the tank (dike) around tank 81. Figure XXII-3 shows the arrangement for transferring Solvent A from the field tank to the in-plant storage tank, and Figure XXII-4 Solvent A from the plant storage tank to the reactor

Figure XXII-1

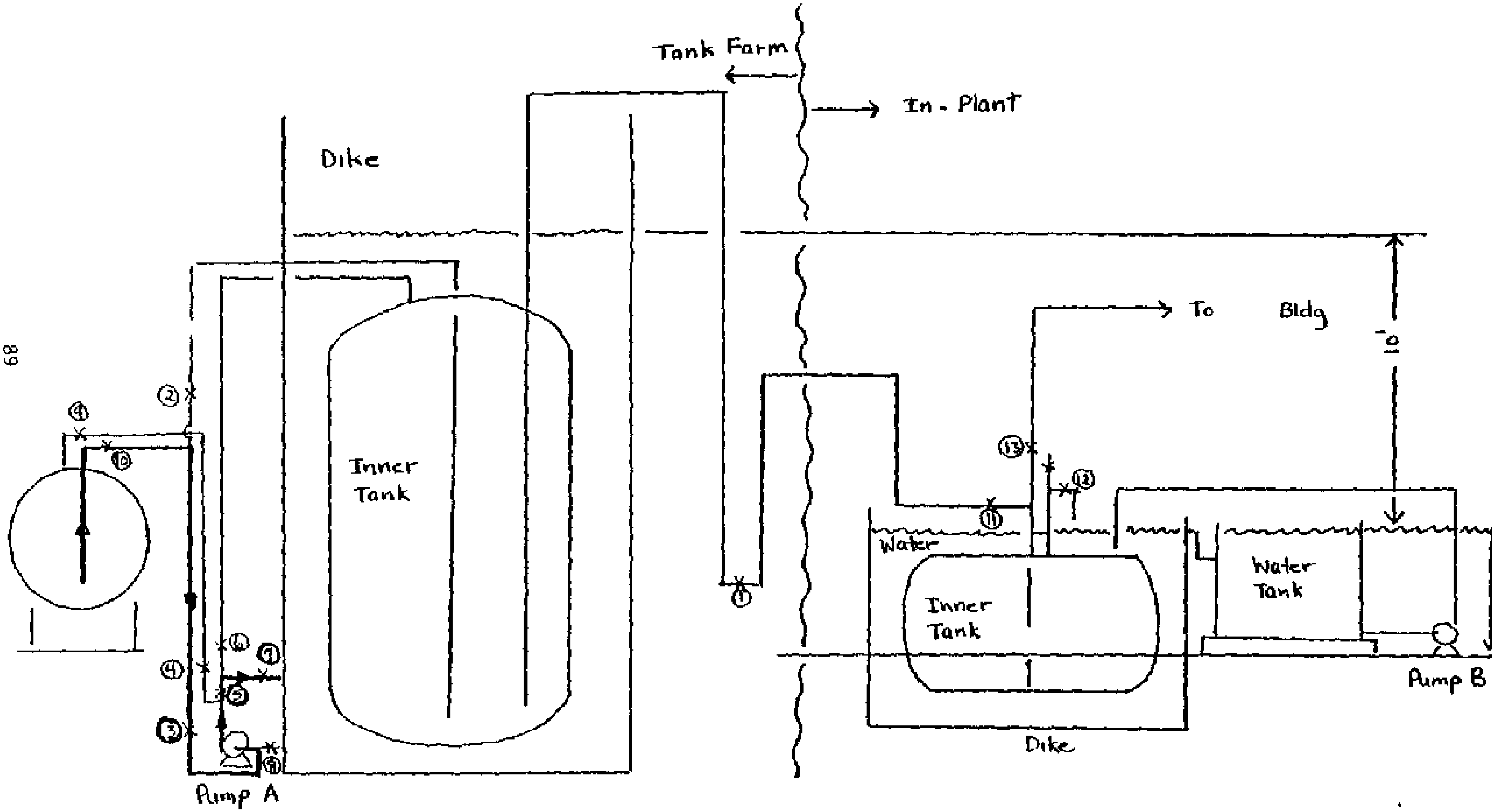
Pipe and Valve Alignment for Tank Car of Solvent A



—— = Lines and Valves Open to Unload Car

Figure XXII - 2

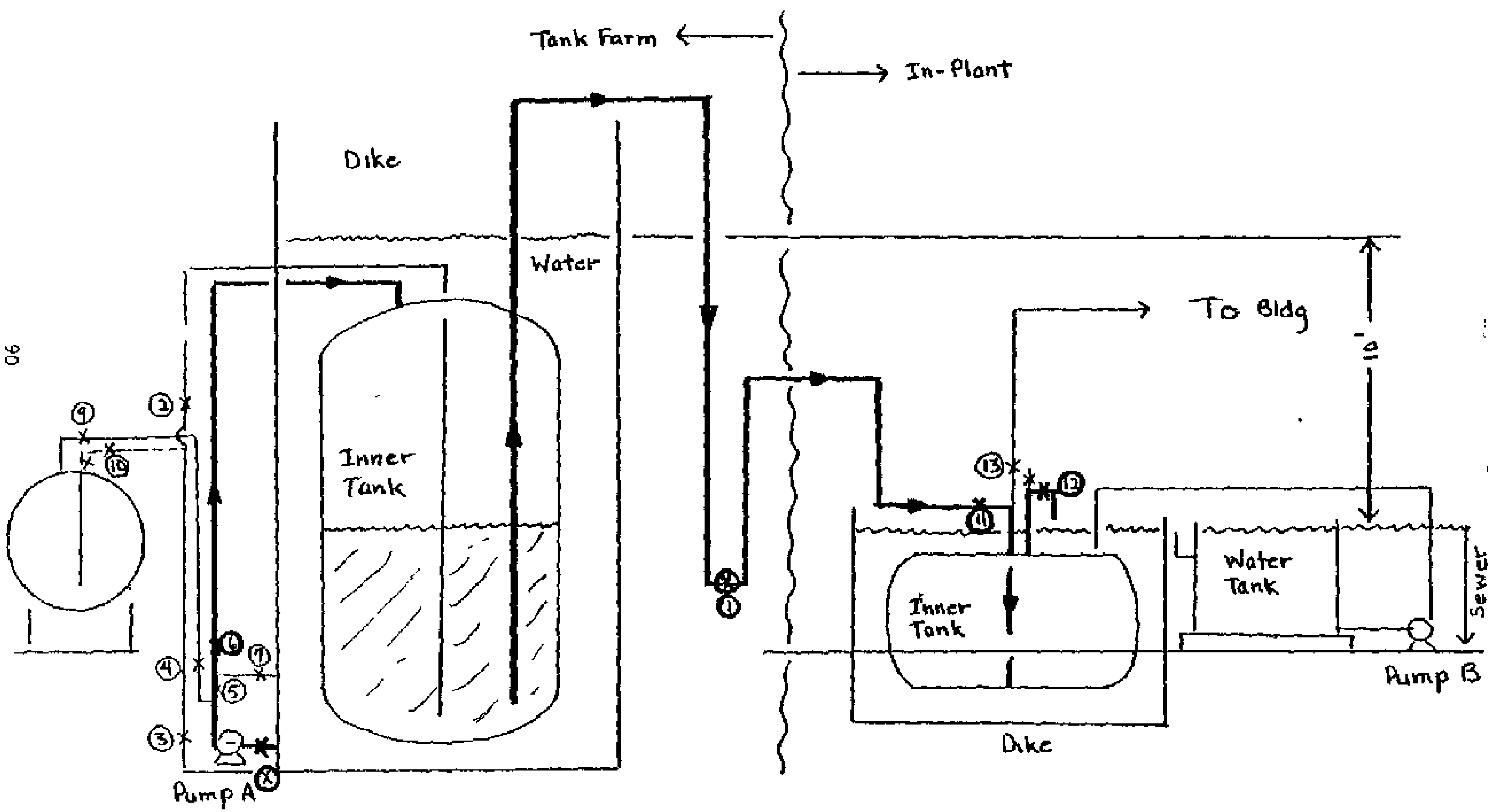
Emptying Car of Water Into Dike



—— = Lines and Valves Open to Return Water

Figure XXII - 3

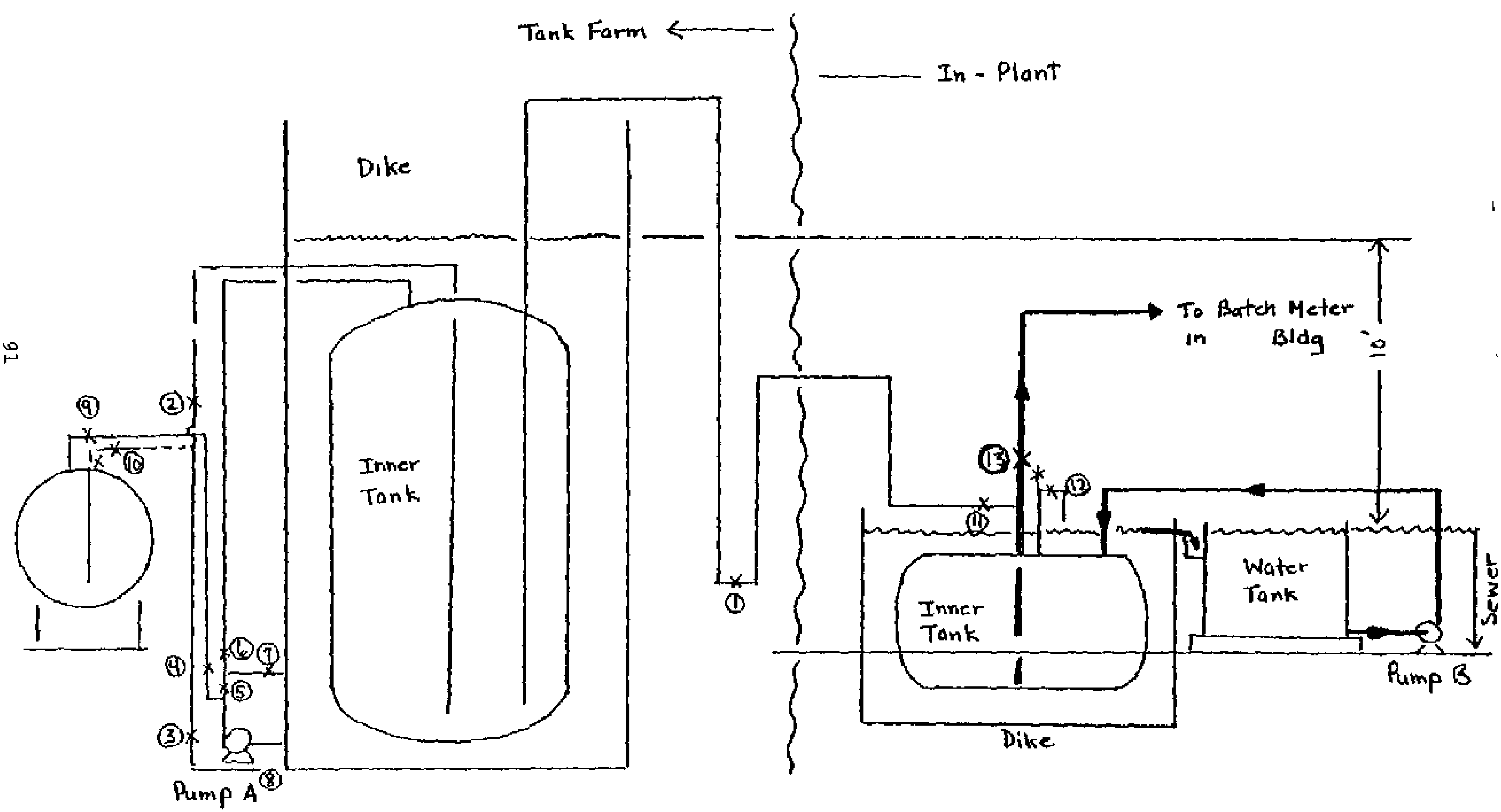
Transferring Solvent A From Field to Plant Storage



—— = Lines and Values Open

Figure XXII-4

Feeding Solvent A to Reactor



—— = Lines and Valves Open to Feed Solvent A to Reactor

XXIII

PROCESS: Cooling, blending, packaging pesticide powder

PROBLEM: The powder is heat and moisture sensitive giving off explosive gas

SOLUTION: Oxygen analyzers

Bldg. A

A Beckman Model F3 analyzer analyzes the atmosphere in 3 hoppers in sequence for % oxygen. The range of the analyzer is 0 to 10% O_2. A 4 to 20 maDC signal out of the analyzer goes to a recorder and a Moore pneumatic controller. The controller sends a controlled signal to throttling control valves in nitrogen feed lines to the 3 hoppers. There is one valve for each hopper, and it is open as required during the interval that the hopper is being sampled. The balance of the time it is closed. The coordinated sampling and control system is fully automatic. In addition, the analyzer has alarm contacts which·

1. Activate monitor lights - yellow when O_2 is below 3%
   green when O_2 is between 3 and 8%
   red when O_2 is above 8%
2. Automatically opens a by-pass nitrogen valve which admits nitrogen into all 3 hoppers when the oxygen analysis goes above 8%.

Bldg. B

The system in building B, which samples and feeds nitrogen to three pieces of equipment, is identical to the Bldg. A system except that it lacks monitor lights and has a range of 0 to 15% and different criteria points.

XXIV

PROCESS: Process ventilation for toxic vapors

PROBLEM: Power failure - loss of ventilation

SOLUTION: Back-up steam driven blower

Toxic gases are removed from the process area and sent through a scrubber by an electrically driven blower. In the event of a power failure, the ventilation would be lost and toxic gases would build up in the process area. A solution to this problem is to have a back up blower drive powered by steam. The steam system is independent of the electricity supply ; the system is automatically activated by an electrically operated solenoid valve which fails in the open position. Upon return of the electricity, the steam system is manually shut down and the electric motors are restarted.

XXV

PROCESS: Packaging a <3 micron dusty pesticide in 250 lb. fibre board drums

PROBLEM: Avoiding dust emissions

SOLUTION. Installation of Carter-Day vacuum packers

Open drums, lined with 6 mil polyethylene bags, are placed in Carter-Day vacuum packers; by a series of evacuations and pulse powder inflows, the drums are filled. Pulsing can be adjusted to give a close approximation of the desired weight. As the powder is packed, it is densified. After filling has been accomplished, the cabinets are opened, drums are drawn out on rollers, drums are weighed and weight of contents is adjusted manually. Polyethylene (P.E.) bag tops are twisted and tied shut. Metal lids with gaskets are placed on the drums and are clamped closed.

The operation of the cabinets is relatively dust free, but cabinet walls eventually acquire a powder coating. (Details of units to be obtained from Carter.)

XXVI

PROCESS: Storing and feeding liquid

PROBLEM: Liquid is temperature sensitive and must be heated

SOLUTION: A specially designed heating and insulating system for a storage tank truck

One of the process intermediates used at Plant J-1 is relatively viscous and flows with difficulty during some ambient temperature conditions at the plant. An insulated tank truck trailer is utilized as a storage vessel for this material, which is used intermittently. This permits storage outdoors with feeding to a smaller (approximately 100 gallon) charging tank indoors, for feeding via a spray header into the process. The piping is traced with electric heating wires, and all piping is flanged or welded. Temperature alarms and controls are provided at various points in the piping system. Nitrogen is provided to blow lines and nozzles clear of material after delivery to the charged tank. The material is filtered at the time of unloading, again during transfer from the tank trailer to the charge tank, and once again prior to heating and spraying, to clean up by-product sedimentation which might cause nozzle plugging.

Figure XXVI-1 shows the tank truck heating jacket system which is provided from a tempered water system. Figure XXVI-2 shows the piping arrangements and connections.

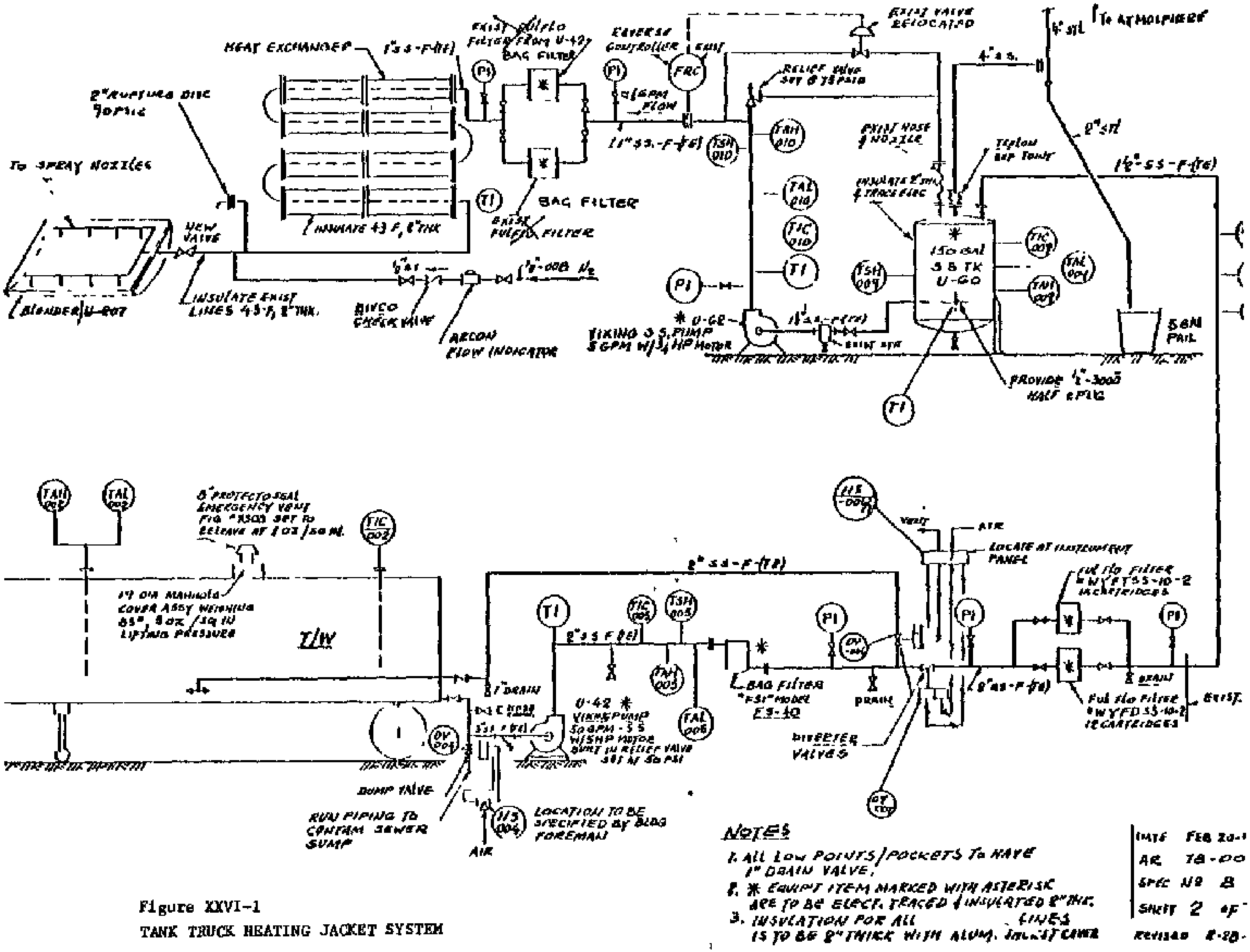


Figure XXVI-1

TANK TRUCK HEATING JACKET SYSTEM

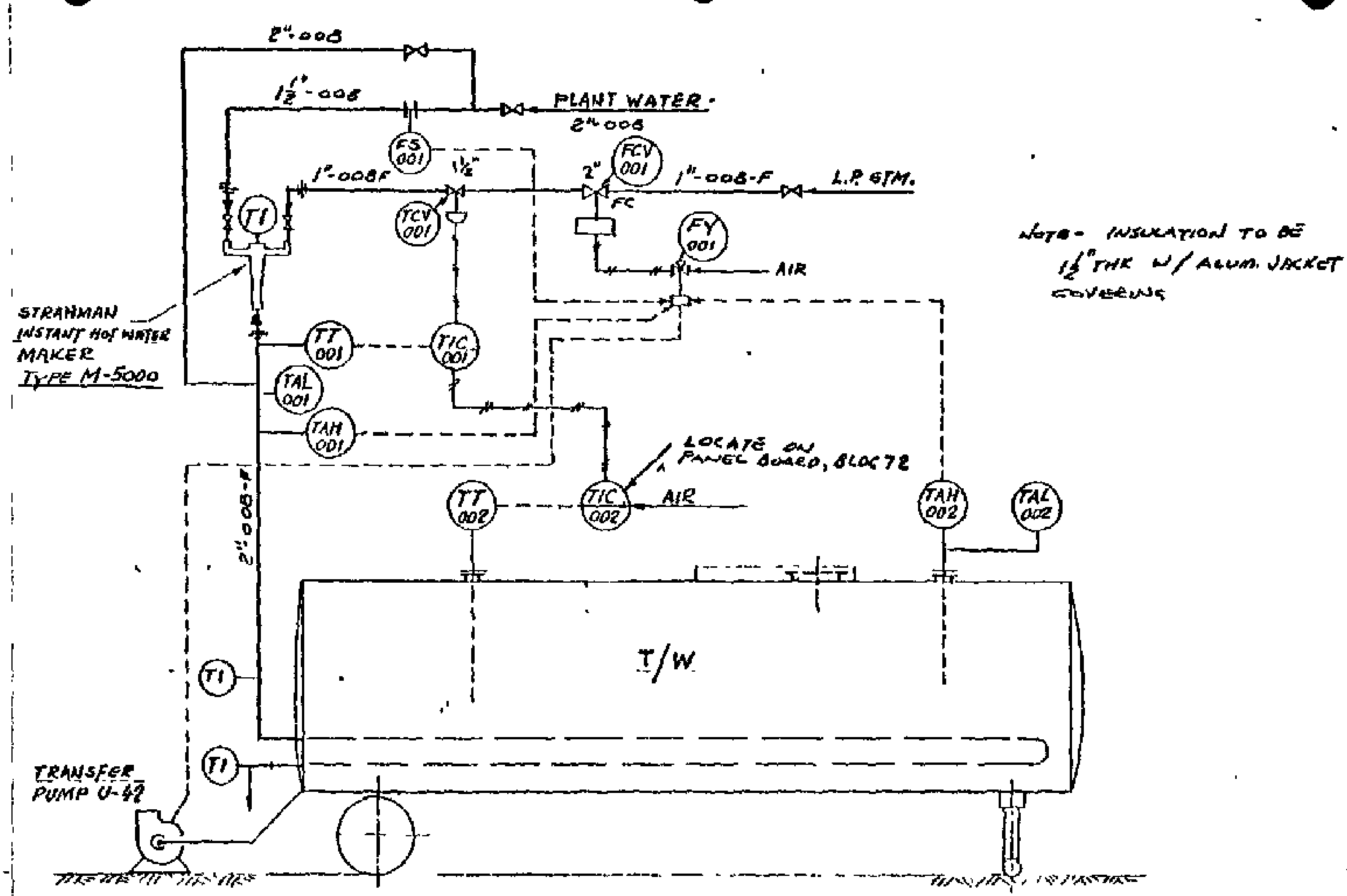


Figure XXVI-2

— TANK WAGON TEMPERED HOT WATER SYST. —

XXVII

PROCESS. Laboratory analysis

PROBLEM: Disposing of small quantities of waste solvent

SOLUTION. Modification of conventional bench cabinet-waste container

Many solvents are used in small quantities in the Q.C. Laboratory In order to prevent contamination of the sanitary sewer system, solvents are discharged into a separate sewer line, which is treated separately. To avoid the need for contaminated sewer lines throughout the laboratory building, solvents are accumulated in containers in each laboratory. Vapors from these containers are a potential health or fire/explosion hazard.

A conventional laboratory cabinet has been set up to serve as a hooded waste disposal cabinet and drain rack for solvent-containing glassware. (Highly toxic and flammable materials are handled separately). As shown in Figure XXVII-1 a waste container (5 gal. can, with lid) is placed in the bottom half of the cabinet, the solvent is emptied, and the glassware left to drain in the rack. The waste can is emptied daily and accumulated at an outside drumming station for subsequent incineration.

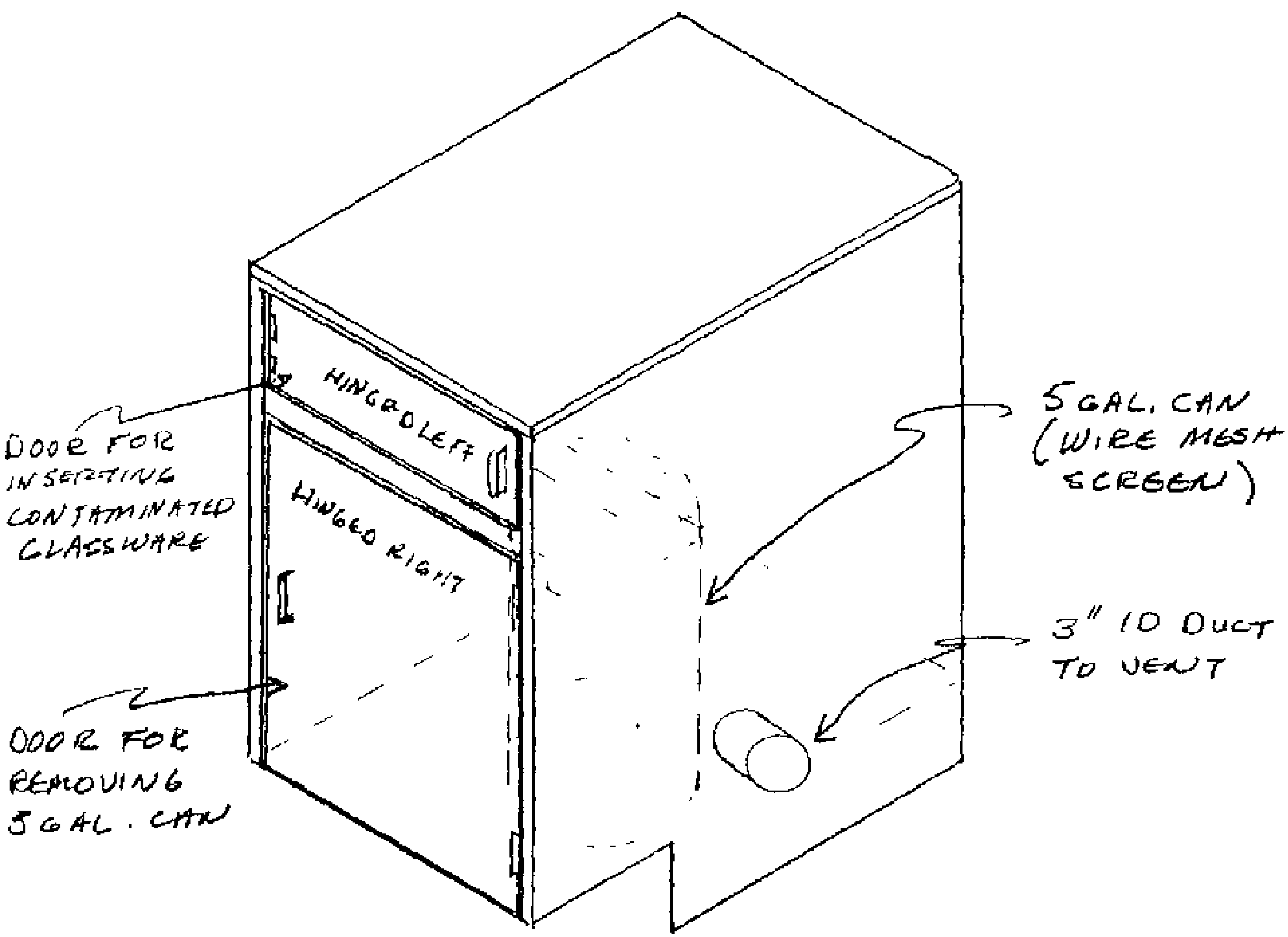


FIGURE XXVII-1: LABORATORY CABINET CONVERTED TO WASTE SOLVENT DISPOSAL CABINET

XXVIII

PROCESS: Unloading/Loading Rail Cars

PROBLEM: Slips and Falls During Icy Weather

SOLUTION. Moveable "Cyclone" Fence Placed Along Sides of Top of Car

Plant J-1 is located in the Northeast and winters are frequently severe. Following several falls, the moveable fence shown in Figure XXVIII was installed in the unloading area. The fences are "cranked in" after the car is spotted and the workers making hose connections atop the car are given freedom to work without fear of falling.

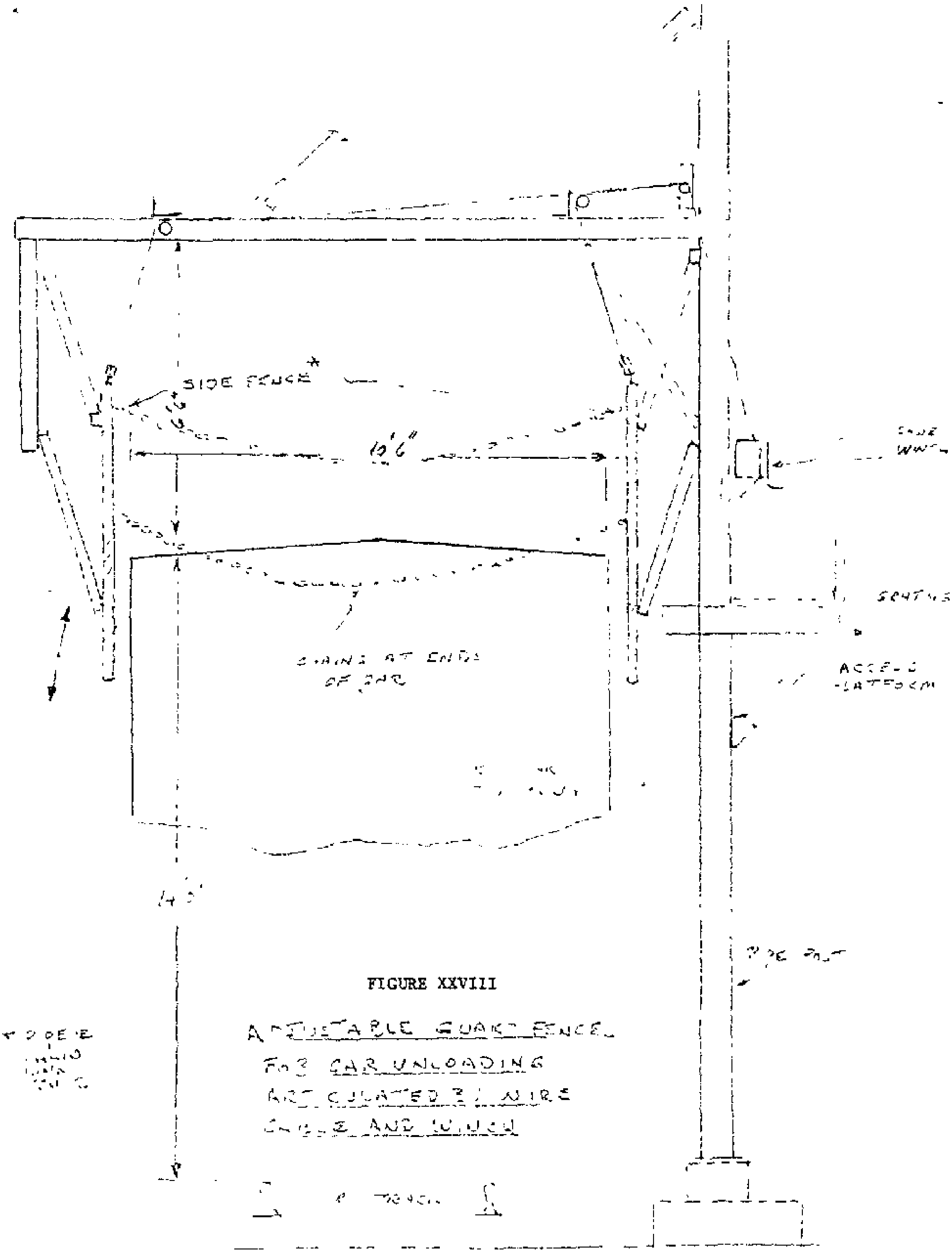


FIGURE XXVIII

ADJUSTABLE GUARD FENCE
FOR CAR UNLOADING
ARTICULATED BY WIRE
CABLE AND WINCH

Method No.: EHP 1-73

Date. July 17, 1973

EMPLOYEE HEALTH PROTECTION DEPARTMENT:

STATEMENT AND POLICY ON PERSONAL PROTECTIVE EQUIPMENT
IN GENERAL AND RESPIRATORY PROTECTION IN PARTICULAR

Introduction:

Protective equipment including personal protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices and protective shields and barriers shall be provided, used and maintained in a sanitary and reliable condition, wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation and substitution of less toxic materials). When effective engineering controls are not available, or while they are being instituted, appropriate respirators shall be used.

Only respirators which are applicable and suitable for the purpose intended shall be provided.

Respirators must be provided when such equipment is necessary to protect the health of the employee. Employees must be instructed in how to use them, and clean and disinfect them regularly. Proper selection, use, and maintenance of respiratory protective devices is a management function.

STANDARD OPERATING PROCEDURES
FOR RESPIRATORY PROTECTIVE DEVICES

This procedure describes standard practices for respirator users. It provides information and guidance on the proper selection, use and care of respirators and sets forth requirements governing their use.

Included are safe practices and requirements for using respirators for protection of the respiratory system from inhalation of particulate matter, noxious gases and vapors, and oxygen deficiency. Although this procedure does not cover engineered protective measures (for example, ventilation), on new processes exposure control shall be accomplished as far as is feasible by accepted engineering methods before considering or instituting use of respirators and on existing processes respirators should be instituted wherever and whenever air monitoring results indicate that a hazard exists.

The use of a respiratory protective device is justified only after a consideration of the factors involved indicates that the device selected will provide satisfactory protection when properly used. It is clearly evident, therefore, that the use of a respirator requires a thorough knowledge of such factors as the following:

1. The chemical, physical and toxicological properties of the substance against which protection is required.

2. The effect of the processes and conditions of use of the substances as they relate to the possible formation of significant secondary products.

3. The processes and conditions of their use as they relate to the dissemination of contaminants.

4. An evaluation of actual and potential hazards to determine whether conditions immediately dangerous to life or health might arise or whether injurious effects would be produced only after prolonged or repeated exposures.

5. The nature of the duties to be performed by the wearer of protective devices, particularly as they relate to restriction of movements.

6. An understanding of the principles, design, scope of use, limitations, advantages and disadvantages of the respiratory protective equipment available.

This release is intended to provide guidance that will assist plant and site managers in safeguarding health and life of all Plant J-1 employees through proper selection and use of respirators. Use of respirators implies that the wearer needs protection from an atmosphere that might threaten his life or health. Therefore, it is imperative that the level of protection needed be determined and provided in both normal and emergency conditions of use, particularly if exposure to the atmosphere could be immediately dangerous to life or health.

CONTENTS

CONTENTS (cont.)

I. PERMISSIBLE PRACTICE

A. When to be Used

In the control of those occupational diseases cuased by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to the following requirements.

B. Company Responsibility

Respirators shall be provided by the company when such equipment is necessary to protect the health of its employees. The company shall provide the respirators which are applicable and suitable for the purpose intended and shall be responsible for the establishment and maintenance of a respiratory protective program which shall include the requirements for a minimal acceptable program.

C. Employee Responsibility

Employees shall use the provided respiratory protection in accordance with instructions and training received. They shall guard against damage to these respirators and report any malfunctions to their immediate superior.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

A. Selection of Respirators

Proper selection of respirators shall be made according to the guidance of American National Standard Practices for Respiratory Protection, Z88.2-1969 (Section 6).

The correct respirator shall be specified for each job. The respirator type is usually specified in the work procedures by a qualified individual supervising the respiratory protective program. The individual issuing them shall be adequately instructed to insure that the correct respirator is used.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

A. Selection of Respirators (cont.)

Approved or accepted respirators shall be used when they are available. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities. [The United States Department of Interior, Bureau of Mines, and the United States Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health are recognized as such authorities in the United States.]

B. Instruction and Training

1. General

For safe use of any respirator, it is essential that the user be properly instructed in its selection, use, and maintenance. It is a common misconception that training is needed only for the self-contained breathing apparatus. Training is necessary for supervisors, such as foremen who are to supervise the use of any type of respiratory protective device, as well as for those who are to wear it, if a device is to be used intelligently, confidently, and safely. Obviously, the more complicated the apparatus or the more hazardous the atmosphere in which it is to be used, the more extensive and intensive the training must be. Such training should be given by a qualified person, such as an industrial hygienist, a safety engineer, or respirator manufacturer's representative.

Training in the use of any respirator should cover the following:

(a) Instruction in the nature of the hazard, whether acute, chronic, or both, and an honest appraisal of what may happen if the respirator is not used.

(b) Discussion of the airborne contaminants against which the wearer is to be protected, including information on their physical properties, possible concentrations or changes thereof, mode of physiological action, toxicity, and means of detection.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

1. General (cont.)

(c) Discussion of the reasons for using the respirator. Explanation of why more positive control is not immediately feasible. This shall include recognition that every reasonable effort is being made to reduce or eliminate the need for respirators. A discussion of why this is the proper type of respirator for the particular purpose.

(d) Description of its construction, operating principles, capabilities, and limitations.

(e) Instruction in procedures for assuring that it is in proper working condition.

(f) Instruction in fitting the respirator properly and checking for the adequacy of fit.

(g) Instruction in the proper use and maintenance of the respirator.

(h) Discussion of the importance of careful reading of labels on the respirator and on its container and of the manufacturer's instructions for its use and care.

(i) Classroom and field training to recognize and cope with emergency situations.

(j) An opportunity for the men to handle the respirator, have it fitted properly, test its facepiece-to-face seal, wear it in normal air for a long familiarity period, and finally to wear it in a test atmosphere.

An important by-product of training is the sense of confidence that the trainee should develop in his ability to use the respirator properly, so that if something suspicious should happen to the respirator, or to the atmospheric conditions, he would act rationally rather than panic.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

1. General (cont.)

To conserve space and avoid repetition, only those items of the foregoing list that require special emphasis will be included in the discussion of specific training for the various types of respirators. However, ALL of the items should be covered adequately in the training program.

2. Specific Training for Air Line Respirator

Supervisory personnel should be trained to select the proper type of respirator for the job. A choice from several makes of the proper type and design of respirator might be left up to those who are to wear them. Such a procedure tends to lessen the workers' apparent inborn resistance to wearing a respirator.

Explain the operating principles and limitations of the air line respirator. Explain the necessity for a supply of respirable air and means for obtaining it. Emphasize the fact that the air pressure applied to the inlet end of the air supply hose must be within the pressure range given on the approval plate of the respirator to maintain the proper rate of flow of air to the breathing zone of the wearer. Stress the importance of using the proper length of the air supply hose specified by the respirator manufacturer. The rate of flow of air through two hoses which are outwardly similar in appearance may be markedly different.

Instruct the trainee as to how to check the respirator to be sure that it is in good wearing condition. Then allow him to actually check a respirator as follows:

(a) Check the air issuing from the air supply line for droplets of water, particulate matter, and objectionable odors. These should be removed by a properly maintained air line filter. The presence of carbon monoxide in the air issuing from the air supply line should be determined at frequent intervals by the control lab analysts.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

2. Specific Training for Air Line Respirator (cont.)

(b) Check the air supply line to see that it is of the proper type, that it is not twisted or kinked, and that it has not been worn through to the fabric.

(c) Check the detachable coupling at the respirator end of the hose to see that it can be detached quickly and easily, and that it does not leak.

(d) Check for the presence of and condition of the filter cartridge which is used on many air line respirators as a secondary filter for the removal of odors and large particles from the air flowing to the wearer.

(e) Check the facepiece, helmet, or hood for obvious defects, such as missing or dirty exhalation valves, cracked or dirty eyepieces, broken or inelastic head harnesses, and defective flexible breathing tubes.

(f) Check the helmets or hoods of abrasive blasting respirators for the general condition of their exteriors, for the presence of the safety glass or plastic eyepiece, and for the protective screen or perforated metal cover for the eyepiece.

(g) Replace missing parts, and repair or replace damaged or defective parts.

If the air line respirator is of the continuous flow class, instruct the user in the proper method of donning the complete respirator and if of the flow control type, of adjusting the rate of flow of air to the interior of the facepiece, helmet, or hood. Allow him to practice uncoupling the detachable coupling so that he could free himself of the encumbrance of the air supply hose quickly in an emergency.

If the air line respirator is of the demand flow class, instruct the user in the proper method of donning the complete respirator, including a test for facepiece fit. This test

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

2. Specific Training for Air Line Respirator (cont.)

may be made by either the positive pressure or the negative pressure method, as described in the following section. Instruct him to set the pressure at the inlet to the air supply hose within the range shown on the approval label.

3. Fitting Problems

a. General

Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators shall not be worn when conditons prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the facepiece, or temple pieces on glasses. Also, the absence of one or both dentures can seriously affect the fit of a facepiece. The worker's diligence in observing these factors shall be evaluated by periodic check.

To assure proper protection, the facepiece fit shall be checked by the wearer each time he puts on the respirator. This may be done by following the manufacturer's facepiece fitting instructions such as these two simple field tests:

(1) Positive Pressure Test:
Close the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires that the wearer first remove the exhalation valve cover and then carefully replace it after the test.

(2) Negative Pressure Test:
Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

3. Fitting Problems

a. General (cont.)

(2) Negative Pressure Test: (cont.)
the seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for 10 seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is satisfactory.

Potential users of respirators should also be required to test their facepiece fit by wearing the respirator under realistic test conditions. A concentration of 100 parts per million isoamyl acetate vapor (obtained by vaporizing 17.3 milliliters of isoamyl acetate for each 1000 cubic feet of room volume) may be prepared in a special chamber, a small plastic enclosure, or in a vacant room. If the person wearing the respirator can enter and remain in this test atmosphere without detecting the odor of isoamyl acetate, he has a good fit. If he detects the odor, he should retreat to fresh air, readjust the facepiece, and repeat the test. If leakage is still noted, it can be concluded that this particular respirator will not protect the wearer. The wearer should not continue to tighten the headband straps until they are uncomfortably tight, simply to achieve a gas-tight face fit. If fitted too tightly the wearer will not wear the respirator or will wear it fitting comfortably loose and will not have a gas-tight seal.

Particulate-filter respirators can frequently be adapted for use with chemical cartridges and may also be tested for face fit in isoamyl acetate.

To check the fit of a respirator equipped with a high-efficiency particulate filter, an irritant smoke tube (glass tube 12 centimeters long by 1 centimeter diameter, filled with stannic chloride-impregnated pumice) produces a very irritating smoke when air is blown through it. The smoke is directed at the facepiece seal and leakage is indicated by irritation of the throat and lungs. (When testing half-

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

3. Fitting Problems

a. General (cont.)

mask facepieces, do not direct the smoke into the eyes and instruct the wearer to keep his eyes closed during the test.) Freshly produced smoke particles from this tube range from less than 0.1 to 3 microns in diameter. The glass tube is secured at each end for easy breaking. A squeeze bulb with a short rubber tube aspirates air through the tube; visible smoke is immediately formed by contact with moisture in the air. The irritant is hydrochloric acid absorbed on the particulate. A similar smoke is produced with a sulfur trioxide or titanium tetrachloride tube.

b. Eyeglasses

Three important considerations attend the attachment of eyepieces to a full face mask.

First, the eyepieces must be secured so as to ensure a leakproof connection which will withstand not only normal flexing but also considerable abuse.

Second, the method of securing the seal must not distort or stress the glass or plastic eyepieces, thus distorting the field of vision and increasing breakage of the eyepieces.

Third, excessive stretching of the facepiece material, which reduces appreciably the serviceable life of the facepiece, must be avoided.

4. How to Attach Eyeglasses

Providing respiratory protection for individuals wearing corrective glasses is a serious problem. A proper seal cannot be established if the temple bars of the eyeglasses extend through the sealing edge of the full face mask. The United States Army furnishes each user of corrective glasses a corrective lens mounted in a wire bracket that snaps into place in the eyepiece socket of the facepiece, which preserves the seal but does not provide really satisfactory vision.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

3. Instruction and Training

4. How to Attach Eyeglasses (cont.)

At least three manufacturers of full face masks have developed systems for mounting corrective lenses inside the facepiece. One mounts the lenses in a special frame attached to a center-mounted adjustable mount inside the facepiece (see Figure 3.8). Another provides corrective glasses with special short temple bars that are supported by a special mount on each side of the facepiece but inside the sealing surface (see Figure 3.9). A third supports with a suction cup a frame which holds prescription glasses from which the temple bars have been detached (see Figure 3.10). An alternative used for many years, but which generally is not very satisfactory, is to remove temple bars or leave one-half inch of bar and tape the eyeglasses to the wearer's head.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

4. How to Attach Eyeglasses (cont.)

Figure 3.8

Full face mask illustrating center mounted prescription glasses inside facepiece and nose cup insert.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

4. How to Attach Eyeglasses (cont.)

Figure 3.9

Full face mask illustrating method of mounting prescription glasses inside facepiece by special mount on each side and nose cup insert.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

4. How to Attach Eyeglasses (cont.)

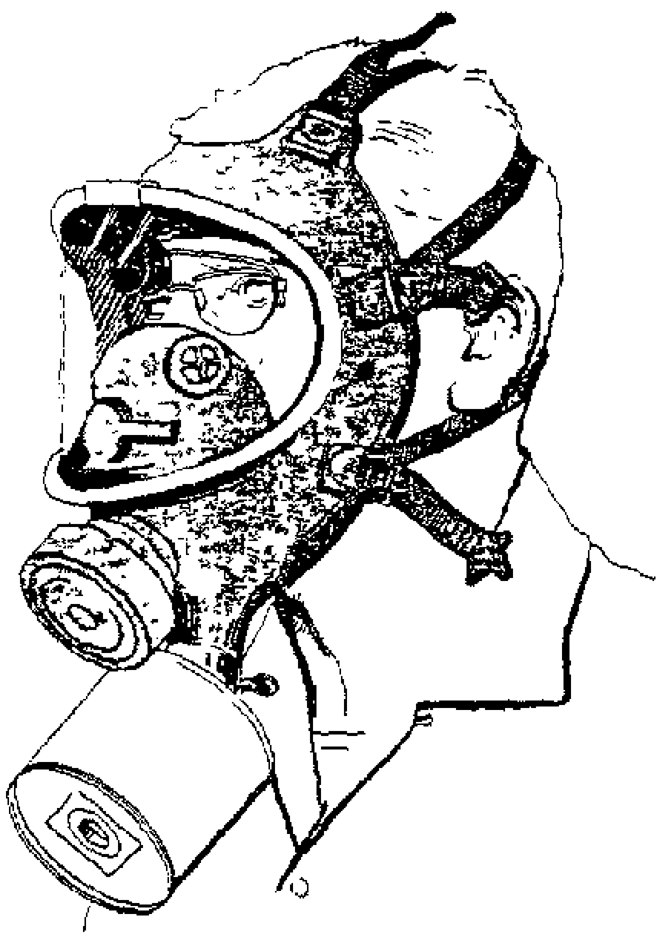


Figure 3.10

Full face mask illustrating method of mounting prescription glasses inside facepiece with center mounted suction cup and nose cup insert.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

4. How to Attach Eyeglasses (cont.)

The ability to wear corrective glasses with a half mask depends on the face fit. It is possible to obtain a seal with a poorly fitting respirator, but quite often the device will rest so high on the face as to make it impossible to wear glasses.

Any respirator affects the wearer's ability to see. The adverse effect may be due to:

(a) Reduced total field of vision.
(b) Reduced binocular field of vision.
(c) Distorted field of vision.
(d) Fogged eyepiece.

The degree of visual impairment from these factors depends not only on the design of the respirator but also on the fit of the particular facepiece. Either the half or the full face mask can reduce the total field of vision. The half mask and the attached elements can restrict normal downward vision appreciably, an objectionable interference to individuals wearing the mask while walking or working at benches or desks.

Upward and downward vision, as well as sideward vision, is of utmost importance in emergencies. Ability to see the safest pathway or stairs, to see and avoid low hanging pipes and supports, and to recognize without delay any motion or situation at the extreme sideward limit of normal vision is often the key to satisfactory handling of critical situations. In selecting masks, this should be carefully weighed, together with the other factors outlined in the release.

Diminished vision in the full face mask may be caused not only by the facepiece and attached canisters, but also by the design and placement of the eyepieces. Here the total field of vision depends on the size of the lens and its distance in front of the eye, that is, a small lens close to the eye gives the individual essentially the same total field

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

4. How to Attach Eyeglasses (cont.)

of vision as a large lens farther from the eye. However, the smaller the lenses or eyepieces, the more critical the face fit of the respirator, because the position of the eye for proper viewing is restricted to small variations.

For this reason, vision data from shadowgraphs of lights placed at the center of the eyepieces reflect only the maximum field of vision of that particular respirator without showing the field of vision of an individual whose eyes are not centered at the optimum position. Also, the smaller the eyepieces, usually the more the binocular field of vision is reduced.

The importance of lessened binocular vision too frequently is overlooked. Quite often respiratory protective equipment is used in actual or potential emergencies, in which a worker's ability to see determines his response, so that diminution of the normal binocular field of vision, with impaired depth perception, could have serious consequences. Although a person could learn to compensate for lack of depth perception, normally he would not wear a respirator often enough to gain this facility. This lack of depth perception may very well be responsible for the sense of uneasiness experienced by many individuals when wearing a respirator; certainly most workers react favorably to a facepiece allowing greater binocular vision even though the total field of vision is somewhat reduced.

Although minor scratches and opacities on an eyepiece are annoying, usually the annoyance is not extreme, and workers endure scratched eyepieces much as spectacle wearers tolerate dirty corrective lenses. Impaired vision from fogged eyepieces, however, is intolerable. When water in warm humid air condenses on cold eyepieces, it fogs them. Thus a worker wearing a respirator under cold temperature conditions finds the eyepieces immediately fogged on the <u>outside</u> when he enters a warm room with relatively high humidity. On the other hand, the eyepieces may become fogged on the

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

B. Instruction and Training

4. How to Attach Eyeglasses (cont.)

inside when the worker is in a cold environment because of condensation of water produced by exhalation and by facial perspiration.

It is impossible and impractical to try to prevent fogging of the eyepieces merely by sealing off exhaled air from the cavity behind the lens, thus creating a sealed goggle physically attached to a half mask respirator. It is possible to prevent fogging successfully for a limited period in a full face mask with a nose cup (see Figures 3.8, 3.9, and 3.10) to lead the exhaled air directly to the exhalation valve and an air inlet system which directs the incoming air across the inside of the eyepieces. In the U. S. Army assault mask, a nose cup with proper valves prevents exhaled air from contacting the lenses. With nose cup and deflector tubes the Army mask can be used at low temperatures with reduced fogging or frosting of the lenses, for limited periods.

Antifogging compounds, an effective adjunct in efforts to reduce eyepiece fogging, should be used routinely. If such a practice is not followed regularly, a situation will inevitably develop in which dangerous fogging of the eyepiece will occur that could have been prevented or alleviated by the use of an antifogging compound.

C. Assignment of Respirator

Where the work requires, respirators should be assigned to individual workers for their exclusive use. For daily use a good procedure is to provide a bin or locker for each workman to store his respirator. Each man, in this way, should be held responsible for cleaning, inspection and maintenance of the respirator. Each respirator permanently assigned to an individual should be durably marked to indicate to whom it was assigned. This mark should not affect the respirator performance in any way.

Written records should be maintained covering the date of issuance, replacement or withdrawal of all respirators.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

D. Maintenance and Care of Respirators

1. Type of Program

A program for maintenance and care of respirators shall be adjusted to the type of plant, working conditions, and hazards involved, and shall include the following basic services:

(a) inspection for defects (including a leak check),
(b) cleaning and disinfecting,
(c) repair, and
(d) storage.

Equipment shall be properly maintained to retain its original effectiveness.

2. Inspection

a. Frequency

All respirators shall be inspected routinely before and after each use.

Self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be fully charged according to the manufacturer's instructions. It shall be determined that the regulator and warning devices function properly.

Emergency respirators should be inspected at least every 30 days because, though they may stand unused for a considerable time, they must be available in first-class condition at a moment's notice.

b. Inspection Procedure

Respirator inspection shall include a check of the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters. Rubber or elastomer parts shall be inspected for pliability and signs of deterioration. Stretching and manipulating rubber or elastomer parts with a massaging action will keep them pliable and flexible and prevent them from taking a set during storage.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

D. Maintenance and Care of Respirators

2. Inspection

c. Recording

A record shall be kept of inspection dates and findings for respirators maintained for emergency use.

3. Cleaning

Routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to insure proper protection is provided for the wearer. Each worker should be briefed on the cleaning procedure and be assured that he will always receive a clean and disinfected respirator. Such assurances are of greatest significance when respirators are not individually assigned to workers.

Respirators maintained for emergency use shall be cleaned and disinfected after each use. After the device is dry, an antifogging compound should be placed on the inside of the lens.

The following procedure is recommended for cleaning and disinfecting respirators:

(a) Remove any filters, cartridges, or canisters.

(b) Wash facepiece and breathing tube in cleaner/disinfectant or detergent solution (see following paragraphs). Use a hand brush to facilitate removal of dirt.

(c) Rinse completely in clean, warm water.

(d) Air dry in a clean area.

(e) Clean other respirator parts as recommended by manufacturer.

(f) Inspect valves, headstraps, and other parts; replace with new parts if defective.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

D. Maintenance and Care of Respirators

3. Cleaning (cont.)

(g) Insert new filters, cartridges, or canisters; make sure seal is tight.

(h) Place in plastic bag or container for storage.

Cleaner/disinfectant solutions are available that effectively clean the respirator and contain a bactericidal agent. The bactericidal agent is generally a quaternary ammonium compound. The respirator may be immersed in the solution, rinsed in clean, warm water, and air dried.

Alternatively, respirators may be washed in a liquid detergent solution, then immersed in:

(a) a hypochlorite solution (50 ppm of chlorine) for two minutes;
(b) an aqueous iodine solution (50 ppm of iodine) for two minutes; or
(c) a quaternary ammonium solution (200 ppm of quaternary ammonium compounds in water with less than 500 ppm total hardness).

Different concentrations of quaternary ammonium salts are required to achieve a disinfecting solution with waters of varying hardness. Also, dermatitis may occur if the quaternary ammonium compounds are not completely rinsed from the respirator. The hypochlorite and iodine solutions are not stable; they age rubber parts, and are corrosive to metallic parts. Therefore, immersion times should not be extended and the disinfectants shall be thoroughly rinsed from the respirator parts.

Strong cleaning and disinfecting agents can damage respirator parts. Temperatures above 185°F and vigorous mechanical agitation should not be used. Solvents which affect elastomer or rubber parts should be used with caution.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

D. Maintenance and Care of Respirators

3. Cleaning (cont.)

Respirators may be contaminated with toxic materials (that is, organic phosphate pesticides and radionuclides). If the contamination is light, normal cleaning procedures should provide satisfactory decontamination; if heavey, a separate decontamination step may be required before cleaning.

For complete decontamination against phosphate pesticides, the respirator should be washed with alkaline soap and rinsed with 50% alcohol (ethyl or isopropyl).

Respirators used to protect against radioactive contaminants should be decontaminated to levels not exceeding 100 disintegrations per minute per 100 square centimeters fixed alpha and 0.2 millirad per hour of beta-gamma above background at contact. There should be no detectable removable activity using standard swipe techniques.

4. Repairs

Replacement or repairs shall be done only by experienced persons with parts designed for the respirator. No attempt shall be made to replace components or to make adjustment or repairs beyond the manufacturer's recommendations. Reducing or admission valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair.

5. Storage

a. General

After inspection, cleaning, and necessary repair, respirators shall be stored in a clean plastic bag to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators placed at stations and work areas for emergency use should be stored in compartments built for the purpose. The compartments should

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

D. Maintenance and Care of Respirators

5. Storage

a. General (cont.)

be clearly marked. Routinely used respirators, such as dust respirators, may be placed in plastic bags. Respirators should not be stored in such places as lockers or tool boxes unless they are in carrying cases or cartons.

b. Facepiece and Exhalation Valve

Respirators should be packed or stored so that the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

c. Written Instructions

Instructions for proper storage of emergency respirators, such as gas masks and self-contained breathing apparatus, are found in "use and care" instructions usually mounted inside the carrying case lid.

E. Physicial Fitness of Wearer

Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work while wearing the respirator equipment. The local physician shall make that determination, by the following methods.

(1) Each employee required to use a respirator shall be provided a medical review.

(2) Each medical review shall include a history to elicit symptomatology of respiratory disease and pulmonary function tests to include forced expiratory volume at 1 second ($FEV_{1.0}$).

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

E. Physical Fitness of Wearer (cont.)

(3) Spirometric tests to measure ventilatory function must be expressed in liters. The reported 1-second forced expiratory volume (FEV_1) should represent the largest of at least three attempts. The three appropriately labeled spirometric tracings, showing distance per second on the abscissa and the distance per liter on the ordinate, must be incorporated in the file. The paper speed to record the FEV_1 should be at least 20 millimeters (mm) per second. The height of the individual must be recorded. Studies should not be performed during or soon after an acute respiratory illness. If wheezing is present on auscultation of the chest, studies must be performed following administration of nebulized broncho-dilator unless use of the later is contraindicated. A statement shall be made as to the individual's ability to understand the directions, and cooperate in performing the tests. If the tests cannot be completed the reason for such failure should be explained.

(4) The employee shall be determined unable to perform the task requiring the wearing of a respiratory protective device on the basis of the spirometric tests in which the forced expiratory volume at 1 second ($FEV_{1.0}$) is equal to or less than the values listed in the following table or by a medically equivalent test:

Height (inches)	FEV_1 equal to or less than	
57 or less	Liters:	1.4
58-59		1.4
60-63		1.5
64-66		1.6
67-68		1.7
69-71		1.8
72		1.9
73 or more		1.9

(5) Where the values specified in paragraph (4) are exceeded, wearing of a respiratory protective device may nevertheless be found disabling to the employee performing the task. It is recognized that an impairment in the transfer of oxygen

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

E. Physical Fitness of Wearer (cont.)

from the lung can exist in an individual even though the ventilatory function tests are normal. Medically accepted clinical and laboratory diagnostic techniques including a medical judgment furnished by one or more physicians shall be considered the medical equivalence of the ventilatory function test described in paragraphs (3) and (4) above.

F. Area Surveillance

Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained and records kept.

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

G. Evaluation of Respirator Program Effectiveness

1. General

Feedback on how a respirator program is functioning is necessary if management is to maintain effective respiratory protection. Program improvements and elimination of deficiencies cannot be effected unless the program is monitored and evaluated on a continuing basis. The following techniques are used in evaluating the effectiveness of respirator programs.

2. Wearer Acceptance

The effectiveness of a respirator program can be largely determined by the degree of working acceptance. Numerous factors affect the worker's acceptance of respirators. These include comfort, ability to breathe without objectionable effort, adequate visibility under all conditions, provisions for wearing prescription glasses if necessary, ability to communicate, ability to perform all tasks without undue interference, and confidence in the facepiece fit. Failure to consider these factors is likely to reduce cooperation of the wearers in promoting a satisfactory program. How well these problems have been overcome can be determined by observing wearers during normal activities and by soliciting their comments.

3. Examination of Respirators in Use

Respiratory protection is no better than the respirator in use, even though it is worn conscientiously. Frequent random inspections shall be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained.

4. Evaluation of Protection Afforded

When respirators are worn in toxic atmospheres, the individual should be provided appropriate periodic laboratory tests. These may include urine, blood, or fecal analyses and other techniques to determine the intake and excretion of toxic

II. MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

G. Evaluation of Respirator Program Effectiveness

4. Evaluation of Protection Afforded (cont.)

substances. The findings of these tests, when correlated with other exposure data (especially air sampling data) for wearers of such equipment, can serve as an indication of the effectiveness of the program. Positive evidence of exposure shall be followed up to determine any relationship to inadequate respiratory protection and need for additional engineering controls.

Nasal or facepiece interior smears, or both, usually will detect any significant penetration of radioactive contaminants into the facepiece.

III. GAS MASK CANISTERS

A. Identification

The primary means of identifying a gas mask canister shall be by means of properly worded labels. The secondary means of identifying a gas mask canister shall be by a color code.

All who issue or use gas masks falling within the scope of this section shall see that all gas mask canisters purchased or used by them are properly labeled and colored in accordance with these requirements before they are placed in service and that the labels and colors are properly maintained at all times thereafter until the canisters have completely served their purpose.

B. Labels

1. Type of Use

On each canister shall appear in bold letters the following·

(a) Canister for . . . .
(name of atmospheric contaminant)

or

Type N Gas Mask Canister

III. GAS MASK CANISTERS

B. Labels

1. Type of Use (cont.)

(b) In addition, essentially the following wording shall appear beneath the appropriate phase on the canister label:

"For respiratory protection in atmospheres containing not more than . . . percent by volume of
. . . . "
(name of atmospheric contaminant)

(c) All of the markings specified above should be placed on the most conspicuous surface or surfaces of the canister.

2. Canisters with Filters

Canisters having a special high-efficiency filter for protection against radionuclides and other highly toxic particulates shall be labeled with a statement of the type and degree of protection afforded by the filter. The label shall be affixed to the neck end of, or to the gray stripe which is around and near the top of, the canister. The degree of protection shall be marked as the percent of penetration of the canister by a 0.3-micron-diameter dioctyl phthalate (DOP) smoke at a flow rate of 85 liters per minute.

3. Warning

Each canister shall have a label warning that gas masks should be used only in atmospheres containing sufficient oxygen to support life (at least 16 percent by volume), since gas mask canisters are only designed to neutralize or remove contaminants from the air.

C. Color Coding

Each gas mask canister shall be painted a distinctive color or combination of colors. All colors used shall be such that they are clearly identifiable by the user and clearly distinguishable

III. GAS MASK CANISTERS

C. Color Coding (cont.)

from one another. The color coating used shall offer a high degree of resistance to chipping, scaling, peeling, blistering, fading, and the effects of the ordinary atmospheres to which they may be exposed under normal conditions of storage and use. Appropriately colored pressure sensitive tape may be used for the stripes. [See chart, page 29.]

CANISTER COLOR CODE CHART

Atmospheric Contaminants to be Protected Against	Colors Assigned*
Acid gases	White.
Hydrocyanic acid gas	White with 1/2-inch green stripe completely around the canister near the bottom.
Chlorine gas	White with 1/2-inch yellow stripe completely around the canister near the bottom.
Organic vapors	Black.
Ammonia gas	Green.
Acid gases and ammonia gas	Green with 1/2-inch white stripe completely around the canister near the bottom.
Carbon monoxide	Blue.
Acid gases and organic vapors	Yellow.
Hydrocyanic acid gas and chloropicrin vapor	Yellow with 1/2-inch blue stripe completely around the canister near the bottom.
Acid gases, organic vapors, and ammonia gases	Brown.
Radioactive materials, excepting tritium and noble gases . .	Purple (Magenta).
Particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above gases or vapors .	Canister color for contaminant, as designated above, with 1/2-inch gray stripe completely around the canister near the top.
All of the above atmospheric contaminants	Red with 1/2-inch gray strip completely around the canister near the top.

* Gray shall not be assigned as the main color for a canister designed to remove acid or vapors.

Note: Orange shall be used as a complete body, or stripe color to represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

IV. GENERAL PRECAUTIONS

A. Respirator Failure

In areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional man shall be present. Communications (visual, voice, or signal line) shall be maintained between both or all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and have the proper rescue equipment to be able to assist the other(s) in case of an emergency.

B. Standby for Self-Contained Apparatus

When self-contained breathing apparatus or hose masks with blowers are used in atmospheres immediately dangerous to life or health, standby men must be present with suitable rescue equipment.

C. Standby for Air Line Respirator

Persons using air line respirators in atmospheres immediately hazardous to life or health shall be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres or other and equivalent provisions for the rescue of persons from hazardous atmospheres shall be used. A standby man or men with suitable self-contained breathing apparatus shall be at the nearest fresh air base for emergency rescue.

* * * * * * * *

Year Inspected: ______

Storage Area: ______________

WRITE YOUR COMMENTS ON THE BACK OF THIS FORM

Equipment Inspected By:

1. ______ 7. ______
2. ______ 8. ______
3. ______ 9. ______
4. ______ 10. ______
5. ______ 11. ______
6. ______ 12. ______

RESPIRATORY EQUIPMENT CHECK LIST
Self-Contained Breathing Apparatus
(Check lists are to be used monthly)

Yes	No	
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Gauge on air tank is within 10% maximum fill pressure
1 2 3 4 5 6	1 2 3 4 5 6	Carrying case is in good condition. Hinges open freely, case protects SCBA, carrying handle is firmly attached to case, case is reasonably clean inside.
7 8 9 10 11 12	7 8 9 10 11 12	
1 2 3 4 5 6	1 2 3 4 5 6	Facepiece lens is in good condition, not scratched or discolored badly enough to distort vision.
7 8 9 10 11 12	7 8 9 10 11 12	
1 2 3 4 5 6	1 2 3 4 5 6	Headstraps are in good condition, can withstand a firm hand pull
7 8 9 10 11 12	7 8 9 10 11 12	
1 2 3 4 5 6	1 2 3 4 5 6	Metal parts such as cylinder clamps, facepiece clips, harness buckles and regulators appear to be in good condition.
7 8 9 10 11 12	7 8 9 10 11 12	
1 2 3 4 5 6	1 2 3 4 5 6	Mainline regulator valve and bypass valve are in good workable condition.
7 8 9 10 11 12	7 8 9 10 11 12	
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Carrying straps and belts are in good condition.
1 2 3 4 5 6	1 2 3 4 5 6	Hoses and connections are properly fitted and ready for instant use.
7 8 9 10 11 12	7 8 9 10 11 12	
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Unit has been checked for leaks.

Year Inspected ________

Storage Area ________________

Equipment Inspected By

1.	________	7	________
2	________	8.	________
3	________	9	________
4	________	10.	________
5	________	11.	________
6	________	12.	________

WRITE YOUR COMMENTS ON THE BACK OF THIS FORM

RESPIRATORS

(Check lists are to be used monthly)

Yes						No						
1	2	3	4	5	6	1	2	3	4	5	6	
7	8	9	10	11	12	7	8	9	10	11	12	Is the respirator clean?
1	2	3	4	5	6	1	2	3	4	5	6	
7	8	9	10	11	12	7	8	9	10	11	12	Is the mouthbit in good condition?
1	2	3	4	5	6	1	2	3	4	5	6	
7	8	9	10	11	12	7	8	9	10	11	12	Are gaskets, inhalation and exhalation valves in good condition?
1	2	3	4	5	6	1	2	3	4	5	6	The respirator facepiece or body is in good condition and does
7	8	9	10	11	12	7	8	9	10	11	12	not show signs of aging or wear.
1	2	3	4	5	6	1	2	3	4	5	6	All breathing air is filtered through the cartridge (There are
7	8	9	10	11	12	7	8	9	10	11	12	no leaks)

PROCEDURE FOR CHECKING MOUTHBIT RESPIRATORS FOR LEAKS
Place a plastic cup, or other equivalent device, over the cartridge inlet and inhale through the mouthpiece If the respirator leaks, cover the exhalation diaphragm with your hand and repeat the test to determine the source of the leak If the gasket leaks, reseat it in its groove, if the exhalation valve leaks, it should be cleaned and the test repeated If it still leaks, get a new respirator

PROCEDURE FOR CHECKING NOSE AND MOUTH RESPIRATORS FOR LEAKS
To check respirators that have tape covers over the cartridge, leave the tape on, properly position the respirator over your nose and mouth, then inhale The vacuum will support the weight of the respirator If leaks are found check the exhalation valve, the facepiece for small holes and the cartridges to see that they are screwed on firmly

For respirators not equipped with tape over the cartridges, use a thin piece of rubber or polyethylene to cover the cartridge A plastic holder can be used to hold these covers in place. Then position the respirator on your face and inhale The vacuum will support the weight of the respirator if there are no leaks. If leaks are noticed and they aren't found when the exhalation valve, facepiece or cartridges are checked, the respirator should be discarded

Year Inspected ______________

Storage Area ______________

WRITE YOUR COMMENTS ON THE BACK OF THIS FORM

Equipment Inspected By:

1.	______________	7.	______________
2.	______________	8.	______________
3.	______________	9.	______________
4.	______________	10	______________
5	______________	11.	______________
6.	______________	12.	______________

GAS MASKS

(Check lists are to be used monthly)

Yes	No	
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Gas mask is stored in plastic bag or case.
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Canister tape seal is intact.
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	The canister is not out of date.
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Are headstraps in good condition? (Check by stretching.)
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Was the exhalation valve replaced within the last year?
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	The facepiece is in good condition and not cracked from age or badly worn.
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	The facepiece lens is in good condition and not scratched or discolored badly enough to distort vision
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Hose, connections and clamps are in good condition.
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Mask is stored with straps in extended position.
1 2 3 4 5 6	1 2 3 4 5 6	
7 8 9 10 11 12	7 8 9 10 11 12	Mask has been checked for leaks.

TO: Holders of Foreman's Safety Manual

FROM. Safety Department

SUBJECT· Safety Permit Procedure

A safety permit is written permission to do certain types of work in hazardous areas or under hazardous conditions.

A hazardous area is hereby defined as any location where flammable, corrosive or toxic materials (solid, liquid or gaseous) are produced, used, transferred or stored.

A safety permit is required in any hazardous area before anyone may undertake work other than that normally carried out as routine in the area if such work involves:

1. Open flames, spark-producing tools or other sources of ignition.
2. Entering tanks, kettles, tank cars, pits, sewers and other confined spaces.
3. Breaking lines which carry flammable, corrosive or toxic materials.
4. Exposure to flammable, corrosive or toxic materials.
5. An oxygen deficiency.

NOTE: A permit is not required for gasoline operated air compressors in non-hazardous areas.

Safety permits may be issued only by the supervisors directly responsible for the area or facilities affected by the work. In those occasional situations where there is an apparent overlap of responsibility, permits should be issued by the supervisor having the most complete knowledge of the hazards associated with the job or, as a joint effort of the two or more supervisors directly affected.

In the Research Laboratory Building, the Building Superintendent or his assistant shall assume the responsibility for issuing permits. In all other laboratories, the Laboratory Head will issue permits for his area of responsibility and may, at his discretion, delegate the duty to his assistants.

On construction projects, permits will be issued only by the engineer in charge and the foreman of the building involved or adjacent to the site of such work.

During night shifts or over weekends and holidays, permits for emergency work will be issued by the shift foremen in those areas which have such supervision. In locations where departmental shift foremen are not employed, the area shift foreman or the Night Supervisor will assume responsibility for issuing permits for emergency work during all shifts other than the normal Monday through Friday day shift. The Night Supervisor on duty must be notified of all permits to be issued on his shift and shall be available to render any assistance which might be required of him.

Hourly-rated persons who have been properly certified may issue safety permits only when they are acting in the full capacity of a substitute supervisor.

A foreman requesting work from the Mechanical Department shall notify that department of the approximate time that the area or equipment will be fully prepared and available for the mechanics to begin work. Such notification should be as far in advance as possible to reduce delays and to permit efficient scheduling of manpower by the Mechanical Department.

It shall be the responsibility of those who issue permits to keep close checks on hazardous jobs. (The Safety Department can be requested to furnish a man to keep check on large scale jobs.) It should be recognized that in many cases changing conditions may rapidly create hazards in areas which had previously been approved for work. If a worker notices any unusual conditions which may be hazardous he should first stop all work involving open flame or spark producing tools and then notify the department foreman. If the person who has issued a permit finds that conditions have changed and that it is no longer safe to proceed with the work, it is his responsibility to withdraw the permit and suspend further work on the job until safe conditions have been re-established. All persons associated with the job must be notified immediately when a permit is withdrawn.

The safety permit form will be made out in duplicate by the responsible individual as indicated above. One copy is to be issued to the workman and must be posted by him in the immediate area of the job, and when it becomes invalid, it must be removed from the area. The other copy is to be retained for his file by the person issuing it. A supply of safety permit forms is kept in the Plant Storeroom.

Our Fire Chief, Fire and Safety Inspectors, and other members of the Safety Department will spot-check workers copies of safety permits during the course of their plant tours, inspections, etc., in order to verify that all necessary precautions have been taken. If there is any doubt about the safety of a job, the work will be halted until the foreman has taken suitable corrective measures.

The safety permit includes a good check list of points to be given close attention before the permit is signed.

The foreman will arrange for all protective measures under his control before any work is started. The Mechanical Department will arrange for the necessary protection which is controlled by it, and the shop foreman will be responsible for the supervision of the men on the job. The department foreman will see that both his and the Mechanical Department personnel have taken steps required to protect against fire or injury before he approves the permit. It must be noted that a permit is only valid for the man whose name is shown on the permit, for the job listed, and for the date and time specified thereon.

Whenever there is any doubt about the safety of the men, equipment, building, etc., in connection with permits, the Safety Department should be consulted without delay.

PREPARATION BY THE DEPARTMENT FOREMEN:

The foreman, the supervisor, or the area engineer in charge of the project has the responsibility of seeing that all traces of corrosive, toxic or flammable substances have been removed from the equipment in question before the mechanics are scheduled to arrive. This may include merely filling with water two or more times to clean it, or it may be necessary to boil with caustic or an appropriate solvent to remove any residual material. Everything should be ready to start the work, and the foreman should have the safety permit completed and filled out ready for the workers. However, another test with the oxygen indicator and explosimeter must be done in the presence of the workers.

Before welding or burning on the outside of a closed vessel may be started, the vessel must be completely emptied, washed out, and filled with water or, if the vessel is leaking, inert gas.

All lines to kettles or stills must be properly blanked off or broken before any work is started. One end of a coil may be blanked off and the other end left open, to prevent unexpected pressure build-up.

Disconnects which control related electrically powered equipment must be locked open. Push-button stations must be operated to be assured that the proper disconnect has been locked open.

Arrangements must be made to have men (Mechanical, Production or Safety) stationed at strategic locations with fire extinguishers or water lines, when necessary.

All operators in the area or building must be warned if welding is in progress and everyone concerned must be on the alert.

Arrangements must be made to stop all transfers of flammable materials into and out of the area while welding is in progress. Outside areas approved for welding should be roped off to prevent vehicles from bringing flammable liquid into the welding area.

Equipment that vents flammable, toxic or corrosive vapors into the building such as open receivers, tanks, open mix kettles and reaction kettles should be shut down.

Block off openings to other floors in the immediate area to prevent sparks from spreading.

NOTE: No burning and welding will ever be permitted in any building while the sprinkler system is shut off for repairs or for any other reason.

Mechanics and welders will be summoned as required. In order to get workers on the job and to minimize delays, it is necessary for complete coordination between the Operating, Mechanical and Safety departments.

The foremen will either be provided with an explosimeter and O_2 indicator or will share one, depending on the building or area. These must be brought to the service area on the first floor of Building A weekly (Thursday or Friday), for a routine check. In the event that repairs are needed at other times, they may be brought to the Safety Department at any time.

Every welder must have available, in his work area, his 2-1/2 lb. dry chemical fire extinguisher. He must use covers and shields when necessary, and must confine sparks and hot metal in order to prevent fires.

Asbestos fire blankets, tarpaulins saturated with water, or other suitable materials will be used as covers over drains or floor openings, in solvent saturated areas, and where flammable materials are located, before burning or welding is started. The Mechanical Department will provide these. On construction jobs, the engineer in charge will make the arrangements for such protection.

The Safety Manual for employees (pages 95 and 96) has a detailed account of the requirements for welding and burning.

TO: Holders of Foreman's Safety Manual

FROM Safety Department

SUBJECT: Entering and Working in Tanks, Tank Cars, Kettles or Other Confined Spaces

No vessel may be entered until it has been established that work cannot be performed from the outside and until a safety permit has been issued to cover the work. It is the responsibility of the operating department to assure that tanks, tank cars, kettles or other confined spaces are safe for entry and work before a request is made of any department to have men enter the vessel.

Notes:

(A) No tank, tank car, or other confined space will be entered when there is an oxygen deficiency or a possibility that an oxygen deficiency could occur.

(B) A pulley block will be arranged over the manhole, prior to tank entry, to aid in removing a person from the confined area should the need arise - exception to the pulley block arrangement may be made when there is not adequate space above the tank or confined area to facilitate use of pulley block.

(C) No tank or confined space will be entered until adequate personnel is available, in addition to the standby man, to facilitate the rescue should the need arise. There shall be a minimum of two persons on the same operating floor within sight and hearing range of the standby man. If there is a borderline case which a supervisor has a question about, the Safety Department will interpret and assist in the final decision. Lunch periods, breaks, etc., will be so arranged that the minimum of two additional persons will be available at all times during the entry.

(D) All persons acting as "Standby Safety Watcher" must have had training in tank rescue work and must understand their duties in detail.

(E) Where there may be a question concerning the application of Article 21, the Safety Department must be consulted for an opinion before any exceptions are made

Definitions:

The word "Foreman" shall include the foreman, the shift foreman, the area engineer, the engineer, supervisor, building supervisor, or Night Supervisor responsible for the immediate area in which the work is to be done. Foremen will be responsible for their men.

The word "Vessel" is defined as: "Any closed or open tank over four feet in depth, any tank car, tank truck, storage tank, kettle, grainer, receiver, still, holder, tote box, bin, hopper, sewer, dike, pit, or any other tank, chamber, boiler, fire box, flue, or confined space which may be hazardous, regardless of location, purpose or construction.

Preparation of Vessel Before Entering:

The foreman must assure that the vessel has been properly cleaned by an appropriate method and is free of toxic, explosive, flammable or corrosive materials. Special precautions must be exercised to protect workmen from toxic or irritating materials during the cleaning operations. THERE MUST BE ADEQUATE OXYGEN (20%) IN THE VESSEL, OR CONFINED SPACE, PRIOR TO AND DURING ENTRY.

Portable blowers shall be used to ventilate vessel and to maintain adequate oxygen content in the atmosphere at the vessel. The blower shall be capable of discharging a minimum of 265 cfm of air. During the period that tank is being ventilated, sampling with an approved oxygen analyzer must be performed periodically to assure adequate oxygen content. Should the oxygen content fall below 20%, all operations must stop and personnel must be removed from the "confined space" until adequate oxygen content can be re-established and the cause of the low oxygen reading corrected.

To provide complete protection, all lines to the vessel must be blanked off or disconnected before anyone is permitted to enter the vessel. Where lines are disconnected, they should be separated sufficiently to prevent materials or vapors from passing through the disconnected pipe into the vessel This includes the nitrogen purge lines on agitator packing glands as well as level control dip pipes.

No vessel may be entered while coils and/or jackets are under pressure, except when coils and jackets are being hydrostatically tested, or pressurized with air to determine the location of leaks. Nitrogen must not be used for this purpose.

Should the vessel be equipped with an agitator, the foreman will see that the fuses are pulled from the power supply switch and that the switch is locked out and tagged with a signed tag reading "Danger - Do Not Operate". (Refer to Foreman's Safety Manual, Article 28 - "Disconnecting Electrical Switches Before Working on Equipment").

The foreman will determine if any operations in the area will affect those working in the vessel and will take appropriate steps to safeguard the area and men. He will instruct operators to notify the standby man before starting any operation that may be dangerous to the men in the vessel, in which case the work in the vessel must be halted until it is safe to start again. The foreman and operator shall be responsible for notifying the standby man.

In some instances, a safety harness must be worn by each man entering a vessel or confined space.

When preparing to weld or burn or heat any jacket or coil in a vessel, the atmosphere between the jacket and the vessel or within the coil will first be tested with an explosimeter for flammable gases. If the work area is left for a period of time, such as lunch or breaks, an explosimeter check for flammable gases and an oxygen determination should be made before work inside the vessel is resumed.

An air-supplied mask must be used when respiratory protection is needed. A RESPIRATOR OR CANNISTER TYPE MASK MUST NOT BE USED IN A VESSEL OR CONFINED SPACE.

No person shall be permitted to enter a vessel or confined space, unless he is physically able to perform the proposed work.

Issuing the Safety Permit

Detailed instructions for issuing safety permits can be found in Article 7 of the Foreman's Safety Manual.

The foreman issuing the permit will make a re-check whenever conditions warrant. This may be specified on the permit or may be the result of activity encountered while working on the job. When there is any doubt about conditions, a re-check must always be made.

Preparation for Working in Vessels:

No one will enter any vessel without having a standby man who will remain outside the vessel, and two other persons available in the near vicinity, to assist in rescue operations should the need arise.

The standby man shall have had recent training in Tank Rescue Procedures and must be physically capable of performing the duties related thereto. He must also be prepared to act in the event of an emergency, using the following procedure.

(1) Have a sealed rescue kit at the job site.

(2) Have a pulley block attached above the manhole, with a 25-foot 9/16" rope passed over the sheave. The snap end of the rope should be inside the tank (or opening) and the other end securely tied to a pipe or support beam.

(3) Constantly observe anyone who may be working inside the vessel.

(4) Be constantly aware of conditions outside the vessel which may adversely affect men in the vessel.

(5) Be prepared to summon help if the need arises.

<u>Emergency Rescue Procedure</u>

When an accident occurs, there is a possibility that the rescuer could be overcome in attempting to reach the victim, especially if he is not wearing the necessary protective breathing equipment. Therefore, rescuers must remember to wear the breathing equipment before entering a vessel to help anyone.

The following procedure <u>must</u> be followed in an emergency:

(1) Open rescue kit.

(2) Sound alarm horn -- call for help.

(3) Open air valve on breathing air cylinder.

(4) Put on air-line mask and check for leaks.

(5) Put on the nylon wristlets equipped with the 25-foot rope.

(6) Attach the wristlets fitted with the "D" ring to the hook on the rope and lower them into the vessel.

<u>NOTE</u> NO STANDBY MAN MAY ENTER A VESSEL <u>UNTIL HELP HAS ARRIVED</u>. [illegible] AIR MASK, PUT ON THE NYLON WRISTLETS WITH THE 25-FOOT ROPE, AND BE READY TO ENTER THE VESSEL. AFTER [illegible] HELP HAS ARRIVED (MINIMUM OF TWO PERSONS), HE WILL ENTER THE VESSEL TO RESCUE.

(7) When help arrives (minimum of two persons), enter the vessel to rescue the victim.

(8) Prepare the victim for removal from the tank or confined space. Place the wristlets, which are attached to the rope, around the wrists of the victim. Make sure the rope is not tangled around a ladder, an agitator shaft, or any other obstruction.

(9) Signal rescuers on outside of tank or confined space to pull victim up. The rescuer should then guide the victim through the manhole opening.

(10) Immediately exit from the vessel or confined space and prevent others from going near the tank or confined space.

Location of Emergency Rescue Kits

Building	Quantity	Building	Quantity
L	2	V	2
M	1	W	1
N	2	X	1
O	3	Y	1
P	1	Z	1
Q	12	H	1
R	1	I	2
S	1	J	2
T	1	K	2
U	1	G	2
		F	1

Contents of Emergency Rescue Kit:

Internal (Contained within the sealed kit)

1 - Demand Fresh Air Mask with 25' length of hose
1 - 40 cu. ft. compressed air cylinder
1 - Emergency horn
1 Pr. - Nylon wristlets with 25 feet of nylon webbing attached (for use of standby man)
1 Pr. - Nylon wristlets fitted with "D" ring (for use on victim)

External (Located with the kit - accessible without breaking the seal on the kit)

1 - Pulley block, fitted with a hook
1 - 60 foot length of 9/16" rope, with a harness snap on one end

NOTE: The kit must remain sealed unless the contents are needed for a rescue emergency. A rescue kit must never be used on a confined space entry job if the seal is broken. Broken seals should be reported to the Safety Department immediately.

Procedure for Entering ______ ___ Vaporizers (Building H):

1. Disconnect electrically - remove fuses, disconnect low level alarm.

2. Drain unit.

3. Disconnect piping at unit - 5 flanges.

4. Remove short section of stack and transition piece from top of unit.

5. Remove roof from enclosure.

6. Position crane and connect cables for lift.

7. One rigger will man the crane any time a man enters the vaporizer. This rigger will be ready at any time to start the crane and lift the vaporizer from its base should an emergency occur. In addition to the above rigger, there shall be a standby man to observe the man entering the vaporizer.

8. It shall be the responsibility of the supervisor of the man entering the vaporizer to see that the above procedures are followed.

Exceptions:

1. Merrill Absorbers

Due to the construction of the Merrill Absorbers, it is impossible and impractical to remove a person from the absorbers with the use of wristlets and handline. Any rescue operation would require passing an individual bodily through the 14" x 16" side opening. Therefore, it will not be necessary for those working in the Merrill Absorbers to wear wristlets. However, a permit must be issued and a standby man with a rescue kit available.

2. Building B - Units #1 , #2 , #3 Building C , Unit #1

Because of the difficulty of blanking or seperating the lines to these units and making a tight fit when connecting them, also the fact that all unblanked accessories are connected only to these units and are completely visible, the Safety Council has agreed that it will not be necessary to separate or blank these lines and we will depend on the valves. All other safety precautions must be taken and the usual safety permit will be required.

3. Powerhouse

A. Boiler Steam and Mud Drums:

1. All lines to these drums will have double valves locked closed.

2. The drain between the non-return valve and shut-off valve will be locked open.

3. No lines will be blanked.

B. Water Softeners:

1. The single control valve will be set on "REGENERATION".
2. The water inlet and outlet valves will be locked closed.
3. The bottom drain line will be locked open.
4. Only the brine, backwash and rinse lines will be blanked.