U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 80-108-705

CORPORATION OF VERITAS
PHILADELPHIA, PENNSYLVANIA
June, 1980

I. SUMMARY

On April 17, 1980, the National institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation of paint stripping operations at and upon the request of the corporation of Veritas, Philadelphia, Pennsylvania. (SIC-7641) A walk-through survey, adminstration of non-directed medical questionnaire interviews and atomspheric evaluation for exposure to methylene chloride vapor were performed.

Charcoal tubes and personal air sampling pumps were utilized to determine workers' exposures to methylene chloride vapors. The breathing zone, time weighted average concentration of operators at the paint stripping operation ranged from 633 to 1017 milligrams per cubic meter (mg/M^3). At the sanding operation, the operator's TWA was 661 mg/M^3. These exposures exceeded the NIOSH recommended limit of 261 mg/M^3- 8 hr. TWA. NIOSH's short-time or ceiling limit of 1740 mg/M^3 was also exceeded in seven (7) samples, ranging up to 4880 mg/M^3 in paint stripping operations. Workers reported symptoms of dizziness and tiredness, which are compatible with excessive exposure to methylene chloride.

On the basis of the data obtained from the personal air sampling and interview data, NIOSH determined that a health hazard existed from over exposure to methylene chloride at the Corporation of Veritas. Recommendation for Environmental controls, personal protection, and medical surveillance are provided to eliminate the health hazard (page 5).

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970*, NIOSH investigates the toxic effects of substances found in the workplace. On March 25, 1980, a request was submitted by the Corporation of Veritas for a health hazard evaluation of their operations being performed at 1311 Ridge Avenue, Philadelphia, Pennsylvania.

*Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health and Human Services, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the plance of employment has potentially toxic effects in such concentrations as used or found.

The request stated that the Corporation of Veritas is a non-profit work rehabilitation project for alcoholics/alcohol abusers which is funded by CETA. They have installed an exhaust fan, purchased respirators, face shields and protective clothing for those employees directly in contact with the paint stripper and wanted to ascertain if these controls are adequate. On April 17, 1980, Walter J. Chrostek, NIOSH Regional Industrial Hygienist, conducted an industrial hygiene walk-through survey of the 1311 Ridge Avenue location. The purpose of the survey was to determine the conditions of use and controls available. Five employees were also questioned about what effects the stripper may have on them.

III. BACKGROUND

This plant is engaged in stripping paint from wood and metal. Some of these items may also later be repainted.

The operations are carried out in a building approximately 80' X 30' with a 25' ceiling.

Articles which are to be stripped are brought into the plant. Hardware which may be on these articles is removed. These objects are then placed in a 12 X 6 feet tank, approximately 40 inches high. This tank contains about 18 inches of the liquid stripper. Information subsequently obtained from the distributor indicates that the stripper contains methylene chloride, methyl alcohol, ammonia and a surfactant.

Following a period of soaking, two employees utilize scrub brushes to remove the paint which has been softened. After the finish has been removed, the object is taken approximately 50 feet across the room where water and drainage are available and hosed off. Following a drying period, hand finishing is performed.

Employees rotate through the stripping operation and work for a period of two hours per day.

IV. EVALUATION DESIGN AND METHODS

During this evaluation, eleven personal and general air samples were collected on charcoal tubes with personal air sampling pumps. The samples were then analyzed for methylene chloride by gas chromotography according to NIOSH Method S329 with modifications. Two bulk samples of the stripping compound were also collected. Subsequent information from the distributor revealed that the major component of the stripper is methylene chloride, however, lesser amounts of methanol, ammonia and a surfactant are also present. No atmospheric sampling was performed for methanol nor ammonia as this information was not available at the time.

V. EVALUATION CRITERIA

The criteria for methylene chloride for this evaluation were taken from three sources, viz., OSHA[2], NIOSH[3], and ACGIH[4] and are presented in the Table. Although no evaluation was performed for methanol or ammonia, the environmental criteria for these substances is also presented.

Substance	OSHA	ACGIH	NIOSH
Methylene Chloride	1740 mg/M^3* 8 hr. TWA 3448 mg/M^3 (Accept. C.**) 6897 mg/M^3 (max. - 5 mins. in 2 hrs.)	700 mg/M^3 8 hr. TWA 870 mg/M^3 STEL	261 mg/M^3 8 hr. TWA 1740 mg/M^3 Ceiling
Methanol	260 mg/M^3	260 mg/M^3(skin)***	260 mg/M^3 for 15 minute Ceiling
Ammonia	35 mg/M^3	18 mg/M^3	35 mg/M^3 for 5 minute Ceiling

*mg/M^3 - denotes milligrams of contaminant per cubic meter of air sampled.
**C - denotes ceiling value that should not be exceeded.
*** Skin - refers to potential contribution to the overall exposures by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance.

VI. TOXICITY OF THE STRIPPER COMPONENT[5]

Methylene Chloride

Local - Repeated contact with methylene chloride may cause a dry, scaly and fissured dermatitis. The liquid and vapor are irritating to the eyes and upper respiratory tract at higher concentrations. If the liquid is held in contact with the skin, it may cause skin burns.

Systemic - Methylene chloride is a mild narcotic. Effects from intoxication include headache, giddiness, stuper, irritability, numbness, and tingling in the limbs. Irritation to the eyes and upper respiratory passages occurs at higher dosages. In severe cases, observers have noted toxic encephalopathy with hallucinations, pulmonary edema, coma, and death. Cardiac arrythmias have been produced in animals but have not been common in human experiences. Exposure to this agent may cause elevated carboxyhemoglobin levels which may be significant in smokers, or workers with anemia or heart disease, and those exposed to CO. Short term exposure to both methylene chloride and alcohol may limitthe true effects of methylene chloride. However, long term exposure to both may increase the liver damage due to either.

Methyl Alcohol

Local - Contact with liquid can produce defatting and a mild dermatitis. Methyl alcohol is virtually non-irritating to the eyes or upper respiratory tract below 2,000 ppm, and it is difficult to detect by odor at less than this level.

Systemic - Methyl alcohol may cause optic nerve damage and blindness. Its toxic effect is thought to be mediated through metobolic oxidation products, such as formaldehyde or formic acid, and may result in blurring of vision, pain in eyes, loss of central vision, or blindness. Other central nervous system effects result from narcosis and include headache, nausea, giddiness, and loss of consciousness. Formic acid may produce acidosis. These symptoms occur principally after oral ingestion and are very rare after inhalation. Simultaneous alcohol (ethanol) ingestion delays the toxic effects of methanol by slowing its metabolism.

Ammonia

Local - Contact with anhydrous liquid ammonia or with aqueous solutions is intensely irritating to the mucous membranes, eyes, and skin. Eye symptoms range from lacrimation, blepharospasm, and palpebral edema to a rise of intraocular pressure, and other signs resembling acute-angle closure glaucoma, corneal ulceration, and blindness. There may be corrosive burns of skin or blister formation. Ammonia gas is also irritating to the eyes and to moist skin.

Systemic - Mild to moderate exposure to the gas can produce headache, salivation, burning of throat, anosmia, perspiration, nausea, vomiting, and substernal pain. Irritation of ammonia gas in eyes and nose may be sufficiently intense to compel workers to leave the area. If escape is not possible, there may be severe irritation of the respiratory tract with the production of cough, glottal edema, bronchospasm, pulmonary edema, or respiratory arrest. Bronchitis or pneumonia may follow a severe exposure if patient survives. Urticaria is a rare allergic manifestation from inhalation of the gas.

VII. RESULTS/DISCUSSIONS

Environmental sampling results showed the concentrations of methylene chloride of the strippers ranged from 1092 to 4482 milligrams per cubic meter of air sampled. (TWA 633-1017 mg/M^3) The sanders' exposure (no respirator), whose station was approximately 10 feet down wind from the stripping tank, ranged from 1737 to 2091 milligrams per cubic meter of air sampled. (TWA 661 mg/M^3) These concentrations exceed environmental criteria (NIOSH and ACGIH) for an 8-hour working day and in some instances the permissible short term exposure levels (ACGIH, NIOSH, and OSHA).

No atmospheric evaluations were performed for methanol or ammonia as the composition of the stripper at the time of the environmental evaluation was not known. If any appreciable amount of methanol was present in the work atmosphere the risk would have increased as both methylene chloride and methanol affect the same organs and give a synergistic effect.

Five employees were interviewed concerning adverse health effects they may have experienced from their exposure to methylene chloride. Their exposure to methylene chloride was one year or less. The complaints were of becoming tired and dizzy when working at the stripping operation. These conditions abate or are non-existent when they are away from this operation.

Corporation of Veritas has been performing stripping for the past 2½ - 3 years. The present program is funded by CETA as an on-the-job training and rehabilitation program for alcoholics/alcohol abusers. From the appearance of the protective clothing, it appeared that the items were only recently purchased. A majority of the respirators were not NIOSH approved. Some of the employees were observed wearing canvas-type shoes. None of the employees had received formal training in the proper procedures to take when fitting the respirator nor were the respirators stored or maintained in the proper manner.

During this visit some controls were discussed.

1. At the present time the liquid level is about 1/3rd of the tank. This necessitates the operator to put his head into the tank to get at the object to be stripped. Decreasing the heightof the tank or installing a false bottom would facilitate the employee to get at the object to be stripped without putting his head into the tank.

2. The object that was paint stripped must be carried approximately 50 feet to an area where water and sewage facilities are available. Having these facilities in area adjacent to the stripping tank would abate unnecessary exposure to methylene chloride.

At the present time a window fan is utilized to exhaust the contaminants. The fan is so located that it has no effect on exhausting the contaminants from the tank. Enclosing the stripping/washing area and relocating the fan would facilitate in removing air contaminants and prevent unnecessary exposures to other employees; exposure to the sander located approximately 10 feet down wind from the stripping operation. See the attached Table.

The position of the strippers should be such that they are up wind from the exhaust fan.

III. RECOMMENDATIONS[3]

a) Medical

Due to the possible toxic interaction between ethyl alcohol and the paint stripper components and the special nature of the workforce at this plant, a careful medical evaluation should be given these workers so as to minimize adverse health effects. These examinations should include, but should not be limited to:

1) A medical history to include the occurrence of headache, dizziness, fatigue, pain in the limbs, and irritation of the skin and eyes.

2) Evaluation of fitness for the workers to use respirators.

3) Such a program should also provide the opportunity for advising the worker of the increased hazards of methylene chloride exposure due to CO from tobacco smoking.

b) Environmental

1) Until such a time as adequate engineering controls are installed, supply and require employees to wear personal respiratory protective equipment approved by NIOSH for organic vapors when performing stripping and water washing off operations.

2) Instruct the employees in the proper use and maintenance of the respiratory protective equipment.

3) Canvas type shoes should be prohibited at the stripping operation. Clothing impervious to the stripper should be worn.

4) Erect a separate room for the stripping and washing operations. At the present time the stripping operation is done in one section of the large building. After the paint is stripped, it is carried 50 feet across the building to the water washing area, exposing all the works. By building a separate room, only two employees would be exposed to the contaminants and also exhausting the contaminant would be facilitated.

5) Install local exhaust ventilation on the stripping tank. Several suggestions are attached.

6) Redesign the dipping so that the level of the solution is high and the employees do not have to put their heads into the tank while brushing the items.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Acknowledgements

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X. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, OH 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, VA. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Corporation of Veritas
2. James Goudlock, Employee Representative
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing the 20 employees of the results of the Corporation of Veritas survey, the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place(s) for their perusal.

XI. REFERENCES

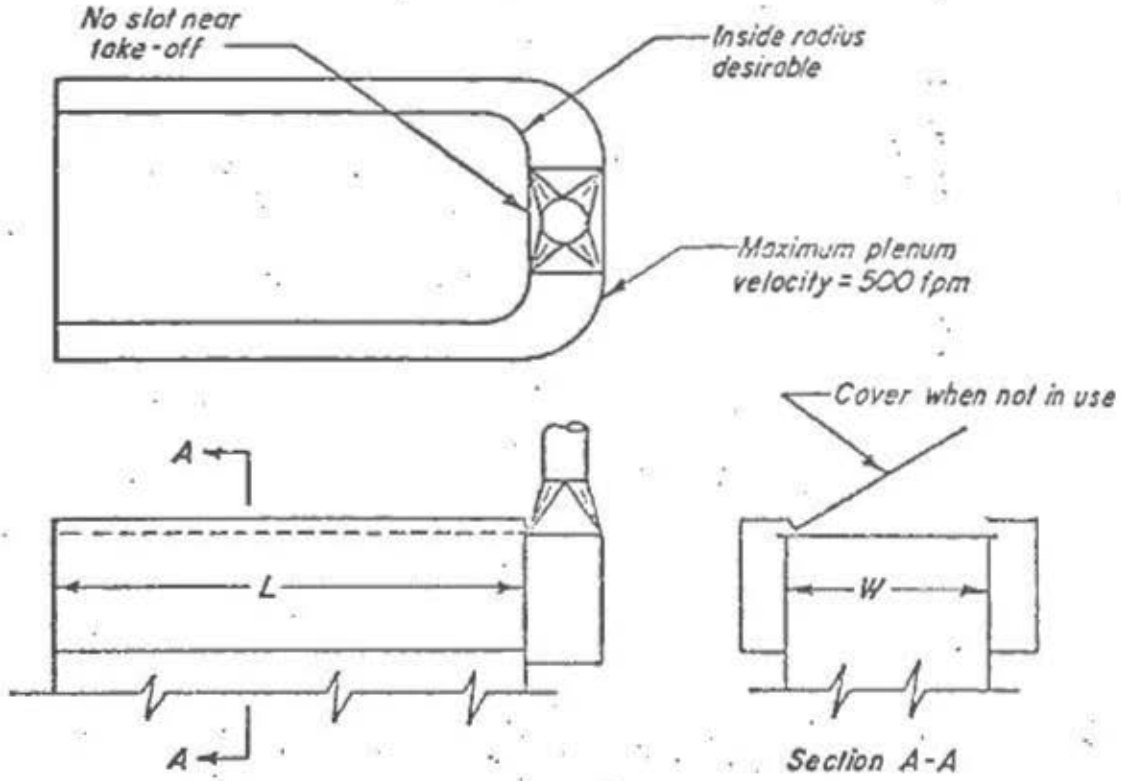
1. NIOSH Manual of Analytical Methods, Volume 3, (NIOSH) Publication No. 77-157C, 1977.
2. U.S. Department of Labor, Occupational Safety and Health Administration, Federal Register, Vol. 39, No. 125, June 27, 1974, (Revised November 7, 1978) Subpart Z, 1910.1000.
3. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Methylene Chloride, Publication No. NIOSH 76-138, March 1976.
4. American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment, 1979
5. Occupational Diseases: A Guide to Their Recognition, USPHS, CDC, NIOSH, Publication No. 77-181, Revised June 1977.
6. Industrial Ventilation, A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienist, 15th Edition, 1978.

Table
Corporation of Veritas
Philadelphia, Pennsylvania
HHE 80-108
Breathing Zone and General Air Concentrations of Methylene Chloride mg/M^3*
April 17, 1980

Sample Number	Job Description	Sampling Period	Concentration*	TWA****	Comment
2	Paint Stripping	9:50-11:26	2091		
5		11:26-12:35	2393	1017	OBZ.**
10		13:30-15:22	1092		
1	Paint Stripping	9:55-11:22	2508	633	OBZ.
4		11:22-11:58	2381		
3	Sanding	9:55-11:28	2122		
6		11:28-12:37	1737	661	OE***
7	Paint Stripping	13:30-14:24	4882		
8		14:24-15:22	2724	909	OBZ
9	Sanding(middle of room)	13:27-15:25	94	23	OE
11	General Air(stripping area)	11:45-15:25	1041		

*mg/M^3 denotes - milligrams of methylene chloride per cubic meter of air sampled
** OBZ denotes - employee breathing zone
***OE denotes - employee exposure
****TWA denotes - time weighted average

Substance	Environmental Standards		
	OSHA[2]	ACGIH[4]	NIOSH[3]
Methylene Chloride	1740 mg/M^3 8hr. TWA	700 mg/M^3 8hr. TWA	261 mg/M^3 8hr. TWA
	3448 mg/M^3(Accept. Ceiling)	870 mg/M^{3}STEL	1740 mg/M^3 Ceiling
	6897 mg/M^3(max.-5 mins in 2 hrs)	Intended change 360 mg/M^3 8hr. TWA	



$Q = 50LW$

Slot velocity = 1000 fpm maximum
Entry loss = 1.78 slot VP + 0.25 duct VP
Duct velocity = 2500-3000 fpm

Also provide: 1. Separate flue for combustion products if direct-fired unit.
2. For cleaning operation, an air-line respirator is necessary.
3. For pit units, the pit should be mechanically ventilated.
4. For further safe guards, see VS-501.1
NOTE: Provide downdraft grille for parts that cannot be removed dry; Q = 50 cfm/sq ft grille area.

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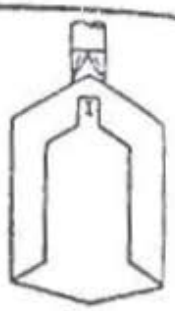
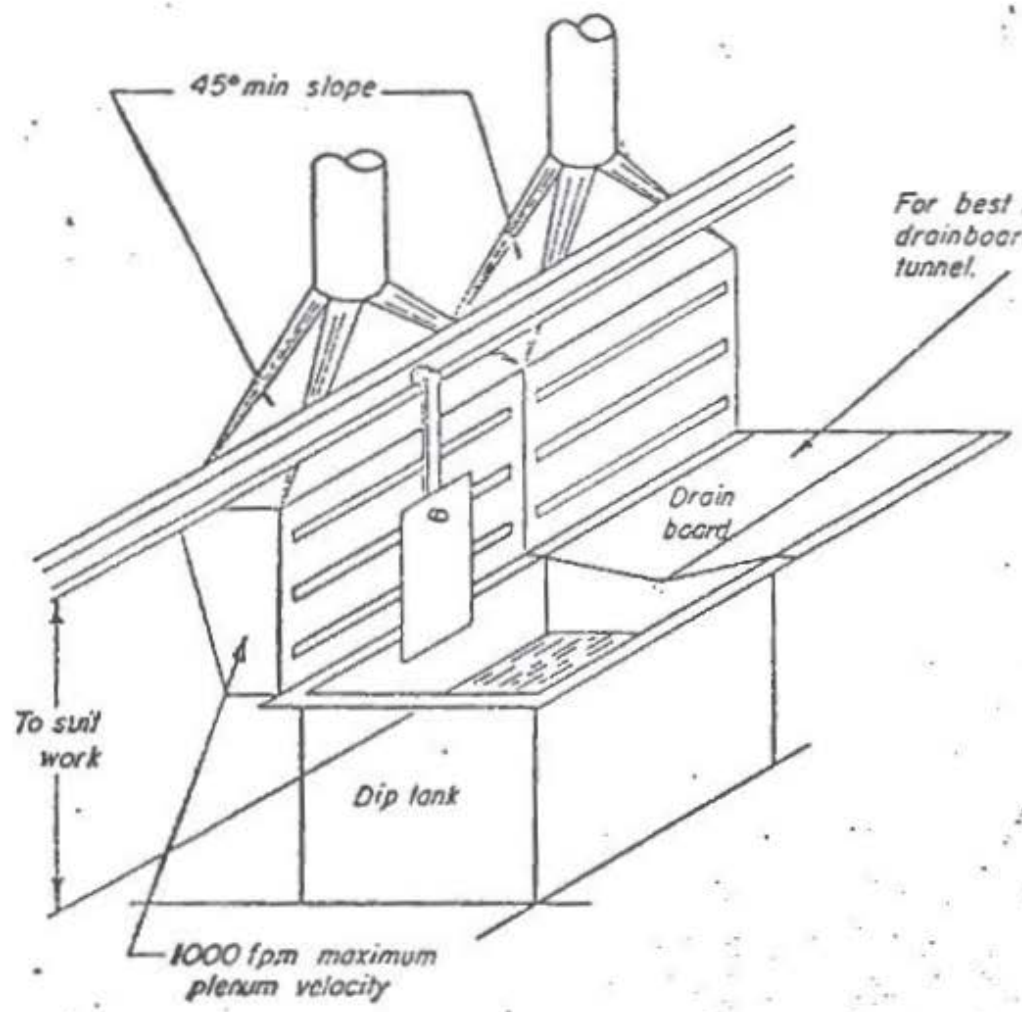
SOLVENT DEGREASING TANKS

DATE 1-78 | VS-501

Locate takeoffs 15" on center
Q = 50 cfm/sq ft drain board area, but not less than 100 fpm indraft through openings
Entry loss = 0.25 duct VP
Duct velocity = 1000 - 3000 fpm





Q = 125 cfm/sq ft of tank and drainboard area
Slot velocity = 2000 fpm
Entry loss = 1.78 slot VP + 0.25 duct VP
Duct velocity = 1000 - 3000 fpm

NOTE: For details on drying oven, See VS-602

For air drying in a room or enclosure, see Section 2 for dilution ventilation required.

For construction and safety, consult NFPA.(113)

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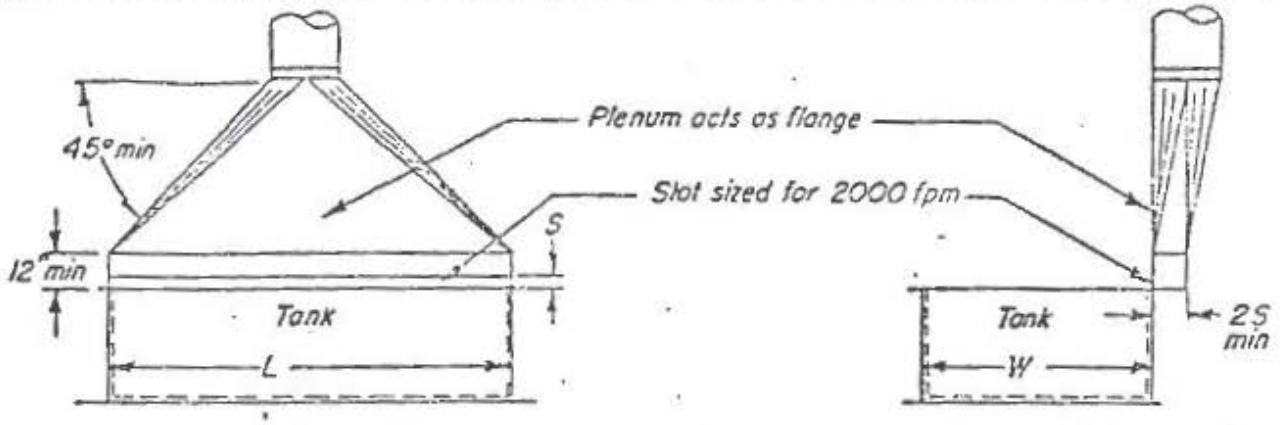
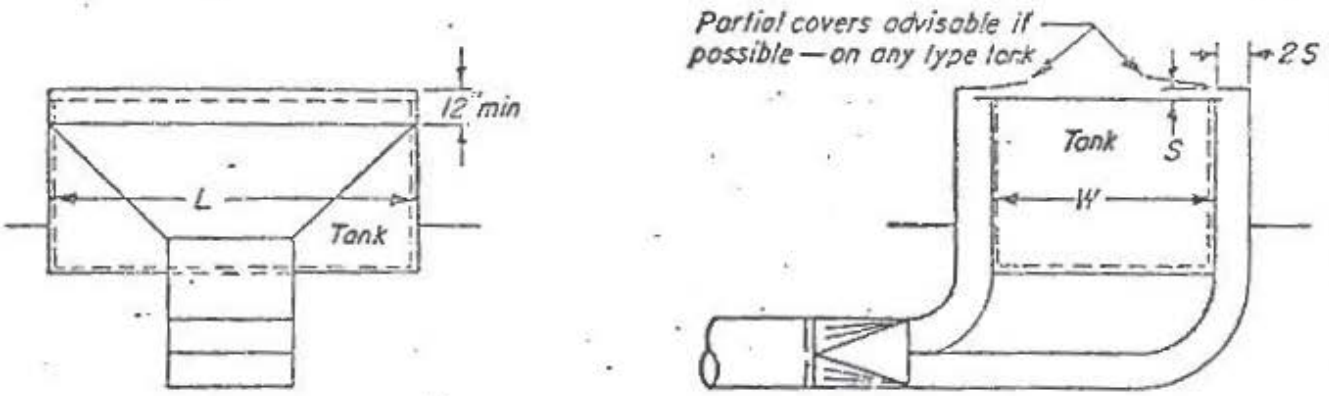
DIP TANK

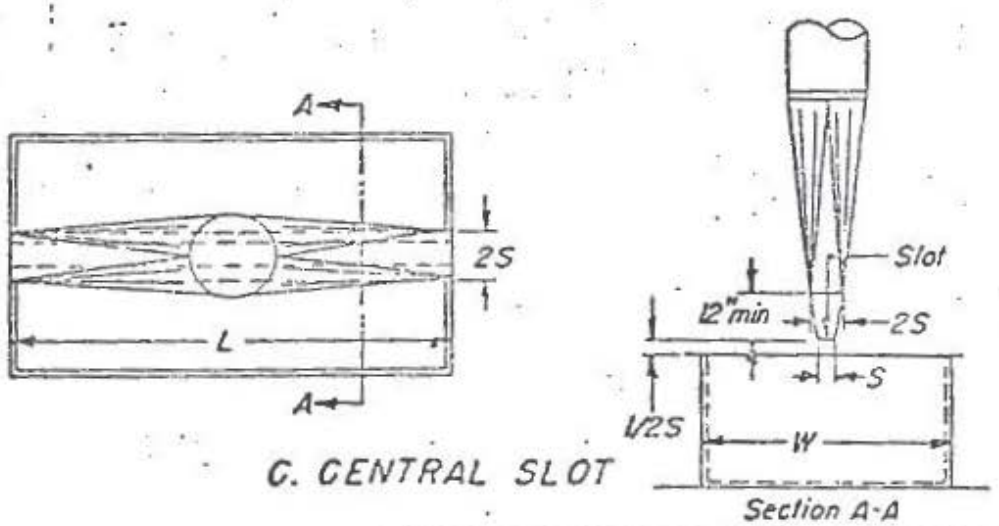
DATE 1-73 | VS-502



A. UPWARD PLENUM



B. DOWNWARD PLENUM



C. CENTRAL SLOT

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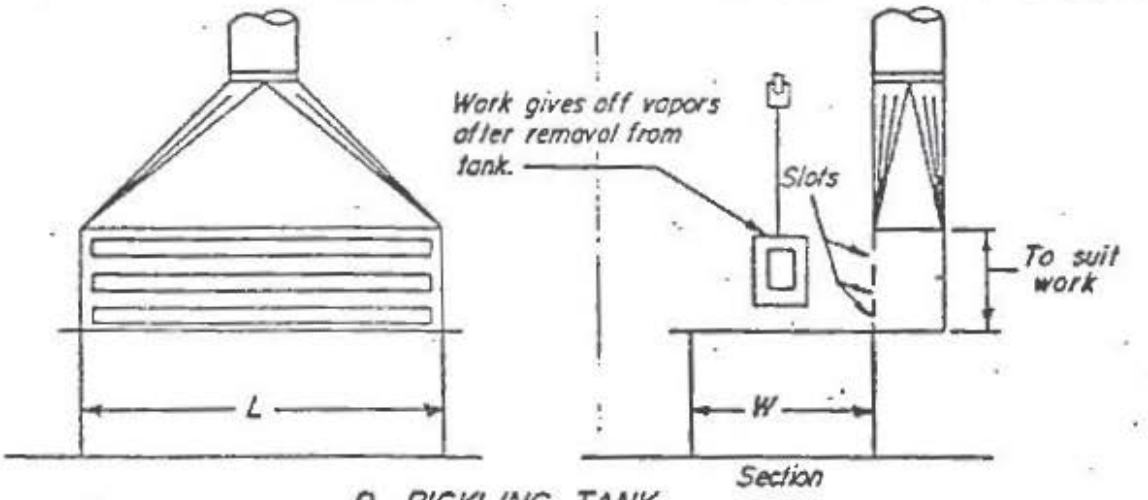
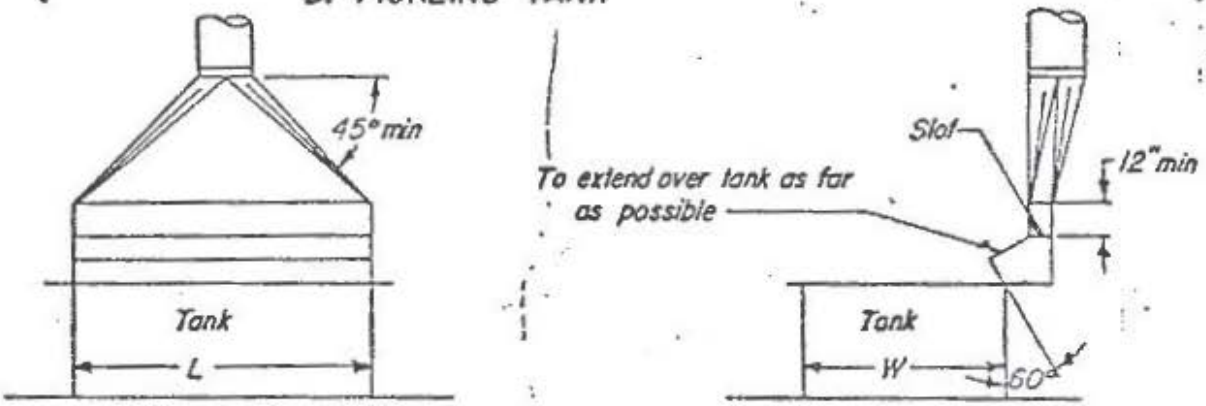
OPEN SURFACE TANKS

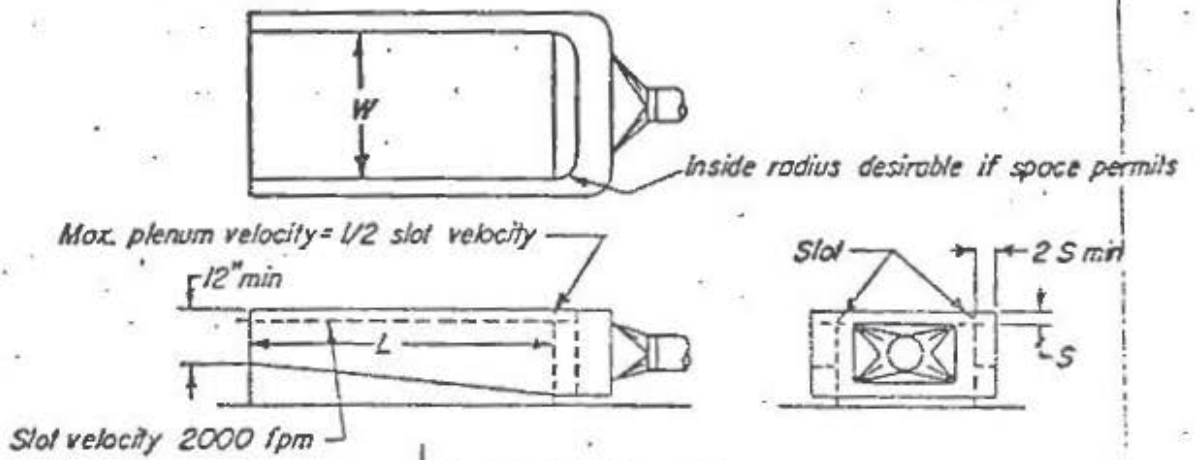
DATE 1-64 | VS-503



D. PICKLING TANK



E. SEMI-LATERAL



F. END TAKE-OFF

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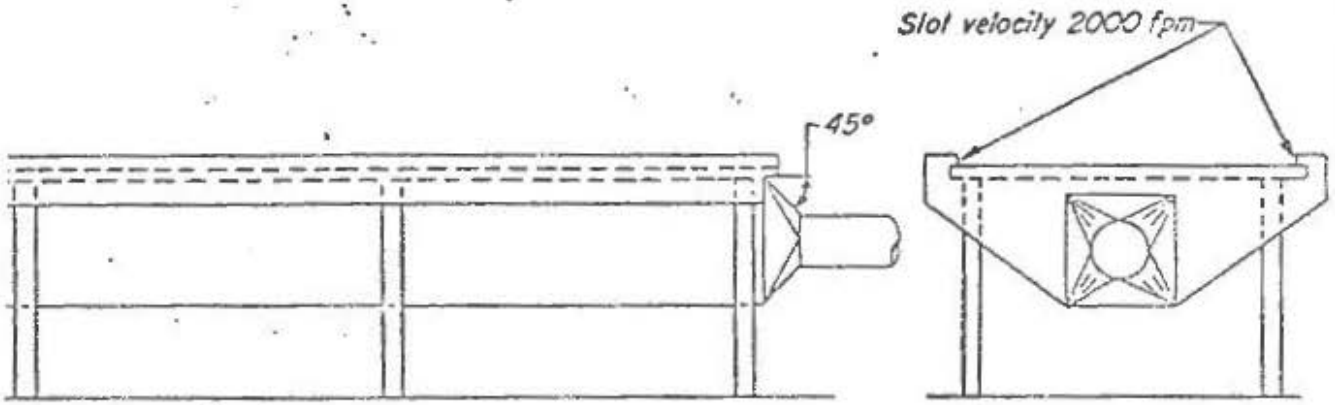
OPEN SURFACE TANKS

DATE 1-66 | VS-504



Q = 50-100 cfm/sq ft of table top.
Duct velocity = 2500-3000 fpm
Entry loss = 1.78 slot VP + 0.25 duct VP

Note: See "Open Surface Tanks", VS-503 and VS-504 for other suitable slot types. Air quantities may be calculated on dilution basis if data is available.
Maximum plenum velocity = 1/2 slot velocity.
Large plenum essential for good distribution.

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TABLE SLOT	
DATE 1-70	VS-505

OPEN SURFACE TANK DESIGN DATA (108)

A. Duct velocity = 2000 fpm minimum.
B. Entry loss = 1.78 slot VP plus duct entry loss.
C. Maximum plenum velocity = $\frac{1}{2}$ slot velocity. See Section 4.
D. Slot velocity = 2000 fpm unless distribution provided by well-designed, tapered takeoff.
E. Provide ample area at small end of plenum.
F. If L = 6 feet or greater, multiple takeoffs are desirable.
If L = 10 feet or greater, multiple takeoffs are necessary.
G. Tank width (W) means the effective width over which the hood must pull air to operate (i.e., where the hood face is set back from the edge of the tank, this set back must be added in measuring tank width).
If W = 20 inches, slot on one side suitable.
If W = 20 to 36 inches, slots on both sides are desirable.
If W = 36 to 48 inches, slots on both sides are necessary unless all other conditions are optimum.
If W = 48 inches or greater, local exhaust is not usually practical. Enclosure is best. (Also see Push-Pull, Figure 4-17.)

It is not practicable to ventilate across the long dimension of a tank whose ratio $\frac{W}{L}$ exceeds 2.0. It is undesirable to do so when $\frac{W}{L}$ exceeds 1.0.

H. Liquid level to be at least 6 inches below top of tank.
I. Hood types A, C, D and E are preferred--plenum acts as baffle to room air currents.
J. Provide enclosures or removable covers on tank if possible.
K. Provide ductwork with cleanouts and drains and corrosion-resistant coating if necessary. Use flexible connection at fan inlet.
L. Install baffles to reduce crossdrafts. If impossible, increase control velocity by vector analysis. Baffle is a vertical plate the same length as tank and with top of plate as high as tank is wide. If exhaust hood is on side of tank against a building wall or close to it, it is perfectly baffled.

Volume Calculation for Good Conditions (No crossdrafts, adequate and well-distributed makeup air):

1. Determine hazard potential from Table 5-5-1 using information from Threshold Limit Value, Solvent Flash Point, Solvent Drying Time Tables in Appendix or Table 5-5-6.
2. Determine contaminant evolution rate from Table 5-5-2 employing number denoting highest range (see Table 5-5-6).
3. From Table 5-5-3 choose minimum control velocity according to hazard potential, evolution rate and hood design (see Table 5-5-5 for typical processes).
4. From Table 5-5-4 select the cfm/sq ft for tank dimensions and tank location.
5. Multiply tank area by value obtained from Table 5-5-4 to calculate required air volume.

Example Problem:

Given: Chrome Plating Tank 6' × 2.5'.
High production decorative chrome.
Free standing in room.
No cross drafts.

a. Tank Hood. See VS-503. Use hood "A" along 6' side. Hood acts as baffle.
W = 2.5'
L = 6.0'
W/L = 0.42

b. Component - Chromic Acid

Hazard potential: A (From Table 5-5-1; From Appendix: TLV = 0.1 mg/m^3
Flash point = Negligible)
Rate of Evolution: 1 (From Table 5-5-2; From Table 5-5-6; Gassing rate = high)
Class: A-1
Control Velocity = 150 fpm.(From Table 5-5-3)
Minimum Exhaust Rate = 225 cfm/ft^2 (From Table 5-5-4; Baffled tank, $\frac{W}{L}$ = 0.42)
Minimum Exhaust Volume = 225 × 15 sq ft = 3375 cfm