



those of spilled liquids. The layering just described is one example. Another is the fact that, when liquids are in sealed containers, gas pressures build up. The size and shape of the container are also important; is it a 55-gallon drum or a 30,000-gallon tank car? The latter will require a longer sampling device and present the problem of getting on top of the tank.

It's much more difficult to get a pure sample from a spilled liquid than from one that's contained; the material will be contaminated by impurities of the surface onto which it has spilled. If the surface is soil, a soil sample may be needed to identify impurities already present there. And if there's no pooling of a spilled liquid, the only option for collecting the material may be a wipe sample.

Whatever method is appropriate, the equipment used to collect and contain the sample should be:

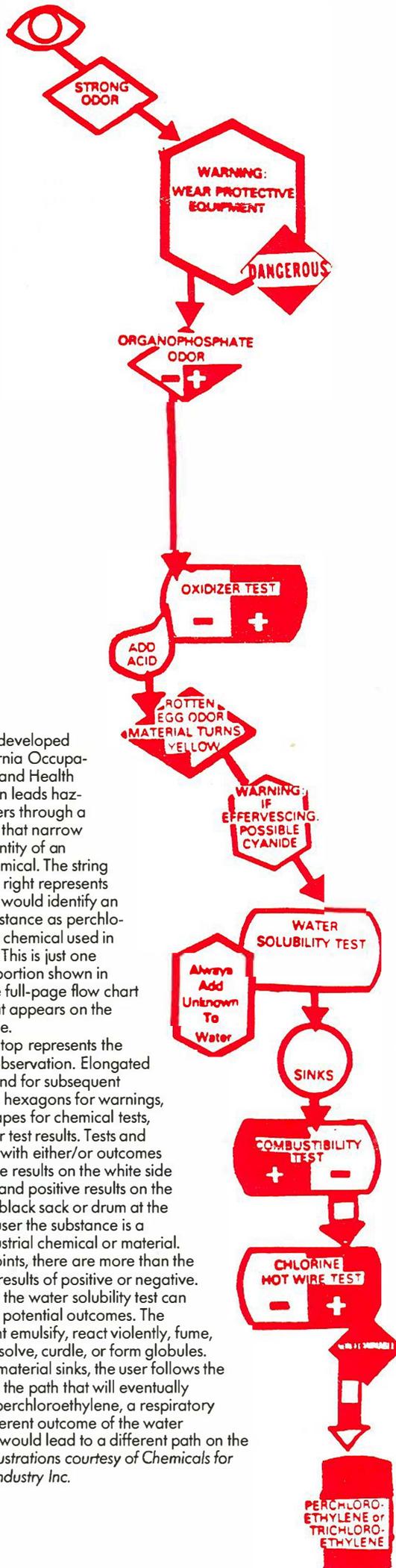
- Disposable or easily cleaned. To prevent cross-contamination from previous samples, a collection device may be reused only after thorough cleaning.
- Inexpensive, especially when the sampling device is disposable.
- Easy to operate when the user is wearing the proper safety equipment.
- Designed for safe use. For instance, moving parts could tear a responder's fully encapsulated suit.
- Compatible with the material to be sampled. Tools that produce sparks could set fire to flammable liquids; a plastic scoop won't work for sampling a solvent, because plastic will dissolve; and wood is dangerous around nitric acid, which is such a strong oxidizer it could ignite the wood. (Although the purpose of testing is to identify the material, there are usually clues from the start that enable us to choose compatible tools.)

Once the sample is collected, it's put into a glass or plastic sample jar. Then the tests can be performed. Haz Mat 1 carries equipment to do field tests, which give qualitative results—giving a general indication of the type of material. These tests aren't meant to be the final word! Their results are only an aid in formulating safe strategy and tactics. Impurities can influence the results of field tests. So Haz Mat turns all samples over to the New York City Department of Environmental Protection for quantitative analysis by a certified test lab. If the field test turned up positive, the lab results will determine the level of decontamination necessary.

The test method is easier to choose than the sampling method. Separate tests exist for PCBs and asbestos, so if firefighters suspect either of these, the appropriate test is performed. Otherwise, a special kit is used to identify unknown materials.

We'll take a look at these tests one at a time. More important than the step-by-step procedure is the chemistry of the test.

PCB (polychlorinated biphenyl) is an ingredient in transformer oil, the oil used on insulation in fluorescent light ballasts, and other oils where thermal stability is important. It's no longer manufactured, but



A flow chart developed by the California Occupational Safety and Health Administration leads hazmat responders through a series of tests that narrow down the identity of an unknown chemical. The string of symbols at right represents the steps that would identify an unknown substance as perchloroethylene, a chemical used in dry cleaning. This is just one strand—the portion shown in color—of the full-page flow chart for liquids that appears on the opposite page.

The eye at top represents the preliminary observation. Elongated diamonds stand for subsequent observations, hexagons for warnings, Band-Aid shapes for chemical tests, and circles for test results. Tests and observations with either/or outcomes show negative results on the white side of the shape and positive results on the black side. A black sack or drum at the end tells the user the substance is a common industrial chemical or material.

At some points, there are more than the two possible results of positive or negative. For example, the water solubility test can result in eight potential outcomes. The material might emulsify, react violently, fume, sink, float, dissolve, curdle, or form globules. Because this material sinks, the user follows the flow chart on the path that will eventually identify it as perchloroethylene, a respiratory irritant. A different outcome of the water solubility test would lead to a different path on the flow chart. Illustrations courtesy of Chemicals for Research & Industry Inc.

it's still around. A polychlorinated biphenyl, as the name implies, consists of two phenyl molecules linked together, with a number of chlorine atoms attached. There are various types of PCBs, the difference being the number of chlorine atoms. A numbering system identifies them by the weight of the chlorine atoms.

In the field test, a Haz Mat member places a precise amount of the suspect oil into a plastic test tube. He adds two substances to strip off the chlorine, forming sodium chloride. Then that's extracted and mixed with additional substances. The result is a color change that indicates the amount of chlorine.

Every PCB molecule contains chlorine. But so do many other, more common molecules. Salt water, the

salt used on streets in winter, and even the salt in perspiration might give a false positive result.

If a test result is positive, the sample must be sent to a lab for quantitative testing. The area, the equipment, and anyone who has come in contact with the oil should be considered contaminated until further tests prove otherwise.

Another hazardous material commonly encountered is *asbestos*, a compound which occurs naturally and has been known for several millennia. It has come into wide usage only in the last 100 years. By far the largest use of asbestos is in electrical and thermal insulation, mainly in six forms of various composition. All of them contain silicon-bound iron, silicon-bound magnesium, or both. Ninety percent of the asbestos in use is in the form of chrysotile, which has no iron.

Haz Mat 1 uses a field test—really two tests—to check for silicon-bound iron and magnesium. Again, color change is the indicator, but in this case, the change shows only presence or absence of the elements, not the amount.

Silicon-bound iron and magnesium exist in other forms besides asbestos, and those forms will give a false positive result that needs to be followed up in the lab. Negative results mean only that there's little or no asbestos in the solid sample tested; there might still be asbestos in the air.

Usually the most difficult haz-mat incident to handle is the one that involves an *unidentified material*. Without special equipment, probably the only thing firefighters can determine is the material's physical state: solid, liquid, or gas. This information is useful, but far from enough to make proper decisions about how to proceed. We need to know more—the chemical and its physical properties. Is it flammable or combustible? Is it toxic? Is it lighter or heavier than air or water? Will it react with other materials?

Until several years ago, we either handled unknown materials without sufficient information or we sent a sample to the lab for analysis and waited for results. The first option, we found, sometimes had undesirable consequences. The second tied units up for hours.

An answer to this dilemma came from a group of research chemists in California. They gathered information on all the haz mats involved in emergency responses in California during the first six months of 1983. Then they devised a simple identification test for each one. As emergency responders used the kit, it was refined to the point that it's now useful in 95 percent of all haz-mat operations. The kit includes a flow chart that leads the user through a series of tests, narrowing down a substance's identity. (See illustration on page 13.) The process can take just a couple of steps to more than a dozen.

Haz Mat 1's use of this kit and the other two tests on the scene reduces the time needed to complete operations and increases the safety of operating forces. They're tools that help the Fire Department carry out that responsibility efficiently and safely.



(Top) Fr. Joe Iovino of Haz Mat 1 uses the mini-lab on the apparatus to test a substance for acidic qualities. (Center) Separate kits test for asbestos, PCBs, and (bottom) unknown chemicals. Photos by Danny Pontecorvo