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Standard Practice for Solvent Vapor Degreasing Operations¹

This standard is issued under the fixed designation D3698; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice recommends work practices for conventional vapor degreasing operations utilizing any solvent or solvent blend that has been categorized as nonflammable.

1.2 This practice is not intended for use in vapor degreasing operations utilizing flammable (low flash point) solvents or in vapor degreasing operations utilizing enclosed (sealed, airtight) equipment. For these non-applicable operations, users should consult the solvent or equipment supplier for additional information.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D2110 Test Method for pH of Water Extractions of Halogenated Organic Solvents and Their Admixtures

D2942 Test Method for Total Acid Acceptance of Halogenated Organic Solvents (Nonreflux Methods)

¹ This practice is under the jurisdiction of ASTM Committee D26 on Halogenated Organic Solvents and Fire Extinguishing Agents and is the direct responsibility of Subcommittee D26.02 on Vapor Degreasing.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D4276 Practice for Confined Area Entry

D4579 Practice for Handling an Acid Degreaser or Still

2.2 Government Documents:³

40 CFR Part 63.460-469 U.S. EPA, National Emission Standards for Halogenated Solvent Cleaning

29 CFR Part 1910 U.S. Department of Labor, Occupational Safety and Health Standards

2.3 Other Documents:

Threshold Limit Values for Chemical Substances and Physical Agents, ACGIH Industrial Ventilation, ACGIH⁴

NFPA 704 Identification System for Fire Hazards of Materials, National Fire Protection Association⁵

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *emergency*—any occurrence that may result in an immediate hazard to health including exposures resulting from, but not limited to, equipment failure, rupture of containers, or failure to control equipment.

3.1.2 *hazardous operation*—any procedure or activity where a release of the solvent or the decomposition products of the solvents might be expected to result in a hazard to health.

3.1.3 *nonflammable solvent(s)*—as used herein, is a solvent or solvent mixture having a NFPA flammability hazard rating of 1 or lower (as determined by NFPA 704), intended for use in vapor degreasing operations.

3.1.4 *solvent vapor degreaser*—a solvent and corrosion-resistant tank with a heated solvent reservoir or sump at the bottom, a condensing means near the top, and freeboard above the condensing means, in which sufficient heat is introduced to boil the solvent and generate hot solvent vapor. Because the hot vapor is heavier than air, it displaces the air and fills the tank up to the condensing zone. The hot vapor condenses on the cooled condensing means, thus maintaining a fixed vapor level and creating a thermal balance.

³ *Code of Federal Regulations*, available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.gpo.gov>.

⁴ Available from American Conference of Governmental Industrial Hygienists (ACGIH), 1330 Kemper Meadow Dr., Cincinnati, OH 45240, <http://www.acgih.org>.

⁵ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

3.1.5 *solvent vapor degreasing operations*—the process by which materials are immersed in vapors of boiling liquids for the purpose of cleaning or altering their surfaces, and are subsequently removed from the vapors, drained and dried in a solvent vapor degreaser.

4. Significance and Use

4.1 This practice is intended for use by employers in developing their own specific operation standards for solvent vapor degreasing operations.

4.2 Certain vapor degreasing operations are subject to the requirements of the National Emission Standards for Halogenated Solvent Cleaning (Halogenated Solvent Cleaner NES-HAP) as found in 40 CFR Part 63, Subpart T. The determination of the applicability of these, or any additional requirements is the responsibility of the user.

4.3 This practice is not intended to address all of the requirements contained in the Halogenated Solvent Cleaner NES-HAP. Development and implementation of training programs, recordkeeping, and other additional requirements of the NES-HAP are the responsibility of the user.

5. Exposure Limit

5.1 No employee may be exposed to any of the solvents utilized in vapor degreasing operations covered by this section in excess of either the OSHA Permissible Exposure Limits (PEL), the ACGIH Threshold Limit Value (TLV (trademarked)), or any manufacturer's recommended exposure limit.

6. System Location and Design

6.1 *Location:*

6.1.1 Degreasers shall be placed in a room having ventilation adequate to maintain operator exposure below the appropriate exposure limit.

6.1.2 A degreaser shall be installed so that it is not affected by drafts from sources such as windows, doors, fans, unit heaters, ventilators, or adjacent spray booths. Normal air circulation (at velocities not exceeding 50 ft (15.24 m)/min) is recommended and should not be confused with direct drafts such as those listed in the preceding sentence. Drafts should be diverted from the top of the degreaser by the use of baffles located on the windward side of the degreaser.

6.1.3 No degreaser shall be installed in areas where solvent vapors may reach open flames or high-temperature surfaces above 350 °F (176 °C). Solvent degreasing equipment shall not be installed in the proximity of welding and heat treating operations or space heaters unless adequate ventilation of the degreaser or other means are provided to prevent solvent fumes from contacting the high-temperature source.

6.1.4 Gas-heated degreasers (provided with natural draft ventilation of combustion tube) shall not be located in an area where the general mechanical exhaust system produces negative pressure, unless positive exhausting of combustion products by mechanical means is provided.

6.2 *Design:*

6.2.1 The level of vapors below the top edge of the degreaser (freeboard) shall at a minimum be a 1.0 ratio of height to width.

6.2.2 All degreasers shall have durable covers which shall be secured in a closed position when degreasing operations are not occurring. Sliding covers, which allow partial closure during degreasing operations are preferred.

6.2.3 Where gas is used as a fuel for heating, the combustion chamber of the degreaser shall be of tight construction, except for such openings as the exhaust flue, and those that are necessary for supplying air for combustion. Flues shall be of corrosion-resistant construction and shall extend to the outside air. If mechanical exhaust is used on the flue, there shall be provision for outside fresh make-up air. If nonmechanical exhaust is used on the flue, a back draft diverter shall be used. Gas burners shall be provided with safety protection to provide shut down if the pilot or igniter fails.

6.2.4 Heating elements shall be so designed and maintained that their surface temperature will not cause the solvent or mixture to decompose or break down.

6.2.5 New solvent vapor degreasers or solvent stills of more than 4 ft² of vapor area shall be equipped with suitable clean-out or sludge doors located at the bottom of the boiling sump and any other sump having an area of more than 4 ft² (0.37 m²). These doors shall be designed and gasketed so that there will be no leakage when they are closed.

6.2.6 Floors and platforms around degreasers shall be prevented from becoming slippery both by the original type of construction and by frequent cleaning. They shall be firm, sound, and of the design and construction to minimize the possibility of tripping. Railing requirements for platforms appear in 29 CFR § 1910.23(c).

6.2.7 When an open top degreaser is located in a pit below floor level, the elevation of the top of the degreaser shall be a minimum of 42 in. (1066 mm) above the floor level or the operating level or else a 42 in. (1066 mm) railing must be provided in accordance with 29 CFR § 1910.23(c)(3) and (e)(1). Pit ventilation shall be designed to provide a minimum of two air changes per minute whenever a degreaser is installed in a pit more than 18 in. (457 mm) deep.

6.2.8 Degreasers shall be equipped with means to prevent solvent vapors from overflowing, such as a vapor level control device (vapor safety thermostat) sensitive enough to shut off the heat input if the solvent vapor level rises above the primary condensing coils.

6.2.8.1 The vapor safety thermostat is typically set at a temperature 20 % to 30 % below the boiling point of the solvent (based on the boiling point in °F) except for very low boiling solvents (for example, methylene chloride). For these solvents, the vapor safety thermostat should be set at ambient temperature +10 °F, but never higher than 100 °F (38 °C). Recommended temperatures for vapor safety thermostat settings can be determined from **Appendix X1**, or from the solvent supplier.

6.2.9 Degreasers shall be equipped with safety devices in the boiling sump that can shut off the heat input if the solvent level drops too close to the heating coils (sump level control device) or if the solvent becomes too contaminated (sump safety thermostat).

6.2.9.1 A sump level control device is designed to prevent heat input unless there is adequate solvent in the boiling sump. Such devices may be mechanical (liquid level sensor) or thermostatic (liquid level safety thermostat). The liquid level sensor should interrupt heat input if the liquid level is less than 2 in. above the heating coils. Liquid level safety thermostats, used on electrically heated degreasers, are attached to the upper surface of the heating coil with a maximum recommended setting of 20 °F above the boiling point of the solvent.

6.2.9.2 Degreasers should also be equipped with a sump safety thermostat immersed in the boiling liquid. If the degreaser is equipped with an auxiliary still, then the degreaser sump safety thermostat should be set at the temperature corresponding to 25 % oil contamination (see 7.4.2.1). The sump safety thermostat in the auxiliary still should then be set at the temperature corresponding to 25 % oil concentration if the unit is electrically heated. However, the sump safety thermostat in the auxiliary still can be set at the temperature corresponding to approximately 70 % oil concentration if the unit is indirectly heated by such means as steam. Recommended temperatures for the sump safety thermostat can be determined from Appendix X1, or from the solvent supplier.

6.2.9.3 If reclamation of solvent will be conducted using the degreaser's boiling sump as the still sump, then the safety thermostat in the degreaser may be adjusted to the higher setting during that operation and then readjusted to the temperature corresponding to 25 % oil concentration during normal operation.

6.2.10 Degreasers shall be equipped with a device to prevent heat input unless there is adequate cooling to ensure sufficient condensation of vapor in the degreaser.

6.2.11 Degreasers of the spray type shall be equipped with a method that will prevent spray pump operation unless the solvent vapors have reached normal operating levels.

6.2.12 Steam-heated degreasers shall be equipped with "pop safety valves" down-stream from any pressure control. The pressure relief setting should be consistent with the solvent in use, and may be determined from Appendix X1, or from the solvent supplier.

6.2.13 Conveyorized degreasers shall be equipped with a thermostat that will prevent work from being processed by stopping conveyorized operation unless the solvent vapors have reached the normal operating levels.

7. Degreaser Operations Procedures

7.1 *Start-Up*—In starting a vapor degreaser follow the procedures enumerated sequentially where applicable:

7.1.1 Turn on the cooling/condensing system coolant and check to ensure proper operation.

7.1.2 Start air exhaust equipment, if any.

7.1.3 Activate all safety control thermostats.

7.1.4 Adjust solvent levels in all compartments as necessary.

7.1.5 Check that all degreaser covers are in place during heat-up as well as cool-down.

7.1.6 Turn on the heat supply and adjust the settings as necessary. Adjust the heat balance in the degreaser so that the level of the vapor remains constant. A proper balance is achieved if solvent vapors are generated at the same rate they are condensed by work entering the vapor zone and by the condensers.

7.1.7 Once the vapor level reaches the condensing coils, check to ensure the flow of condensed solvent through the water separator and its return to proper degreaser compartments.

7.1.8 Check all gages and thermometers for proper operation.

7.1.9 Begin vapor degreasing of work items.

7.1.10 Check condenser coolant flow and adjust coolant flow or temperature, or both, to maintain temperature to ensure that the vapor line does not rise above the condenser and to minimize condensation of moisture from the room air on the condenser coils. Check that all coolant and heating lines are free of leaks and the water separator is functioning properly to prevent contamination in the degreaser.

7.2 *Degreasing*—In degreasing follow the procedures enumerated:

7.2.1 Do not allow work loads to exceed designed degreaser capacity. Work should not generally occupy more than 50 % of the open horizontal area of the machine unless the work permits easy passage of vapor through or around it. Secure a highly durable tag to each degreaser indicating the maximum weight and volume of a single load expressed in terms of pounds per load and loads per hour.

7.2.2 Place work loads, where necessary, in free-draining nonporous baskets, trays, racks, and so forth, and position to eliminate solvent drag out.

7.2.3 When working with cup-shaped parts or parts with cavities that may collect liquid, load the parts, and rotate if necessary, in a manner to facilitate complete drainage while in the vapor zone.

7.2.4 Do not allow the vertical rate of entry and withdrawal of work loads to exceed the maximum degreaser design, which should not exceed 11 ft/min (3.4 m/min).

7.2.5 Allow the work loads (and accompanying baskets, trays, racks, and so forth) to remain in the vapor zone until condensation on the work loads (and accompanying baskets, trays, racks, and so forth) has stopped.

7.2.6 Conduct all spraying of work loads within the vapor zone.

7.3 *Shutdown*—In shutting down, follow the procedures enumerated as follows:

7.3.1 Stop the throughput of the work loads.

7.3.2 Turn off the heat supply.

7.3.3 After the level of the vapor has dropped below the condensing coil, turn off the cooling/condensing system.

7.3.4 Turn off the air exhaust equipment, if any.

7.3.5 Put covers in place and maintain the degreaser in a closed condition when the degreaser is not in actual use.