## Let's Take a Peek at the PEAC software

*by S. Bruce King*

This month our example is Piperidine. It is sometimes identified by the following names or synonyms: azacyclohexane, cyclopentimine, cypentil, hexahydropyridine, hexazane, and pentamethyleneamine. It is used in a number of commercial applications, e.g., synthetic flavors; used in the manufacturing of local anesthetics, analgesics and other pharmaceuticals, and for wetting agents and germicides; hardening agent for epoxy resins; ingredient in oils & fuels; and seafood flavoring.

It is a clear, colorless liquid with amine-like or heavy, sweet, floral, animal odor. It is a liquid at room temperature with a melting point of 19°F and a boiling point of 223°F. It is soluble in all proportions in water, alcohol, soluble in ether, acetone, benzene, chloroform. Its chemical formula is $C_5H_{11}N$, which corresponds to a molecular weight of 85.15. Its vapor density is 3.0, so it will seek low areas and it has a vapor pressure of 40 mm of mercury at 84°F. It is extremely flammable with a flash point of 38°F. The lower Explosive Limit (LEL) is 1.4%; the Upper Explosive Limit (UEL) is 10%.

There is no established IDLH for Piperidine but the Department of Energy's Emergency Management Advisory Committee's Subcommittee on Consequence Assessment and Protective Action (SCAPA) has developed a TEEL-(1,2,3) (Temporary Emergency Exposure Limit) as a temporary substitute for the ERPGs through a formulaic derivation. In many instances, the TEELs are reported since there are no ERPGs available for the specific chemical. The SCAPA has established TEELs for Piperidene as follows: TEEL1: 3 $mg/m^3$, TEEL2: 20 $mg/m^3$, TEEL3: 750 $mg/m^3$.

**<u>Hazards and protection</u>**

**Storage -** Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from strong acids. Flammables-area.

**Handling -** Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use only in a well ventilated area. Ground and bond containers when transferring material. Do not get in eyes, on skin, or on clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Avoid contact with heat, sparks and flame. Do not ingest or inhale. Discard contaminated shoes. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames.

**Protection -** Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166. Skin: Wear appropriate protective gloves to prevent

skin exposure. Clothing: Wear appropriate protective clothing to prevent skin exposure.

**Respirators -** Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

**Small spills or leaks -** Absorb spill with inert material, (e.g., dry sand or earth), then place into a chemical waste container. Remove all sources of ignition.

**Stability -** Stable under normal temperatures and pressures.

**Incompatibilities** - Acids; acid chlorides; acid anhydrides; carbon dioxide; strong oxidizing agents; dicyanofurazan; N-nitrosoacetanilide; 1-Perchlorylpiperdine.

**Hazardous Decomposition -** Nitrogen oxides, carbon monoxide, carbon dioxide.

**Other hazards -** May react violently with water.

## Health related information

**Exposure effects** - Repeated inhalation may cause chronic bronchitis. Prolonged or repeated contact may cause skin necrosis and/or ulceration of the skin. May cause chronic cough.

**Ingestion -** Harmful if swallowed. Causes gastrointestinal tract burns. Can cause nervous system damage. May cause tremors and convulsions.

**Inhalation –** May cause severe irritation of the respiratory tract with sore throat, coughing, shortness of breath and delayed lung edema. Causes chemical burns to the respiratory tract.

**Skin -** Harmful if absorbed through the skin. Penetration may continue for several days. Causes skin irritation and possible severe skin irritation especially if the skin is wet or moist.

**Eyes -** Causes eye irritation. Contact with liquid or vapor causes severe burns and possible irreversible eye damage. Eye damage may be delayed. May cause blindness.

## First aid

**Ingestion -** Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

**Inhalation -** Get medical aid immediately. Remove from exposure to fresh air immediately. If breathing is difficult, give oxygen.

**Skin -** Get medical aid immediately. Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

**Eyes -** Get medical aid immediately. Do NOT allow victim to rub or keep eyes closed. Extensive irrigation is required (at least 30 minutes). SPEEDY ACTION IS CRITICAL!

In using the PEAC application we access information for the chemical by first locating Piperidine in the database. The following figures show the screens displayed for chemical properties, Figure 1 for the *PEAC-WMD for Windows* application and Figure 2-4 for the *PEAC-WMD for the Pocket PC* application.

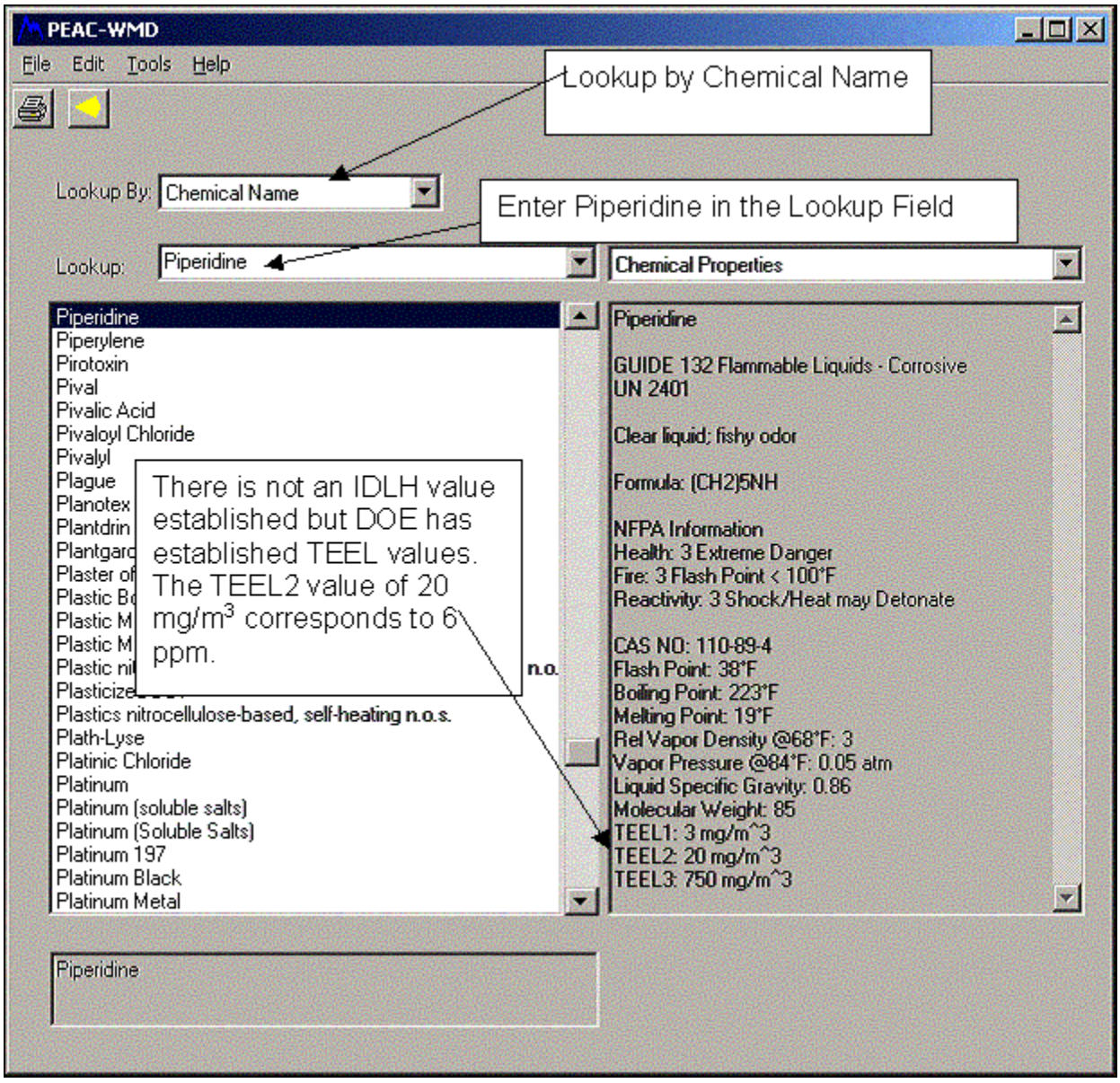



**Figure 1 - Using the Lookup By: Name for Piperidine using the PEAC-WMD for Windows application**

Review of the information displayed in the chemical properties screen whether in Figure 1 (above) or Figures 2-4 (below), show chemical properties values discussed earlier at the top of this discussion. In addition, other values are provided such as the TEELs (Temporary Emergency Exposure Limit) published by Department of Energy.

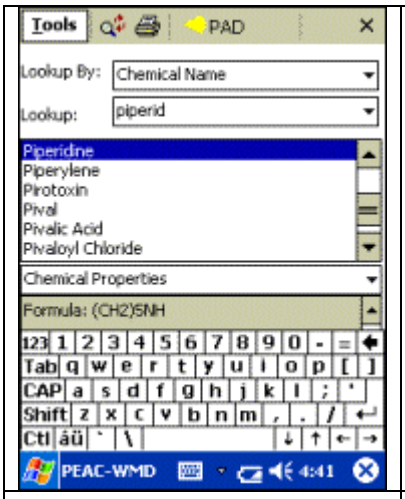



**Figure 2**–Selecting Piperidine using the PEAC-WMD for Pocket PC application

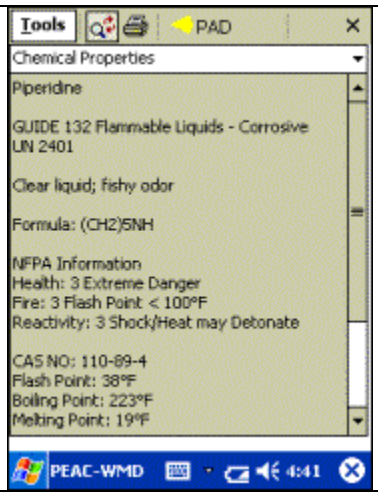



**Figure 3**–The top portion of the Chemical Properties Data Display Screen

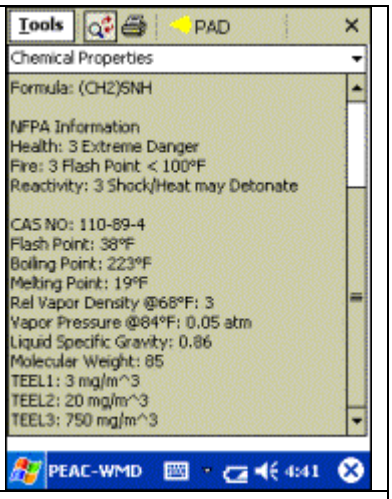
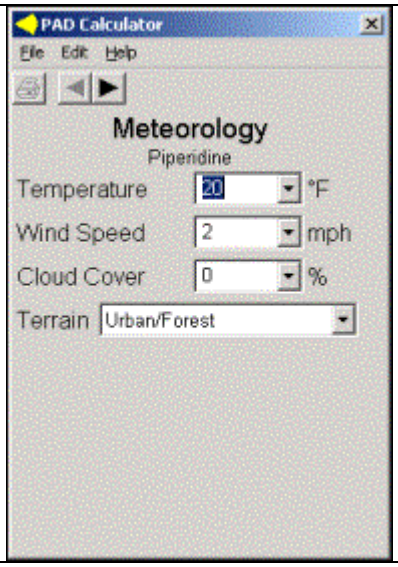



**Figure 4**–The bottom portion of the Chemical Properties Data Display Screen

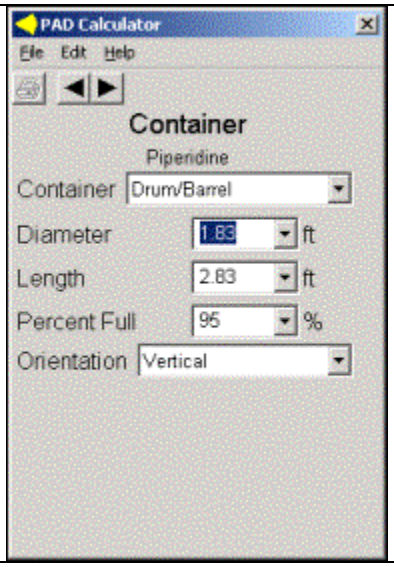
A benefit of using the PEAC tool is assistance in the development of an evacuation zone for those chemicals that produce a toxic vapor cloud. Piperidine has a relatively low vapor pressure (30 mm Hg), so if a small amount is spilled and forms a puddle, the amount of vapor released is very minimal. As with all of our examples, AristaTek creates a scenario for a spill or release of the specific chemical, and then we work through the development of a PAD (Protective Action Distance) to demonstrate how the PEAC system works. For our scenario using Piperidine as the spilled chemical we'll use Salt Lake City as the location and the time as 2:30 AM on January 16th. A trailer with twenty 55-gallon drums of Piperidine has rolled off the Interstate 15 on the outskirts of the city. At least one of the drums is leaking liquid because a pool has formed that is about 15 feet in diameter. The temperature is about 20°F, the winds are very light, say 2 mph, and it's a clear night (no clouds).

As seen at the top of the data display screens, there is a yellow icon displayed; this is the PEAC icon for notifying the user that a Protective Action Distance can be calculated. Clicking or tapping on the PAD icon will display a screen as shown in Figure 5. Following through the screens, we provide information on the Meteorology, Container Size, and Type of Release (Source). The last screen displays the PAD based on the provided information. If you decide to follow along on this example, remember to change the location to Salt Lake City and the time to 2:30 AM, January 16th.



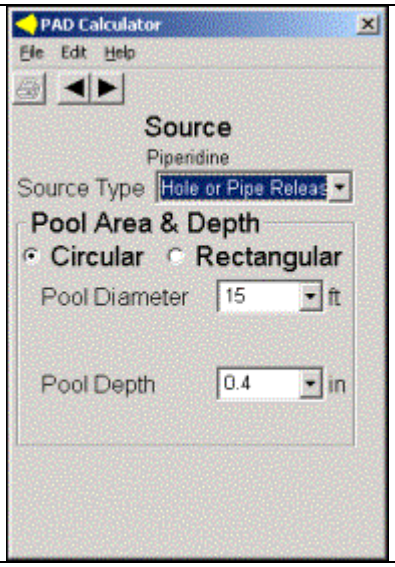

**Meteorology**

It's Salt Lake City in January and the temperature about 20°, light wind is set for 2 mph, clear sky so we'll set cloud cover to 0%, and the terrain is Urban/Forest since it's an urban setting.




**Container**

We have selected from our list of container sizes the **Drum/Barrel** selection. This provides us with a default size that should get us pretty close to the actual size.




**Source**

Since the scenario has a pool, we've selected a **Hole or Pipe Release** as the **Source** type of release (it might be a **Rupture** but we're not sure). We have set the pool diameter to 15'.

**Figure 5 – Calculating a PAD using the PEAC System**

By pressing the right arrow at the top of the screen, the PEAC system will display a screen as shown in Figure 6. This calculates a **PAD** (Protective Action Distance) based on the default **Level of Concern** set at 1 ppm. Since we know the TEEL2 for Piperidine is 20 $mg/m^3$ (which is equivalent to about 6 ppm) we can enter 6ppm as shown in Figure 7 and get an appropriate PAD of 218 yards.

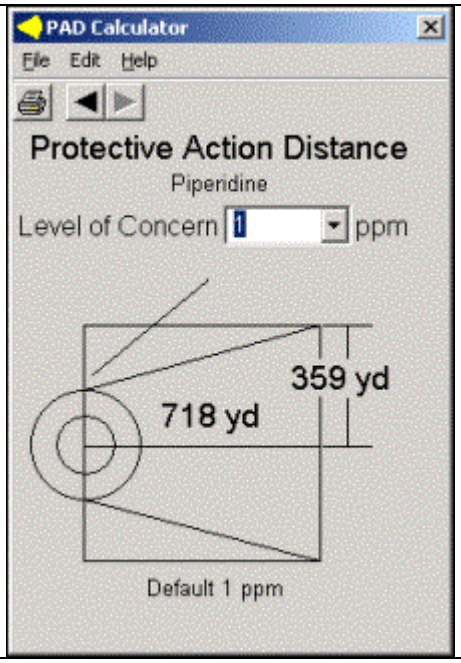



**Figure 6**–Default PAD for Piperdine using 1 ppm as the Level of Concern.

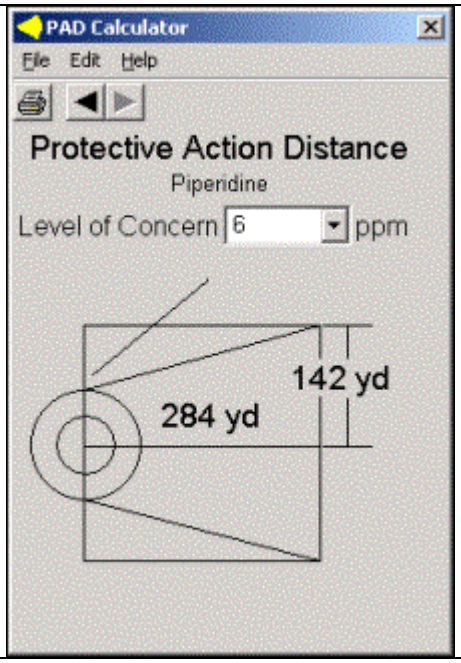



**Figure 7**–PAD for Piperdine using 6 ppm (equivalent to 20 $mg/m^3$ - the TEEL2) as the Level of Concern.

Portions of this discussion were adapted from the WEB site supported by the Hardy Research Group, Department of Chemistry, The University of Akron: http://ull.chemistry.uakron.edu/. Additional information was adapted from the National Library of Medicine's Specialized Information Services: http://toxnet.nlm.nih.gov/.