241. DIP TANKS CONTAINING FLAMMABLE OR COMBUSTIBLE LIQUIDS

01. Scope: (7-1-97)

a. Dip tanks containing flammable or combustible liquids shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. (7-1-97)

02. Definitions: For definitions of other terms used in this section, see sub-section 010 of this standard. (7-1-97)

a. Dip Tank is a tank, vat, or container of flammable or combustible liquid in which articles or materials are immersed for the purpose of coating, finishing, treating or similar processes. (7-1-97)

b. Molten Materials Handling Operations are all operations, other than welding, burning, and soldering operations involving the use, melting, smelting, or pouring of metals, alloys, salts, or
other similar substances in the molten state. Such operations also include heat treating baths,
descaling baths, die casting stereotyping, galvanizing, tanning, and similar operations. (7-1-97)

c. Surface Coating Operations are all operations involving the application of protective,
decorative, adhesive, or strengthening coating or impregnation to one or more surfaces, or into
the interstices of any object or material, by means of spraying, spreading, flowing, brushing, roll
coating, pouring, cementing, or similar means; and any subsequent draining or drying operations,
excluding open-tank operations. (7-1-97)

d. Vapor Area is any area containing dangerous quantities of flammable vapors in the vicinity of
dip tanks, their drain-boards or associated drying, conveying, or other equipment during
operation or shutdown periods. (7-1-97)

03. General Requirements: (7-1-97)

a. This section applies to all operations involving the immersion of materials in liquids, or in the
vapors of such liquids, for the purpose of cleaning or altering the surface or adding to or
imparting a finish thereto or changing the character of the materials and their subsequent removal
from the liquid or vapor, draining, and drying. These operations include washing, electroplating,
anodizing, pickling, quenching, dying, dipping, tanning, dressing, bleaching, degreasing, alkaline
cleaning, stripping, rinsing, digesting, and other similar operations. (7-1-97)

b. Except where specific construction specifications are prescribed in this section, hoods, ducts,
elbows, fans, blowers, and all other exhaust system parts, components, and supports thereof shall
be so constructed as to meet conditions of service and to facilitate maintenance and shall
conform in construction to the specifications contained in American National Standard,
Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2. (7-1-97)

04. Construction of Dip Tanks: (7-1-97)

a. Dip tanks, including drain-boards if provided, shall be constructed of substantial
noncombustible material, and their supports shall be of heavy metal reinforced concrete, or
masonry. Where dip tanks extend through a floor to the story below or where the weakening of
the tank supports by fire may result in the material having not less than one (1) hour fire
resistance. (0-0-00)

b. Dip tanks of over one-hundred-fifty (150) gallons in capacity or ten (10) square feet in liquid
surface area shall be equipped with a properly trapped overflow pipe leading to a safe location
outside buildings. Smaller dip tanks should also be so equipped, where practical. The discharge
of the overflow pipe should be so located and arranged that if the entire combustible contents of
the dip tanks is overflowed through overflow pipe by the application of water during fire
fighting, property will not be endangered. The size of the overflow pipe should be sufficient to
conduct the maximum rate of flow of water expected to be applied to the liquid surface of the dip
tank from automatic sprinklers or from other sources in the event of fire. (7-1-97)
c. Overflow pipes shall be of sufficient capacity to overflow the maximum delivery of dip tank liquid fill pipes but shall not be less than three (3) inches in diameter and shall be increased in size depending upon the area of the liquid surface and the length and pitch of pipe. (7-1-97)

d. Piping connections on drains and overflow lines shall be designed so as to permit ready access for inspection and cleaning of the interior. (7-1-97)

e. The bottom of the overflow connection shall be not less than six (6) inches below the top of the tank. See also sub-section 241.04.f. and sub-section 241.04.g. of this sub-section. (7-1-97)

f. Dip tanks over five-hundred (500) gallons in liquid capacity shall be equipped with bottom drains automatically and manually arranged to quickly drain the tank in the event of fire, unless the viscosity of the liquid at normal atmospheric temperature makes this impractical. Manual operation shall be from a safely accessible location. Where gravity flow is not practicable, automatic pumps shall be required. (7-1-97)

g. Bottom drains shall be trapped and discharged to a closed properly vented salvage tank or to a safe location outside which will not endanger property. (7-1-97)

h. According to tank capacity the diameter of bottom drainpipe shall be not less than the size indicated in Table 241.04-A. (7-1-97)

<table>
<thead>
<tr>
<th>Gallons</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 to 750</td>
<td>3</td>
</tr>
<tr>
<td>750 to 1,000</td>
<td>4</td>
</tr>
<tr>
<td>1,000 to 2,500</td>
<td>5</td>
</tr>
<tr>
<td>2,500 to 4,000</td>
<td>6</td>
</tr>
<tr>
<td>over 4,000</td>
<td>8</td>
</tr>
</tbody>
</table>

(i) The capacity of the salvage tank shall be greater than the capacity of the dip tank or tanks to which they are connected. (7-1-97)
j. Except as noted in sub-section 241.09. of this section (applying to hardening and tempering tanks), all dip tanks exceeding one-hundred-fifty (150) gallons liquid capacity or having a liquid surface area exceeding four (4) square feet shall be protected with at least one of the automatic extinguishing facilities conforming to sub-section 241.08 of this section. (7-1-97)

k. Dip tanks utilizing a conveyor system shall be so arranged that in the event of fire, the conveyor system shall automatically cease motion and required bottom drains shall open. Conveyor systems shall automatically cease motion unless required ventilation is in full operation. See also sub-section 241.14. of this section. (7-1-97)

l. When dip tank liquids are artificially heated, either by the dipping of heated articles, or by other application of heat to the liquid, provision shall be made to prevent a temperature rise greater than fifty (50) degrees Fahrenheit below the flashpoint of the liquid. See also sub-section 241.09. of this section. (7-1-97)

**05. Liquids used in Dip Tanks Storage and Handling:** (7-1-97)

a. The storage of flammable and combustible liquids in connection with dipping operation shall conform to the requirements of section 220 of this standard, where applicable. Where portable containers are used for the replenishment of flammable and combustible liquids, provision shall be made so that both the container and tank shall be positively grounded and electrically bonded to prevent static electric sparks. (7-1-97)

**06. Electrical and Other Sources of Ignition:** (7-1-97)

a. There shall be no open flames, spark producing devices, or heated surfaces having a temperature sufficient to ignite vapors in any vapor area. Except as specifically permitted in sub-section 241.11.c. of this section, relating to electrostatic apparatus, electrical wiring and equipment in any vapor area (as defined in sub-section 241.02.b. of this section) shall be explosion proof type according to the requirements of section 150 of this standard and the National Electric Code for Class I, Group D locations and shall otherwise conform to section 150 of this standard. (7-1-97)

b. Unless specifically approved for locations containing both deposits of readily ignitable residues and explosive vapors, there shall be no electrical equipment in the vicinity of dip tanks or associated drain-boards or drying operations which are subject to splashing or dripping of dip tank liquids, except wiring in rigid conduit or in threaded boxes or fittings containing no taps, splices, or terminal connections, and except as specifically permitted in sub-section 241.11.c. of this section. (7-1-97)

c. In any floor space outside a vapor area but within twenty (20) feet therefrom, and not separated by tight partitions, there shall be no open flames or spark producing devices except as specifically permitted in NFPA Standard No. 86, Ovens and Furnaces, and electrical wiring and equipment shall conform to the provisions of section 150 of this standard and the National Electric Code. (7-1-97)
07. Operations and Maintenance: (7-1-97)

a. Areas in the vicinity of dip tanks shall be kept as clear of combustible stock as practical and shall be kept entirely free of combustible debris. (7-1-97)

b. When waste or rags are used in connection with dipping operations, approved self closing metal waste cans shall be provided and all impregnated rags or waste deposited therein immediately after use. The contents of waste cans shall be properly disposed of at least once daily at the end of each shift. (7-1-97)

c. Periodic inspection or tests of all dip tank facilities shall be made, including covers, overflow pipe inlets and discharge, bottom drains and valves, electrical wiring and equipment and grounding connections, ventilating facilities, and all extinguishing equipment. Any defects found shall be promptly corrected. (7-1-97)

d. "NO SMOKING" signs in large letters on contrasting color background shall be conspicuously posted in the vicinity of dip tanks. (7-1-97)

08. Extinguishment: (7-1-97)

a. Areas in the vicinity of dip tanks shall be provided with manual fire extinguishers suitable for flammable and combustible liquid fires, conforming to Standard for Portable Fire Extinguishers NFPA No. 10. and section 061 of this standard. (7-1-97)

b. Automatic water spray extinguishing systems shall conform to NFPA Standard for Water Spray Systems for Fire Protection NFPA No. 15 and shall be arranged to protect tanks, drain-boards, and stock over drain-boards. (7-1-97)

c. Automatic foam extinguishing systems shall conform to NFPA Standard for Foam Extinguishing Systems, NFPA No. 11. Foam producing material selected shall be suitable for the intended use, taking into account characteristics of the dip tank liquid. (7-1-97)

d. Overflow pipe shall be arranged to prevent the floating away of foam and clogging the overflow pipe. This may be accomplished by either of the following: the overflow pipe may be extended through tank wall and terminated in an "L" pointing downward. The bottom of the overflow pipe at the point it pierces tank wall should not be over two (2) inches above the opening or face of the "L"; or the overflow pipe inlet may be provided with a removable screen of one-fourth (1/4) inch mesh having an area of at least twice the cross-sectional area of overflow pipe. (Screens which may be clogged by dip tank ingredients shall be inspected and cleaned periodically.) (7-1-97)

e. Automatic Carbon Dioxide Systems. Automatic carbon dioxide systems shall conform to NFPA Standards for Carbon Dioxide Extinguishing Systems NFPA No. 12 and sub-section 063.06. of this standard and shall be arranged to protect both dip tanks and drain-boards and unless stock over drain-boards is otherwise protected with automatic extinguishing facilities, shall also be arranged to protect such stock. (7-1-97)
f. Dry chemical extinguishing systems shall conform to NFPA Standard for Dry Chemical Extinguishing Systems NFPA No. 17 and sub-section 063.05 of this standard and shall be arranged to protect both dip tanks and drain-boards, and unless stock over drain-boards is otherwise protected with automatic extinguishing facilities, shall also be arranged to protect such stock. (7-1-97)

g. Dip tank covers arranged to close automatically in the event of fire shall be actuated by approved automatic devices and shall also be arranged for manual operation. (7-1-97)

h. Dip tank covers shall be of substantial noncombustible material or of tin-clad type with enclosing metal applied with locked joints. (7-1-97)

i. Chains or wire rope shall be used for cover support or operating mechanism where the burning of a cord would interfere with the action of a device. (7-1-97)

j. Dip tank covers shall be kept closed when tanks are not in use. (7-1-97)

09. Hardening and Tempering Tanks: (7-1-97)

a. Tanks shall be located as far as practicable from furnaces and shall not be located on or near combustible floors. (7-1-97)

b. Tanks shall be provided with a noncombustible hood and vent or other equally effective means of venting to the outside of the building to serve as a vent in case of fire. All such vent ducts shall be treated as flues and be kept well away from combustible roofs or materials. (7-1-97)

c. Tanks shall be so designed that the maximum workload is incapable of raising the temperature of the cooling medium to within fifty (50) degrees Fahrenheit below its flash point, or such tanks shall be equipped with circulating cooling systems which will accomplish the same result. (7-1-97)

d. Tanks shall be equipped with a high temperature limit switch arranged to sound an alarm when the temperature of the quenching medium reaches within fifty (50) degrees Fahrenheit below the flashpoint. If practical from an operating standpoint, such limit switches shall also shut down conveying equipment supplying work to the tank. (7-1-97)

e. The provisions of sub-section 241.08 of this section shall apply to tanks having a liquid surface area of twenty-five (25) square feet or more or a capacity of five-hundred (500) gallons or more. (7-1-97)

f. Air under pressure shall not be used to fill or to agitate oil tanks. (7-1-97)

g. Drain facilities from the bottom of the tank may be combined with the oil circulating system or arranged independently to drain the oil to a safe location. The drain valve shall be operated
automatically with approved heat actuated devices or manually, and if the latter, the valve shall be operated from a safe distance. (7-1-97)

10. **Flow Coat**: (7-1-97)

a. Except as modified in this subsection, all of the applicable requirements of this section for dip tanks apply. (7-1-97)

b. All piping shall be strongly erected and rigidly supported. (7-1-97)

c. Paint shall be supplied by direct low-pressure pumping arranged to automatically shut down by means of approved heat actuated devices, in the case of fire, or paint may be supplied by a gravity tank not exceeding ten (10) gallons in capacity. (7-1-97)

d. The area of the sump and any areas on which paint flows shall be considered the area of dip tank. (7-1-97)

11. **Electrostatic Apparatus**: (7-1-97)

a. Installation and use of electrostatic detearing equipment shall conform to all of the applicable requirements of this section. (7-1-97)

b. Electrostatic apparatus and devices used in connection with paint detearing operations shall be of approved types. (7-1-97)

c. Transformers, power-packs, control apparatus, and all other electrical portions of the equipment, with the exception of high voltage grids and their connections, shall be located outside the vapor area or shall conform to the requirements of sub-section 241.06. of this section. (7-1-97)

d. Electrodes shall be of substantial construction, shall be rigidly supported in permanent locations, and shall be effectively insulated from ground. Insulators shall be nonporous and noncombustible. (7-1-97)

e. High voltage leads to electrodes shall be effectively and permanently supported on suitable insulators, and shall be effectively guarded against accidental contact or grounding. An automatic means shall be provided for grounding and discharging any accumulated residual charge on the electrode assembly or the secondary circuit of the high voltage transformer when the transformer primary is disconnected from the source of supply. (7-1-97)

f. A space shall be maintained between goods being deteared and electrodes or conductors of at least twice the sparking distance. A suitable sign stating the sparking distance shall be conspicuously posted near the assembly. (7-1-97)

g. Goods being deteared using this electrostatic process are to be supported on conveyors. The conveyors shall be so arranged as to maintain safe distance between the goods and the electrodes
at all times. All goods shall be so supported as to prevent any swinging or movement which would reduce the clearance to less than specified in sub-section 241.11.f. of this section. (7-1-97)

h. This electrostatic process is not approved where goods being deteared are manipulated by hand. (7-1-97)

i. Electrostatic apparatus shall be equipped with automatic controls which will operate without time delay to disconnect the power supply to the high voltage transformer and to signal the operator under any of the following conditions: stoppage of ventilating fans or failure of ventilating equipment from any cause; stoppage of the conveyor carrying goods past the high voltage grid; occurrence of a ground of imminent ground at any point on the high voltage system; or reduction of clearance below that specified in sub-section 241.11.f. of this section. (7-1-97)

j. Adequate fencing, railings, or guards shall be so placed about the equipment that they, either by their location or character or both assure that a safe isolation of the process is maintained from plant storage or personnel. Such railings, fencing and guards shall be of conducting material, adequately grounded, and should be at least five (5) feet from processing equipment. (7-1-97)

k. Electrode insulators shall be kept clean and dry. (7-1-97)

l. The detearing area shall be ventilated by exhausting adequate air from the area as specified in sub-section 243.01. of this section. (7-1-97)

m. All areas for detearing shall be protected by automatic sprinklers where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment shall be provided. (7-1-97)

n. Drip plates and screens subject to paint deposits shall be removable and shall be taken to a safe place for cleaning. (7-1-97)

12. Roll Coating: (7-1-97)

a. The processes of roll coating, spreading and impregnating, in which fabrics, paper or other materials are passed directly through a tank containing flammable or combustible liquids, or over the surface of a roller that revolves partially submerged in a Class I, or Class II liquids, as these terms are defined in sub-section 220.02 of this standard, shall conform to the applicable requirements of sub-sections 241.03 through 241.08. of this section. (7-1-97)

b. Adequate arrangements shall be made to prevent sparks from static electricity by bonding and grounding all metallic rotating and other parts of machinery and equipment and by the installation of static collectors or maintaining a conductive atmosphere such as a high relative humidity. (7-1-97)

13. Chlorine Used in Chlorinator Systems: (7-1-97)

**14. Ventilation**: (7-1-97)

a. Vapor areas as defined in sub-section 241.02.b. of this section shall be limited to the smallest practical space by maintaining a properly designed system of mechanical ventilation arranged to move air from all directions towards the vapor area origin and thence to a safe outside location. Ventilating systems shall conform to the Standards of Blower and Exhaust Systems NFPA 91. Required ventilating systems shall be so arranged that the failure of any ventilating fan shall automatically stop any dipping conveyor system. See sub-section 241.04. of this section. (7-1-97)

b. When a required ventilating system serves associated drying operations utilizing a heating system which may be a source of ignition, means shall be provided for prevention before the heating system can be started; the failure of any ventilating fan shall automatically shut down the heating system; and the installation shall otherwise conform to the Standard for Ovens and Furnaces NFPA 86. (7-1-97)

c. Open-surface tank operations shall be classified into sixteen (16) classes, numbered A-1 to D-4, inclusive. (7-1-97)

d. Class is determined by two factors, hazard potential designated by a letter from A to D, inclusive, and rate of gas, vapor, or mist evolution designated by a number from one (1) to four (4), inclusive (for example, B.3). (7-1-97)

e. Hazard potential is an index, on a scale from A to D, inclusive, of the severity of the hazard associated with the substance contained in the tank because of the toxic, flammable, or explosive nature of the vapor, gas, or mist produced therefrom. The toxic hazard is determined from the concentration, measured in parts by volume of a gas or vapor, per million parts by volume of contaminated air (p.p.m.) or in milligrams of mist per cubic meter of air (mg./m.³), below which ill effects are unlikely to occur to the exposed worker. The concentrations shall be those in sub-section 300.05 of this standard. (4-7-83)

f. The relative fire or explosion hazard is measured in degrees Fahrenheit in terms of the closed-cup flash point of the substance in the tank. Detailed information on the prevention of fire hazards in dip tanks may be found in Dip Tanks Containing Flammable or Combustible Liquids, NFPA 34, National Fire Protection Association. Where the tank contains a mixture of liquids, other than organic solvents, whose effects are additive, the hygienic standard of the most toxic component (for example, the one having the lowest p.p.m. or mg./m.³) shall be used, except where such substance constitutes an insignificantly small fraction of the mixture. For mixtures of organic solvents their combined effect, rather than that of either individually, shall determine the hazard potential. In the absence of information to the contrary, the effects shall be considered as additive. If the sum of the ratios of the airborne concentration of each contaminant to the toxic concentration of that contaminant exceeds unity, the toxic concentration shall be considered to have been exceeded. (See NOTE below.) (7-1-97)
NOTE: \( \left( \frac{c_1}{\text{TLV}_1} \right) + \left( \frac{c_2}{\text{TLV}_2} \right) + \left( \frac{c_3}{\text{TLV}_3} \right) + \cdots + \left( \frac{c_n}{\text{TLV}_n} \right) \) where \( C \) equals concentration measured at the operation in p.p.m. (7-1-97)

**g.** Hazard potential shall be determined from Table 241.14-A with the value indicating greater hazard being used. When the hazardous material may be either a vapor with a threshold limit value (TLV) in p.p.m. or a mist with a TLV in mg./m\(^3\), the TLV indicating the greater hazard shall be used (for example, A takes precedence over B or C; B over C; C over D). (7-1-97)

<table>
<thead>
<tr>
<th>TABLE 241.14-A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DETERMINATION OF HAZARD POTENTIAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hazard Potential</th>
<th>Toxicity Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gas or vapor (p.p.m.)</td>
</tr>
<tr>
<td>A</td>
<td>0-10</td>
</tr>
<tr>
<td>B</td>
<td>11-100</td>
</tr>
<tr>
<td>C</td>
<td>101-500</td>
</tr>
<tr>
<td>D</td>
<td>Over 500</td>
</tr>
</tbody>
</table>

**h.** Rate of gas, vapor, or mist evolution is a numerical index, on a scale of from one (1) to four (4), inclusive, both of the relative capacity of the tank to produce gas, vapor, or mist and of the relative energy with which it is projected or carried upwards from the tank. Rate is evaluated in terms of: the temperature of the liquid in the tank in degrees Fahrenheit; the number of degrees Fahrenheit that this temperature is below the boiling point of the liquid in degrees Fahrenheit; the relative evaporation of the liquid in still air at room temperature in an arbitrary scale -- fast, medium, slow, or nil; and the extent that the tank gases or produces mist in an arbitrary scale -- high, medium, low, and nil. (See Table 241.14-B, Note 2.) Gassing depends upon electrochemical or mechanical processes, the effects of which have to be individually evaluated for each installation (see Table 241.14-B, Note 3). (7-1-97)

**i.** Rate of evolution shall be determined from Table 241.14-B. When evaporation and gassing yield different rates, the lowest numerical value shall be used. (7-1-97)

<table>
<thead>
<tr>
<th>TABLE 241.14-B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DETERMINATION OF RATE OF GAS, VAPOR, OR MIST EVOLUTION</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rate</th>
<th>Liquid</th>
<th>Degrees below</th>
<th>Relative</th>
<th>Gassing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature, F</td>
<td>boiling point</td>
<td>evaporation²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Over 200</td>
<td>Fast</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>150-200</td>
<td>21-50</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>3</td>
<td>94-149</td>
<td>51-100</td>
<td>Slow</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Under 94</td>
<td>Over 100</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

NOTE 1: In certain classes of equipment specifically vapor degreasers, an internal condenser or vapor level thermostat is used to prevent the vapor from leaving the tank during normal operation. In such cases, rate of vapor evolution from the tank into the workroom is not dependent upon the factors listed in the table, but rather upon abnormalities of operating procedure, such as carry-out of vapors from excessively fast parts, contamination of solvent by water and other materials, or improper heat balance. When operating procedure is excellent effective rate of evolution may be taken as 4. When operating procedure is average, the effective rate of evolution may be taken as 3. When the operation is poor, a rate of 2 or 1 is indicated, depending upon observed conditions.

NOTE 2: Relative evaporation rate is determined according to the methods described by A.K. Doolittle in Industrial and Engineering Chemistry, Vol. 27, P. 1169, (3) where time for 100 percent evaporation is as follows: Fast: 0-3 hours; Medium: 3-12 hours; Slow: 12-50; Nil: more than 50 hours.

NOTE 3: Gassing means the formation by chemical or electrochemical action of minute bubbles of gas under the surface of the liquid in the tank and is generally limited to aqueous solutions.

**j.** Where ventilation is used to control potential exposures to workers as defined in sub-section 241.14.c. through sub-section 241.14.i of this section, it shall be adequate to reduce the concentration of the air contaminant to the degree that a hazard to the worker does not exist. Methods of ventilation are discussed in American National Standard, Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2. (7-1-97)

**k.** Control velocities shall conform to Table 241.14-C in all cases where the flow or air past the breathing or working zone of the operator and into the goods is undisturbed by local environmental conditions, such as open windows, wall fans, unit heaters, or moving machinery. (7-1-97)

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**TABLE 241.14-C**

| CONTROL VELOCITIES IN FEET PER MINUTE (F.P.M.) FOR UNDISTURBED LOCATIONS |
### Table 241.14-D

<table>
<thead>
<tr>
<th>Class</th>
<th>Enclosing hood</th>
<th>Lateral exhaust¹</th>
<th>Canopy hood²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One open side</td>
<td>Two open sides</td>
<td>Three open sides</td>
</tr>
<tr>
<td>B-1 and A-2</td>
<td>100</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>A-3 (Note 2, B-1, B-2, and C-1)</td>
<td>75</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>A-3, C-2, and D-1 (Note 3)</td>
<td>65</td>
<td>90</td>
<td>75</td>
</tr>
<tr>
<td>B-4 (Note 2, C-3, and D-2 (Note 3)</td>
<td>50</td>
<td>75</td>
<td>50</td>
</tr>
<tr>
<td>A-4, C-4 (Note 3), and D-4</td>
<td>General room ventilation required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE 1:** See Table 241.14-D for computation of ventilation rate.

**NOTE 2:** Do not use canopy hood for Hazard Potential A Processes.

**NOTE 3:** Where complete control of hot water is desired, design as next highest class.

(7-1-97)

**k.** All tanks exhausted by means of hoods which: project over the entire tank; are fixed in position in such a location that the head of the workman, in all his normal operating positions while working at the tank, is in front of all hood openings; and are completely enclosed on at least two sides, shall be considered to be exhausted through an enclosing hood. The quantity of air in cubic feet per minute necessary to be exhausted through an enclosing hood shall be not less than the product of the control velocity times the net area of all openings in the enclosure through which air can flow into the hood. (7-1-97)

**l.** All tanks exhausted by means of hoods which do not project over the entire tank, and in which the direction of air movement into the hood or hoods is substantially horizontal, shall be considered to be laterally exhausted. The quantity of air in cubic feet per minute necessary to be laterally exhausted per square foot of tank area in order to maintain the required control velocity shall be determined from Table 241.14-D for all variations in ratio of tank width (W) to tank length (L). The total quantity of air in cubic feet per minute required to be exhausted per tank shall be not less than the product of the area of tank surface times the cubic feet per minute per square foot of tank area, determined from Table 241.14-D. (7-1-97)
### TABLE 241.14-D

**MINIMUM VENTILATION RATE IN CUBIC FEET OF AIR PER MINUTE PER SQUARE FOOT OF TANK AREA FOR LATERAL EXHAUST**

<table>
<thead>
<tr>
<th>Required minimum control velocity, f.p.m.</th>
<th>C.f.m. per sq. ft. to maintain required minimum velocities at following ratios (tank width (W)/tank length (L)). (^{1,2})</th>
</tr>
</thead>
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**Hood along one side or two parallel sides of tank when one hood is against a wall or baffle.** Also for a manifold along tank centerline. \(^{2}\)

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**Hood along one side or two parallel sides of free standing tank not against wall or baffle.**

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**Note 1:** It is not practicable to ventilate across the long dimension of a tank whose ratio \(W/L\) exceeds 2.0. It is undesirable to do so when \(W/L\) exceeds 1.0. For circular tanks with lateral exhaust along up to \(1/2\) the circumference, use \(W/L = 1.0\); for over \(1/2\) the circumference use \(W/L = 0.5\).  

**Note 2:** Baffle is a vertical plate the same length as the tank, and with the top of the plate as high as the tank is wide. If the exhaust hood is on the side of a tank against a building wall or close to it, it is perfectly baffled.  

**Note 3:** Use \(W/2\) as tank width in computing when manifold is along centerline, or when hoods are used on two parallel sides of a tank. Tank width (\(W\)) means the effective width over which the hood must pull air to operate (for example, where the hood face is set back from the edge of the tank, this set back must be added in measuring tank width). The surface area of tanks can frequently be
reduced and better control obtained (particularly on conveyorized systems) by using covers extending from the upper edges of the slots toward the center of the tank.

(7-1-97)

m. For lateral exhaust hoods over forty-two (42) inches wide, or where it is desirable to reduce the amount of air removed from the workroom, air supply slots or orifices shall be provided along the side or the center of the tank opposite from the exhaust slots. The design of such systems shall meet the following criteria: The supply air volume plus the entrained air shall not exceed fifty (50) percent of the exhaust volume. The velocity of the supply airstream as it reaches the effective control area of the exhaust slot shall be less than the effective velocity over the exhaust slot area. The vertical height of the receiving exhaust hood, including any baffle, shall not be less than one-quarter the width of the tank. The supply airstream shall not be allowed to impinge on obstructions between it and the exhaust slot in such a manner as to significantly interfere with the performance of the exhaust hood. Since most failure of push-pull systems result from excessive supply air volumes and pressures, methods of measuring and adjusting the supply air shall be provided. When satisfactory control has been achieved, the adjustable features of the hood shall be fixed so that they will not be altered. (7-1-97)

n. All tanks exhausted by means of hoods which project over the entire tank and which do not conform to the definition of enclosing hoods, shall be considered to be overhead canopy hoods. The quantity of air in cubic feet per minute necessary to be exhausted through a canopy hood shall be not less than the product of the control velocity times the net area of all openings between the bottom edges of the hood and the top edges of the tank. (7-1-97)

o. The rate of vapor evolution (including steam or products of combustion) from the process shall be estimated. If the rate of vapor evolution is equal to or greater than ten (10) percent of the calculated exhaust volume required, the exhaust volume shall be increased in equal amount. (7-1-97)

p. Wherever spraying or other mechanical means are used to disperse a liquid above an open-surface tank, control must be provided for the airborne spray. Such operations shall be enclosed as completely as possible. The inward air velocity into the enclosure shall be sufficient to prevent the discharge of spray into the workroom. Mechanical baffles may be used to help prevent the discharge of spray. Spray painting operations are covered by section 240 of this standard. (7-1-97)

q. Tank covers, foams, beads, chips or other materials floating on the tank surface so as to confine gases, mists, or vapors to the area under the cover or to the foam, bead, or chip layer; or surface tension depressive agents added to the liquid in the tank to minimize mist formation, or any combination thereof, may all be used as gas, mist, or vapor control means for open-surface tank operations, provided that they effectively reduce the concentrations of hazardous materials
in the vicinity of the worker below the limits set in accordance with sub-section 241.14.m. of this section. (7-1-97)

r. The equipment for exhausting air shall have sufficient capacity to produce the flow of air required in each of the hoods and openings of the system. (7-1-97)

s. The capacity required in sub-section 241.14.r. of this section shall be obtained when the airflow producing equipment is operating against the following pressure losses, the sum of which is the static pressure: (7-1-97)

i. Entrance losses into the hood; (7-1-97)

ii. Resistance to air flow in branch pipe including bends and transformations; (7-1-97)

iii. Entrance loss into the main pipe; (7-1-97)

iv. Resistance to airflow in main pipe including bends and transformations; (7-1-97)

v. Resistance of mechanical equipment, that is, filters, washers, condensers, absorbers, etc., plus their entrance and exit losses; (7-1-97)

vi. And resistance in outlet duct and discharge stack. (7-1-97)

t. Two or more operations shall not be connected to the same exhaust system where either one or the combination of the substances removed may constitute a fire, explosion, or chemical reaction hazard in the duct system. Traps or other devices shall be provided to insure that condensate in ducts does not drain back into any tank. (7-1-97)

u. The exhaust system, consisting of hoods, ducts, air mover, and discharge outlet, shall be designed in accordance with American National Standard, Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2 or the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists. Airflow and pressure loss data provided by the manufacturer of any air cleaning device shall be included in the design calculations. (7-1-97)

v. The required air flow shall be maintained at all times during which gas, mist or vapor is emitted from the tank, and at all times the tank, the draining, or the drying area is in operation or use. When the system is first installed, the airflow from each hood shall be measured by means of a pitot transverse in the exhaust duct and corrective action taken if the flow is less than that required. When the proper flow is obtained, the hood static pressure shall be measured and recorded. At intervals of not more than three (3) months operation, or after a prolonged shutdown period, the hoods and duct system shall be inspected for evidence of corrosion or damage. In any case where the airflow is found to be less than required, it shall be increased to the required value. (Information on airflow and static pressure measurement and calculations may be found in American National Standard Fundamental Governing the Design and Operation
of Local Exhaust systems Z9.2, or in the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists. (7-1-97)

w. The exhaust system shall discharge to the outer air in such a manner that the possibility of its effluent entering any building is at a minimum. Recirculation shall only be through a device for contaminant removal which will prevent the creation of a health hazard in the room or area to which the air is recirculated. (7-1-97)

x. A volume of outside air in the range of ninety (90) percent to one-hundred-ten (110) percent of the exhaust volume shall be provided to each room having exhaust hoods. The outside air supply shall enter the workroom in such a manner as not to be detrimental to any exhaust hood. The air-flow of the make-up air system shall be measured on installation. Periodically, thereafter, the airflow should be remeasured, and corrective action shall be taken when the airflow is below that required. The makeup air shall be uncontaminated. (7-1-97)

15. Personal Protection. (7-1-97)

a. All employees working in and around open-surface tank operations must be instructed as to the hazards of their respective jobs, and in the personal protection and first aid procedures applicable to these hazards. (7-1-97)

b. All persons required to work in such a manner that their feet may become wet shall be provided with rubber of other impervious boots or shoes, rubbers, or wooden-soled shoes sufficient to keep feet dry. (7-1-97)

c. All persons required to handle work wet with a liquid other than water shall be provided with gloves impervious to such a liquid and of a length sufficient to prevent entrance of liquid into the tops of the gloves. The interior of gloves shall be kept free from corrosive or irritating contaminants. (7-1-97)

d. All persons required to work in such a manner that their clothing may become wet shall be provided with such aprons, coats, jackets, sleeves, or other garments made of rubber of other materials impervious to liquids other than water, as are required to keep their clothing dry. Aprons shall extend well below the top of boots to prevent liquid splashing into the boots. Provisions of dry, clean, cotton clothing along with rubber shoes or short boots and an apron impervious to liquids other than water shall be considered a satisfactory substitute where small parts are cleaned, plated, or acid dipped in open tanks and rapid work is required. (7-1-97)

e. Whenever there is a danger of splashing, for example, when additions are made manually to the tanks, or when acids and chemicals are removed from the tanks, the employees so engaged shall be required to wear either tight-fitting chemical goggles or an effective face shield. See sub-section 050.04 of this standard. (7-1-97)

f. When, during emergencies as described in sub-section 241.16.e. of this section, workers must be in areas where concentrations of air contaminants are greater than the limit set by sub-section 241.14.e. of this section, or oxygen concentrations are less than nineteen-point-five (19.5)
percent, they shall be required to wear respirators adequate to reduce their exposure to a level below these limits, or to provide adequate oxygen. Such respirators shall also be provided in marked, quickly accessible storage compartments built for the purpose, when there exists the possibility of accidental release of hazardous concentrations of air contaminants. Respirators shall be approved by NIOSH and the U. S. Bureau of Mines, U. S. Department of the Interior and shall be selected by a competent industrial hygienist or other technically qualified source. Respirators shall be used in accordance with sub-section 050.05 of this standard, and persons who may require them shall be trained in their use. (7-1-97)

**g.** Near each tank containing a liquid which may burn, irritate, or otherwise be harmful to the skin if splashed upon the worker's body, there shall be a supply of clean cold water. The water pipe (carrying a pressure not exceeding twenty-five (25) pounds per square inch) shall be provided with a quick opening valve and at least forty-eight (48) inches of hose not smaller than three-fourths (3/4) inch, so that no time may be lost in washing off liquids from the skin or clothing. Alternately, deluge showers and eye flushes shall be provided in cases where harmful chemicals may be splashed on parts of the body. (7-1-97)

**h.** Operators with sores, burns, or other skin lesions requiring medical treatment shall not be allowed to work at their regular operations until so authorized by a physician. Any small skin abrasions, cuts, rash, or open sores which are found or reported shall be treated by a properly designated person so that chances of exposures to the chemicals are removed. Workers exposed to chromic acids shall have a periodic examination made of the nostrils and other parts of the body, to detect incipient ulceration. (7-1-97)

**i.** Sufficient washing facilities, including soap, individual towels, and hot water, shall be provided for all persons required to use or handle any liquids which may burn, irritate, or otherwise be harmful to the skin, on the basis of at least one basin (or its equivalent) with a hot water faucet for every ten (10) employees. See sub-section 080.16 of this standard. (7-1-97)

**j.** Locker space or equivalent clothing storage facilities shall be provided to prevent contamination of street clothing. (7-1-97)

**k.** First aid facilities specific to the hazards of the operations conducted shall be readily available. (7-1-97)

**l.** Dikes or other arrangements shall be provided to prevent the possibility of intermixing of cyanide and acid in the event of tank rupture. (7-1-97)

**16. Inspection, Maintenance and Installation:** (7-1-97)

**a.** Floors and platforms around tanks shall be prevented from becoming slippery both by original type of construction and by frequent flushing. They shall be firm, sound, and of the design and construction to minimize the possibility of tripping. (7-1-97)
b. Before cleaning the interior of any tank, the contents shall be drained off, and the clean-out doors shall be opened where provided. All pockets in tanks or pits, where it is possible for hazardous vapors to collect, shall be ventilated and cleared of such vapors. (7-1-97)

c. Tanks which have been drained to permit employees to enter for the purposes of cleaning, inspection, or maintenance may contain atmospheres which are hazardous to life or health, through the presence of flammable or toxic air contaminants, or through the absence of sufficient oxygen. Before employees shall be permitted to enter any such tank, appropriate tests of the atmosphere shall be made to determine if the limits set by sub-section 241.14.e. of this section are exceeded, or if the oxygen concentration is less than nineteen-point-five (19.5) percent and appropriate subsections of section 043 of this standard. (7-1-97)

d. If the tests made in accordance with sub-section 241.16.c. of this section indicate that the atmosphere in the tank is unsafe, before any employee is permitted to enter the tank, the tank shall be ventilated until the hazardous atmosphere is removed, and ventilation shall be continued so as to prevent the occurrence of a hazardous atmosphere as long as an employee is in the tank. (7-1-97)

e. If, in emergencies, such as rescue work, it is necessary to enter a tank which may contain a hazardous atmosphere, suitable respirators, such as self-contained breathing apparatus; hose mask with blower, if there is a possibility of oxygen deficiency; or a gas mask, selected and operated in accordance with sub-section 241.15.f. of this section shall be used. If a contaminant in the tank can cause dermatitis, or be absorbed through the skin, the employee entering the tank shall also wear protective clothing. At least one trained standby employee, with suitable respirator, shall be present in the nearest uncontaminated area. The standby employee must be able to communicate with the employee in the tank and be able to haul him out of the tank with a lifeline if necessary. Rescue shall be conducted following the requirements of sub-section 043.09 of this standard. (7-1-97)

f. Maintenance work requiring welding or open flame, where toxic metal fumes such as cadmium, chromium, or lead may be involved, shall be done only with sufficient local exhaust ventilation to prevent the creation of a health hazard, or be done with respirators selected and used in accordance with sub-section 243.11.f. of this section and sub-section 050.05. of this standard. Welding, or the use of open flames near any solvent cleaning equipment shall be permitted only after such equipment has first been thoroughly cleaned of solvents and vapors. (7-1-97)

17. Vapor Degreasing Tanks. (7-1-97)

a. In any vapor degreasing tank equipped with a condenser or vapor level thermostat, the condenser or thermostat shall keep the level of vapors below the top edge of the tank by a distance of at least equal to one-half (1/2) the tank width, or at least thirty-six (36) inches, whichever is shorter. (7-1-97)

b. Where gas is used as a fuel for heating vapor degreasing tanks, the combustion chamber 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 outer air. If mechanical exhaust is used on this flue, a draft diverter shall be used. Special precautions must be taken to prevent solvent fumes from entering the combustion air of this or any other heater when chlorinated or fluorinated hydrocarbon solvents (for example, trichloroethylene, Freon) are used. (7-1-97)

c. Heating elements shall be so designed and maintained that their surface temperature will not cause the solvent mixture to decompose, break down, or be converted into an excessive quantity of vapor. (7-1-97)

d. Tanks or machines of more than four (4) square feet of vapor area, used for solvent cleaning or vapor degreasing, shall be equipped with suitable clean-out or sludge doors located near the bottom of each tank or still. These doors shall be so designed and gasketed that there will be no leakage of solvent when they are closed. (7-1-97)

242. -- 249. (RESERVED)