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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

CLASS HANDBOOK

for Basic, Intermediate, & Advanced HazCat Classes

by

ROBERT TURKINGTON

and

JERRY GREY

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October 1992

The HazCat Chemical Identification System manual and class handbooks are constantly updated. If you are working with another person, be certain that both of you have the same edition and impression.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

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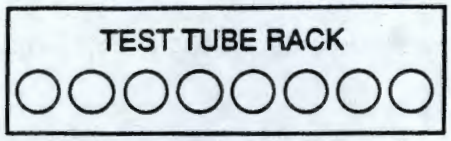
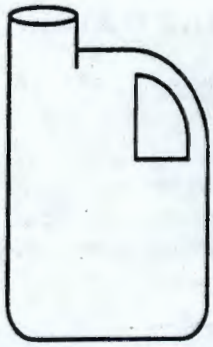
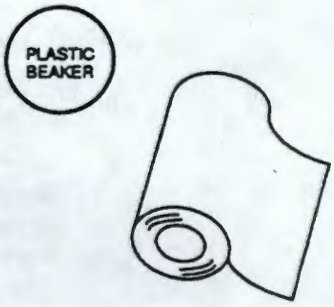
HOW STATION SHOULD LOOK



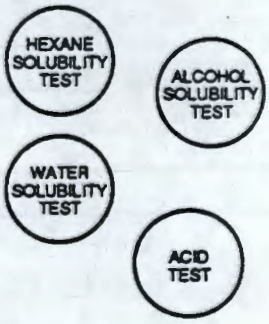
10 Latex Gloves
3 Pair of Safety Glasses
Field Sheets
3 Field Handbooks





EQUIPMENT IN PLASTIC BAG

Magnet
Flame Test Wires (6)
QA-10 Filter Papers (5)
Blue Glass
Green Blass
Ketone Test Piece



	LABORATORY EQUIPMENT
Test Tubes Pipettes	Glass Stiring Rod Wood Stir Sticks (24) 00 Test Tube Cork Test Tube Clamp Chemical Scoop 10 ml Syringe Swynex Filter Cassette Torch Burner Head Chlorine Hot Wire

BLACK BOX

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SAFETY

USE AND CARE INSTRUCTIONS:

The HazCat Chemical Identification System's SAFETY depends upon three basic premises:

1. Very small quantities of the unknown are used.
2. Suggested protective clothing should prevent contact with these small amounts of the unknown, even if the clothing is not the optimum material to prevent break through.
3. Very reactive chemicals provide sufficient warning prior to collection.

MAINTAIN YOUR WORK AREA AND EQUIPMENT:

Develop good work habits; work in a ventilated environment; wear safety equipment; maintain the equipment; clean-up spills immediately; and keep work area clean, organized and uncluttered.

TEST TUBES:

Borosilicate test tubes must be used while performing HazCat tests. The amounts of reagent given in the directions for HazCat are specific for 13 x 100 mm borosilicate test tubes.

Occasionally a batch of these test tubes is defective. This can be seen as an unusual amount of breakage, especially during the Char Test. HazTech Systems Inc. recommends the immediate replacement of the entire batch. If the tubes were purchased from HazTech, we will replace them immediately at no cost.

TESTS ARE QUALITATIVE ONLY:

HazCat is qualitative field chemistry. Usually the amounts of reagents used during the tests are purposely small and approximate. If something does not seem right, more or less reagent may be added. When HazCat instructions are specific "add one drop" or "add one drop at a time", FOLLOW THESE DIRECTIONS CAREFULLY.

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SAFETY

ALWAYS **wear protective clothing** when collecting samples and performing tests!

Caution
Wear Gas Mask

Caution
Wear Gloves

Caution
Wear Goggles

You may not require a respirator in every case, but always wear gloves and goggles.

ALWAYS **watch tests!!!!** Looking away can be very dangerous. Do not assume that nothing more is going to happen once you have finished the test. Some delayed reactions can be very violent or, at least, spectacular.

ALWAYS **consider that a material may have more than one hazard categorization.** If material is still unknown at the end of the test procedure, make sure that you have done a pH test, ignition test, oxidizer test and a peroxide test.

ALWAYS **keep track of the people who may have been exposed** until you have a hazard classification.

ALWAYS **wash off any contaminated skin or clothing immediately.** Keep your work station clean. Keep track of your spent test tubes. Do not empty them until you know what the material is.

ALWAYS remember that this system identifies most commonly spilled materials, but not all materials - **treat as dangerous!!!!**

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

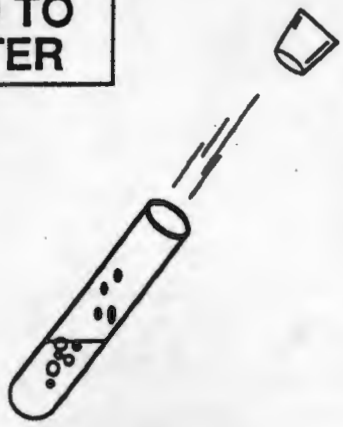
SAFETY

DO NOT point test tube at anyone!

DO NOT add water to the unknown!

ALWAYS ADD
ACID TO
WATER

DO NOT put HOT chlorine hot wire into the liquid.



DO NOT put cork in test tube containing effervescing material!

DO NOT heat the unknown material directly in the char test. Preheat the tube above the material, and slowly work the flame into the region of the test tube containing the unknown.

DO NOT breath or smell the fumes coming off the char test

DO NOT hold the test tube in your bare hands.

If no visible reaction is taking place, you may feel the test tube carefully to determine whether the reaction is exothermic or endothermic.

DO NOT sniff an unknown material. Often the odor will waft toward you. If the material is not fuming, you may fan a small amount of the head space material in your direction with your hand. Do this after you have completed the tests and have a sense of the category of material you are dealing with.

DO NOT use the same test tube for more than one test. Use a new test tube for each test so that there is definitely no contamination from the previous test. You may do the pH test using the water solubility test done just previously.

DO NOT allow flame near open container of the unknown. Keep container of unknown material away from water, reagents and other unknowns.

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GLOSSARY

This glossary is specific to the HazCat Chemical Identification System. Some of the definitions may not reflect the broadest meaning or the most common usage of the word. To keep the HazCat Chemical Identification System as simple as possible under the conditions of its intended use, many of these words have been given the very narrowest possible meaning.

ACID: A substance with a pH of less than or equal to 2 (pH < 2) are categorized as corrosives by the Environmental Protection Agency (EPA).

ALIPHATIC HYDROCARBON: A solvent or oil in which only hydrogen and carbon are involved, and there are no double bonds. Typical aliphatic hydrocarbons are kerosene, most paint thinners, and stoddard solvent.

AMINE: A hydrocarbon with a functional group (reactive area of the molecule) of NH2 which can act very much like ammonia in lung irritation activity causing a delayed pulmonary edema. Amines can be very basic, however some are very mild and present no hazard.

ANION: An ion having a negative charge.

AQUEOUS SOLUTION: A water solution. Typical aqueous solutions would be salt water, soda pop, etc. You can usually tell that the solution is aqueous by pouring more water into it. The solution will simply dilute.

AROMATIC HYDROCARBON: A solvent in which the main component contains a benzene ring. These tend to be slightly more toxic than aliphatic hydrocarbons, but have the same general chemical toxicology of causing central nervous system depression. Benzene, the most basic of the aromatic hydrocarbons, is considerably more toxic and is very destructive to the blood producing organs, especially if there is a long period of exposure.

ASPHYXIANT: A material which is not very toxic in itself, but has the property to remove oxygen from the atmosphere. Less than 12 percent oxygen in the air is sufficient to create a situation where death by asphyxiation may occur. Examples of simple asphyxiants include: argon, freon, carbon dioxide, and nitrogen.

ATMOSPHERE: Refers to the gases, vapors, mists, fumes, and dusts within a confined space.

AUTOIGNITES: Flame propagation of the unknown at the bottom of the test tube with no contact between the torch flame and the unknown.

BLANK: A blank is a material known NOT to contain the unknown which the test is designed to detect. The Blank Test is done concurrently with the unknown to see the reaction in the absence of the unknown. Blanks are done to insure seeing certain reactions.

CATION: An ion having a positive charge (usually metals).

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CAUSTIC: A substance with a pH of greater than or equal to 12.5 (pH > 12.5) are categorized as corrosives by the Environmental Protection Agency (EPA). Caustics often have secondary characteristics. Cyanide, arsenic, and strychnine often have pH's near or above 12.

CEILING LEVEL: An airborne level of human inhalation exposure to a material which should NEVER be exceeded.

CHAR: The unknown becomes black from the point of contact with the heat source in a test tube. The blackening is not necessarily uniform. Charring must be accompanied by smoke which is usually ignitable.

CHEMICAL ASPHYXIANTS: Materials which prevent or slow down the absorption of oxygen by the blood, causing illness or death due to the lack of oxygen to the body despite sufficient available oxygen in the atmosphere.

CHLORINATED HYDROCARBON: A hydrocarbon which contains a chlorine atom. Most of the chlorinated hydrocarbons that are likely to be seen at a spill are cleaning solvents. Chlorinated hydrocarbons have a very high odor threshold, and it is not uncommon to have people asphyxiated by these solvents in confined areas while doing cleaning operations. The vapors are heavier than air and can easily collect in low areas. When involved in fire, chlorinated hydrocarbons produce hydrochloric acid. When there is a high intensity energy source, they can produce highly toxic phosgene gas. Heart attacks and permanent liver or kidney damage have been associated with short term, high level exposure to chlorinated hydrocarbons.

COMBUSTIBLE LIQUID: A solvent with a flash point at or above 100 degrees F. For HazCat, consider an unknown combustible if it cannot be ignited to cause free burning without a match as a wick.

CONFINED SPACE: Refers to a space which by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include but are not limited to storage tanks, compartments of ships, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.

CONFINED SPACE, CLASS "A": A confined space that presents a situation that is immediately dangerous to life or health (IDLH). These include but are not limited to oxygen deficiency, explosive or flammable atmospheres, and/or concentrations of toxic substances.

CONFINED SPACE, CLASS "B": A confined space that has the potential for causing injury and illness if preventive measures are not used, but not immediately dangerous to life and health.

CONFINED SPACE, CLASS "C": A confined space in which the potential hazard would not require any special modification of the work procedure.

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CRYSTALS: MOST IMPORTANT - any fuzzy deposit on the lid or around the top of a container. Crystals usually are smooth-surfaced, tend to either sink without forming a suspension, or dissolve in the Water Solubility Test.

CURDLES: Curdling means that there is some surface interaction between the unknown and the water. This interaction is usually seen as a white film. When placing the unknown in water, it tends to bunch up and become stringy with a film forming between the unknown and the water.

DISSOLVES: For HazCat, the unknown must completely dissolve in water leaving the liquid either completely clear or colored as Kool-Aid™ would look.

EFFERVESCING: Produces small bubbles when placed in acid or water. On the watch dish, this usually looks like foam. Effervescing is the same type of action that occurs when placing Alka-Seltzer™ in water or when opening a soda.

EMULSION: Emulsion is a cloudy milky formation created when a liquid is added to distilled water. This is usually an immediate reaction, but does not necessarily occur when the liquids first interact. The emulsion usually will not settle out. An emulsion can often be created by shaking two dissimilar materials violently (oil, water, and vinegar to make a salad dressing). For HazCat, to consider the reaction as an emulsion, drops or globules should not reform at the top or bottom of the test tube during the period of the testing.

ENDOTHERMIC: The test tube becomes colder as the unknown dissolves. This is an indication of an ammonium salt.

EXTREMELY FLAMMABLE: The flash point is less than 30 degrees F. For HazCat, consider a material extremely flammable if the flame jumps from the match to the unknown on the watch dish.

EXOTHERMIC: Test tube becomes hotter as the unknown dissolves.

FIBERS: Any indication that something is poking out of a powder should key into the Fiber Section. Most asbestos pipe-lagging has only a small percentage of asbestos entrained in the powder. Look closely for an indication of fibers.

FLAMMABLE: A liquid with a flash point from 30 degrees F. to 100 degrees F. For HazCat, a liquid that flashes or continues to burn after the match has been removed.

FLAMMABLE LIQUID: A liquid with a flash point below 100 degrees F.

FOAMED: This term is only used in the chart to key out soap or detergent. Both of these foam considerably. Do not consider the unknown as foaming unless you feel that the foaming is adequate for washing clothes, etc. If not certain, go negative.

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FUMING: [sic] Fuming indicates a recondensing of metals. However, since the visible cloud forming over acid is usually called fuming, for HazCat fuming indicates a vapor or smoke-like cloud hanging over the unknown and apparently generated by the unknown. THIS CAN BE EXTREMELY DANGEROUS!

RED FUMES: Possibly nitric acid, bromine, other oxidizers, or acid gases. These are very hazardous.

YELLOW FUMES: Possibly nitric acid or chlorine coming from some reaction of hydrochloric acid. These are very hazardous.

GREEN FUMES: Often seen above asphalt where there has been a hydrochloric acid spill (combination of chlorinated gases).

WHITE FUMES: Most acids, including all of the above.

GLOBULES: When one liquid stays cohesive with itself inside of another liquid it is forming globules. There can be no interaction between the unknown and water (no indication of dissolving, or filming up on the surface of the unknown). An interface is set up between the water and the unknown. An example would be lava lamps or wave action panels as seen at novelty gift shops.

GOOEY, GOOS, GELS: Thicker than an oil, becoming almost jello- like. Cohesive and able to stand somewhat off the ground on its own.

GRANULAR MATERIAL: Non-defined chunky material, like kitty litter.

HEAD SPACE: Area inside a test tube above the unknown.

HYDROLYZING: The unknown reacts with water to become some other material. For example, dimethyl sulfate in water becomes methane and sulfuric acid, creating considerable heat. This is a form of a water-reactive material. These can be very dangerous chemicals.

IARC: International Agency for Research on Cancer.

IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH): The maximum concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

INERT: For HazCat, this means that there is no VISIBLE activity taking place as the unknown is found. Remember, this doesn't mean that no activity is taking place. ALWAYS BE CAREFUL!

ION: An atom or radical that has lost or gained one or more electrons and has thus acquired an electric charge.

LEL (Lower Explosive Limit): The minimum concentration of gas or vapor in air below which it is not possible to ignite the vapors.

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MELTS: The unknown forms a liquid when heated, but does not change in any other way. This is typical of salts.

MSDS (Material Safety Data Sheet): A written brief description of a material which is more complete than could be provided on a label. This document is to be provided to a worker to help the worker in understanding the associated hazards of the material.

NITRILE: This is a hydrocarbon with cyanide (CN) as its active group. These are not the same toxicologically as inorganic cyanide, but are toxic in their own right. When nitriles burn, cyanide gas is given off in large amounts.

NTP: National Toxicology Program.

ODOR THRESHOLD: The lowest airborne concentration of a material which is detectable by odor by an average person.

OILS/SYRUPS: The liquid is viscous enough that it will coat the side of the test tube when the liquid is rolled around in the test tube. Syrups are usually sugar or polyol solutions. Oils and syrups will appear the same (honey and motor oil can look almost identical).

ORGANIC PEROXIDES: Organic peroxides are organic oxidizers. The inclusion of both the oxidizing capabilities and the fuel in a single molecule makes these potentially very explosive. This class of oxidizing chemicals should be stored away from all other materials.

OXIDIZER: Initiates or promotes combustion in other materials. Oxidizers increase the flamrnability of materials and can cause fire either of itself or through the release of oxygen or other gases. Chlorine is the second most common oxidizing gas.

OXYGENATED HYDROCARBON: Commonly used hydrocarbons. The most familiar are alcohols, radiator fluids, and acetone. There is an oxygen atom attached to the hydrocarbon which makes the solvent slightly to very soluble in water. The polarity also gives these solvents the characteristic orange color in the Iodine Crystal Test.

PARTICULATE MATERIAL: For HazCat purposes only, this denotes a material too coarse to be considered a powder, but too fine to be granular. The particle size is between sand and dirt.

PELLETS: Materials that appear to have been stamped out by a machine. Examples: round balls, pills, or cylinders.

PERMISSIBLE EXPOSURE LIMIT (PEL): The permissible concentration of air contaminants to which nearly all workers may be repeatedly exposed eight (8) hours a day, forty (40) hours a week, over a working lifetime of thirty (30) years without adverse health effects.

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pH: The pH of a material can only be between 0 and 14. A pH of 7 is neutral and is considered the natural pH of water. As the number decreases below 7, the material is more acidic. As the number increases above 7, the material is more caustic. Normally, materials are not dangerous to humans until the pH reaches 2 on the acidic side or 12.5 on the caustic side. The pH of soap may be as high as 9 or 10, and cola can have a pH as low as 3. On the other hand, pHs of 3 or 10 can be very detrimental to the environment.

Acids work by forming bonds in the body's proteins. Caustics break proteins down into small pieces. Generally, acids have better warning properties, and pain can warn prior to irreparable damage. Caustics can do considerable damage prior to the person being aware of their actions. Very strong acids and caustics allow almost no time between contact and destruction of the tissue.

POWDER: A material so finely divided that it appears flour-like.

PPM (Parts Per Million): Parts by volume of the gas or vapor in a million parts of air. Also used to indicate the concentration of a particular substance in a liquid or solid.

PRECIPITATE: A clouding (often like an emulsion but usually more flocculated) caused by a solid material forming as the result of mixing two salts in solution. In HazCat, this usually indicates a positive test result.

PROPOSITION 65: A state initiative passed in the State of California which requires that certain materials be labeled as carcinogens.

PYROPHORIC: A chemical that will ignite spontaneously in air at a temperature of 130 degrees F. or below.

REACTION: A chemical transformation or change. The interaction of two or more substances to form new substances.

REACTS VIOLENTLY: A very water-reactive material will not effervesce or boil in water, but will complete all activity immediately. Phosphorous pentoxide is consumed immediately upon hitting water. The reaction is so violent that even a piece of the material half the size of a pea will make enough noise to be heard throughout a room. Sodium metal will burst into flame when in contact with water.

REAGENT: A chemical which reacts in a predictable manner with an unknown (another chemical) to aid in the identification of that unknown.

RESPIRATORY PROTECTION: Devices that will protect the users respiratory system from overexposure by inhalation to airborne contaminants. Respiratory protection is used when a worker must work in an area where he/she might be exposed to concentrations in excess of the allowable exposure limit. For HazCat, use an organic vapor/acid filter with a particulate pre-filter.

RESPONSE TIME: The interval between an instrument "sensing" a contaminant and generating data.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

SOLUBILITY IN WATER: A term expressing the percentage of a material (by weight) that will dissolve in water at ambient temperature. Solubility information can be useful in determining spill cleanup methods and fire extinguishing agents. Terms used to express solubility are:

1. NEGLIGIBLE: Less than 0.1 percent
2. SLIGHT: 0.1 to 1.0 percent
3. MODERATE: 1 to 10 percent
4. APPRECIABLE: More than 10 percent
5. COMPLETE: Soluble in all proportions

HazCat is based on what a person can easily see. Therefore if a material is less than 10 percent soluble, it is considered insoluble in HazCat. If a material is more than 10 percent soluble, it is considered soluble in HazCat. In HazCat, a 1 to 10 ratio of unknown to water is recommended.

SOLUTION IN WATER: Once an unknown is placed in water, whether it has dissolved or not, the water shall be called the "solution" in HazCat.

SOLVENT: In HazCat, consider something solvent-like if it:

1. Looks like water;
2. Evaporates more quickly than water;
3. Sinks, floats, or dissolves;
4. Has an organic odor; and
5. Can be ignited.

More broadly defined, a solvent is a substance, usually a liquid, in which other substances are dissolved. The most common solvent is water. In HazCat, solvent describes a liquid that is NOT water, but has the same viscosity as water.

SPONTANEOUSLY COMBUSTIBLE: A material that ignites as a result of retained heat from processing; a material that will oxidize to generate heat and ignite; or a material that absorbs moisture to generate heat and ignite without an apparent source of ignition.

SUBLIMES: The literal meaning is the material goes from the solid to the gaseous state without becoming a liquid. In HazCat, a liquid is often formed by superheating the unknown to speed up the subliming process. Consider a solid unknown to sublime if: (1) the total unknown has left the test tube and only a clean test tube remains; and/or (2) the unknown re-condenses before leaving the test tube in what looks like a small rain storm at the top of the test tube, raining back down into the test tube.

SUSPENDED SOLIDS: This is a cloudy solution which differs from an emulsion in that it is not a liquid suspended in a liquid, but a solid suspended in a liquid. Paints are common examples of suspended solids, and paints (like all suspended solids) will eventually separate and the solid will fall to the bottom.

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SYRUPS/OILS: The liquid is viscous enough that it will coat the side of the test tube when the liquid is rolled around in the test tube. Syrups are usually sugar or polyol solutions. Oils and syrups will appear the same. Honey and motor oil can look almost identical. The viscosity is about 2 to 3.

TEST TUBE: In HazCat, wherever the word test tube appears, it means 13 X 100 mm borosilicate test tubes.

TLV (Threshold Limit Value): (Copyright ACGIH) A standard for allowable inhalation concentrations of airborne substances in workroom air averaged over eight (8) hours a day, forty (40) hours a week, over a working lifetime of thirty (30) years without adverse health effects.

TOXIC SUBSTANCE: A substance which can cause death or injury in small doses.

TOXICITY: The ability of a material to cause injury to the body or organs. The less material required to cause injury, the greater the toxicity.

UEL (Upper Explosive Limit): The maximum concentration of gas or vapor in air above which it is no longer possible to ignite the vapors.

VISCOSITY: Describes the thickness of a liquid. In HazCat, viscosity is very important in the separation of materials. Viscosity is described in HazCat as follows:

1 = Watery.
2 = Kerosene.
3 = Cooking Oil.
4 = Motor Oil.
5 = Jelly / Vaseline.

VOLATILITY: A measure of how quickly a material evaporates. In HazCat and in any consideration of hazardous materials, the more quickly a material evaporates, the more likely it can harm, as it is getting into the air.

WATER: Distilled or deionized water.

WATER-REACTIVE: A material reacts in such a way that it changes volume or becomes hot in water. In HazCat, these reactions are subdivided into four reactions:

1. REACTS VIOLENTLY: Reaction is immediate.
2. HESITATES, FUMES, AND REACTS: Reacts with a slow rolling boil.
3. BOILS: Large bubbles.
4. BECOMES HOT.
5. EFFERVESCES: Small Alka-Seltzer™ size bubbles.

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G150-8E13146

HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

SHORT DESCRIPTION OF TESTS

The following is an abbreviated description in alphabetical order of most of the tests. These short descriptions are to be used as a REMINDER for persons who are already familiar with the tests. This section does not include interferences and handling suggestions. If you have not done the test before, it is best to go to the "DETAILED DESCRIPTION OF TESTS" in the HazCat Chemical Identification System manual.

ACETIC ACID GAS TEST:

1. Use the Acetic Acid Sensidyne Tube to collect a sample in the head space of a test tube containing the unknown.
2. A color change from a pink to a dull yellow indicates acetic acid or acetates.

ACID TEST:

1. Place a pea-size amount of the solid unknown on a watch dish.
2. Add several drops of Acid Test (a drop at a time) to the unknown.
3. Observe reactions.

$AgNO_3$ ORGANOPHOSPHATE TEST:

1. Add 1 drop of the unknown to a test tube containing 1/2 inch of water.
2. Add 1/4 inch of Chloride Test to the test tube.
3. Slowly add 1/4" to 1/2" QA-4 to the test tube.
4. A slow forming dark yellow to brown precipitate indicates organophosphates.

ALCOHOL SOLUBILITY TEST:

1. Add a pea-size amount of the solid unknown to 1/2" of Alcohol Solubility Test.
2. Allow time for the solid unknown to dissolve.
3. a. If a suspension forms, filter to another test tube.
   b. If no suspension forms but a solid remains, decant the clear solution to another test tube.
4. Add water to the clear solution and look for a milky emulsion to form which indicates a pesticide is likely.

ALCOHOL TEST:

1. Add 5 drops of QA 7 to 1/2" of the unknown solution in a test tube.
2. Add 5 drops of Lead Test # 3 to the QA 7/unknown solution.
3. A slow color change from orange to blue indicates the presence of an -OH group.

ALUMINUM TEST:

1. Add 1/4 inch of Aluminum Test 1 to 1/2 inch of the unknown solution in a test tube.
2. Add 1/4 inch of Aluminum Test 2.
3. Add Acid Test solution until the pH is 3 or less.
4. A red flocculate indicates the presence of chromium, iron, or aluminum. Aluminum remains red with the addition of QA-8.

AMMONIA GAS TEST:

1. Use the Ammonia Sensidyne Tube to collect a sample in the head space of a test tube containing the unknown.
2. A color change from purple to yellow indicates ammonia or amines.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

ARSENIC TEST:

1. Soak Arsenic Test 6 Filter with Arsenic Test 1 and allow to dry.
2. Add the following to 1/2 inch of the unknown solution in a test tube:
   a. 1/2 pea-size of Arsenic Test 2.
   b. 1/2 pea-size of Arsenic Test 3.
   c. 1/4 inch of Arsenic Test 4. (Mix with stirring rod.)
   d. 1/2 pea-size of Arsenic Test 5.
3. The solution should effervesce. If not, add more Arsenic Test 4.
4. Insert the filter paper so that the stopper in the test tube holds the filter paper above and out of the solution.
5. The filter paper turns yellow, then orange, and finally brown/black indicates arsenic.

BORAX BEAD TEST:

1. Place 1/2 inch of Borax Bead Test in a test tube.
2. Add one (1) granule of solid or 1/4 inch liquid unknown.
3. Heat until the borax forms a glassy bead.
4. Allow to cool and observe the color.

BROMINE TEST: NEVER DO THIS TEST ON A MATERIAL THAT IS ORGANIC OR CAUSTIC!

1. Carefully add a few drops of Asbestos Test A5 to a test tube containing 1/2 a pea-size amount of the solid or 1/4 inch of the liquid unknown. BE CERTAIN THAT THE TEST TUBE IS POINTED AWAY FROM EVERYONE!
2. A red fume indicates the presence of bromine.

CADMIUM TEST:

1. Add 1/4 inch of Cadmium Test 2 to 1/2 inch of the unknown solution in a test tube.
2. A pink precipitate indicates cadmium.

CALCIUM TEST:

1. Add 1/4 inch of Calcium Test to 1/2 inch of the unknown solution in a test tube.
2. A white precipitate indicates calcium.
3. This must be confirmed with a red Flame Test.

CARBON DIOXIDE GAS TEST:

1. Use the Carbon Dioxide Sensidyne Tube to collect a sample in the head space of a test tube containing an effervescing unknown.
2. A color change from white to purple confirms carbon dioxide.

CARBON MONOXIDE GAS TEST:

1. Use the Carbon Monoxide Sensidyne Tube to collect a sample in the head space of a test tube containing an effervescing unknown.
2. A color change from yellow to dark brown confirms carbon monoxide.

CHAR TEST: ALWAYS DO A HAIRPIN TEST BEFORE DOING THE CHAR TEST!

1. Add two pea-size amounts of the solid or 1/2 inch of the liquid unknown to a test tube.
2. a. Solids: Heat until no further reaction takes place or the test tube is melting.
   b. Liquids: Heat gently until the liquid reacts or evaporates completely, then continue to heat until no further reaction takes place or the test tube is melting.
3. Observe reactions.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

CHLORIDE TEST:
1. Add a few drops of Chloride Test to a test tube containing 1/4 inch of the unknown solution.
2. A white precipitate indicates chloride.

CHLORINE HOT WIRE TEST:
1. Heat the Chlorine Hot Wire in a torch flame until there is no green flame.
2. Allow the wire to cool.
3. Place the wire into the unknown solution or solvent in a test tube.
4. Reheat the wire in the torch flame.
5. A green flame indicates chlorine, an amine, a nitrate, an ammonium salt, urea, or a weak solution of nitric acid.

CHLOROBENZENE GAS TEST:
1. Use the Chlorobenzene Sensidyne Tube to collect a sample in the head space of a test tube containing the unknown.
2. A color change from white to yellow indicates chlorobenzene.

CHROMIUM TEST:
1. Adjust the pH to less than 3 by adding several drops of Acid Test to 1/2 inch of the unknown solution in a test tube.
2. Add 1/2 inch of Chromium Test 1.
3. A deep purple color indicates a chromate.

COMBUSTIBILITY TEST:
1. Add the liquid unknown to a watch dish to form a pool the size of a fifty cent piece.
2. Try to ignite with a lit match.

CYANIDE GAS TEST:
1. Use the Cyanide Sensidyne Tube to collect a sample in the head space of a test tube containing the ignited unknown solvent.
2. A color change from yellow to red indicates cyanide.

CYANIDE TEST:
1. Add a pinch of Cyanide Test 2 to a test tube containing 1/4 inch of Cyanide Test 1 solution.
2. Add 1/2 inch of the unknown solution to another test tube.
3. Add the "rejuvenated" Cyanide Test 1 solution to the unknown solution.
4. Add Acid Test solution to the unknown solution.
5. A deep Prussian blue color indicates cyanide.

EVAPORATION TEST:
1. Add the liquid unknown to a watch dish to form a pool the size of a dime.
2. Leave it there while you complete a few tests.
3. Observe whether the liquid quickly evaporates, leaves a residue, or does not evaporate.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

FLAME TEST:
1. Heat and then touch a Flame Test Wire loop to a grain size solid or drop of liquid unknown so that some of the unknown sticks to the wire.
2. Hold the wire in a torch flame.
3. Observe flame color.
4. If only a slight color appears, add a drop of Acid Test solution to the small portion of the unknown and redo the test.

FLOUR TEST:
1. Place a pea-size amount of the solid unknown on a watch dish.
2. Add 2 to 3 drops of Flour Test.
3. A color change from orange to blue/black indicates flour.

FLUORIDE TEST:
1. Add 1/4 inch of Fluoride Test to 1/4 inch of the unknown solution in a test tube.
2. A color change from purple to yellow indicates fluoride.

HAIRPIN TEST: THIS IS A TEST FOR EXPLOSIVENESS.
1. Place a grain size solid or drop of liquid unknown on a watch dish.
2. Heat the hairpin until cherry red.
3. Touch the hairpin to the unknown. NEVER DO THE CHAR TEST IF THERE IS ANY INDICATION OF A HAZARD FROM THE HEAT FROM THIS TEST.
4. If no reaction occurs, place the hairpin back in the torch flame and look for a reaction.

HEXANE SOLUBILITY TEST:
1. Add a pea-size amount of the solid unknown to 1/2 inch of Hexane Solubility Test.
2. Allow time for the solid unknown to dissolve.
3. a. If a suspension forms, filter to another test tube.
   b. If no suspension forms but a solid remains, decant the clear solution to another test tube.
4. Add water to the clear solution and look for a milky emulsion to form which indicates a pesticide is likely.

HYDROCHLORIC ACID GAS TEST:
1. Use the Vinyl Chloride Sensidyne Tube to collect a sample in the head space of a test tube containing the charred unknown.
2. A color change from yellow to red/brown indicates hydrochloric acid.

IGNITION TEST:

Perform the Hairpin Test on all solids and observe for ignition. If the unknown effervesces in water, try to ignite the gas being driven off.

IODINE CRYSTAL TEST:
1. Add a small iodine crystal to a test tube containing 1/2 inch of the unknown solvent.
2. Observe the color.

IRON TEST:
1. Add 1 drop of Asbestos Test A2/Iron Test to 1/2 inch of the unknown solution in a test tube.
2. A deep red to an orange/yellow color indicates iron.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

KETONE TEST
1. Place a few drops of the liquid unknown on a Ketone Test Strip.
2. Rub the wetted Ketone Test Strip with the finger of your glove.
3. If the Ketone Test Strip becomes soft and slick to the touch while it is still wet or feels gritty and rough when dry, the unknown contains a ketone.

LEAD TEST:
1. Add 1/4 inch of Lead Test 1 to a 1/2 inch solution of the unknown and Lead Test 2 in a test tube.
2. A color change from purple to brown indicates lead.

MAGNESIUM TEST:
1. Add a few drops of Asbestos Test C3/Magnesium Test to 1/4 inch of the unknown solution in a test tube.
2. A color change from purple to baby blue indicates magnesium.

MERCURY TEST:
1. Add a drop of Acid Test solution to Mercury Test (copper slug).
2. Add a drop of the unknown solution to the drop of acid.
3. Use a tissue to wipe the liquids off the metal.
4. A bright silver coating on the metal indicates mercury.

NICKEL TEST:
1. Add 1/2 inch of Nickel Test to 1/2 inch of the unknown solution in a test tube.
2. Add 2 or 3 drops of Asbestos Test C2 slowly to the test tube until the solution is basic (greater than pH 8).
3. A pink precipitate indicates nickel.

NITRIC ACID TEST:
1. Dip dry Peroxide Test Paper into the unknown solution.
2. A color change to yellow indicates nitric acid, to blue indicates a peroxide or weak chromic acid, and to brown indicates strong chromic acid.

OXIDIZER TEST:
1. Acidify an Oxidizer Test Paper with 2 or 3 drops of Acid Test solution.
2. Touch the unknown with the paper.
3. A blue/black or purple color indicates an oxidizer.

PCB CLOR-N-OIL TEST:
See directions in the box.

PERCHLORATE TEST:
1. Add 1 drop of Perchlorate Test to a test tube containing 1/4 inch of the unknown solution.
2. A color change from blue to violet indicates perchlorates, to fushia indicates a possibility of mercury.

PEROXIDE TEST:
1. Wet a Peroxide Test Paper with one drop of water.
2. Touch the paper to the unknown.
3. A color change to blue indicates a peroxide.

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PHENOL GAS TEST:
1. Use the Phenol Sensidyne Tube to collect a sample in the head space of a test tube containing the unknown.
2. A change from pale yellow to pale brown indicates phenol.

PHOSPHATE TEST:
1. Add 1 drop of the unknown acid to a test tube containing 1/2 inch of water.
2. Add 1/4 inch of Chloride Test to the test tube.
3. Slowly add 1/4" to 1/2" QA-4 to the test tube.
4. A yellow precipitate indicates phosphates.

pH TEST:
1. Add 1/4 inch of the unknown to a test tube containing 1/2 inch of water.
2. Dip the pH Test Paper into the unknown solution.
3. Compare the colors with those on the container.

SUGAR TEST:
1. Add 1/4 inch of Sugar Test 1 and 1/4 inch of Sugar Test 2 to a test tube. Stopper and shake the test tube.
2. Add ONE (1) DROP of Acid Test solution to 1/2 inch of the unknown solution in a separate test tube.
3. Gently heat the unknown until it is almost boiling.
4. Add the Sugar Tests 1 and 2 mixture to the heated unknown.
5. An orange to copper colored precipitate indicates sugar.

SULFATE TEST:
1. Add a few drops of Sulfate Test to a test tube containing 1/2 inch of the clear unknown solution.
2. A white precipitate indicates sulfate.

SULFIDE TEST:
1. Wet Sulfide Test Paper with a few drops of water.
2. Touch the paper to acidified unknown on a watch dish.
3. A color change from white to brown indicates sulfide.

UREA TEST:
1. Heat the Chlorine Hot Wire in a torch flame until there is no green flame.
2. Allow the wire to cool.
3. Place the wire in the unknown solution.
4. If a blue color appears in the solution, heat the solution gently and look for the blue to turn to a waxy purple color which indicates urea.

WATER REACTIVE TEST:
1. Place a pea-size amount of the solid unknown or form a dime size pool of the liquid unknown on a watch dish.
2. Put a drop of Acid Test solution on the Oxidizer Test paper.
3. Touch the Oxidizer Test Paper to the unknown.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

WATER TEST:

1. Add a pea-size amount of Alka Seltzer(tm) to 1/2 inch of the unknown solution.
2. Effervescence indicates the presence of greater than 1% water in the solution.

WATER SOLUBILITY TEST:

1. Add a pea-size amount of the unknown to 1/2 inch of water in a test tube.
2. If the unknown is not effervescing, stopper the test tube and shake it vigorously.
3. Allow time for reactions to occur.
4. Observe results.

ZINC TEST:

1. Add a pea-size amount of the unknown to 1/2 inch of water in a test tube.
2. Make the solution slightly basic by adding QA-4 a drop at a time until the pH is greater than 8.
3. Add several drops of Chromium Test 1.
4. A mauve color indicates Zinc.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

Legend/Symbols

Test (shaded TV screen)	
Sub-Test (dotted, shaded TV screen)	
Procedure or Action (TV screen)	
Result (bubble)	The result of a specific test, procedure or action, e.g. "blue" (in color), "does not ignite", etc.
Previous result (dotted bubble)	The result of a specific test, procedure or action executed previously.
Observation (ellipse)	An observation made at that particular point by using one of the five senses.
Previous observation (dotted ellipse)	An observation made previously (possibly by someone else, e.g. reported) by using one of the five senses.
Comment (box)	Any comment to be made (general or specific) about an item or procedure.

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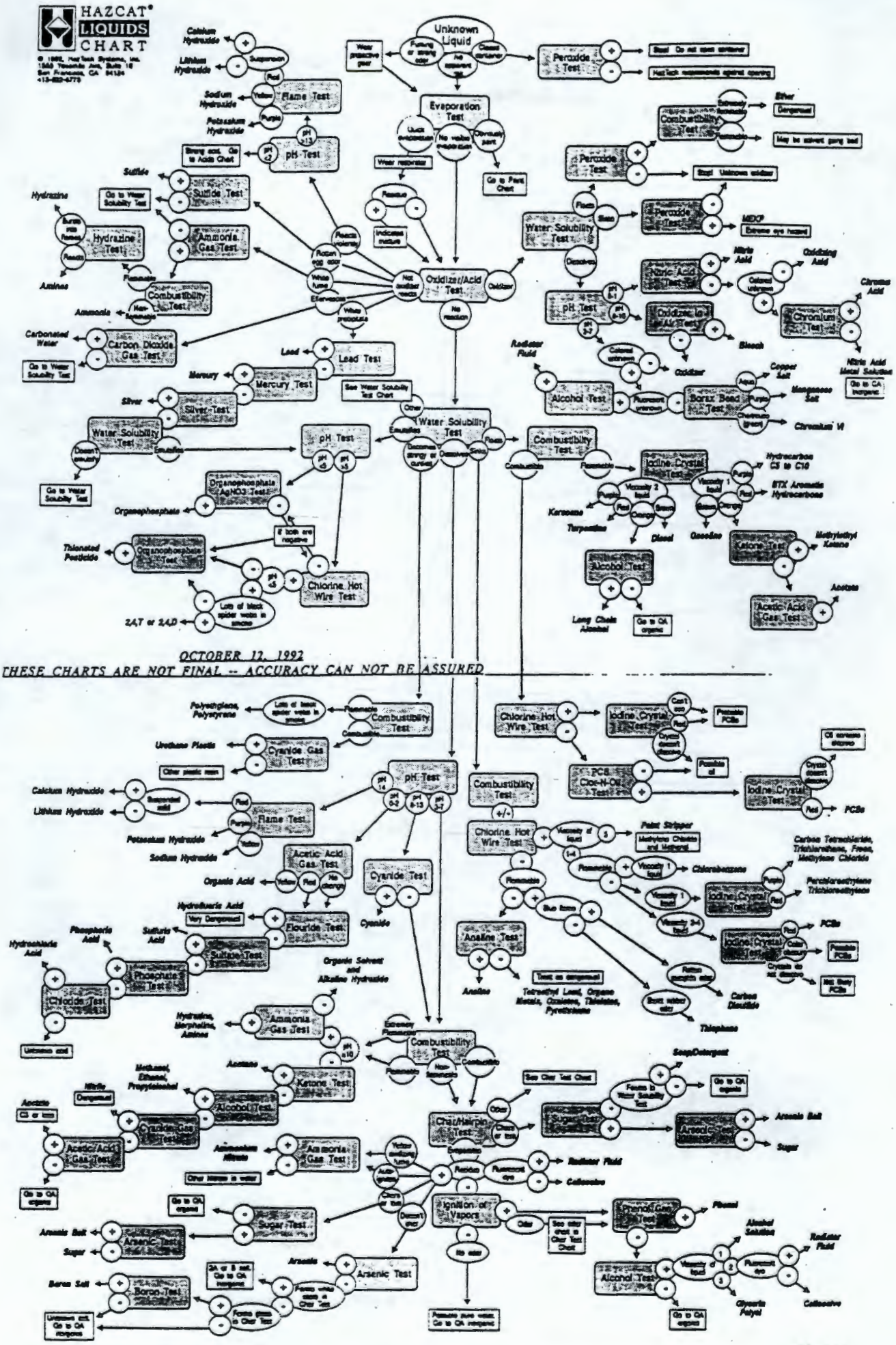

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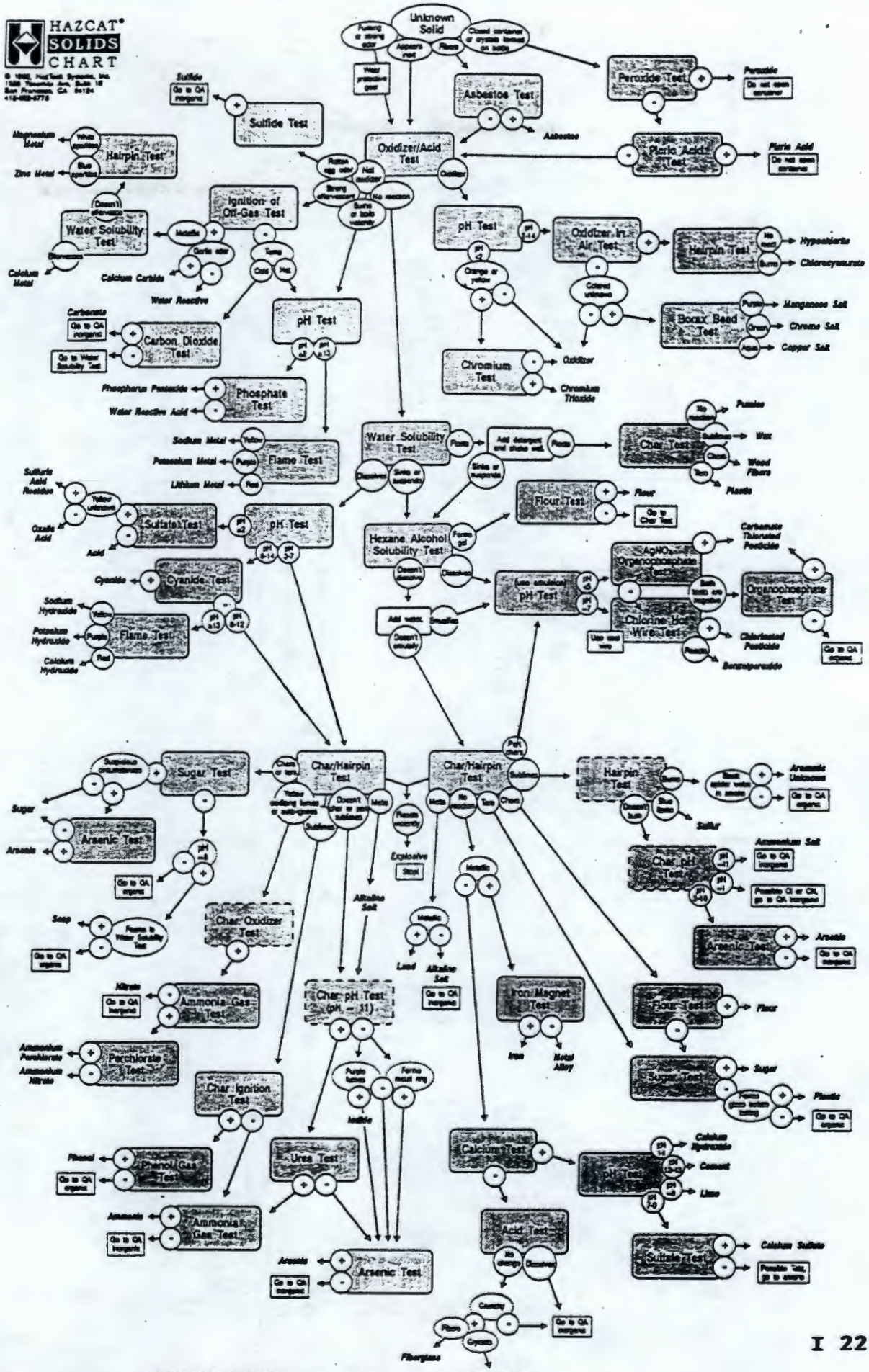

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HAZCAT® OXIDIZER LIQUIDS CHART

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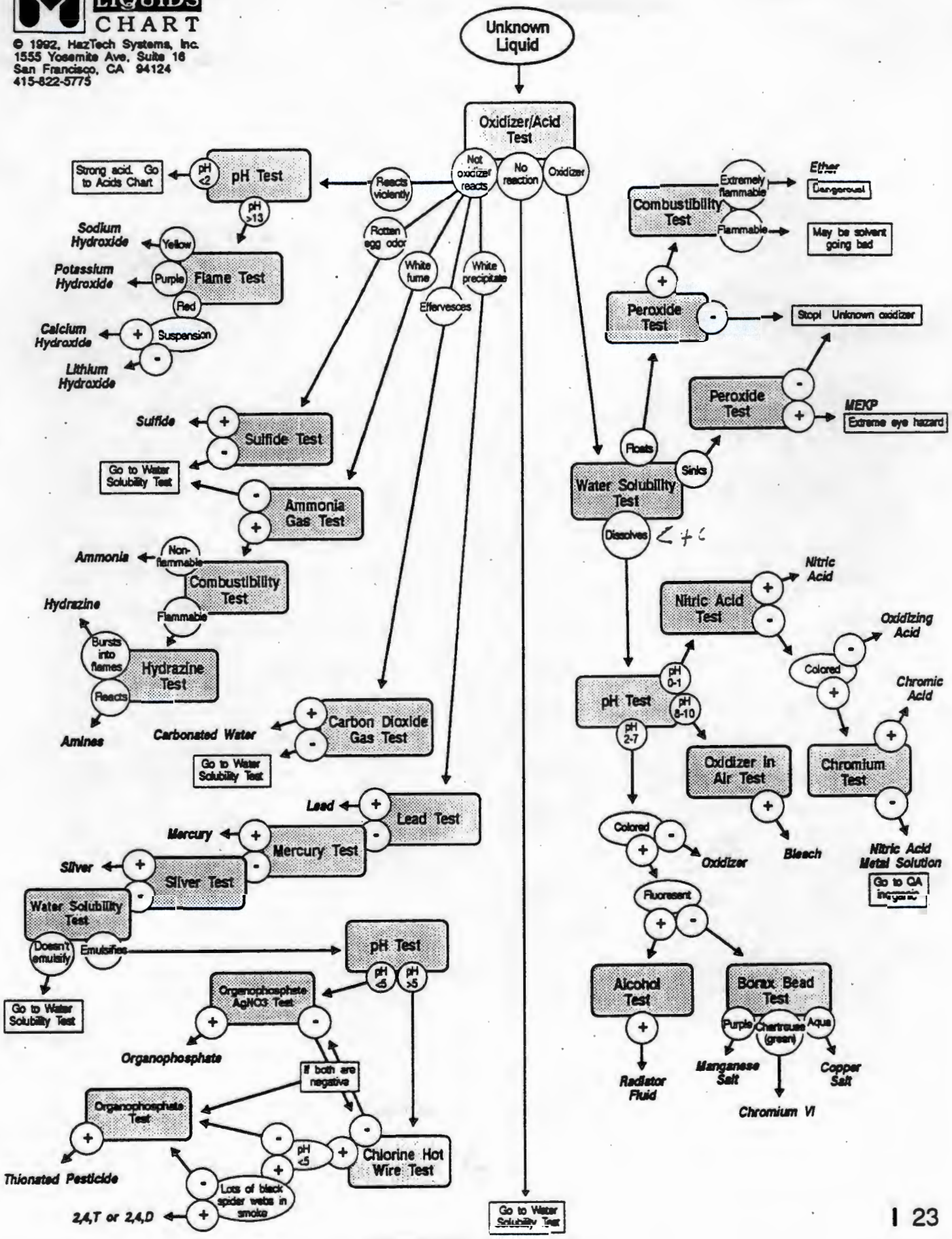

HAZCAT® OXIDIZER SOLIDS CHART

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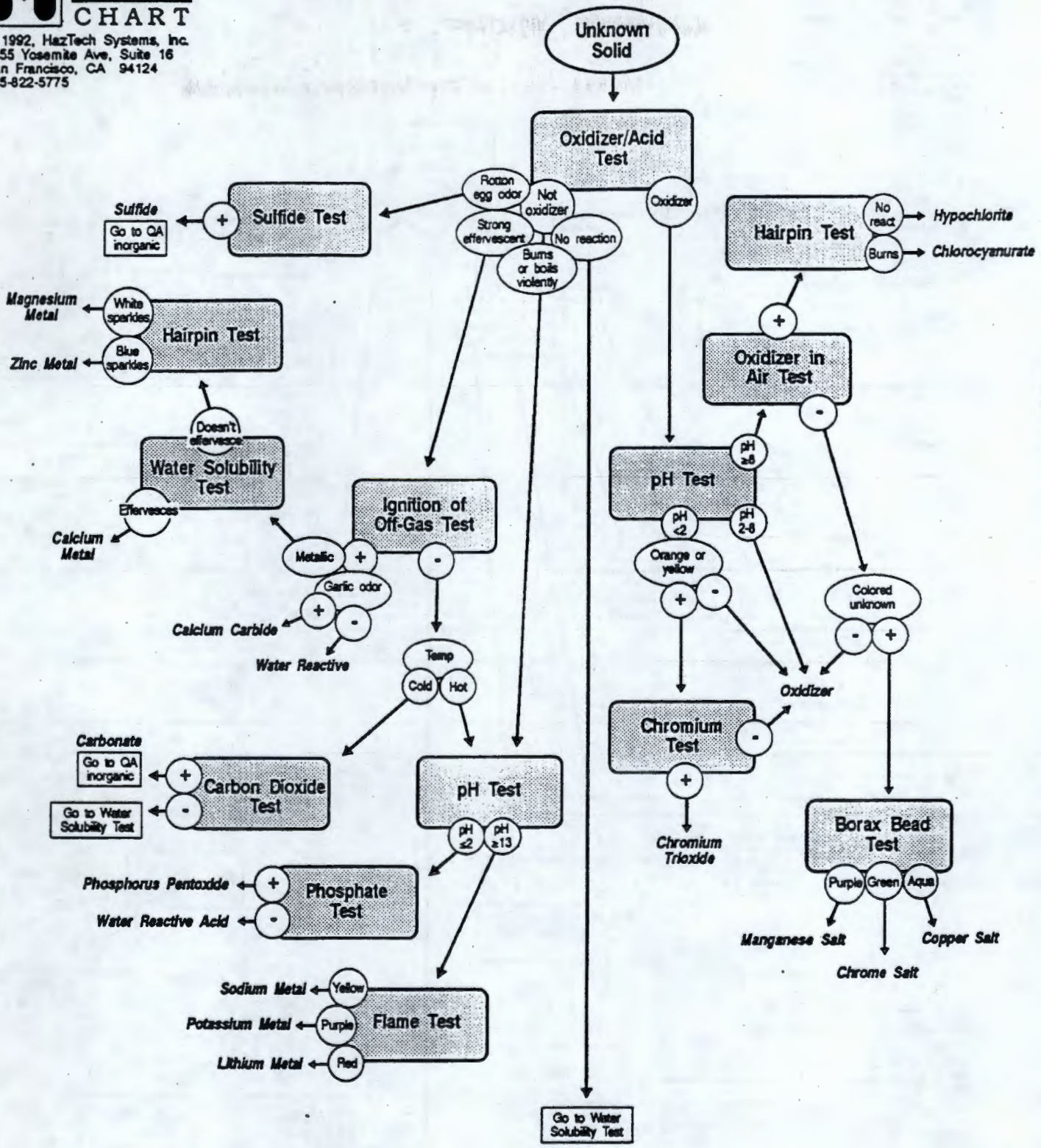

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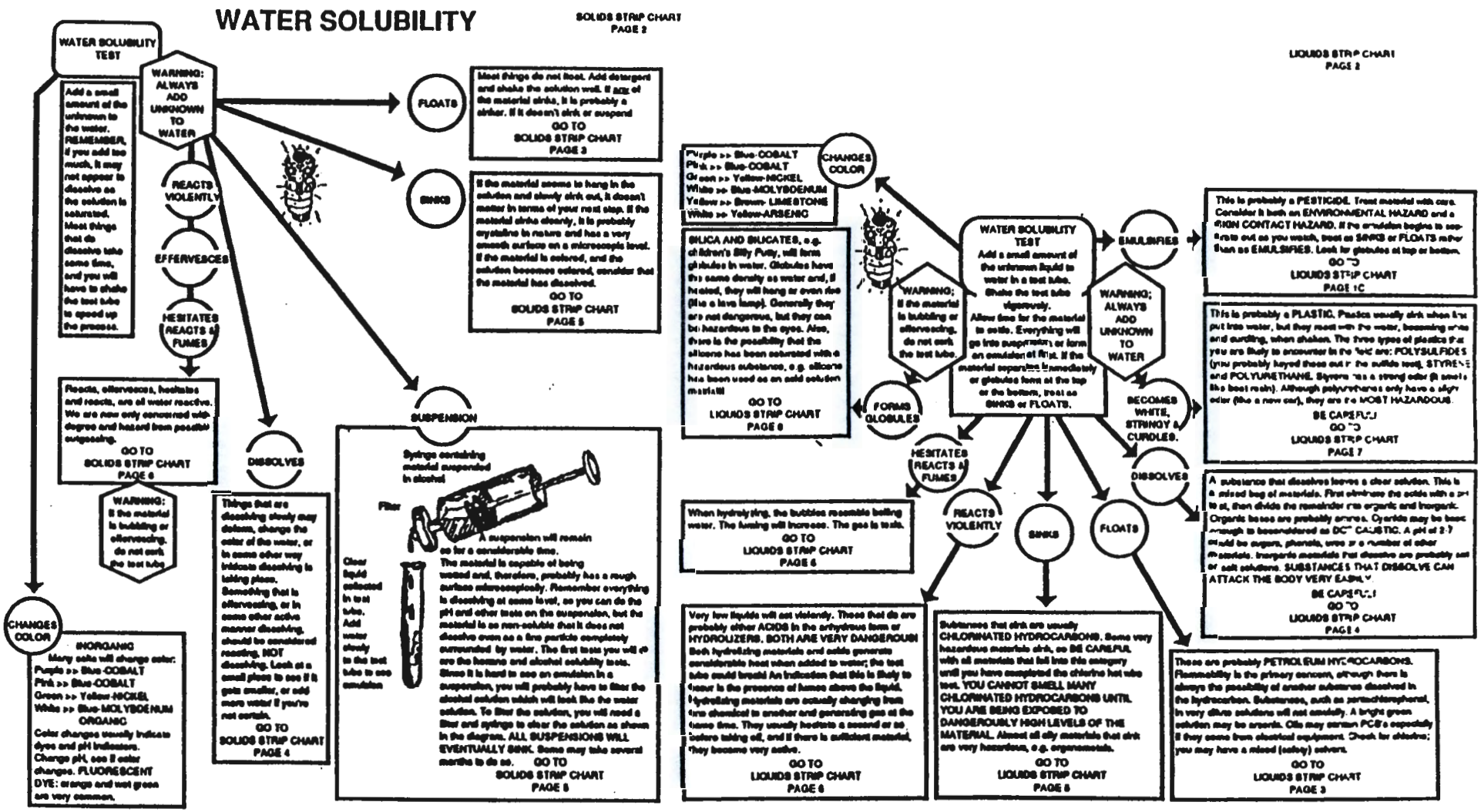
WATER SOLUBILITY



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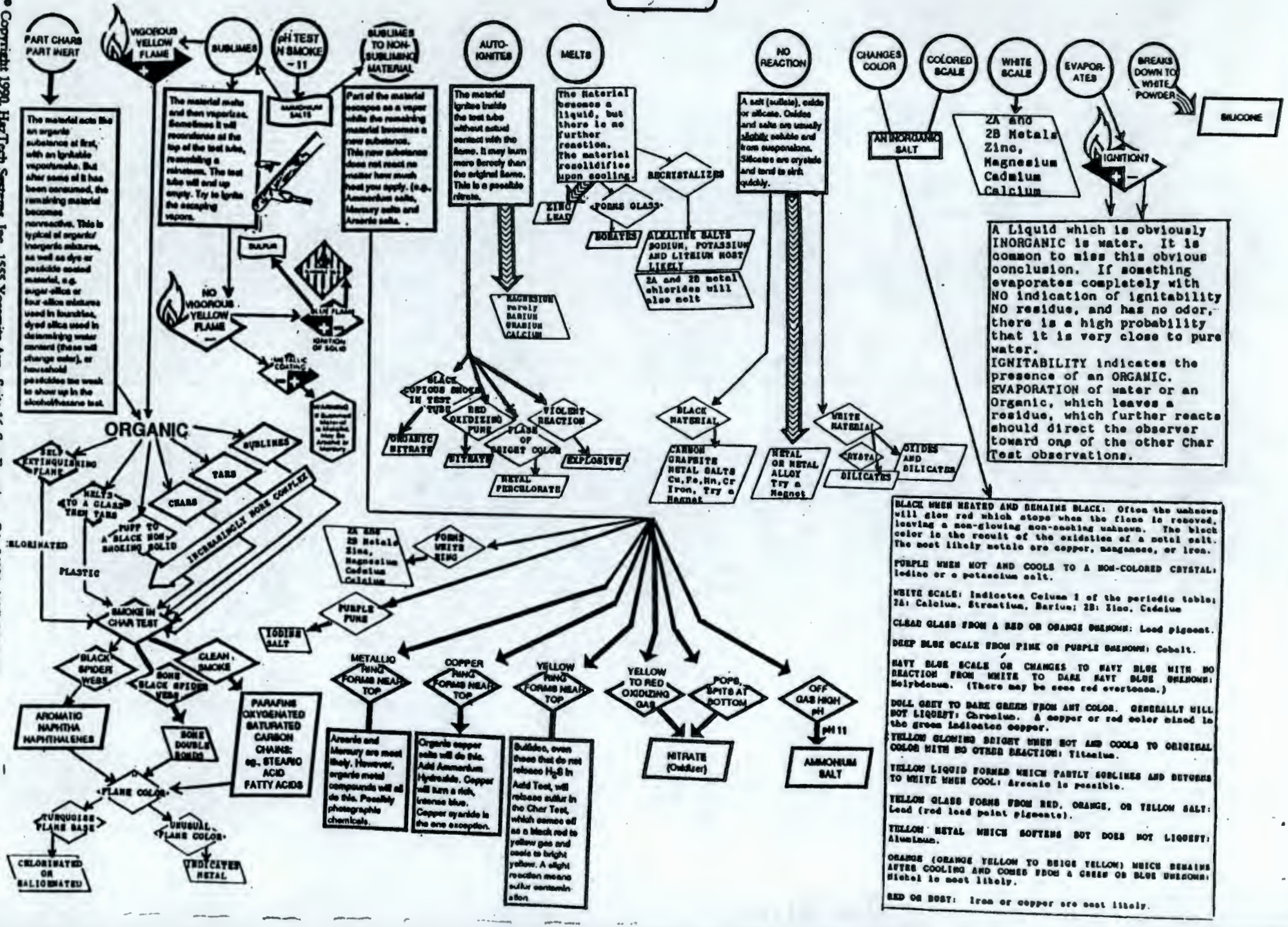
CHAR TEST



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HAZCAT® ACIDS CHART

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Group 1: Oxidizing Acids

Keep away from metals, wood, solvents, and other acids. A spill on wood can ignite spontaneously

Group 2: Chromic Acid

An inhalation carcinogen. AVOID SKIN CONTACT. If it gets on your skin, you can develop a persistent and disfiguring CHROME ULCER

Group 3: Organic Acids

Volatile, but generally less hazardous than inorganic acids

Group 4: Hydrofluoric Acids

BE VERY CAREFUL, THIS IS DANGEROUS! If there is skin contact, go to the hospital. HF acid can eat all the way through the bone

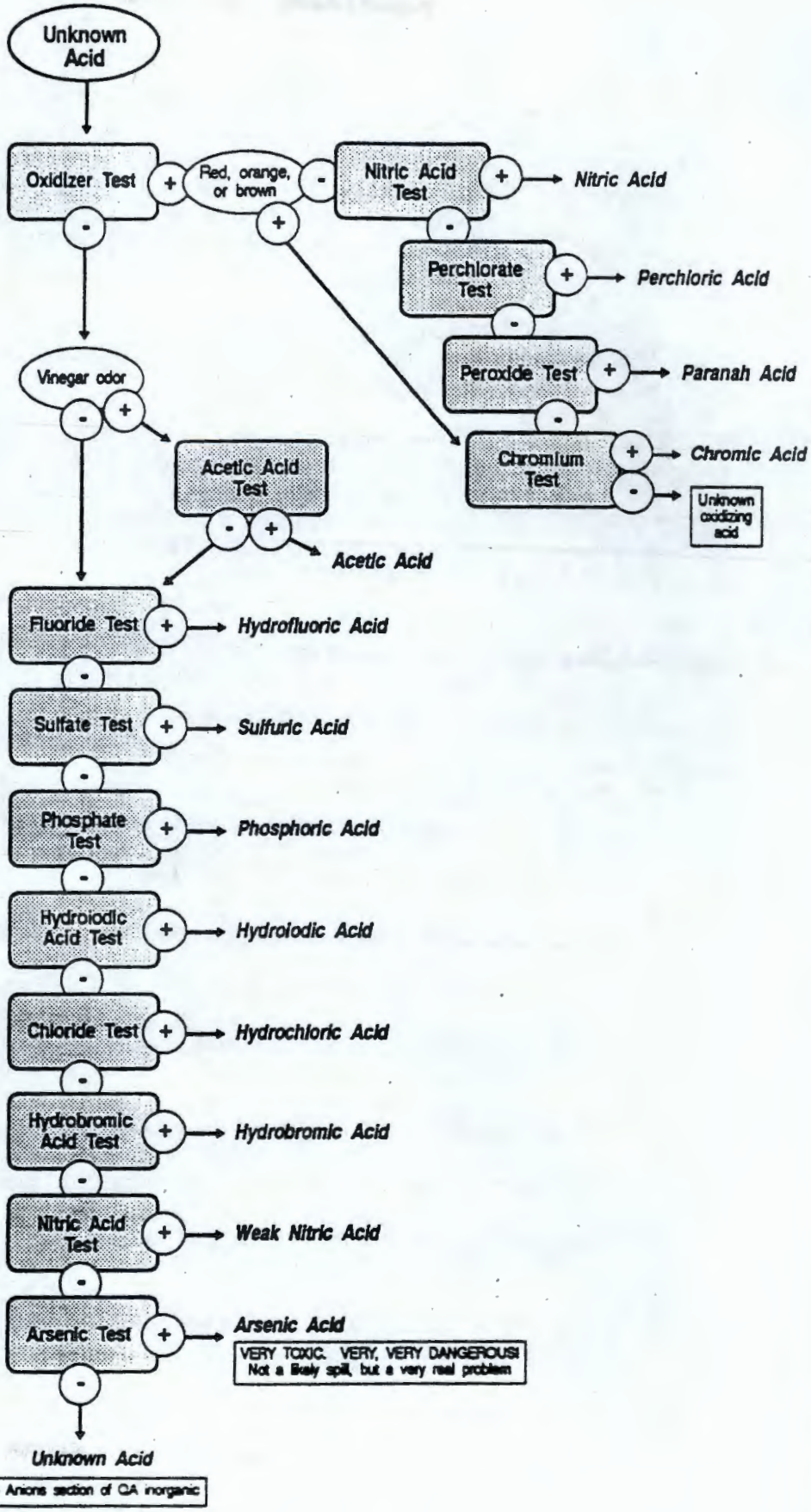
Group 5: Mineral Acids

Not volatile. Keep away from zinc. Strong skin irritant

Group 6: Acid Gases

Very volatile! If spilled on pavement, it can release CHLORINE or CHLORINATED gases. BE CAREFUL

A slight positive should be considered negative



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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

CHAR TEST

WARNING: IF A TEST TUBE EVER BREAKS DURING THIS TEST, IT MAY BE CAUSED BY A BAD BATCH OF TEST TUBES. IF THAT OCCURS, WE RECOMMEND THE TOTAL LOT OF TEST TUBES BE REPLACED AT ONCE. BROKEN HOT TEST TUBES CAN BE VERY DANGEROUS! CERTAIN REACTIONS CAN BE SO EXPLOSIVE THEY CAN BREAK THE TEST TUBE. (SEE # 4 LIQUIDS AND # 7 SOLIDS)

This is a key screening test that differentiates between organic and inorganic substances. This test can be definitive for the presence of alkali salts, metal oxides, arsenic, ammonium salts, iodide salts, pesticides, and/or nitrates.

For safety, the Hairpin Test must be performed before the Char Test. To maximize the effectiveness of the Char Test, the Char Ignition Test, the Char pH Test, and the Char Oxidizer Test must be performed concurrently with the Char Test. The results of the three concurrent tests together with observations of how the unknown reacts in extreme heat and the characteristics of the resulting flame vapors and smoke make the Char Test the most powerful test in the entire HazCat arsenal.

WARNING: NEVER DO THE HAIRPIN TEST WITH A LARGE AMOUNT OF UNKNOWN OR WITH THE UNKNOWN THAT IS STILL IN THE ORIGINAL CONTAINER.

HAIRPIN TEST: THIS TEST MUST BE DONE BEFORE PERFORMING THE CHAR TEST. The Hairpin Test is designed to look for explosives and some of the more shock sensitive oxidizers. It is very important to know that the unknown will not explode before performing the Char Test.

1. a. Place a few grains of the solid unknown on a watch dish;
   -or-
   b. Place a puddle of liquid about the size of a dime on a watch dish.
2. Heat a hairpin until all of the plastic coating has been cleaned off and continue heating the hairpin until it is cherry red.
3. Touch the cherry red hairpin to the unknown on the watch dish.
4. If there is no noticeable reaction, put the hairpin back into the torch flame.
5. If there is still no noticeable reaction, and none of the unknown sticks to the hairpin, add a few drops of Acid Test (3N HCl) to the unknown on the watch dish.
6. Touch the hairpin to the acidified unknown and again put the hairpin into the torch flame and look for a reaction.
7. Observations / Colorations:

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

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a. FLASHES OR IGNITES VIOLENTLY:
   YELLOW FLASH: Nitrates, nitrites, organic peroxides, picric acid, hydrides.
   WHITE FLASH: Gun powder.

b. BURNS WITH WHITE SPARKLES IN TORCH FLAME: Magnesium.

c. BURNS VIGOROUSLY ON WATCH DISH (doesn't appear to be organic): Hydrides.

d. PERSISTENT ORANGE SPARKLES IN TORCH FLAME: Carbon and iron are most likely if the unknown is black.

e. BECOMES STRONGLY LUMINESCENT IN FLAME: Tungsten.

f. YELLOW POWDER BURNS WITH SMALL BLUE FLAME: Sulfur.

g. IF A FLAME COLOR APPEARS, SEE FLAME TEST. If the color is faint, a drop of Acid Test placed on the unknown prior to placing it in the torch flame may intensify the color.

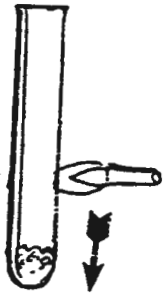
h. BURNS WITH A YELLOW FLAME: Organic.

i. WILL NOT BURN: Inorganic.

WARNING: NEVER DO THE CHAR TEST IF THERE IS ANY INDICATION OF A HAZARD DUE TO THE HEAT FROM THE HAIRPIN TEST.

NEVER DO THE CHAR TEST WITHOUT FIRST DOING THE HAIRPIN TEST.

NEVER DO THE CHAR TEST ON LIQUIDS UNTIL A COMBUSTIBILITY TEST HAS DETERMINED THAT THE LIQUID IS NON-FLAMMABLE.



START HEATING THE TEST TUBE FROM THE TOP, THEN WORK THE FLAME DOWN TO THE UNKNOWN. THIS WILL PREVENT THE UNKNOWN FROM BOILING AT THE BOTTOM AND BLOWING THE UNKNOWN OUT OF THE TEST TUBE. BE CAREFUL NOT TO POINT THE TEST TUBE AT ANYONE WHILE HEATING.

ALWAYS WEAR GOGGLES WHILE DOING THIS TEST.

AVOID BREATHING THE VAPORS. IT IS WISE TO WEAR AN ORGANIC/ACID VAPOR RESPIRATOR WHILE DOING THIS TEST.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

CHAR TEST: (Done concurrently with the Char Ignition Test, the Char pH Test, and the Char Oxidizer Test.

1. a. Add two pea-size amounts of the solid unknown to a test tube;
   -or-
   b. Add 1/2 inch of the liquid unknown to a test tube.

2. a. SOLIDS: Heat the unknown in the test tube gently. The unknown may initially melt, sublime, burn, or char. Note the first reaction, but continue to heat the unknown gently until it no longer reacts. Then use direct flame on the unknown in the test tube until no further change occurs or the test tube begins to melt;
   -or-
   b. LIQUIDS: Keep the flame directed above the liquid, and heat very gently until there is no change in the unknown.

3. Very fine powders may appear to sublime as water vapor is driven off. Water vapor will appear as a white or clear non-flammable vapor.

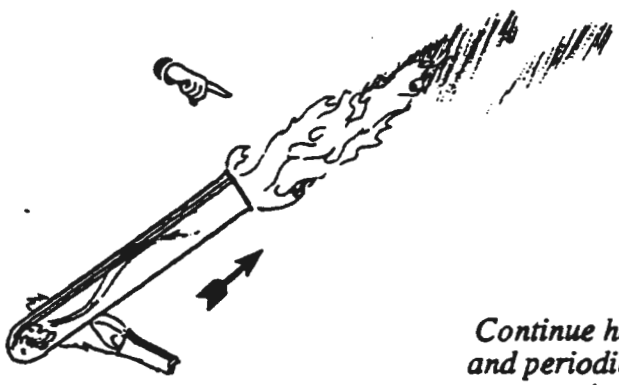
4. Simultaneously perform the Char Ignition Test, the Char Oxidizer Test, and the Char pH Test.

   a. **CHAR IGNITION TEST:**

   Attempt to ignite the vapors or smoke that is being driven out of the test tube. Ignition of the vapors with a brilliant yellow flame indicates an organic compound and can only lead to chars/tars, sublimes (organic), or partly chars. The smoke which comes off the ignited unknown provides additional information. If the ignited smoke burns clean, the unknown is probably saturated. If black smoke containing black spider webs is produced, the unknown is unsaturated and most likely there is a benzene ring in the molecular structure.

CHAR IGNITION TEST

Always touch the top of the test tube with the torch flame to determine if the unknown is organic. Organics will burst into a self-propagating yellow flame.



Continue heating the unknown and periodically try to light any escaping vapors.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

b. **CHAR OXIDIZER TEST:**

Do an Oxidizer Test on the gases or vapors coming out of the mouth of the heated test tube. (Oxygen is an oxidizer, and the paper will change color much faster in the heated atmosphere at the mouth of the test tube, so look for a very fast and pronounced reaction.) Wet the Oxidizer Paper with Acid Test and wave the paper across the mouth of the test tube in such a way that you do not have your fingers in front of the mouth of the test tube. TREAT THE TEST TUBE AS THOUGH IT WERE A LOADED GUN. The following gas colors and a positive Char Oxidizer Test, indicate the presence of the following salts:

GAS	SALT
PURPLE	Iodine
YELLOW/RED	Nitrate
RED	Bromine
CLEAR	Chlorine

c. **CHAR pH TEST:**

Do a pH Test on any gases or vapors coming out of the mouth of the heated test tube. Wet the pH Paper with water and wave the paper across the mouth of the test tube in such a way that you do not have your fingers in front of the test tube. TREAT THE TEST TUBE AS THOUGH IT WERE A LOADED GUN. (This is not a very definitive test, however a pH of about 11 can indicate an ammonium salt. A very low pH (less than 1) can indicate Cl or CN radicals in the salt of an organic compound. Do the pH Test only if the original unknown has a pH in water between 5 and 9.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

OBSERVATIONS: MORE THAN ONE REACTION MAY OCCUR

SOLIDS

1. CHARS
2. TARS
3. PUFFING TO BLACK SOLID
4. COPIOUS SMOKE INSIDE TEST TUBE
5. SUBLIMES
   a. Vapor Ignites
      1) Burns Dirty
      2) Burns Clean
   b. Vapor doesn't Ignite
      1) Yellow/Red Oxidizing Gas
      2) Yellow forms Red Rain
      3) Metallic forms Purple Gas
6. DOES NOT CHAR
7. AUTOIGNITES
8. PARTLY SUBLIMES
   a. Metallic Ring or Coating
   b. Yellow Ring
   c. Yellow/Red Oxidizing Gas
   d. Copper Coating
   e. Purple Gas
9. CHANGES COLOR
10. MELTS
    a. Non-Metallic
       1) Recrystallizes upon Cooling
       2) Forms Glass when Cooling
       3) Forms a Scale
       4) Forms Metallic Coating on test tube, or metallic spots on Non-Metallic Base
    b. Metallic
       1) Forms Black Glassy Crystal
       2) Forms a Metallic Puddle
11. NO CHANGE
12. DECOMPOSES TO WHITE POWDER
13. PARTLY CHARS

LIQUIDS

1. EVAPORATES, VAPORS IGNITE
2. EVAPORATES, VAPORS IGNITE, LEAVES RESIDUE WHICH CHARS/TARS
3. EVAPORATES WITH NO IGNITION, LEAVES RESIDUE WHICH CHARS/TARS
4. LIQUID SHOOTS OUT EXPLOSIVELY
5. FORMS SCALE, NO CHAR
6. FORMS SOLID, WHICH FURTHER REACTS
7. GOOEY MATERIAL, CHARS TO WHITE POWDER
8. EVAPORATES COMPLETELY, VAPORS DON'T IGNITE

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SOLIDS:

IGNITES: This indicates the presence of ORGANIC materials. For the unknown to be considered as an organic, the blackening of the unknown must be accompanied with yellow flame propagation or strong indication of possible yellow flame propagation (ignition) at the top of the test tube during heating. Sublimation with propagation of flame at the top of the test tube, partial charring with propagation of flame at the top of the test tube, and puffing black growing crispy column of unknown also indicate organic materials.

FLAME COLORS:
SOLID YELLOW: Amines, aromatics.
BLUE: Alcohols.
YELLOW FLAMES, BLUE BASE: Unknown floats - short chain aliphatic C5 - C10; dissolves or partially dissolves in water - ketones.
SELF EXTINGUISHING: Halogenated.
INVISIBLE FLAME: Very hot ethers.
VERY WHITE AREA IN FLAME: Sulfur group present.
OTHER DISTINCT COLOR IN FLAME: May indicate metal, see Flame Colors.

SMOKE COLORS:
CLEAR OR CLEAN SMOKE: Saturated hydrocarbon (aliphatic)
VERY PRONOUNCED BLACK SPIDER WEBS: Unsaturated hydrocarbon (aromatic, benzene ring).
PURPLE SMOKE: Organic iodide (rare).
SMOKE RESOLIDIFIES, PRODUCING A WHITE PLASTIC SNOW: Metaldehyde or other prepolymers (rare).

1. CHARS:

   a. BLACKENS FROM OUTSIDE, BUT INSIDE MAY REMAIN UNCHANGED: This is the reaction that would be expected if the unknown were flour or sawdust. The unknown will smoke, and the smoke will ignite. This is an organic unknown.

   b. IF NO SMOKE OR FLAME IS PRODUCED AS THE UNKNOWN BECOMES BLACK, SEE # 9, CHANGES COLORS: This is an inorganic unknown.

   c. BECOMES BLACK AND SMOKES, THEN CHANGES TO ANOTHER COLOR (USUALLY WHITE) AND STOPS SMOKING. SEE # 13, PARTLY CHARS: This is an organic/inorganic mixture.

2. TARS:

   BECOMES BLACK, TARRY, AND BUBBLES; ALL OF THE UNKNOWN IS QUICKLY INVOLVED; CONSIDERABLE SMOKE WHICH CAN BE IGNITED IS PRODUCED: This is an organic unknown.

3. **PUFFING TO BLACK SOLID**: Very complex carbon structures may do this. The

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reaction is much like a 4th of July snake or a marshmallow. If the functional groups burning off are not organic, there may be no ignitable smoke. The Carbon Monoxide Gas Test will be positive.

4. COPIOUS AMOUNTS OF SMOKE INSIDE TEST TUBE: This indicates autoignition (usually not visible) in the bottom of the test tube. Organic nitrates are indicated. Organic iodide nitrates give off a thick purple smoke. Other organic nitrates will give off a red or black smoke.

5. SUBLIMES:

MELTS, THEN BOILS, AND FINALLY DISAPPEARS (USUALLY AS A VAPOR) LEAVING ONLY A CLEAN OR SLIGHTLY STAINED TEST TUBE: Often a subliming unknown will resolidify before leaving the test tube in what appears to be a rain storm above the unknown. If the unknown is heated very quickly, some of the unknown may be denatured and char, leaving a slight black scale. A subliming unknown can be either organic or inorganic. To distinguish between organic and inorganic, do the Char Ignition Test at the top of the test tube. An organic will burn vigorously while an inorganic will not propagate a flame. An organic will also produce smoke while an inorganic will not.

a. VAPORS IGNITE: This is an ORGANIC.
   1) BURNS DIRTY: Pentachlorophenol, phenol, phenolic compounds, and naphthalene.
   2) BURNS CLEAN: Waxes, stearic acids, and foods.

b. ESCAPING VAPORS DO NOT IGNITE: This in an INORGANIC.
   1) SUBLIMING UNKNOWN PRODUCES YELLOW TO RED OXIDIZING GAS: Nitrate. If it completely sublimes, it is most likely ammonium nitrate.
   2) YELLOW UNKNOWN FORMS A RED RAIN: Sulfur.
   3) METALLIC UNKNOWN QUICKLY SUBLIMES TO A PURPLE GAS: Iodine crystal.

SUBLIMING SOLID

There is often a storm cloud formed which rains back down on the original unknown.

The main indicator that the unknown is subliming is that upon continued heating, the test tube will end up empty.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

6. **DOES NOT CHAR:**

This is a broad designation for inorganic unknowns which appear on the Solids Chart. None of these should produce a self propagating yellow flame. This designation includes all of the phenomenon described in 7 through 11 below. See the specific reaction for more detail.

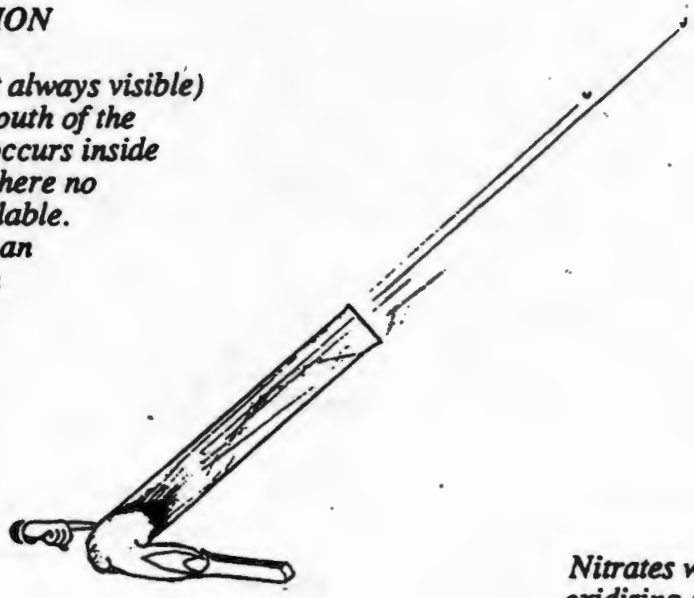
7. **AUTOIGNITES:**

a. UNKNOWN SNAPS, CRACKLES, POPS, AND MAY IGNITE AT THE BOTTOM OF THE TEST TUBE; THIS IS ALWAYS ACCOMPANIED BY AN OXIDIZING GAS: Ignition occurs inside the test tube usually at the bottom, but the vapor does not flame at the mouth of the test tube. The unknown may be a nitrate, a nitrite, or a perchlorate. Although stable at room temperature, nitrates can be explosive. Once ignited, nitrates can burn much hotter than other flammable solids. Other indicators of the presence of nitrates include: (1) A positive Chlorine Hot Wire Test performed on an aqueous solution of the unknown (look for a green or yellow/green flame); (2) the Char Oxidizer Test is positive on red/yellow gas; and (3) a positive Nitrogen Dioxide Gas Test. Nitrites which are more reactive than nitrates, will form the red/yellow gas with the addition of Arsenic Test 4 (sulfuric acid).

Perchlorates act very much like nitrates, however they can be a little more reactive. This is especially true of the metal perchlorates which will probably be noted in the Hairpin Test as most perchlorates have brilliantly colored flames. Ammonium perchlorate is almost indistinguishable from ammonium nitrate except when water is added to the cooled remaining unknown after the Char Test and then a Chloride Test is performed, the Char Test will be positive. The Chloride Test is NOT positive prior to heating.

AUTOIGNITION

The flame (not always visible) is not at the mouth of the test tube, but occurs inside the test tube where no oxygen is available. This indicates an oxidizer which is most likely a NITRATE.



Nitrates will produce a red/yellow oxidizing gas.

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b. A METALLIC FILING OR SHAVING WHICH AUTOIGNITES AS A VERY BRIGHT FLAME AT THE BOTTOM OF THE TEST TUBE: Often these reactions will not occur as they all require oxygen which is usually not available at the bottom of the test tube. However, if there is sufficient turbulence to get air into the test tube, magnesium, calcium, barium, and uranium will burn when heated. With magnesium, if there is a little water in the test tube, it will burn.

1) WHITE FLAME, WHITE CRUST RESIDUE: Magnesium is commonly encountered.
2) RED FLAME, WHITE CRUST RESIDUE: Calcium.
3) GREEN FLAME, WHITE CRUST RESIDUE: Barium.
4) GREEN BORAX BEAD, SLIGHTLY RADIOACTIVE, AND IS VERY HEAVY: Uranium is not a commonly spilled material and is associated with the manufacture of munitions.

Usually there is not sufficient oxygen in the test tube to ignite the metal. The bright flame may only be observed during the Hairpin Test.

c. VIOLENT AUTOIGNITION OF METALLIC OR BLACK POWDER (BRIGHT WHITE FLASH): The unknown is most likely gun powder. This reaction should have been observed during the Hairpin Test.

8. **PARTLY SUBLIMES**: (SUBLIMING TO NON-SUBLIMING SOLID)

A visible or invisible gas or vapor leaves the unknown solid. Usually, but NOT always, some change is noticed in the remaining solid, such as melt and resolidify upon cooling, form a dry scale, change color, etc. These secondary reactions are equally if not more important in understanding the unknown and should be investigated by reading the appropriate sections below.

Observations:

a. **BLACK TO METALLIC** RING FORMS ABOUT HALF WAY UP THE TEST TUBE: Arsenic or mercury salts will do this. Go directly to Arsenic Test and Mercury Tests. If these tests are both negative, consider lead or organo-metal compounds. (Photo chemicals often contain iron, or chrome.)

b. **YELLOW** RING FORMS HALF WAY UP THE TEST TUBE: This is common for mineral sulfides, sulfites,and pyrites which sublime and resolidify as sulfur inside the test tube.

c. **YELLOW TO RED** GASEOUS SUBLIMED MATERIAL WHICH DOES NOT RESOLIDIFY ON THE TEST TUBE: Although there may be no recognizable autoignition, this is most likely a NITRATE. The Char Oxidizer Test will be a strong positive with nitrates. The Nitrogen Dioxide Gas Test will also be positive with nitrates.

d. **COPPER** METALLIC COATING FORMS ON THE INTERIOR OF THE TEST TUBE: If the original unknown is green and a copper colored ring forms half way up the test tube, the unknown may be copper arsenate (commercial wood

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preservative). Add QA-4 (ammonium hydroxide) to a new solution of the unknown and look for a blue color which indicates copper.

e. **PURPLE** SUBLIMING GAS: Do a Char Oxidizer Test. A positive Char Oxidizer Test indicates the unknown contains an iodide salt.

9. CHANGES COLOR:

The heated solid may do a number of things. Usually there is a change or decomposition of the solid to a nondescript bubbling mass, although other reactions may occur. Generally, non-reversible changing of color indicates a transition metal dehydrating. Many of the color changes listed below are very specific. The resulting colors listed below are different than the original unknown. If the unknown does not react, but changes color when hot and again changes as it cools, the unknown may be identified below:

Observations: (Colors are subjective, look for colors which are close such as orange or yellow.)

a. **BLACK** WHEN HEATED AND REMAINS BLACK: Often the unknown will glow red which stops when the flame is removed, leaving a non-glowing non-smoking unknown. The black color is the result of the oxidation of a metal salt. The most likely metals are copper, manganese, or iron.

b. **PURPLE** WHEN HOT AND COOLS TO A NON-COLORED CRYSTAL: Iodine or a potassium salt.

c. **WHITE** SCALE: Indicates Column 2 of the periodic table; 2A: Calcium, Strontium, Barium; 2B: Zinc, Cadmium

d. **CLEAR** GLASS FROM A RED OR ORANGE UNKNOWN: Lead pigment.

e. **DEEP BLUE** SCALE FROM PINK OR PURPLE UNKNOWN: Cobalt.

f. **NAVY BLUE** SCALE OR CHANGES TO NAVY BLUE WITH NO REACTION FROM WHITE TO DARK NAVY BLUE UNKNOWN: Molybdenum. (There may be some red overtones.)

g. **DULL GREY TO DARK GREEN** FROM ANY COLOR. GENERALLY WILL NOT LIQUEFY: Chromium. A copper or red color mixed in the green indicates copper.

h. **YELLOW** GLOWING BRIGHT WHEN HOT AND COOLS TO ORIGINAL COLOR WITH NO OTHER REACTION: Titanium.

i. **YELLOW** LIQUID FORMED WHICH PARTLY SUBLIMES AND RETURNS TO WHITE WHEN COOL: Arsenic is possible.

j. **YELLOW** GLASS FORMS FROM RED, ORANGE, OR YELLOW SALT: Lead (red lead paint pigments).

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k. YELLOW METAL WHICH SOFTENS BUT DOES NOT LIQUEFY: Aluminum.

l. ORANGE (ORANGE YELLOW TO BEIGE YELLOW) WHICH REMAINS AFTER COOLING AND COMES FROM A GREEN OR BLUE UNKNOWN: Nickel is most likely.

m. **RED OR RUST**: Iron or copper are most likely.

10. **MELTS**: (BECOMES A LIQUID)

The liquid may change color when hot and return to the original color when cool. Powders, crystals, or granules may melt into one piece or crystal. Before designating the unknown as melting, continue heating until the test tube is melting.

a. NON-METALLIC CRYSTAL THAT MELTS, THEN RESOLIDIFIES:
   1) RECRYSTALLIZES UPON COOLING: An alkaline salt.
   2) FORMS BUBBLY AND STICKY LOOKING GLASS WHILE HOT, WHICH REMAINS A CLEAR SINGLE SOLID PIECE OF GLASS AFTER COOLING: Borates and some carbonates; if orange or red, lead is indicated.
   3) FORMS A SCALE: Melts then quickly forms a scale which won't melt with continued heating. If colored, see 9, changes colors. If white, the unknown may be zinc, magnesium, calcium, or other Column 2 metals.
   4) FORMS METALLIC COATING OR METALLIC SPOTS ON NON-METALLIC BASE: Salts of noble metals and copper will go to the metallic form upon heating. The newly formed metal will set in the base material. Gold color indicates gold. Copper color indicates copper. Silver color is either platinum or palladium. Copper cyanide, a common insoluble yellow to white copper salt, will be identified here (most copper salts are green or blue). To determine if cyanide is present, do the Cyanide Gas Test in the head space of the heated salt.

b. METALLIC THAT MELTS:
   1) MELTS TO A BLACK GLASSY CRYSTAL (the inside will be a metallic chunk): Magnesium is most likely. Zinc and magnesium will form a white scale.
   2) MELTS TO FORM A METALLIC PUDDLE: Lead and tin are most likely. Zinc and magnesium will usually form a white crust. Zinc may only partly melt forming a mirrored metallic coating on the inside of the glass around the unknown.
   3) SOFTENS BUT DOESN'T QUITE MELT: A yellow color indicates aluminum; a white crust indicates zinc.

11. **NO CHANGE**:

There is not sufficient heat to affect the unknown. The resulting color and the original color are the same. This is an inert inorganic unknown that could be a non-alkaline salt, silicate oxide, or an elemental material. Silicates will have absolutely no reaction.

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Do a Borax Bead Test. Silica will remain unchanged, swimming in the melted borax; salts and oxides will appear to blend into the borax. If the unknown is black to begin with, it could be pure carbon or graphite. If it glows with a slow red glow like barbecue charcoal, do a Carbon Monoxide Gas Test * in the head space of the test tube over the glowing material. A positive CO Test indicates carbon or graphite. If the CO Test is negative, consider the unknown to be a metal oxide. Copper, manganese, or iron are a best guess. A metal that won't melt is probably iron or an iron alloy. Test for iron with a magnet.

12. **DECOMPOSES TO A WHITE POWDER:** Silicate. If original unknown was purple, the unknown is most likely potassium carbonate (Purple K).

13. **PARTLY CHARS:**

BECOMES BLACK AND SMOKES, THEN CHANGES FROM BLACK TO ANOTHER COLOR (USUALLY WHITE OR THE ORIGINAL COLOR) AND STOPS SMOKING: This reaction is characteristic of an organic/inorganic mixture. The reaction is due to the organic burning off, leaving the inorganic. Events involving such mixtures include sugar-sand or flour-sand mixtures. These mixtures are common industrial materials used in foundries. The unknown may also be a household pesticide, where the pesticide is in such a small quantity that an emulsion is not formed in the Hexane or Alcohol Solubility Tests. Some carbamates do not emulsify. Do the Organophosphate Test. If the Organophosphate Test is positive, a pesticide may be present.

LIQUIDS:

Almost all liquids are either hydrocarbons or water. Other liquids include:

Mercury metal
Bromine, which quickly becomes gaseous.
Hydrazine, carbon disulfide, and thionyl chloride which all act like hydrocarbons.
Silicone oils and gels which char to a white amorphous powder.

When heating a liquid, if the off-gasing vapors do not ignite, water is indicated. To confirm water, perform the Water Test. If the vapors ignite at first, an then do not ignite, the unknown may be a mixture of water and a solvent which is lighter than water. If the vapors will not ignite and then ignite, the unknown may be a solvent that is heavier than water or a solid dissolved in water.

1. **LIQUID COMPLETELY EVAPORATES, VAPORS IGNITE:**

IGNITION OF VAPORS OCCURS AFTER A COMBUSTIBILITY TEST SHOWED THE UNKNOWN TO BE NON-FLAMMABLE: This unknown is probably a long chain alcohol or polyol (several -OH groups). A soap or a long chain aliphatic hydrocarbon C15 or greater.

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2. **LIQUID EVAPORATES WITH IGNITION OF VAPORS, LEAVING CRYSTALS OR SCALES WHICH CHARS OR TARS:**

   Organic materials dissolved in an organic, where each burns at different temperatures. If the vapors or smoke from remaining charring crystals ignite at the top of the test tube, the solution contains an organic. The ignition may be subtle if the solution is weak. Look for a color change to black with slight smoking.

3. **LIQUID EVAPORATES WITH NO IGNITION OF VAPORS, THEN CHARS OR TARS:**

   A water solution which contains an organic. This reaction is typical of water soluble solids (sugar).

4. **LIQUID SHOOTS OUT OF THE TEST TUBE EXPLOSIVELY:**

   A solvent/water mixture or solvent mixture. This reaction is analogous to the reactions of pouring water on hot bacon grease and is often accompanied by smoke rings with the bursts of unknown from the test tube. The reaction is caused by two materials with different boiling points being heated together. This is not a good end point as it only indicates a possible mixture. Continue to heat the unknown at a lower temperature and look for another liquid reaction.

WARNING: THIS CAN BE SUFFICIENTLY EXPLOSIVE TO BLOW THE TEST TUBE APART.

5. **LIQUID EVAPORATES AND FORMS A SCALE WHICH DOES NOT CHAR:**

   Possibly salt. Add water to the cooled test tube. An alkaline salt will redissolve in the water, however an oxide or calcium salts such as found in hard water deposits will remain even after adding water.

6. **LIQUID EVAPORATES AND FORMS A SOLID WHICH FURTHER REACTS:**

   See reactions in Solids, Sections 7 through 11.

7. **GOOEY MATERIAL, WHICH CHARS TO A WHITE POWDER:**

   May be silicone.

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8. LIQUID EVAPORATES COMPLETELY, VAPORS DO NOT IGNITE:

A HEATED LIQUID WHICH COMPLETELY EVAPORATES FROM THE TEST TUBE: Any odor or slight charring indicates organic contamination of an aqueous solution. (Scaling, charring or tarring can not be included in this category, no matter how slight.) This is mostly water or all water.

If it appears that the liquid is pure water, but there is an odor associated with the water, the following chart lists common organics and their odor thresholds in water for an estimate of contamination.

ODOR DETECTION LEVEL IN WATER

CHEMICAL	PPM	SOLUBILITY
Acetaldehyde	0.034	yes
Acetic acid	97.00	yes
Acetone	20.00	yes
Ammonia	1.5	280,000 ppm
Aniline	65.00	120 ppm
Benzene	0.17	0.17 ppm
Carbon disulfide	0.00039	1700 ppm
Carbon tetrachloride	0.52	0.52 ppm
Chlorine	0.002	0.0065 ppm
Chloroform	2.4	0.28 ppm
p-Dichlorobenzene	0.011	79 ppm
Epichlorohydrin	3.0	7 ppm
Ethylenediamine	170.00	yes
Ethyl ether	0.75	56,000 ppm
Formaldehyde	0.6	550,000 ppm
Formic acid	1700.	yes
Hydrazine	160.	yes
Hydrogen cyanide	0.17	yes
Hydrogen sulfide	0.000029	3,500 ppm
Isoamyl acetate	0.017	1,400 ppm
Methylene chloride	250.	550,000 ppm
Methyl ethyl ketone	8.4	210,000 ppm
Morpholine	0.01	yes
Gasoline	48.0	0.6 ppm
Phenol	7.9	85,000 ppm
Pyridine	0.95	yes
Styrene	0.011	320 ppm
Perchloroethylene	0.5	2,900 ppm
Toluene	0.042	540 ppm
Trichloroethylene	0.31	1,100 ppm
Xylene	0.017	170 ppm

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WATER SOLUBILITY TEST

SAFETY TIP: NEVER POINT A TEST TUBE AT ANYONE!

This is a key screening test to the HazCat Chemical Identification System because it divides unknowns into so many mutually unique universes. The Water Solubility Test is the most critical test as the user is directed to specific locations in the system based on these observations.

The more subjective observations in this system are "Dissolves and Sinks" when unknown crystals are being observed. The best way to determine if a crystal is dissolving is to turn the test tube on its side and watch a single crystal. If it becomes rounded, it is probably melting or dissolving. If the edges of the crystal remain angular, the crystal is not dissolving.

TEST:

1. Add about 1/2 inches of water to a test tube.

2. a. Add a pea-size amount of the solid unknown to the test tube;
   -or-
   b. Add 1/2 inch of the liquid unknown to the test tube.

3. Allow time for a reaction to occur or for the unknown to dissolve.

4. There are more than twenty (20) possible reactions which might occur. Multiple reactions may occur. For example, nitrates dissolve and become colder.

5. Observations:

A. SOLIDS

1. Reacts Violently
2. Hesitates, Reacts with Fumes
3. Boils
4. Becomes Hot
5. Effervesces
6. Becomes Cold
7. Breaks Down
8. Dissolves
9. Forms Suspension
10. Sinks
11. Floats
12. Dissolves, then Forms a Gel
13. Changes Colors

B. LIQUIDS

1. Reacts Violently
2. Hesitates, Reacts with Fumes
3. Boils
4. Becomes Hot
5. Dissolves
6. Floats
7. Sinks
8. Emulsifies
9. Forms Globules
10. Curdles, White Stringy
11. Changes Colors

TIP: Only when there is no further obvious reaction, consider carefully touching the test tube to feel for a temperature change.

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A. **SOLIDS:**

1. REACTS VIOLENTLY: The unknown reacts with considerable heat generation. The reaction occurs quickly without a period of effervescing. The unknown is usually inorganic. Metal may be sodium, potassium, or calcium. Do a pH Test on the resulting unknown before categorizing further.

2. HESITATES, AND REACTS WITH FUMES: The unknown is a very dangerous skin contact toxin. Do a pH Test on the resulting unknown before categorizing further.

3. BOILS: May be a very strong caustic. Sodium hydroxide will get hot enough to boil water. Look for large bubbles. This is not as violent as "Hesitates, Reacts, and Fumes". Do a pH Test.

4. BECOMES HOT: The unknown is an acid or base. Do a pH Test.

5. EFFERVESCES: The solid has a reaction similar to Alka Seltzer(tm) in water (small bubbles aggressively rise to the surface). Boiling water is not effervescence. A few bubbles may only be the release of trapped air. Look for aggressive bubbling action. DO NOT STOPPER THE TEST TUBE IF THE UNKNOWN IS EFFERVESCING. Attempt to ignite the effervescing gas. Avoid inhalation of the gases. The unknown is probably inorganic. Ignition usually indicates the release of hydrogen.

6. BECOMES COLD: Nitrates, ammonium salts, thiosulfide, and acetates are the most common endothermic salts.

7. BREAKS DOWN INTO OTHER COMPONENTS: Inorganic unknown. Look for off-gassing. If you suspect some break down, test for oxidizing gas, carbon dioxide, or flammable gas.

   a. ALKALINE SULFIDE: May form gels.
   b. BICARBONATE OF SODA: Emits CO_2 gas.

8. DISSOLVES: If the unknown starts with jagged edges that become rounded, this is an indication that the unknown is dissolving. Use a small amount of unknown and allow enough time. Resulting solution must be clear. If the solution becomes the same color as the solid, consider it dissolving. These unknowns may be inorganic or organic.

9. SUSPENSION: Water becomes cloudy due to dispersed particles. Suspensions will eventually settle. The unknown is probably not crystalline. The unknown may be inorganic or organic.

10. SINKS: Solid unknowns that sink are most likely crystalline. They could also be glasses or plastics. If the water becomes the same color as the solid, the unknown is dissolving. If the water becomes the color of the unknown, but the solid changes to another color, the solid is made of at least two separate compounds or materials. This often happens with dyed materials. Treat the solid and the liquid as separate samples. Unknown may be inorganic, organic or both.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

11. FLOATS: Either the unknown will be a man made product or a vegetable (wood, pollen, seeds, etc.). Always add soap or detergent to see if the unknown will sink or possibly form a suspension. Consider adding alcohol or soap before the Acid Test or the pH Test to break the surface tension. Never add the alcohol or soap after the Acid Test because the unknown may effervesce and pop acid rapidly off the watch dish.

12. DISSOLVES, THEN FORMS A GEL: The unknown is most likely a food product. Gelatin and cornstarch will set-up or gel. The unknown may gel during the Alcohol Solubility Test right after filtering. The unknown may appear as a jelly in the receiving test tube. If you see this reaction, do the Flour Test. Some glycol ethers may also form gels.

13. CHANGES COLOR: With the addition of water, a new color appears.

    a. COMPLETELY DISSOLVES:

        1) INORGANIC (determined by Char Test): Most likely a metal salt; Some examples are listed below, the color change may go in either direction:

BLUE - PINK:	Cobalt
BLUE - YELLOW:	Iron
BLUE - PURPLE:	Chrome
BLUE - GREEN:	Copper
ORANGE - YELLOW:	Chrome
YELLOW - GREEN:	Nickel and/or Chrome

        2) ORGANIC (determined by Char Test): Most likely an indicator dye.
            a) ORANGE/RED SOLID CHANGES TO FLUORESCENT GREEN SOLUTION: FLUORESCEIN DYE (Common).
            b) OTHER COLORS: May be indicator dyes. Test these by changing the pH. They will change colors if the pH is changed. See pH indicator dye chart next page.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

	pH														
INDICATOR DYE	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Methyl Violet	Y	T	V	P											P
Malachite Green	Y			BG							B				C
Thymol Blue	R			Y							B				B
Metacresol Purple	R			Y							B				B
Methyl Orange	CR				O	Y									Y
2,6,Dinitrophenol	C				Y										Y
Bromophenol Blue	Y					B									B
Congo Red	B					R									R
Bromocresol Green	Y					G	B								B
Alizarin	Y						Y	R							R
Chlorophenol	Y							R							R
Bromocresol Purple	Y							P							P
Bromthymol Blue	Y							G	T						T
Phenol Red	Y							O	R						R
Litmus	R								B						B
Cresol Red	Y								PK	R	V				V
Phenophthalein	C									PK	R	V			V
Thymolphthalein	C											B			B
Alizarin Yellow R	Y										O		R		R
1,3,5,Trinitrobenzene	C													O	O
Indigo Carmine	T													PG	BY

B=BLUE BG=BLUE GREEN BY=BURNT YELLOW C=COLORLESS
CR=CORAL RED G=GREEN O=ORANGE P=PURPLE PG=PEA GREEN
PK=PINK T=TURQUOISE V=VIOLET Y=YELLOW

b. PARTLY DISSOLVES, ORIGINAL COLOR GOES INTO THE SOLUTION, AND THE REMAINING SOLID CHANGES TO A NEW COLOR: The unknown is a dyed material. If the unknown is food, then the color is food coloring.

B. **LIQUIDS:**

1. REACT VIOLENTLY: The unknown reacts violently with heat generation. Liquids may fume. The reaction will be completed in split seconds. Unknown may be a very strong inorganic acid.

2. HESITATES, REACTS AND FUMES: Slower than the above reaction. Liquid develops into a fast boil with large bubbles. Unknown may be hydrolyzing and producing a strong inorganic acid. A strong base can also react this way. UNKNOWN IS A VERY STRONG SKIN CONTACT POISON AND/OR CORROSIVE.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

3. BOILS: Most likely an acid. Do a pH Test.

4. BECOMES HOT: The unknown is an acid or base. Do a pH Test.

5. DISSOLVES: Unknown is miscible with water. Add additional amounts of unknown. If the addition of more liquid causes a layer to form on top or bottom, consider unknown as "Sinks or Floats". Small amounts of methyl ethyl ketone (MEK) will dissolve, but when more MEK is added to the water, the water becomes saturated and the MEK floats. Nitriles on the other hand will appear to float, but when shaken they will dissolve in water. Acetone, short chain alcohols, and aqueous solutions will dissolve completely, no matter what the ratio of solvent to water.

6. FLOATS: The liquid unknown floats forming a distinctive layer. Unknown is most likely a petroleum distillate, but may be a long chain alcohol, ketone, cooking oil, or a plant distillate. All of these are organic.

7. SINKS: Unknown sinks and forms a distinct layer. Unknown is most likely a chlorinated cleaning solvent. Oils that sink can be very dangerous.

8. EMULSIFIES: Unknown immediately turns uniformly white and milky and will not separate. Emulsification is a liquid in a liquid. A precipitate which is a suspension of a solid in a liquid may appear as an emulsion. Allow the unknown to set to ensure that materials do not settle out. If it separates, do not treat this as an emulsion.

9. FORMS GLOBULES: The density of the unknown is very close to that of water, causing the unknown to hang in the water, sometimes sinking and sometimes floating. This unknown will not react with water, so the globules will remain clear. Silicone grease and gels will form such globules.

10. CURDLES, WHITE STRINGY: Unknown appears at first as a globule, but when shaken becomes white and sometimes globs and sometimes becomes stringy. The white color shows that there is some sort of surface reaction occurring. Unknown is typically a liquid plastic resin.

11. CHANGES COLOR: Unknown may be an indicator dye. See chart on previous page.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

FLAME TEST

This is a definitive as well as a screening test for cations and some anions. This test is not easy if two or more colors show up. It is best to see as many flame colors as possible before doing this test in the field. The HazCat reagents can be used as a standard for comparing some flame colors.

TEST:

1. a. Place a pea-size amount of the solid unknown on a watch dish;
   -or-
   b. Place a dime size puddle of unknown liquid on a watch dish.
2. Heat and then dip the Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
3. Put the wire in a torch flame and observe the color.
4. If no color is visible, add 2 to 3 drops of QA-6 (concentrated HCl acid) to the watch dish and redo steps 2 and 3.
5. Observations / Colorations:

COLOR	ELEMENT
RED	Lithium, Calcium
ORANGE	Strontium
YELLOW	Sodium
LIME YELLOW/GREEN	Molybdenum
YELLOW/GREEN	Barium, Boron
GREEN	Thallium, Tellurium, Boron, Zinc salts, sometimes Ammonia
BLUE/GREEN	Copper, Phosphates mixed with Sulfates
ROBINS EGG BLUE	Lead
BLUE	Arsenic, Selenium, Zinc metal
LAVENDER	Potassium, Cesium, Rubidium

---

a. **BRIGHT WHITE LUMINESCENCE ON WIRE:** TUNGSTEN.

b. **YELLOW LUMINESCENCE ON WIRE:** TITANIUM.

c. **BRIGHT WHITE SPARKLES IN FLAME:** MAGNESIUM.

d. **VERY RED:** LITHIUM (color is very distinct and lasts a long time).
   Red/violet through Cobalt Blue Glass
   Invisible through Green Glass (color is persistent)

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e. **BRICK RED**: CALCIUM.
Yellow through Cobalt Blue Glass
Orange through Green Glass (color appears and disappears quickly)

f. **ORANGE**: STRONTIUM. The best color is displayed by placing the loop in the reducing flame (the center blue portion of the flame).
Violet through Cobalt Blue Glass
Yellow through Green Glass

g. **YELLOW**: SODIUM.
This is in most cases an inconclusive test. Sodium is a very common contaminant and the sodium flame is very strong usually masking other colors. Sodium has a very persistent flame color. This is the only definitive test for sodium, but in order to be considered a sodium salt, the unknown must meet the following criteria:

1) Dissolves completely in Water Solubility Test.
2) Melts in Char Test.
3) Unknown is white or clear (no coloration).
4) Yellow flame is invisible in Cobalt Blue Glass.

In the yellow flame, but looking through Cobalt Blue Glass, the following metals may be detected by their flame colors. The colors may be difficult to see if you have not practiced using standards.

1) INVISIBLE: Sodium
2) RED/VIOLET: Lithium
3) YELLOW: Calcium
4) VIOLET: Strontium
5) RED/BLUE: Potassium

In the yellow flame, but looking through Green Glass, the following metals may be detected by their flame colors. The colors may be difficult to see if you have not practiced using standards.

1) YELLOW: Strontium
2) ORANGE: Calcium
3) BLUE/GREEN: Potassium
4) Other indicating colors may appear.

h. **LIME YELLOW/GREEN**: MOLYBDENUM (color is very distinct and lasts a long time).

i. **YELLOW/GREEN**: BARIUM and/or BORATES.

j. **GREEN**: THALLIUM, TELLURIUM, BORIC ACID, and/or COPPER.
Thallium has a strong garlic odor.

k. **FEEBLE GREEN**: ANTIMONY and/or AMMONIUM SALTS.
Ammonium salts are usually too feeble to see.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

l. **WHITE/GREEN:** ZINC salts.

m. **BLUE/GREEN:** COPPER HALIDES, and PHOSPHATES in the presence of SULFATES.

n. **ROBINS EGG BLUE:** LEAD.
The color is a white/blue with a blue/green edge.

o. **LIGHT BLUE:** ARSENIC and/or SELENIUM. ZINC metal burns with a brilliant blue dancing flame which is on the edge of the yellow flame.

p. **LAVENDER:** POTASSIUM*, CESIUM, and/or RUBIDIUM.
This is the only definitive test for potassium. In order to be considered a potassium salt, the unknown must meet the following criteria:

1) Dissolves completely in Water Solubility Test.
2) Melts in Char Test (usually yellow when hot).
3) Unknown is white, clear (no coloration), or yellow (sometimes almost brown).
4) Red/blue flame in Cobalt Blue Glass.
5) Blue/green flame in Green Glass.

* Cesium and Rubidium are very rare, therefore if the flame is lavender potassium is most likely.

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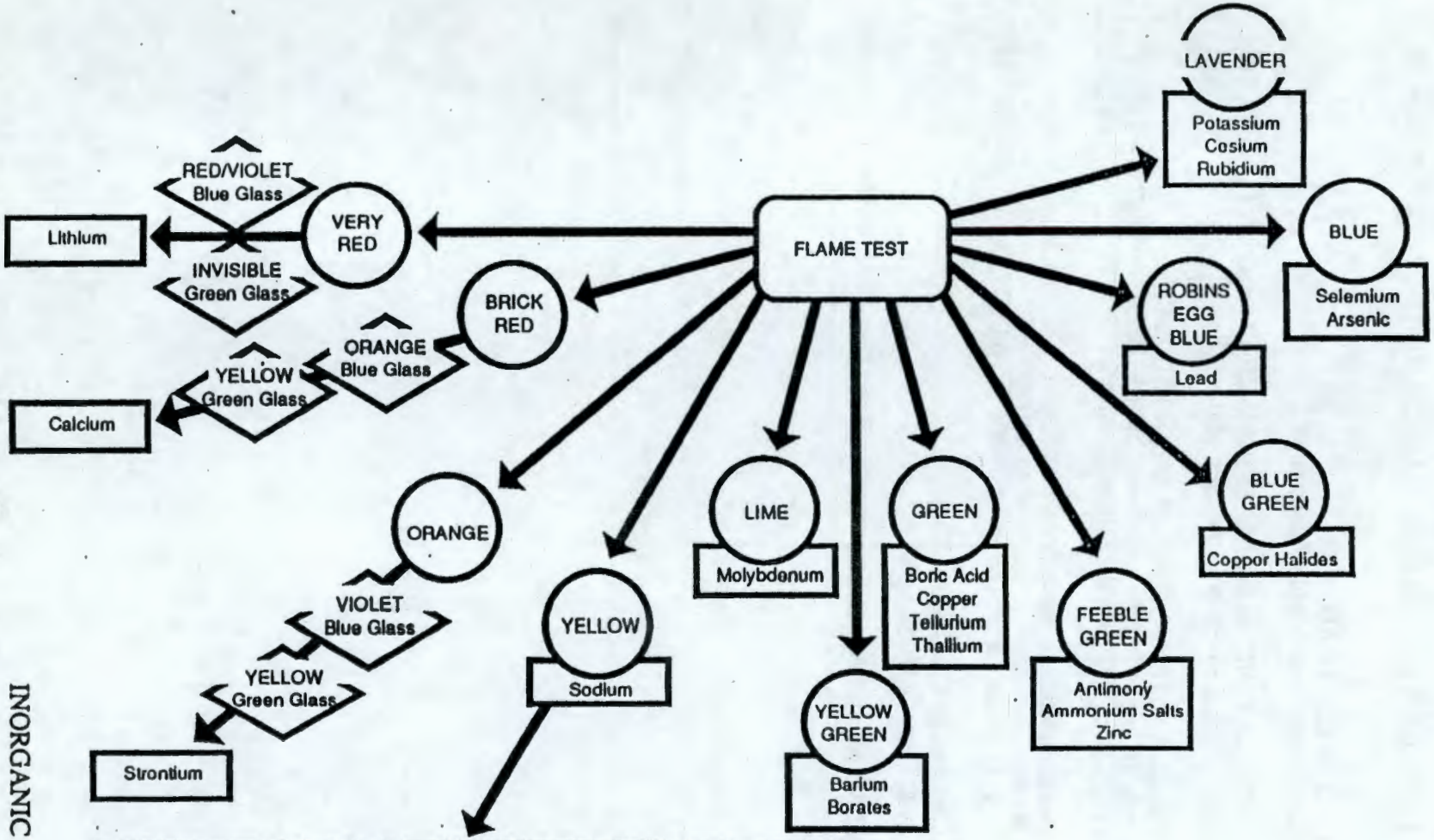
INORGANIC QUALITATIVE ANALYSIS

Screening Procedure 1

When complete, go to next page



This is, in most cases, an inconclusive test. Sodium is a very common contaminant and the sodium flame is ver strong, usually masking other colors.

Look at the flame color through Cobalt Blue Glass. This may be difficult if you have not practiced using standards.
1) Invisible if Sodium.
2) Red/violet is Lithium.
3) Yellow is Calcium.
4) Violet is Strontium.

Look at the flame color through Green Glass.
1) Yellow is Strontium.
2) Orange is Calcium.
3) Other colors, see chart above.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

BORAX BEAD TEST

This test is a definitive cation test. A borax color bead can be a simple, quick and accurate method for screening common metals. The colors are fairly specific and distinct as long as the unknown is not a mixture of metals.

Reagents which have an * after them are accessory items for the HazCat Chemical Identification System. These reagents are available, but due to the unlikely need for the reagents by most users, they are not included in the standard kit.

TEST:

1. Add 1/2 inch of Borax Bead Test (sodium borate [borax]) to a test tube.

2. a. Add a granule of the solid unknown to the test tube;
   -or-
   b. Add 1/4 inch of the liquid unknown to the test tube. Mercury salts may turn yellow/brown in borax.

3. Heat the borax until if forms a glassy bubbling solution at the bottom of the test tube. Look for colored specks as the unknown begins to melt into the borax.

4. When the color has either spread or disappeared and the borax has formed a puddle (bead) at the bottom of the test tube, remove the test tube from the heat.

WARNING: THE BORAX REMAINS HOT MUCH LONGER THAN THE TEST TUBE AND THE DIFFERENCE IN HEAT WILL CRACK THE TEST TUBE. USE CAUTION IN OBSERVING THE TEST TUBE AS THE BEAD WILL SHATTER THE TEST TUBE. NEVER HOLD THE HEATED TUBE OVER FLAMMABLE, COMBUSTIBLE, OR VALUABLE SURFACES. HOLD THE TEST TUBE AWAY FROM YOUR BODY.

5. The color is best observed after the bead cools. The color may be false when the bead is still hot. Both mercury and lead give a grey/black color to the bead. See Borax Bead Color Chart.

OXIDIZING BORAX BEAD

6. It is likely that the color observed in steps 1 through 5 is the oxidized color. Chlorides and other common anions which contain oxygen (carbonates, chromates, sulfates) usually provide sufficient oxidation potential to keep the borax in an oxidizing state. However, the only way to be certain is to redo steps 1 through 5 in a new test tube, but add step 1.a. The color formed in the new bead will always be in the oxidized state. See Borax Bead Color Chart.

1. a. Add 1 drop of QA-7 (nitric acid).

WARNING: AVOID BREATHING VAPORS, AS THE NITRATES DRIVEN OFF

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

OF THE BORAX ARE DANGEROUS INHALATION HAZARDS. ALWAYS POINT THE TEST TUBE AWAY FROM YOURSELF AND OTHERS. IF AIR REACHES THE HEATED CALCIUM, IT MAY IGNITE.

REDUCING BORAX BEAD

7. If the color does not change after adding the QA-7, the reduced state color can be seen by again redoing steps 1 through 5 in a new test tube. Do not do step 1.a, but add steps 2.c, d, and e.

2. c. Gently heat the borax to remove any moisture.

2. d. Add Borax Bead Test 2* (calcium metal) to the dry borax in the test tube.

2. e. Add 1/8 inch of borax to cover the calcium metal.

Ignition of the calcium is rare as the borax generally coats the calcium if the instructions are followed. Ignition of the calcium may cause the test tube to break from the heat. The main hazard is the unknown flying out of the test tube. Ignition of the calcium will have little effect on the test, although it may cause the borax bead to be opaque. See Borax Bead Color Chart.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

BORAX BEAD COLOR CHART

OXIDIZED	ELEMENT	REDUCED
Deep Blue	COBALT	Deep Blue
Aquamarine	COPPER	Red Opaque Grey, usually with specks of free copper metal
Green to Lime	CHROMIUM	Green to Lime Green
Yellow	IRON	Green (similar to chromium)
Deep Purple, Almost Brown/Red	MANGANESE	Colorless
Clear	MOLYBDENUM	Chocolate Brown
Brown	NICKEL	Dark Grey opaque
Colorless, (Yellow when hot)	TITANIUM	Powder Blue (Yellow when hot)
Colorless	TUNGSTEN	Yellow
Yellow	URANIUM	Green
Colorless	VANADIUM	Green

TIP: Silica and silicates swim undissolved in the borax.

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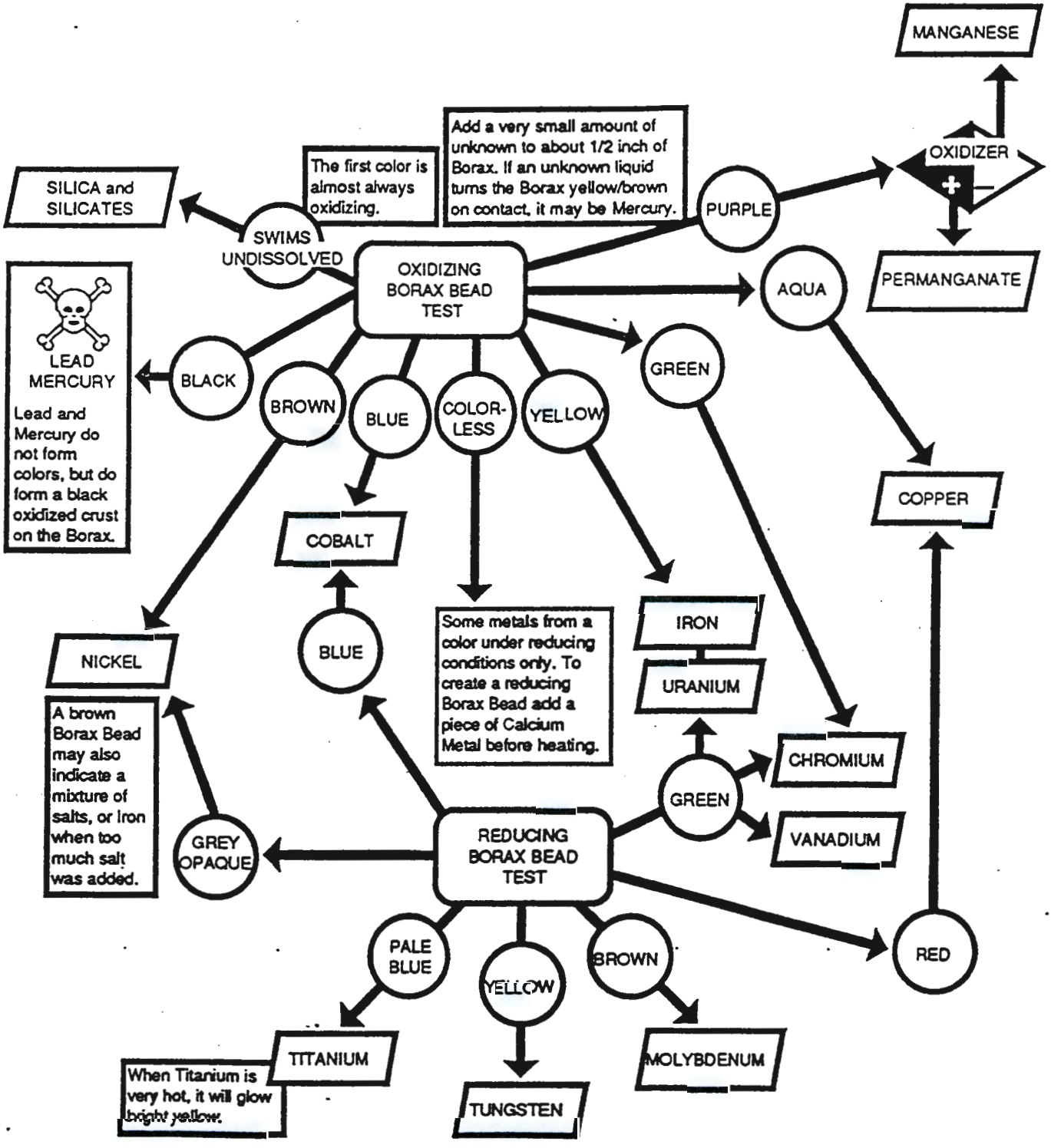
INORGANIC QUALITATIVE ANALYSIS
Screening Procedure 2



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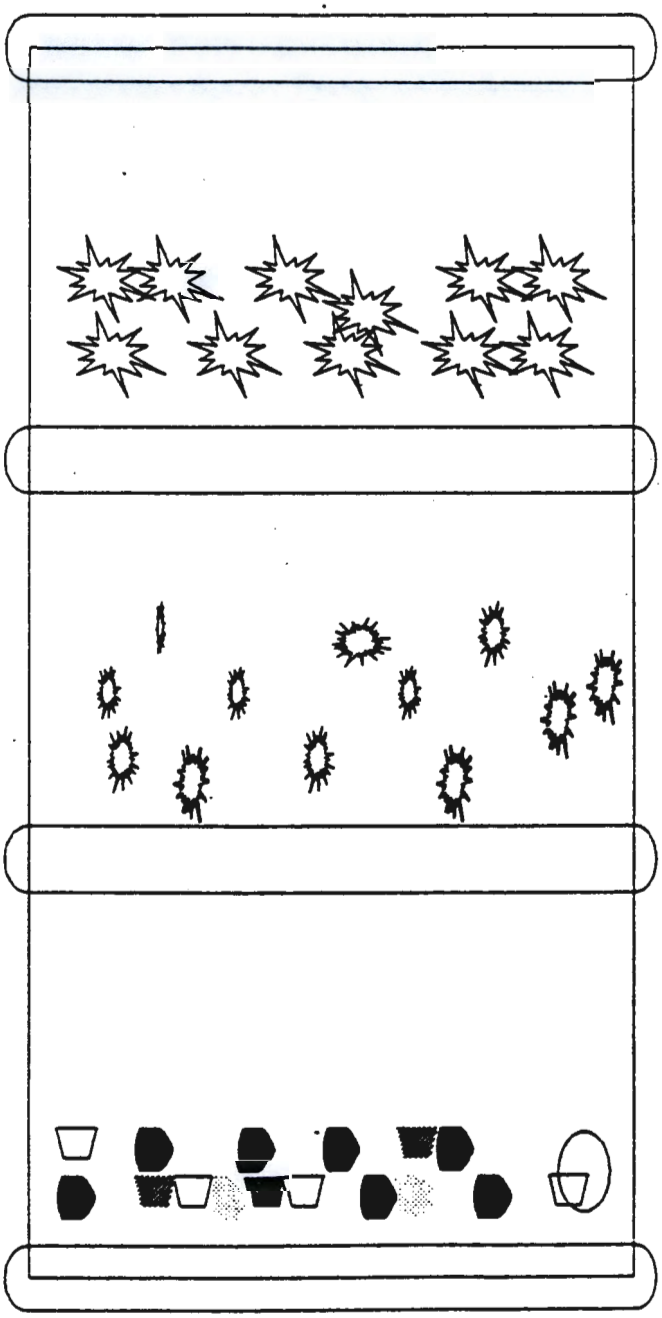
HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

THE BARREL

Summary Sheet



TOP LAYER

1. _____
2. _____
3. _____

MIDDLE LAYER

4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

BOTTOM LAYER

12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

ORGANIC QUALITATIVE ANALYSIS SUMMARY SHEET

Date Tested: _____ Company: _____
by: _____ Location: _____
Container # _____ Job #: _____
Color of the solvent: _____ Odor: _____
DOT Label: _____ Container type: _____
Material is part of/only material. Layer_____of_____Layers

Observations: _____

_____

PROCEDURE A: Water Solubility
(Floats) (Sinks) (Dissolves) Indicates: _____

PROCEDURE B: Flammability Test
Estimated Flash point: _____°F Indicates: _____
(Observe smoke characteristics and flame color for Procedure C.)

PROCEDURE C: Structure and functional group
Viscosity: _____ Indicates: _____
Odor: _____ Indicates: _____
Iodine Crystal: _____ Indicates: _____
Smoke Characteristics: _____ Indicates: _____
Flame Color: _____ Indicates: _____
Char Test: _____ Indicates: _____

PROCEDURE D: Chlorination
Chlorinated: (YES) (N0) Estimated Level: _____
PCBs: (YES) (NO) Possible Dioxin: (YES) (NO)

PROCEDURE E: Corrosives pH: _____
Acidic Organic: _____ Basic Organic: _____
Acidic Inorganic: _____ Basic Inorganic: _____

PROCEDURE F: Dyed Solvents
Fluorescent: (YES) (NO) Indicates: _____

PROCEDURE G: Suspected Inorganics: _____

_____

PROCEDURE H: Separation Indicates Mixture: _____

_____

SUMMARY (Best estimate of the nature of the organic liquid):

_____

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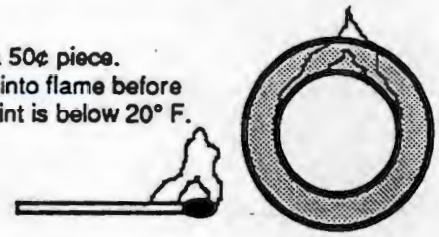
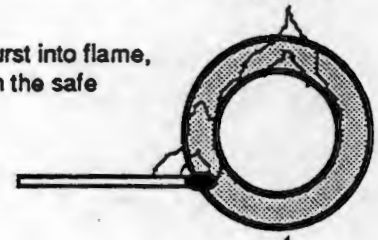
ORGANIC QUALITATIVE ANALYSIS
FLAMMABILITY
Procedure B

FLASH POINT HAS A VERY SPECIFIC LEGAL DEFINITION:
Flash point below 30°F - EXTREMELY FLAMMABLE
Flash point below 100° - FLAMMABLE
Flash point above 100°F - COMBUSTIBLE
Hazardous waste Flash point below 140°F is considered to be IGNITABLE
There are two main methods for determining flash point - Open and Closed cup. The method below is not exact enough to establish a legal classification of FLAMMABLE and/or COMBUSTIBLE, but it will give you a field estimation of how flammable the material is. Do not present the estimated flash points below as anything but a rough estimate.

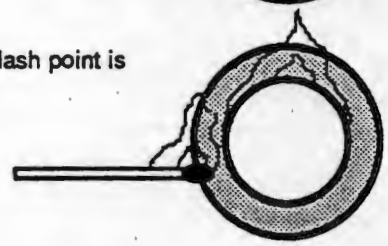
Place a puddle of liquid on a watch dish about the size of a 50¢ piece. Approach the dish with a lit paper match. If the liquid burts into flame before the match reaches the edge of the watch dish, the flash point is below 20° F. **Extremely Flammable.**.



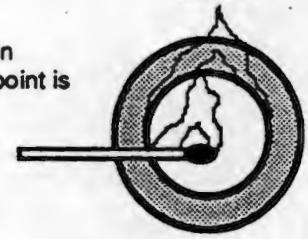
If as you barely touch the puddle of liquid on the watch dish, it burst into flame, the flash point is below 50°F. To be certain that you are erring on the safe side, consider as **Extremely Flammable.**



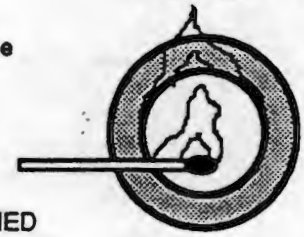
If you touch the puddle, and the liquid ignites fairly quickly, the flash point is below 60°F. **Flammable.**



If the material first soaks into the match, where it quickly wicks, and then steadily covers the total surface area of the liquid with flame, the flash point is below 70°F. **Flammable.**

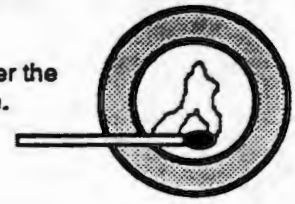


If the material flashes slightly, wicks and then the flame spreads over the whole surface of the puddle reluctantly, the flash point is below 90°F. **Flammable.**



WARNING: CONSIDER ANY FLASHING OF THE LIQUID, IF SUSTANED OR NOT, AS AN INDICATOR THAT THE LIQUID HAS A FLASH POINT UNDER 100°F.

If the material wicks slowly and steadily, but the flame will not spread over the surface of the liquid, the flash point is about 115°F. **Treat as Flammable.**



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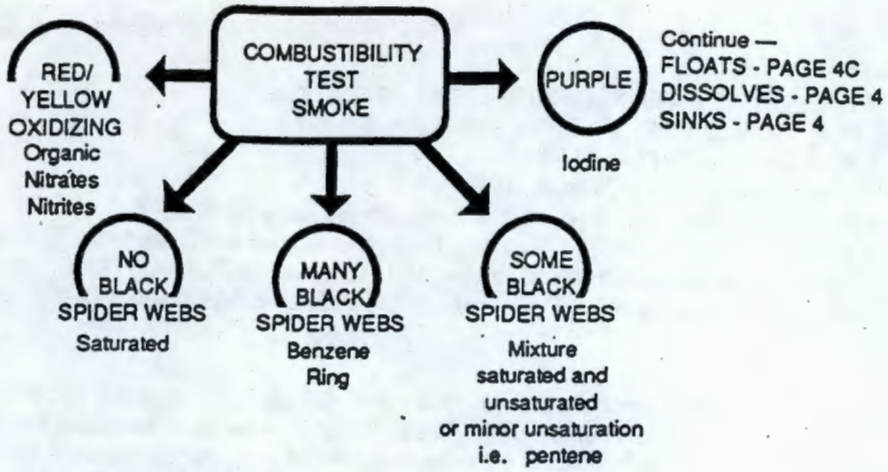
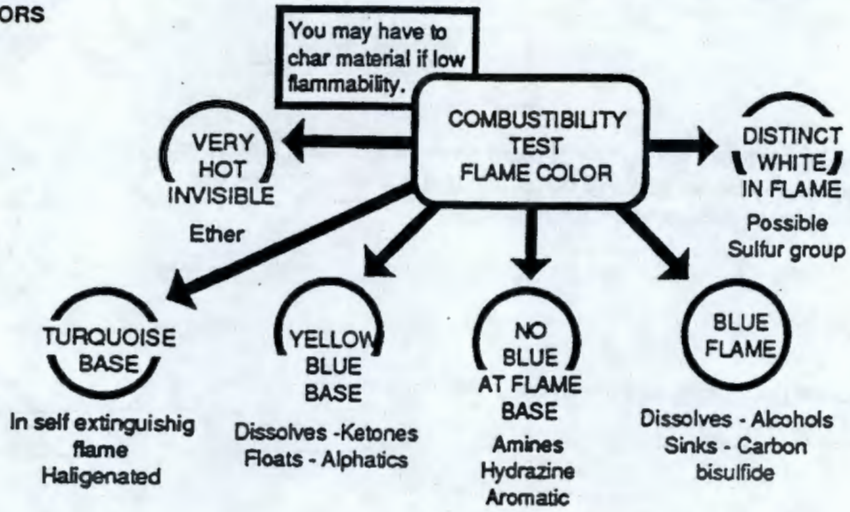
ORGANIC QUALITATIVE ANALYSIS

PRELIMINARY TESTS
Procedure C

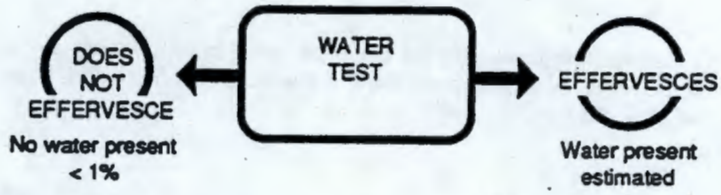
1. SMOKE COLORS



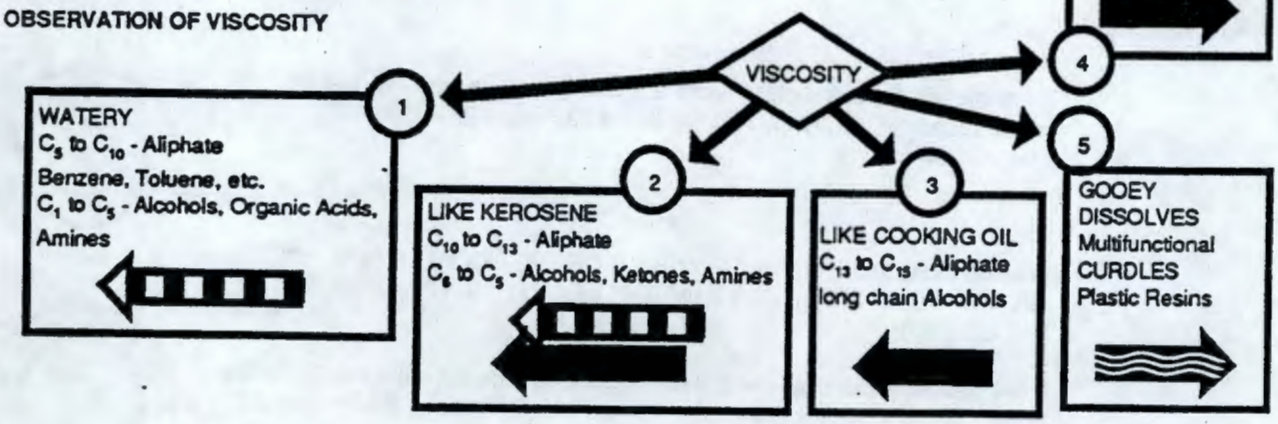
2. FLAME COLORS



3. WATER TEST



4. OBSERVATION OF VISCOSITY



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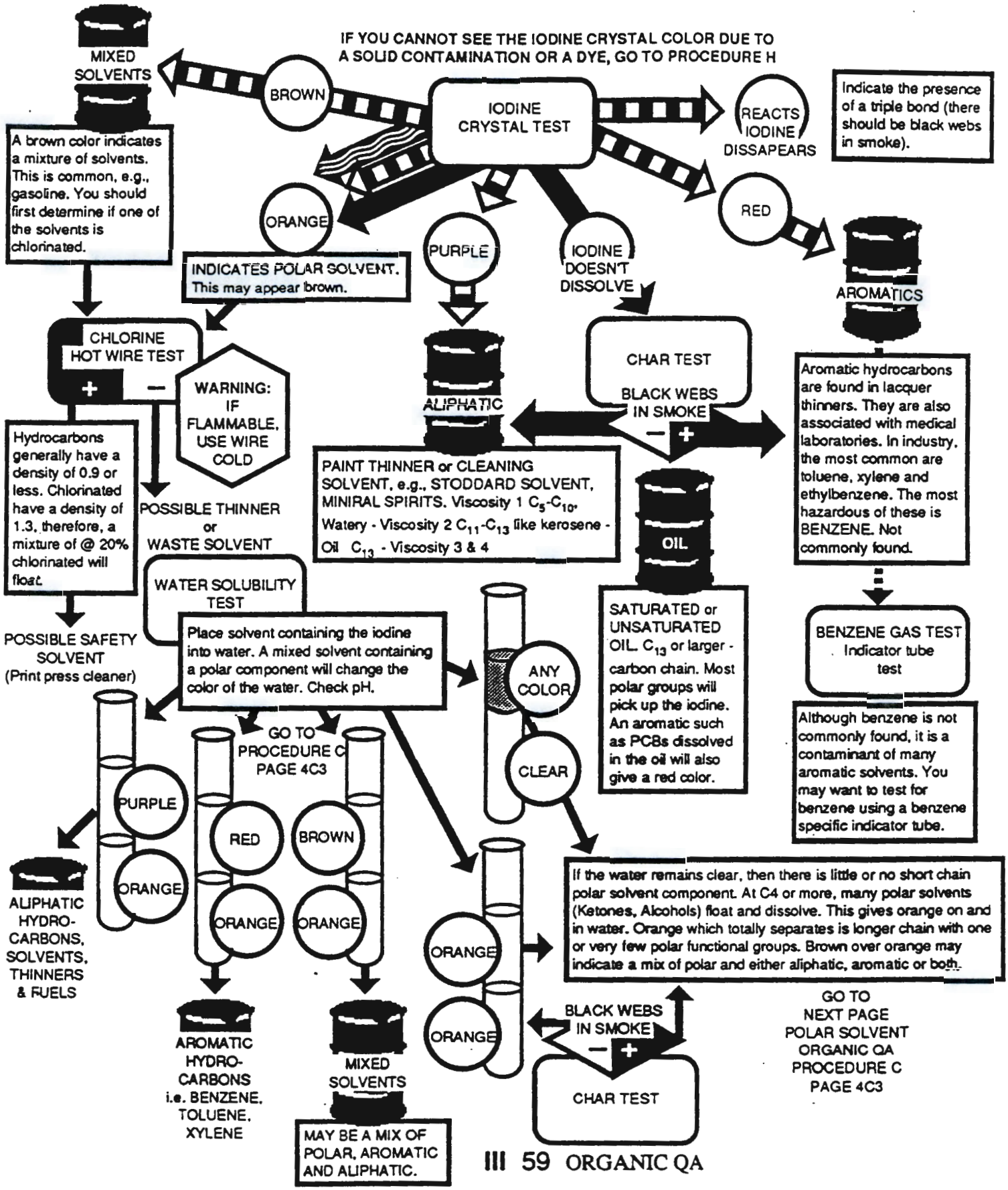
ORGANIC QUALITATIVE ANALYSIS
SOLVENT FLOATS
Procedure C



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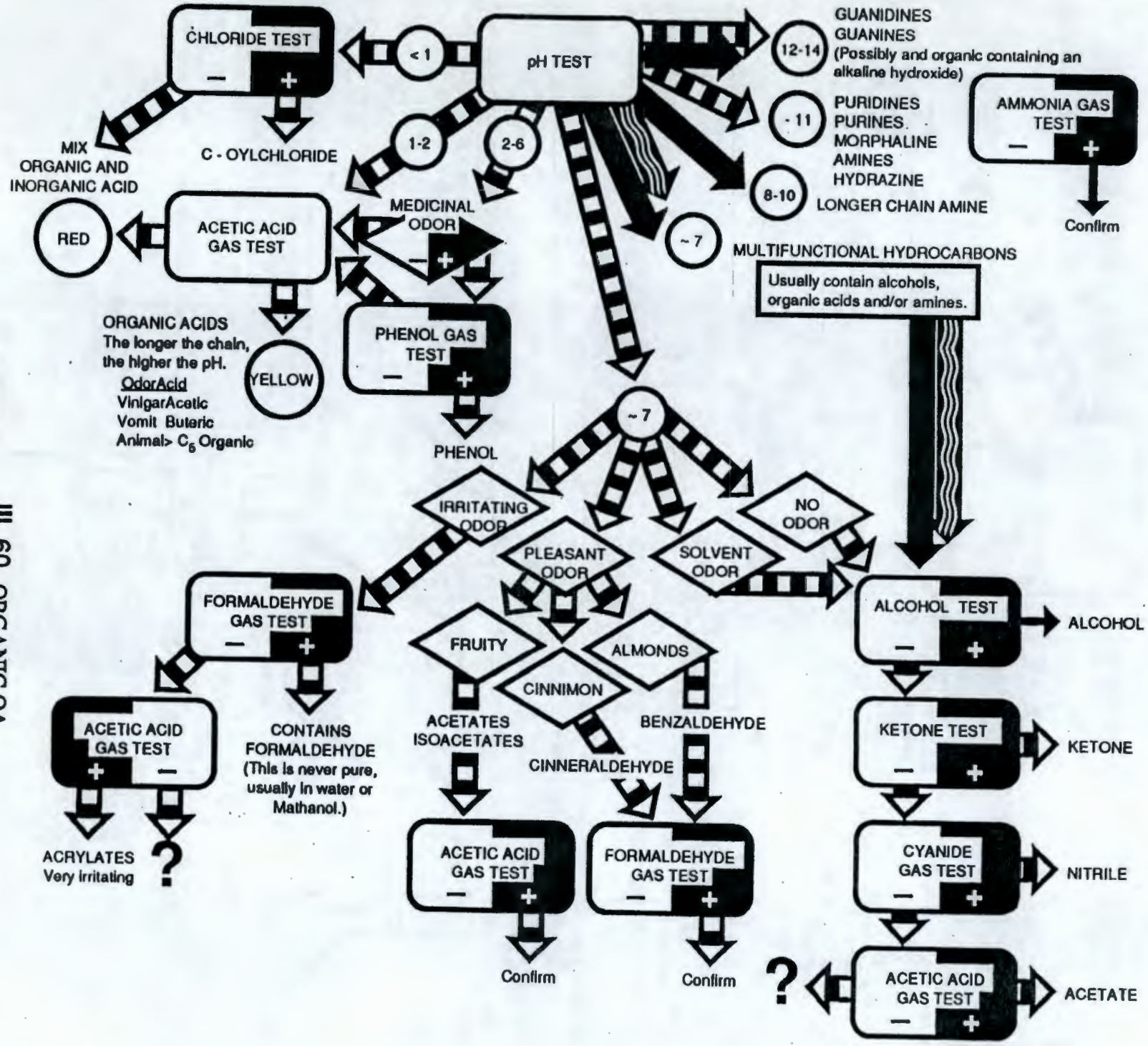
ORGANIC QUALITATIVE ANALYSIS
DISSOLVES YELLOW IODINE CRYSTAL
Procedure C



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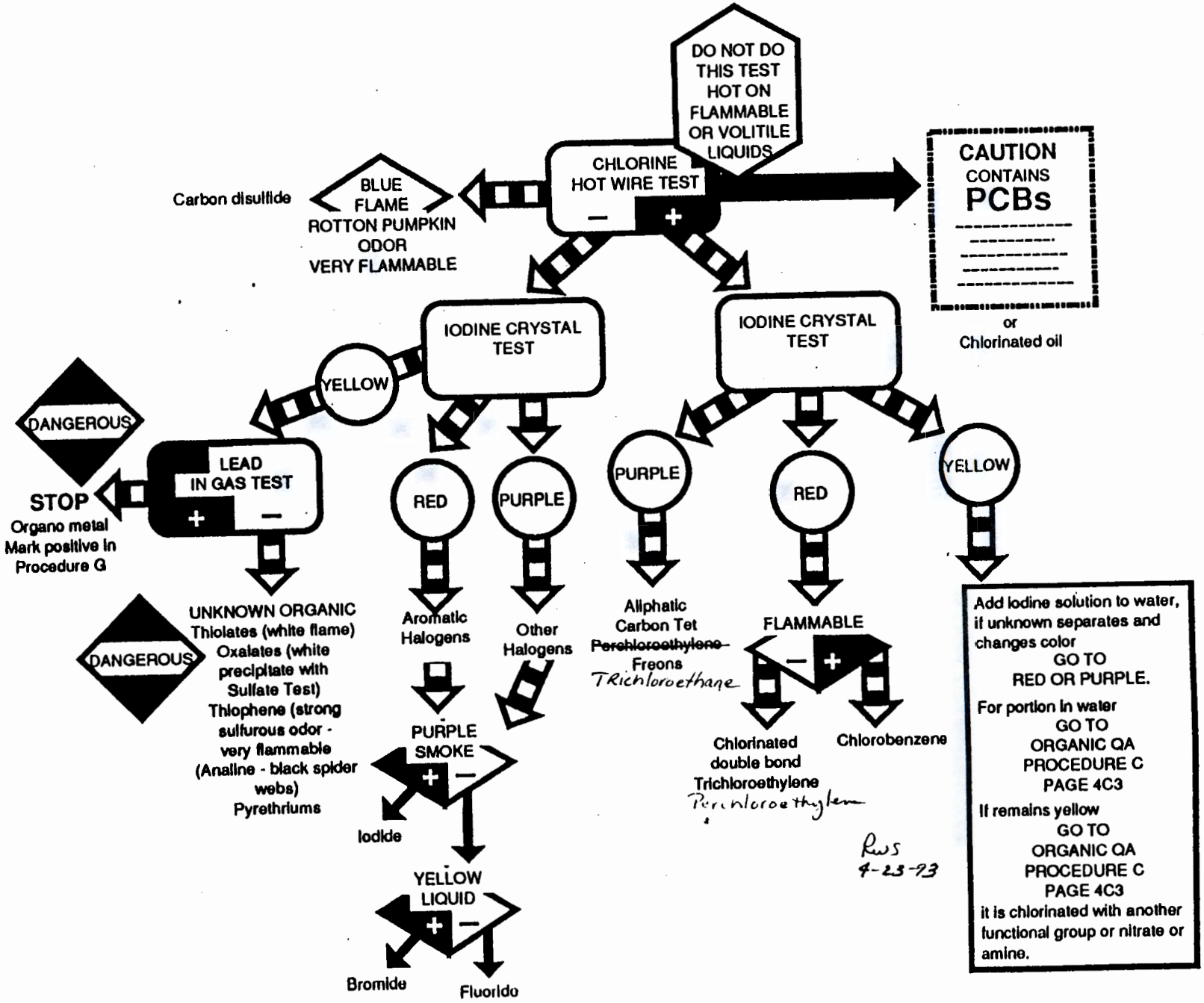
ORGANIC QUALITATIVE ANALYSIS
SOLVENT SINKS
Procedure C



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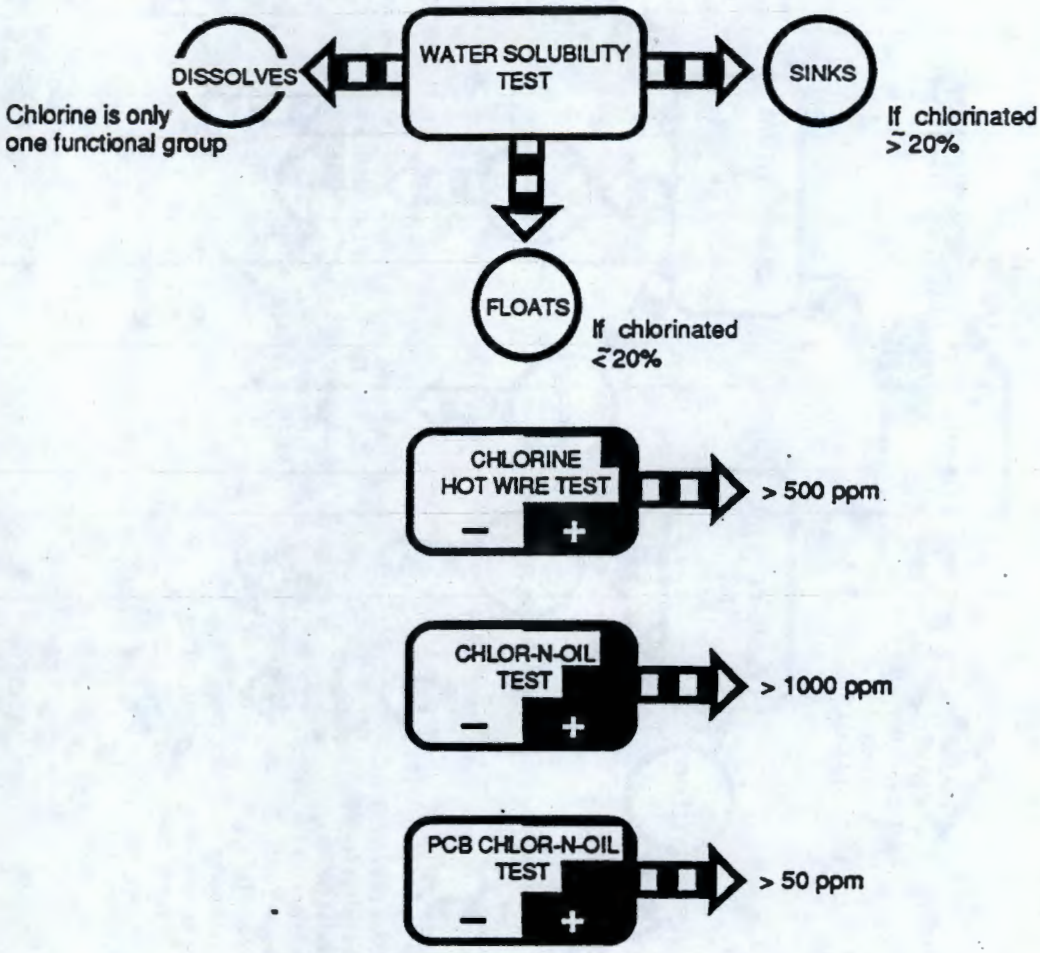
ORGANIC QUALITATIVE ANALYSIS

DEGREE OF CHLORINATION
Procedure D

Common Chlorinated Solvents have a density of about 1.3 to 1.7 times water.

Common Solvents and Oils have a density from 0.7 to 0.9%.

When mixed, the density is averaged. Therefore, at approximately 20% chlorinated or more, the mixed solution sinks - at 20%, the solution floats.



>0.1% (1000 ppm) is considered to be chlorinated waste.
> 50 ppm requires special handling for PCBs

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ORGANIC QUALITATIVE ANALYSIS

CORROSIVITY
Procedure E

If you have already done the pH Test in Procedure C,
you need only record the results here and continue on — pH_____

Chemical definition:
Acid pH < 7
Base pH > 7

Corrosive EPA:
Acid pH < 2
Base pH > 12.5

DOT Corrosive:
Will erode skin and/or steel

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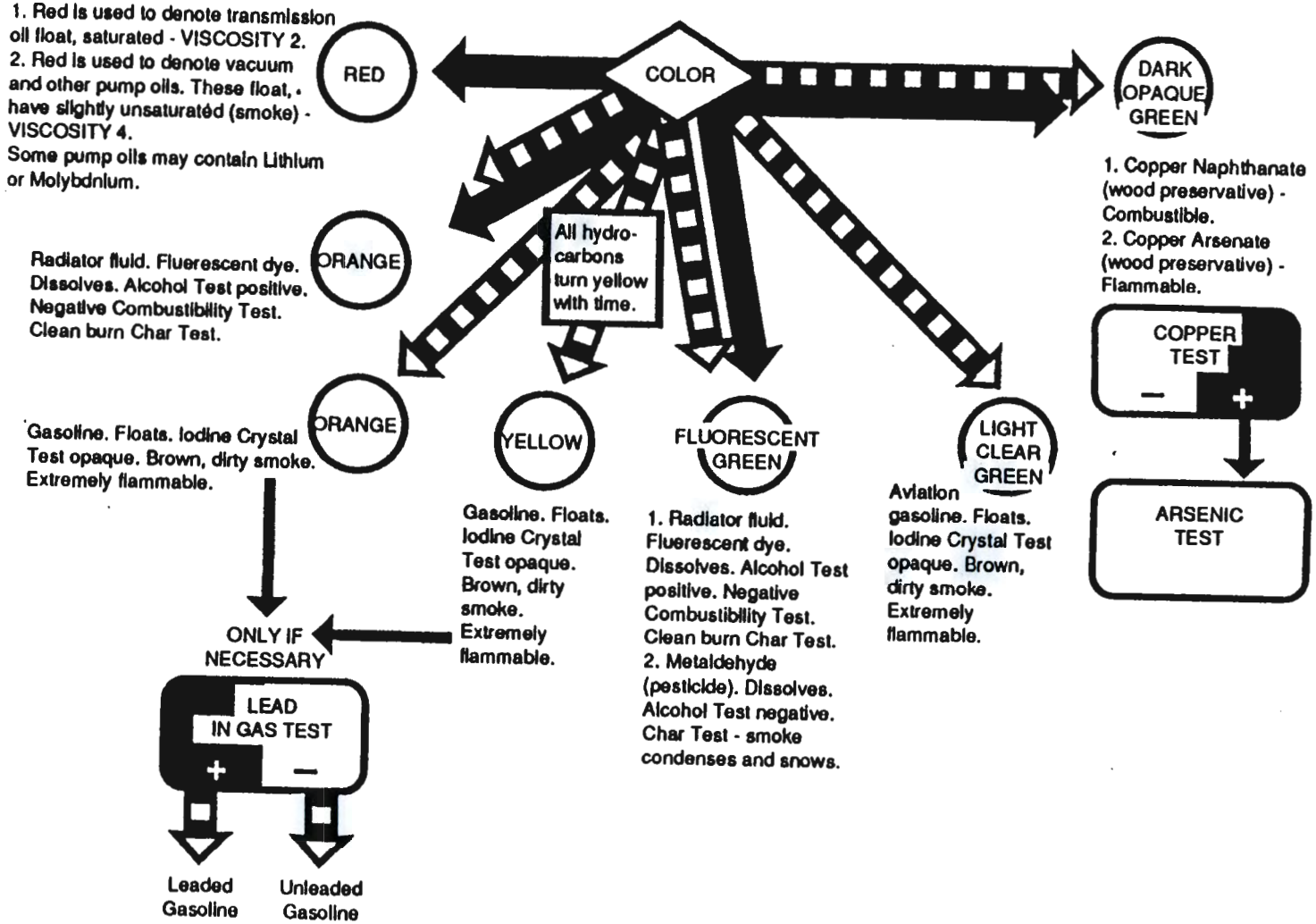
ORGANIC QUALITATIVE ANALYSIS

DYED SOLVENTS
Procedure F

There are very vew commonly encountered brightly colored organic liquids which have not been artificially colored. Organics with conjugated double bonds, and the analine'benzidine dyes are brightly colored, but are very rare. Transition metals as functional groups will cause the organic to go to the traditional metal color, eg. copper and nickel organic compounds are green. Brominated hydrocarbons are yellow. The colorations listed below are COMMONLY USED COLORATIONS FOR GROUPS OF HYDROCARBONS USED AT HOME OR IN INDUSTRY.



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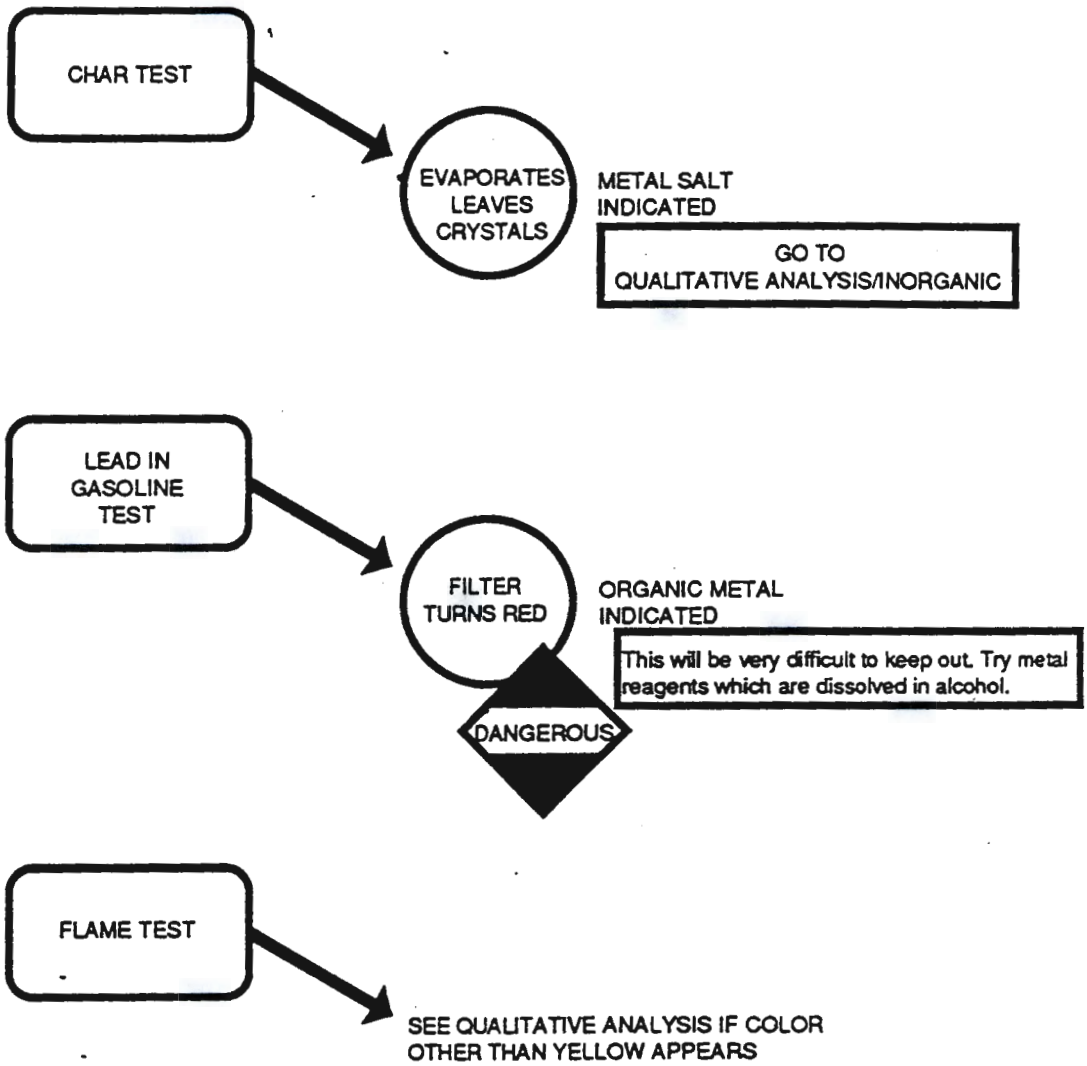
ORGANIC QUALITATIVE ANALYSIS

POSSIBLE INORGANIC METALS IN SOLVENT
Procedure G

Metal in solvents are not common, but it is not extremely rare either, and should be considered. Examples of metals in solvents include molybdnium in certain oils, lithium in greases, and mercury in light solvents (illegal drug laboratories). Neither test is absolute, but both have a possibility of detecting metals.



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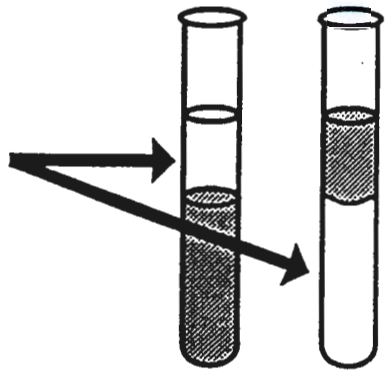
ORGANIC QUALITATIVE ANALYSIS

SEPARATION PROCEDURES
Procedure H

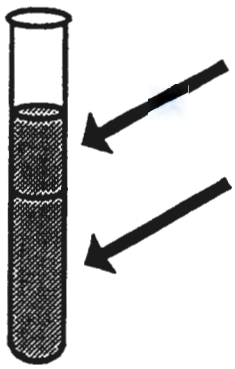
Separation of liquids (floats only):

1. Add 3 times as much Alcohol Solubility Test to 1/2 inch solvent. Shake gently and allow to stand. If there is separation, collect the excess alcohol from the clearer area. If the muck or dye remains, add more alcohol to dilute, then collect a portion of the clearer solution.



2. Add iodine crystal to the collected portion. Shake well.

3. Add water to collected portion containing iodine crystal. If no separation occurs, add more water. If separation occurs:



unknown solvent. Note color and go back to Procedure C Page 4C2.

alcohol/water - disregard color

Separation of solids from liquids (floats only):

1. Remove as much liquid from solid as possible using pipette.

2. Add hexane and shake - remove as much liquid as possible using pipette.

2. Add alcohol and shake - remove as much liquid as possible using pipette.

4. Add water and shake well - remove as much liquid as possible using pipette.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

ORGANIC QUALITATIVE ANALYSIS CONFIRMATION TESTS

Acetic Acid Gas Test:
1. Use the Acetic Acid Sensidyne Tube to collect a sample in the head space of a test tube containing the unknown.
2. A color change from a pink to a dull yellow indicates acetic acid or acetates.

Alcohol Test: This test identifies the -OH groups and will be positive on alcohols, glycols, polyols, and multi-functional hydrocarbons containing alcohol functional groups.
1. Add 5 drops of QA 7 to 1/2" of the unknown solution in a test tube.
2. Add 5 drops of Lead Test # 3 to the QA 7/unknown solution.
3. A slow color change from orange to blue indicates the presence of an -OH group.

Aldehyde Gas Test:
1. Use the Formaldehyde* Sensidyne 91L Tube to collect a sample in the head space of a test tube containing the unknown.
2. A color change from yellow to red/brown indicates the presence of the -O aldehyde group.

Benzene Gas Test:
1. Use the Benzene Sensidyne Tube* to collect a sample in the head space of a test tube containing the unknown.
2. A color change from white to dark green indicates the presence of Benzene.

Char Test: ALWAYS DO A HAIRPIN TEST BEFORE DOING THE CHAR TEST!
1. Add two pea-size amounts of the solid or 1/2 inch of the liquid unknown to a test tube.
2. a. Solids: Heat until no further reaction takes place or the test tube is melting.
   b. Liquids: Heat gently until the liquid reacts or evaporates completely, then continue to heat until no further reaction takes place or the test tube is melting.
3. Observe reactions.

Chloride Test:
1. Add a few drops of Chloride Test to a test tube containing 1/4 inch of the unknown solution.
2. A white precipitate indicates chloride.

Chlorine Hot Wire Test:
1. Heat the Chlorine Hot Wire in a torch flame until there is no green flame.
2. Allow the wire to cool.
3. Place the wire into the unknown solution or solvent in a test tube.
4. Reheat the wire in the torch flame.
5. A green flame indicates chlorine, an amine, a nitrate, an ammonium salt, urea, or a weak solution of nitric acid.

CLOR-N-OIL Test 1000*. See instructions in the box.

CLOR-N-OIL Test 50. See instructions in the box.

Combustibility Test:
1. Add the liquid unknown to a watch dish to form a pool the size of a fifty cent piece.
2. Try to ignite with a lit match.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

Copper Test:
1. Place about 1/2 inch of unknown into test tube.
2. Add an equal amount of QA 4 to the unknown liquid.
3. A color change to blue indicates the presence of copper.

Cyanide Gas Test:
1. Use the Cyanide Sensidyne Tube to collect a sample in the head space of a test tube containing the ignited unknown solvent.
2. A color change from yellow to red indicates cyanide.

Iodine Crystal Test:
1. Add a small Iodine Crystal to a test tube containing 1/2 inch of the unknown solvent.
2. Observe the color.

Ketone Test: Ketones rapidly attack PVC plastics. Although other organics will attack PVC. None are so rapid or destructive as the ketones.
1. Place a few drops of the unknown liquid on a Ketone Test Strip.
2. Rub the wetted Ketone Test Strip with the finger of your glove.
3. If the Ketone Test Strip becomes soft and slick to the touch while it is still wet or feels gritty and rough when dry, the unknown contains a ketone.

Lead in Gasoline Test:
1. Place a few drops of unknown liquid that you suspect contains an organometal (gasoline) on the center of a QA-10 (Wattman) Filter.
2. Radiate the QA-10 using an ultraviolet light source (black light).
3. Add Lead Test #6* to the QA-10 Filter at the same spot the unknown organic liquid was added.
4. A color change from green to orange indicates the presence of lead.

Mercaptan Gas Test:
1. Place 1/2 inch of unknown liquid in a test tube.
2. Break off the ends of the Sensidyne 71 Mercaptan indicator tube*.
3. Place the tube in the pump so that the arrows point towards the pump.
4. Draw a headspace sample through the tube, using several strokes (Depending upon the intensity of the odor)
5. Look for a color change from white to yellow.

Phenol Gas Test:
1. Use the Phenol Sensidyne Tube to collect a sample in the head space of a test tube containing the unknown.
2. A change from pale yellow to pale brown indicates phenol.

pH Test:
1. Add 1/4 inch of the unknown to a test tube containing 1/2 inch of water.
2. Dip the pH Test Paper into the unknown solution.
3. Compare the colors with those on the container.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

Water Solubility Test:

1. Add a pea-size amount of the unknown to 1/2 inch of water in a test tube.
2. If the unknown is not effervescing, stopper the test tube and shake it vigorously.
3. Allow time for reactions to occur.
4. Observe results.

Water Test:

1. Add a pea-size amount of Alka Seltzer(tm) to 1/2 inch of the unknown solution.
2. Effervescence indicates the presence of greater than 1% water in the solution.

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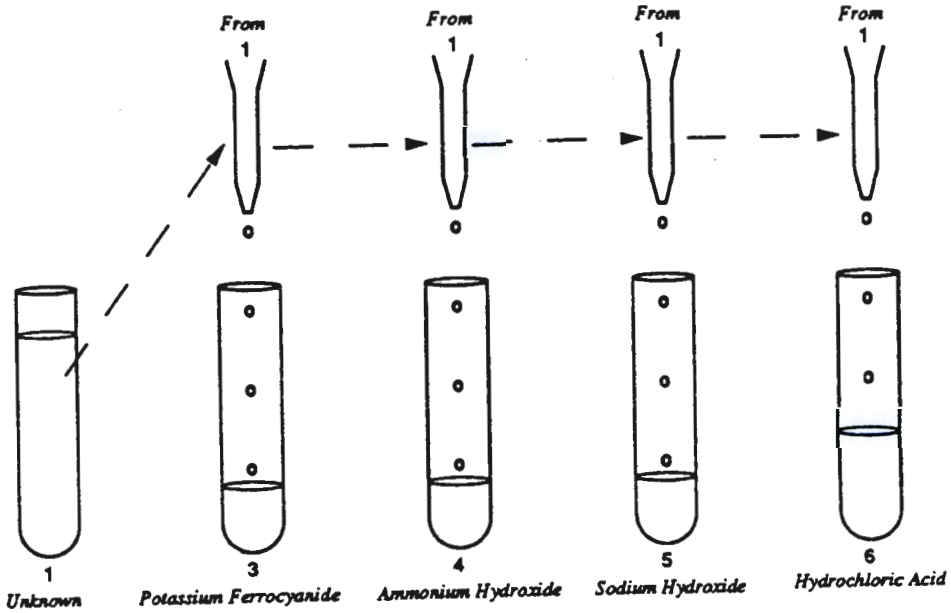
WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

SETTING UP FOR INORGANIC QUALITATIVE ANALYSIS

SETTING-UP THE TEST TUBE RACK



1. Set up 5 test tubes in a test tube rack, numbered 1, 3, 4, 5, & 6. Add the reagents and unknown as follows:

Test Tube 1: Original unknown.

Test Tube 3: Add 1/2 inch of Zinc Test (potassium ferro- cyanide). Add 1/2 inch of the unknown. Let stand. (SCREENING PROCEDURE THREE)

Test Tube 4: Add 1/2 inch of QA-4 (ammonium hydroxide). Add a 1/2 inch of the unknown from Test Tube 1. Let stand. (SCREENING PROCEDURE FOUR)

Test Tube 5: Add 2 or 3 QA-5 Pellets (sodium hydroxide) to 1/4 inch of water. Add 1/4 inch of the unknown from Test Tube 1. Let stand. (SCREENING PROCEDURE FIVE)

Test Tube 6: Add 1 inch of QA-6 (concentrated HCl acid). Add 1/4 inch of the unknown. If there is any indication of a white precipitate forming, add more unknown. (SCREENING PROCEDURE SIX)

SCREENING PROCEDURES 7, 8, & 9 ARE ONLY REQUIRED IF SCREENING PROCEDURES 1 THROUGH 6 ARE ALL NEGATIVE.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM
INORGANIC QUALITATIVE ANALYSIS SUMMARY SHEET

1. Determine that an aqueous solution exists by adding Alka-Seltzer™.

   a. Non-aqueous solution, go to solvents.
   b. Aqueous solution, continue.

2. Do the Cyanide Test: Positive: _____ Negative: _____

3. Do a pH Test: pH: _____

Potassium Ferrocyanide Filter Paper: Number of rings noted: _____

Colors Noted: Possible Metal(s) Indicated:

_____ _____
_____ _____
_____ _____

See Screening Procedure # 3 for Ferrocyanide colors.

Screening Procedure # 1, Flame Test.

Colors Noted: Possible Metal(s) Indicated:

_____ _____
_____ _____
_____ _____

Screening Procedure # 2, Borax Bead Test.

Colors noted: Possible Metal(s) Indicated:

_____ _____
_____ _____
_____ _____

Screening Procedure # 3, Potassium Ferrocyanide Precipitates.

Colors noted: Possible Metal(s) Indicated:

_____ _____
_____ _____
_____ _____

Screening Procedure # 4, Ammonium Hydroxide Screen Test.

Colors noted: Possible Metal(s) Indicated:

_____ _____
_____ _____
_____ _____

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

INORGANIC QUALITATIVE ANALYSIS SUMMARY SHEET

Screening Procedure # 5, Sodium Hydroxide Screen Test.

Colors noted: _____ _____ _____

Possible Metal(s) Indicated: _____ _____ _____

Screening Procedure # 6, Insoluble Chlorides.

White Precipitate: Yes _____ No _____

Color of Solution: _____

Possible Metal(s) Indicated: _____ _____

Screening Procedure # 7, Insoluble Acidic Sulfides.

Color of Precipitate: _____ _____

Possible Metal(s) Indicated: _____ _____

METAL CONFIRMING TESTS:

_____	Pos _____	Neg _____
_____	Pos _____	Neg _____
_____	Pos _____	Neg _____
_____	Pos _____	Neg _____
_____	Pos _____	Neg _____
_____	Pos _____	Neg _____
_____	Pos _____	Neg _____

SUSPECTED METAL(S) PRESENT IN UNKNOWN SOLUTION:

_____ _____

_____ _____

_____ _____

_____ _____

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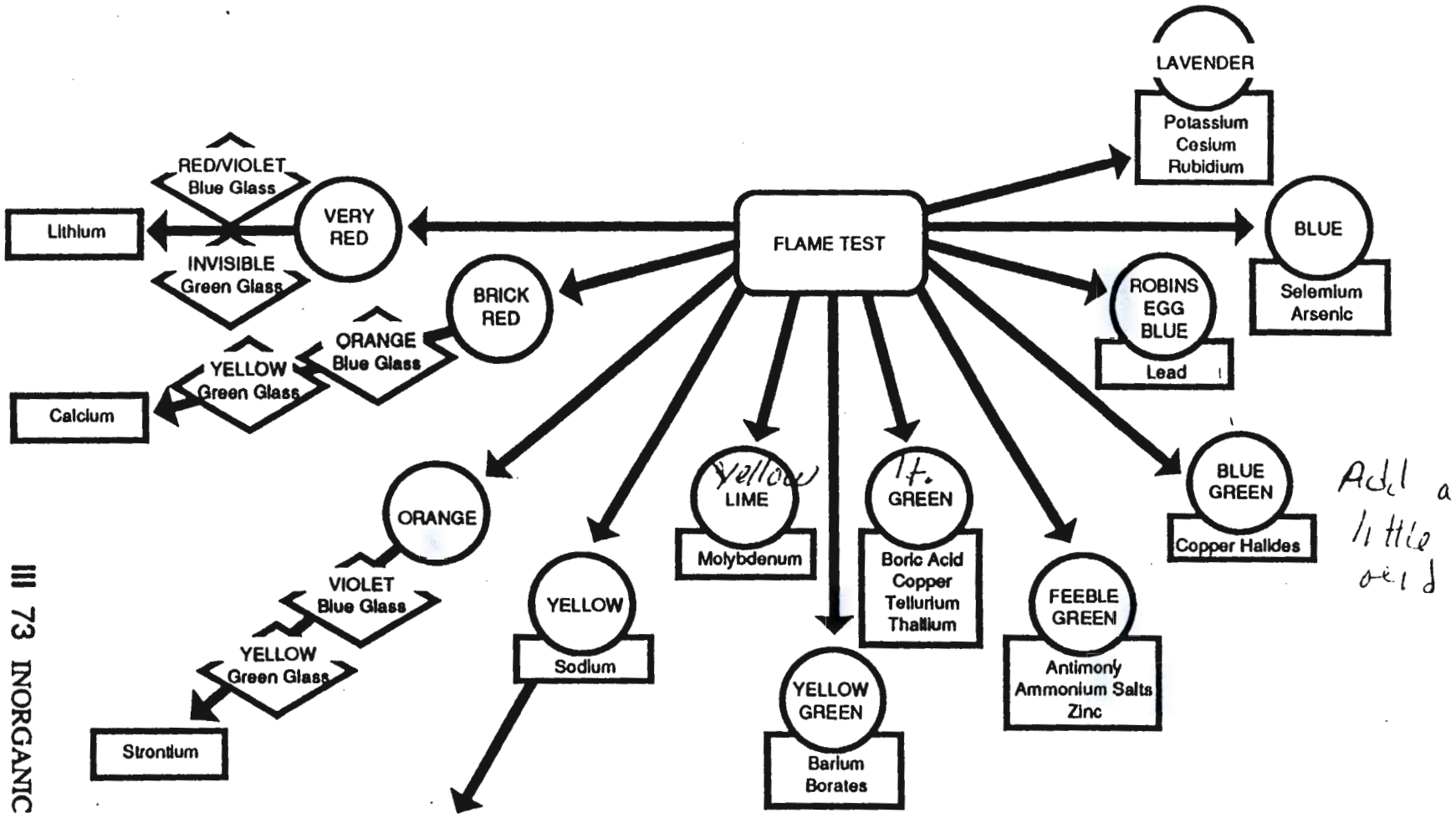
INORGANIC QUALITATIVE ANALYSIS

Screening Procedure 1

When complete, go to next page



This is, in most cases, an inconclusive test. Sodium is a very common contaminant and the sodium flame is ver strong, usually masking other colors.

Look at the flame color through Cobalt Blue Glass. This may be difficult if you have not practiced using standards.
1) Invisible if Sodium.
2) Red/violet is Lithium.
3) Yellow is Calcium.
4) Violet is Strontium.

Look at the flame color through Green Glass.
1) Yellow is Strontium.
2) Orange is Calcium.
3) Other colors, see chart above.

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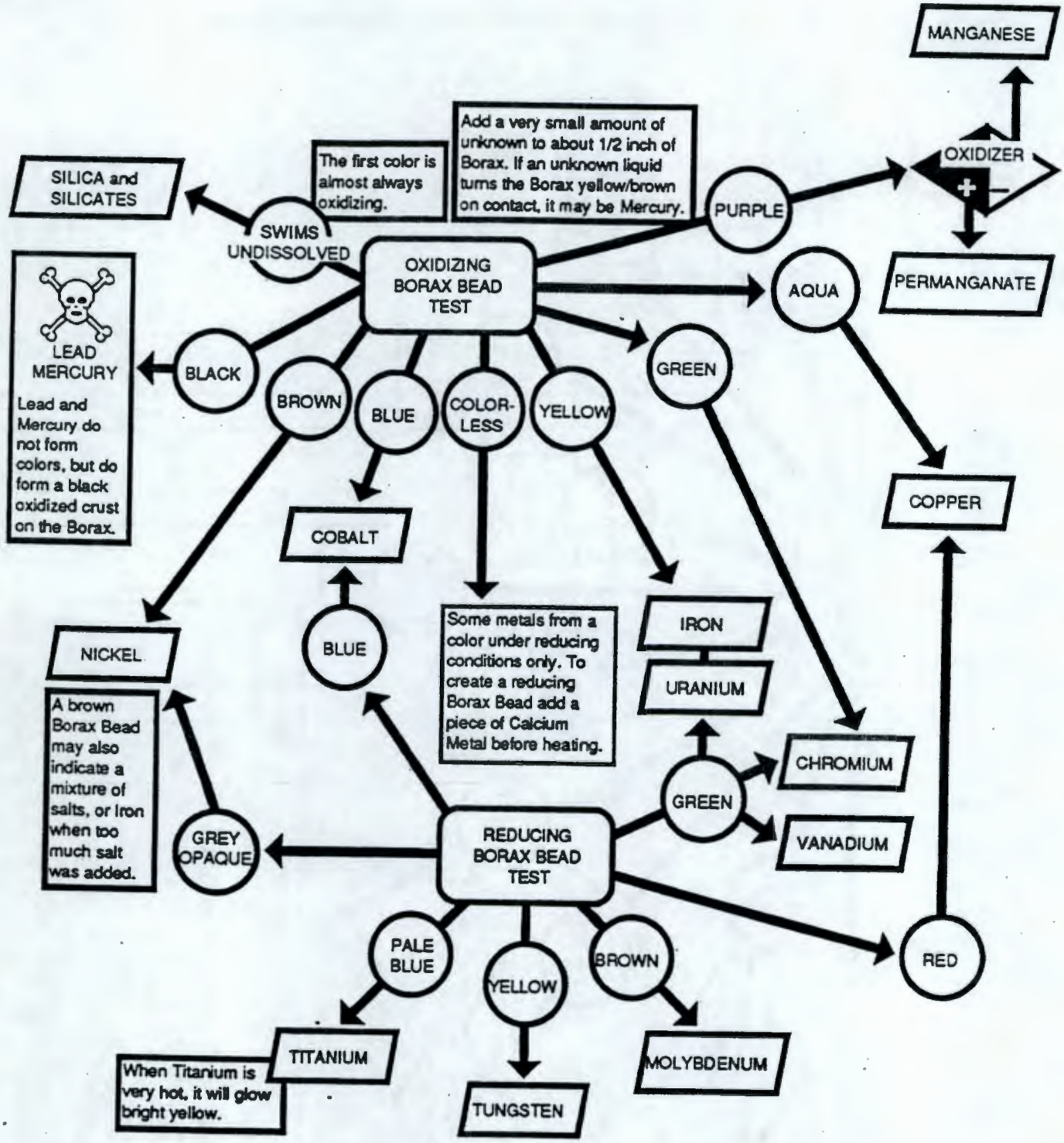
INORGANIC QUALITATIVE ANALYSIS
Screening Procedure 2



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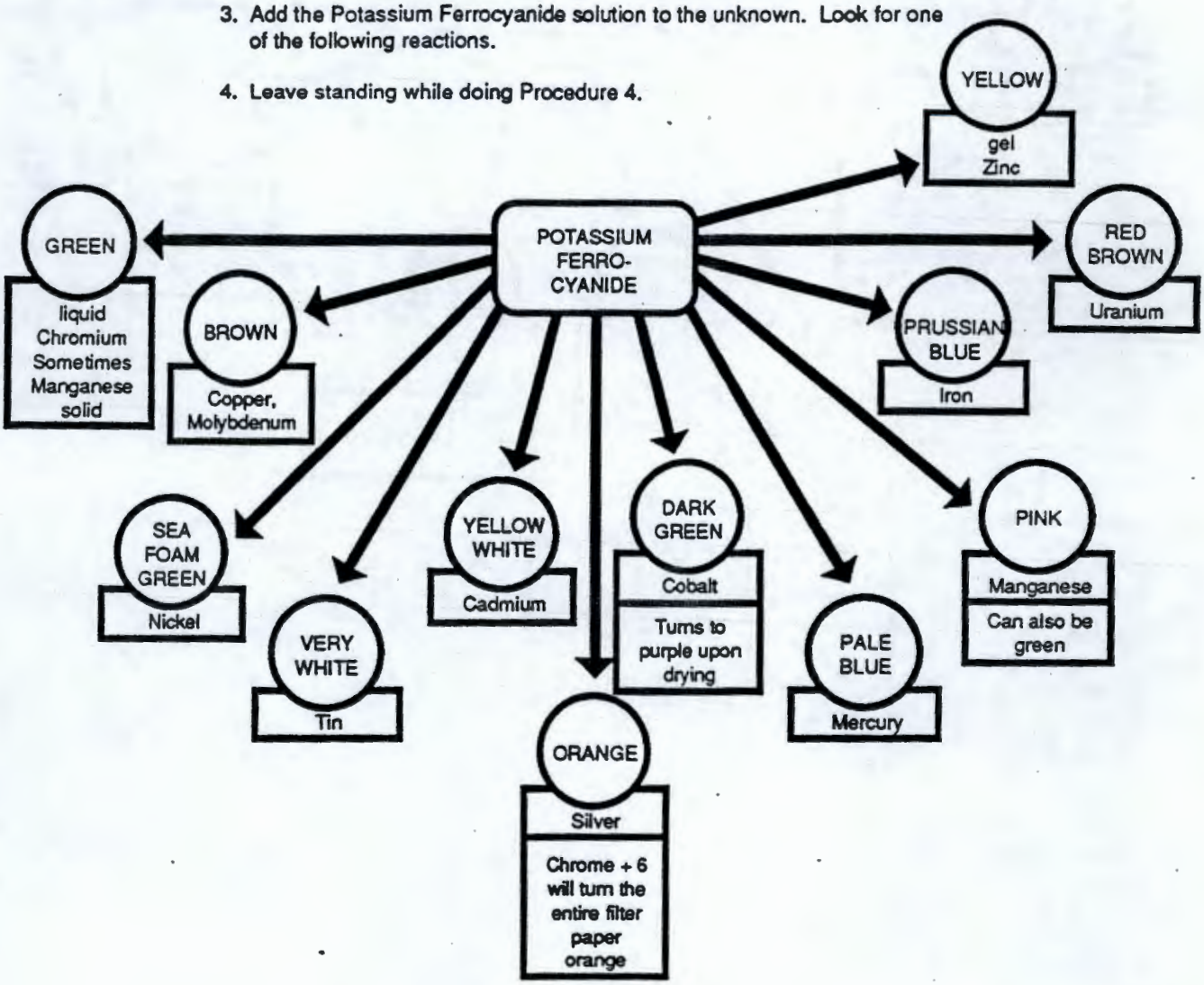
POTASSIUM FERROCYANIDE PRECIPITATES
Screening Procedure 3

1. Add concentrated hydrochloric acid, Qualitative Analysis #6, to a solid in a test tube. Add water to dilute slightly. Do not add acid if unknown is already a solution.

2. To a second test tube, add hydrogen peroxide, Qualitative Analysis #3 and a Potassium Ferrocyanide, Zinc test. Allow to stand a minute.

3. Add the Potassium Ferrocyanide solution to the unknown. Look for one of the following reactions.

4. Leave standing while doing Procedure 4.



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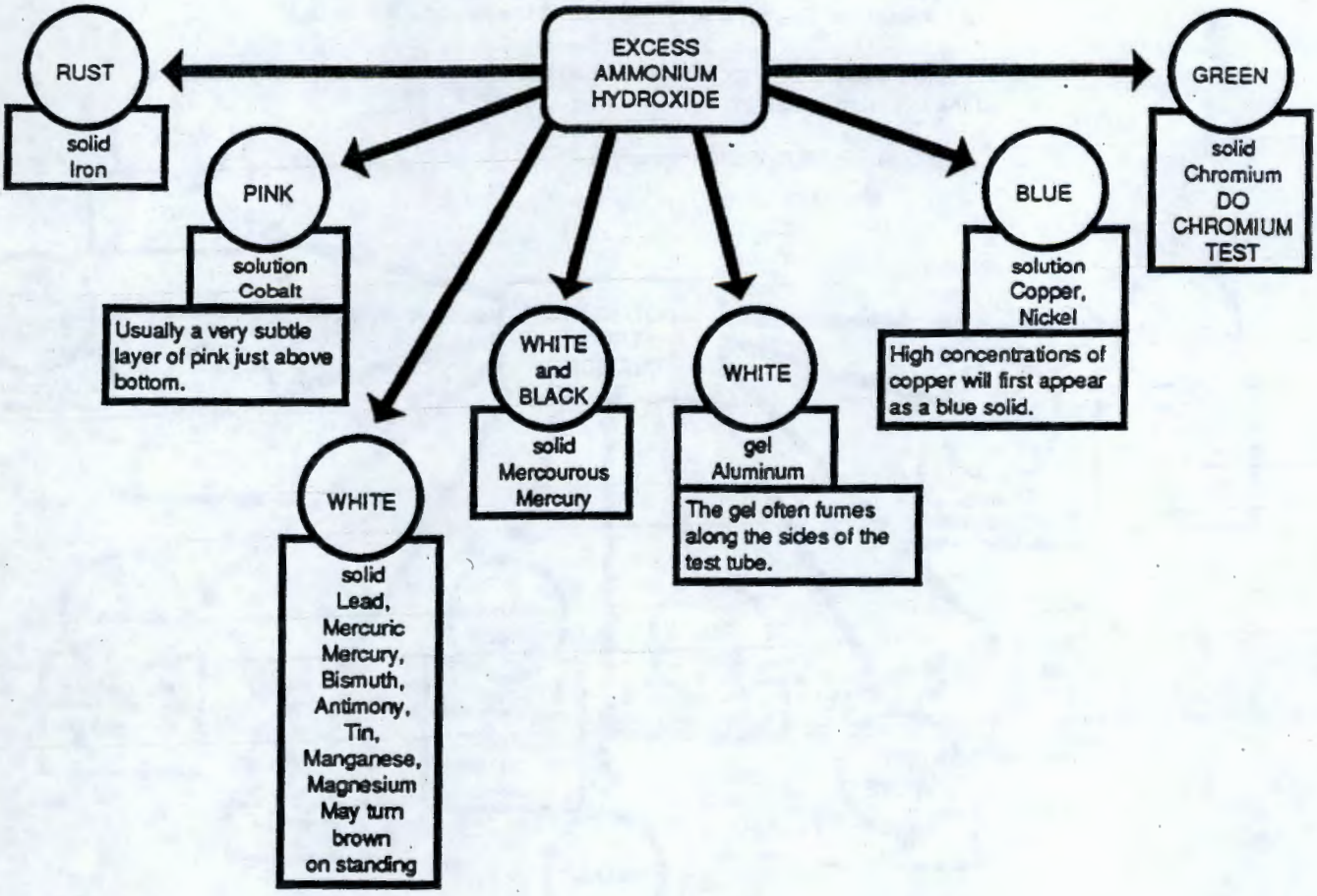
AMMONIUM HYDROXIDE SCREEN TEST
Screening Procedure 4

1. Put 5ml of Ammonium Hydroxide, Qualitative Analysis #4 in a test tube.
2. Add unknown to the test tube and observe results.
3. Leave standing while doing Procedure 5.



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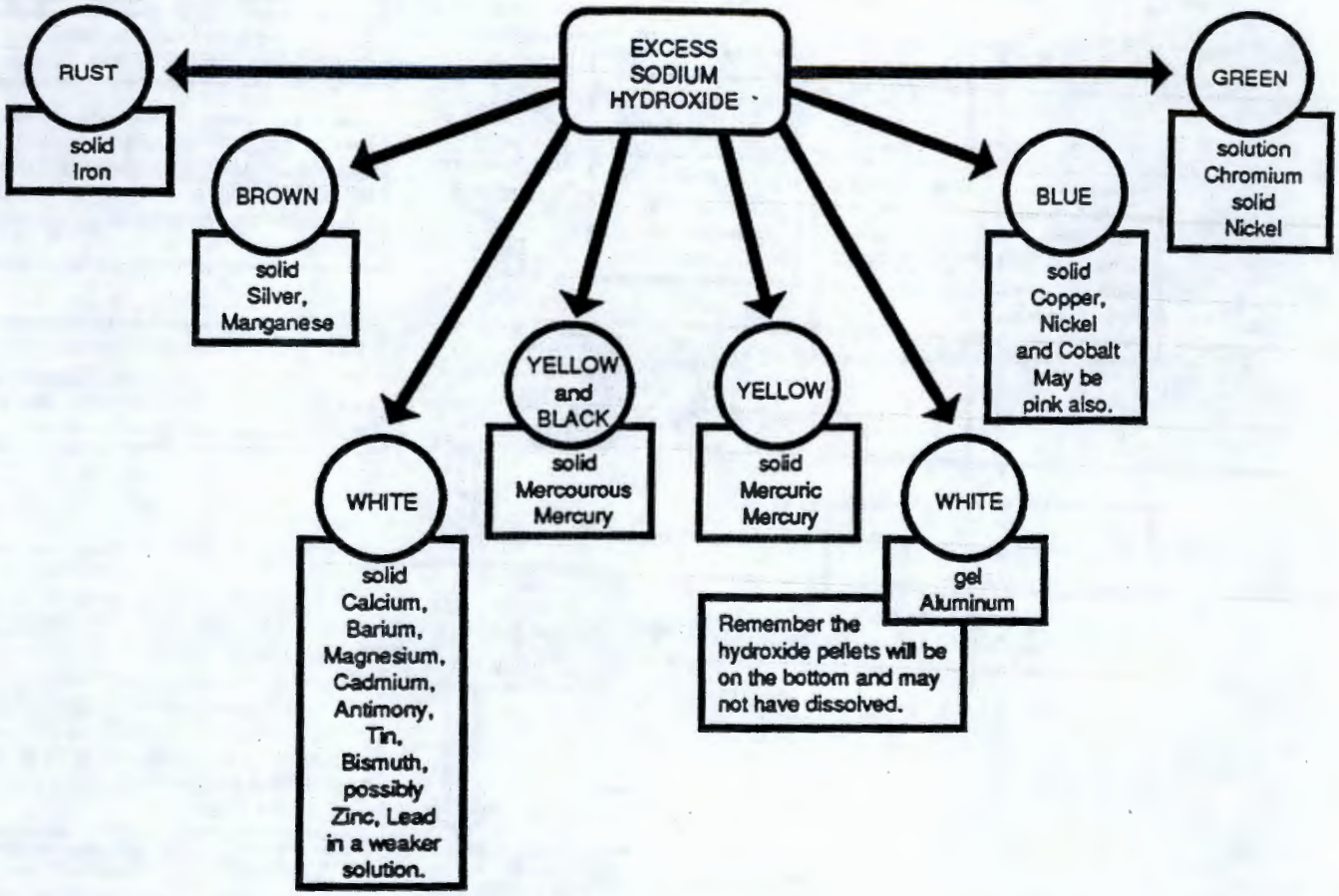
INORGANIC QUALITATIVE ANALYSIS

SODIUM HYDROXIDE SCREEN TEST
Screening Procedure 5

1. Make a strong hydroxide solution by adding approximately 3 pellets of Sodium Hydroxide Qualitative Analysis #5 to a test tube. Add just enough water to cover the pellets.

2. Add unknown solution to the hydroxide. Warning: Hold the test tube with a test tube clamp. This will be an exothermic reaction, the test tube will become very hot.

3. Leave standing and go to Procedure 4, next page.



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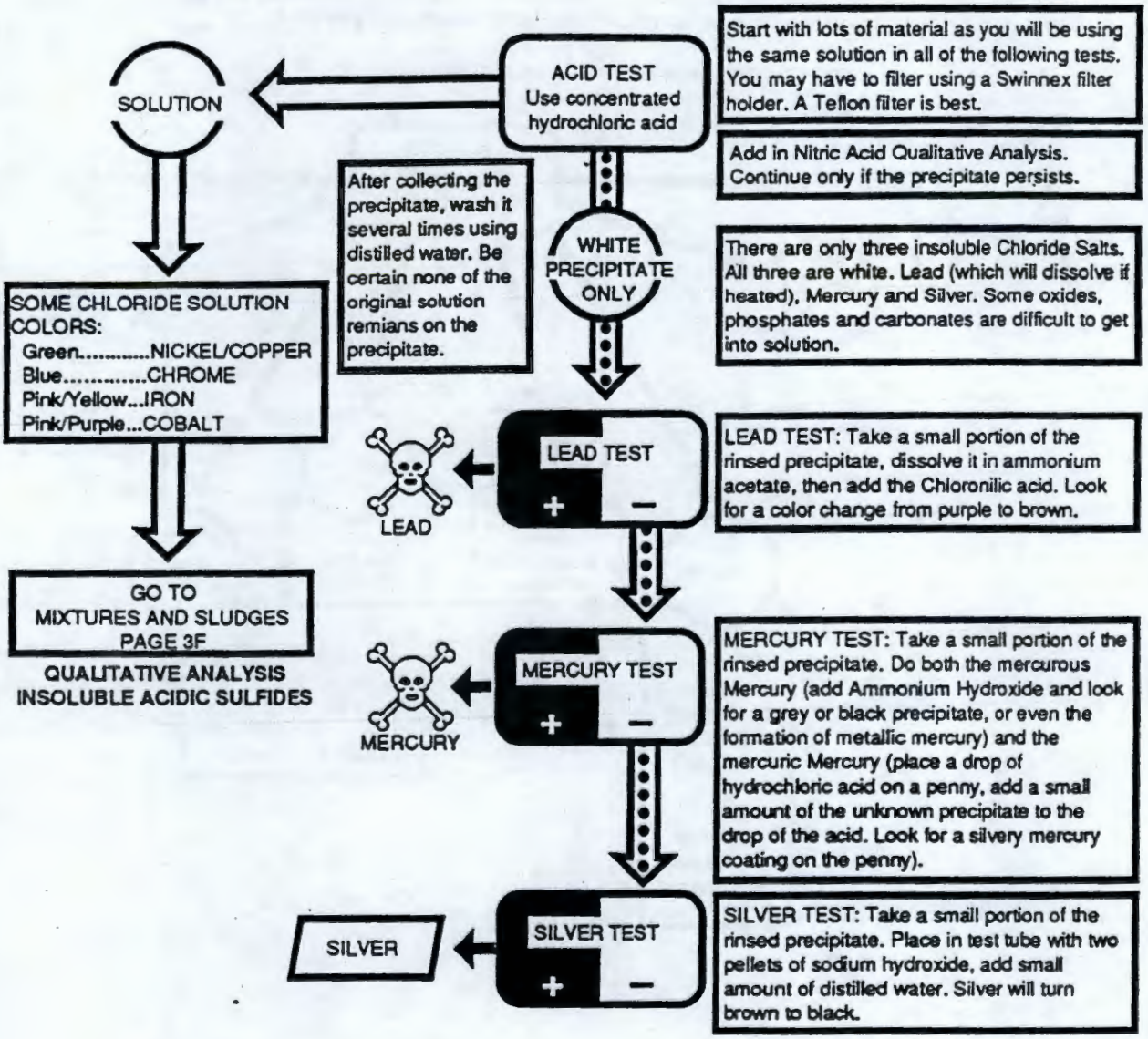
INORGANIC QUALITATIVE ANALYSIS
INSOLUBLE CHLORIDES
Screening Procedure 6

THIS IS A DIFINITIVE TEST FOR LEAD AND SILVER.
IF THERE IS NO PRECIPITATE, THESE ARE NOT PRESENT.



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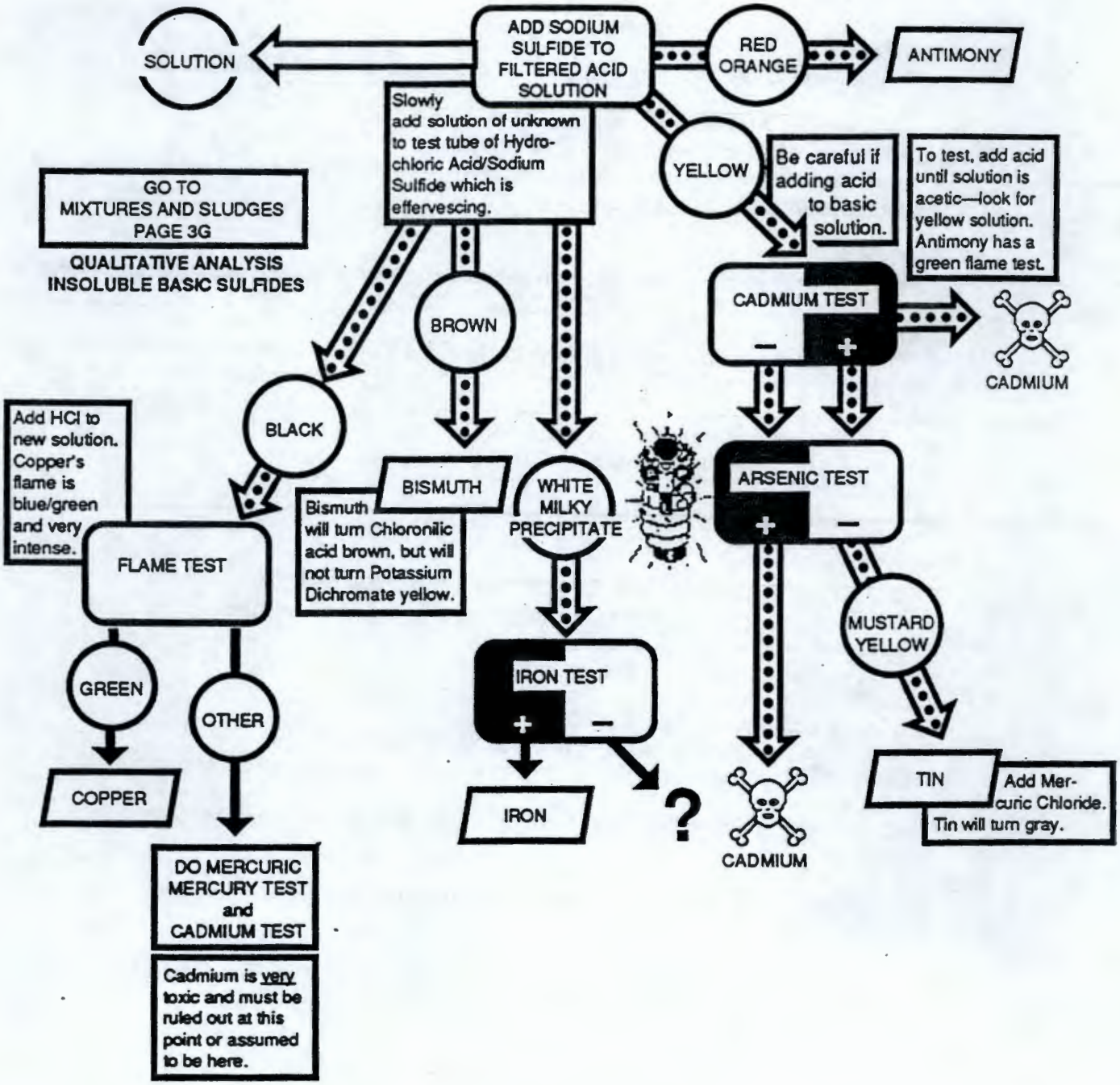
INORGANIC QUALITATIVE ANALYSIS
INSOLUBLE ACIDIC SULFIDES
Screening Procedure 7

If solution turns black, always do Cadmium Test. Cadmium is the most hazardous material that shows up here. Cadmium is often masked by the black precipitate of another metal.



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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

METAL CONFIRMING TESTS:

This section is abbreviated for easy reference. For more complete descriptions of these tests, including the interferences, refer to the alphabetically listed test descriptions section of this book. Tests which have an # behind them are only described in this section.

Reagents which have an * after them, are accessory items for the HazCat Chemical Identification System. These reagents are available, but due to the unlikely need for the reagents by most users they are not included in the standard kit.

ALUMINUM:

1. Add Acid Test to 1/2 inch of the unknown solution in a test tube until the pH is 3 or less.
2. Add 1/4 inch of Aluminum Test 1 to the test tube.
3. Add 1/4 inch of Aluminum Test 2 to the test tube.
4. A red color indicates the presence of chromium, iron or aluminum. Aluminum remains red with the addition of QA-8.

ANTIMONY:#

1. Add QA-4 to 1/2 inch of the unknown solution in a test tube until the solution is basic (pH > 7).
2. Add QA-6 until acidic (pH < 7).
3. a. If a white precipitate does not form at this time STOP. Unknown does not contain antimony.
   -or-
   b. If white precipitate forms, go to step 4.
4. Add 1/4 inch of Antimony Test 1* (sodium thiosulfate).
5. Heat gently.
6. An orange/red precipitate indicates antimony.

ARSENIC:

1. Soak Arsenic Test 6 Filter with Arsenic Test 1 and allow to dry.
2. Add the following to 1/2 inch of the unknown solution in a test tube:
   a. 1/2 pea-size of Arsenic Test 2.
   b. 1/2 pea-size of Arsenic Test 3.
   c. 1/4 inch of Arsenic Test 4. (Mix with stirring rod.)
   d. 1/2 pea-size of Arsenic Test 5.
3. The solution should effervesce. If not, add more Arsenic Test 4.
4. Insert the filter paper so that the stopper in the test tube holds the filter paper above and out of the solution.
5. The filter paper turns yellow, then orange, and finally brown/black indicates arsenic.

BARIUM:#

1. Add 1/4 inch Lead Test 3 to 1/2 inch of the unknown solution in a test tube.
2. A yellow precipitate indicates barium.

TIP: To see a positive Barium Test, place Lead Test 3 in Sulfate Test (barium chloride). Lead Test 3 is a California Prop. 65 carcinogen.

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HAZCAT® CHEMICAL IDENTIFICATION SYSTEM

WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

BISMUTH:# The best indicator for Bismuth, is to satisfy the following three conditions:
1. No white precipitate in QA-6 (concentrated HCl).
2. Turns Lead Test 1 from purple to brown.
3. Does not turn Lead Test 3 yellow. (Lead Test 3 is a California Prop. 65 carcinogen.)

BORON:#
1. Add a pea-size amount of the solid unknown to a watch dish or the unknown solution to a watch dish to form a pool the size of a dime.
2. Add Alcohol Solubility Test until the pool is the size of a quarter.
3. Ignite the alcohol.
4. A green flame indicates borates.
5. If there is no green flame, add a few drops of Arsenic Test 4 and redo steps 1 thru 4.
6. A green flame indicates borates.

CADMIUM:
1. Add 1/4 inch of Cadmium Test 2 to 1/2 inch of the unknown solution in a test tube.
2. A pink precipitate indicates cadmium.

CALCIUM:
1. Add 1/4 inch of Calcium Test to 1/2 inch of the unknown solution in a test tube.
2. A white precipitate indicates calcium.
3. This must be confirmed with a brick red Flame Test.

CESIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A purple flame indicates cesium.

CHROMIUM:
1. Add 5 drops of Acid Test to 1/2 inch of the unknown solution in a test tube.
2. Add 1/2 inch of Chromium Test 1.
3. A deep purple color indicates a chromate.

COBALT:#
1. Dissolve a pea-size amount of Cobalt Test* (sodium thiocyanate) in 1/2 inch of Alcohol Solubility Test in a test tube.
2. To 1/2 inch solution of the unknown in a test tube, add the Cobalt Test* solution.
3. A royal blue color indicates cobalt. If there is water in the end solution, the reaction may favor any iron mixed in the unknown. If there is sufficient iron and water, the solution will turn red.

COPPER:# There is no specific test for copper. The best indicator for copper is a combination of the following:
1. Zinc Test which turns copper colored in the presence of copper;
2. QA-4 which turns blue in the presence of copper; and
3. Chromium Test which will turn deep purple in the presence of copper, when the solution is neutral.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

GOLD:#

1. Add 1/4 inch of the unknown solution to a test tube with about 1/2 inch of Borax Bead Test.
2. Heat.
3. Gold will cause the bead to become carmel red. The gold will also plate out as metallic gold on top of the bead.

IRON:

1. Add 1 drop of Asbestos A2/Iron Test to 1/2 inch of the unknown solution in a test tube.
2. A deep red to an orange/yellow color indicates iron.

LEAD:

1. Add 1/4 inch of Lead Test 1 to 1/2 inch of the unknown solution in a test tube.
2. A color change from violet to brown indicates lead.

LITHIUM:#

1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A very red flame indicates lithium.
4. The very red flame which becomes invisible through Green Glass indicates lithium.

MAGNESIUM:

1. Add 1/2 inch of Asbestos Test C3/Magnesium Test to 1/2 inch of the unknown solution in a test tube.
2. A color change from purple to baby blue indicates magnesium.

MANGANESE:#

1. Add 1/4 inch of the unknown to a test tube containing about 1/2 inch of Alka-Seltzer(tm)* (sodium bicarbonate).
2. Heat until the sodium bicarbonate has melted.
3. A green color which may disappear when the bead cools, or a purple color which may persist indicates manganese.

MERCURY:

1. Add a drop of Acid Test to a copper slug.
2. Add a drop of the unknown solution to the drop of acid.
3. Use a tissue to wipe the liquids off the metal.
4. A bright silver coating on the metal indicates mercury.

MOLYBDENUM:#

1. Add 1 drop of QA-7 to 1/2 inch of the unknown solution in a test tube.
2. Add 1/8 inch of Arsenic Test 2.
3. Add one drop of Asbestos Test C1.
4. A deep blue color indicates Molybdenum. Usually the deep blue color will occur in step 2 due to the presence of small amounts of phosphate as a contaminant.

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NICKEL:
1. Add 1/2 inch of Nickel Test to 1/2 inch of the unknown solution in a test tube.
2. Add 2 or 3 drops of Asbestos Test C2 slowly to the test tube until the solution is basic (greater than pH 8).
3. A pink precipitate indicates nickel.

PALLADIUM:#
1. Add a QA-1 pellet to 1/2 inch of the unknown solution in a test tube.
2. Add 1/4 inch of Nickel Test.
3. A yellow precipitate indicates palladium or platinum.

PLATINUM:#
1. Add a QA-1 pellet to 1/2 inch of the unknown solution in a test tube.
2. Add 1/4 inch of Nickel Test.
3. A yellow precipitate indicates platinum or palladium.

POTASSIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A lavender flame indicates potassium.
4. A blue flame through Cobalt Blue Glass or a blue/green flame through Green Glass indicates potassium.

RUBIDIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A purple flame indicates rubidium.

SELENIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A blue flame indicates selenium.

SILVER:#
1. Add a few drops of Cadmium Test to 1/2 inch of the unknown solution in a test tube.
2. A cream/yellow precipitate indicates silver. If an orange precipitate forms, look for a cream color precipitate on the bottom.
3. Confirm by adding 1/4 inch of Acid Test to 1/2 inch of the unknown solution in a new test tube.
4. A white precipitate indicates silver.

SODIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A yellow flame indicates sodium.
4. The yellow flame which becomes invisible through Cobalt Blue Glass indicates sodium.

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

STRONTIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. An orange flame in the reducing flame (the center blue portion of the torch flame) indicates strontium.
4. A violet flame through Cobalt Blue Glass indicates strontium.
5. A yellow flame through Green Glass indicates strontium.

TELLURIUM:#
1. Heat and then dip Flame Test Wire (metal loop) in the unknown so that some of the unknown sticks to the wire.
2. Put the wire in a torch flame and observe the color.
3. A pure green flame indicates tellurium.

THALLIUM:#
1. Add 1/4 inch of Acid Test to 1/2 inch of the unknown solution in a test tube.
2. Add a pea-size amount of Arsenic Test 3.
3. A yellow precipitate which is insoluble in Antimony Test 1* (sodium thiosulfate) indicates thallium.

TIN:#
1. Add 1/4 inch of Arsenic Test 1 to 1/2 inch of the unknown solution in a test tube.
2. If the solution simultaneously turns black and white, and finally grey, it indicates tin.

TITANIUM:#
1. Add 1/4 inch of QA-7 and 1/4 inch of Asbestos Test A5 to 1/2 inch of the unknown in a test tube.
2. Add 1/4 inch of QA-3.
3. A cream/yellow color indicates titanium.
4. Add 1/4 inch of Asbestos Test A1.
5. A white precipitate which replaces the cream/yellow color, also indicates titanium.

TUNGSTEN:#
1. Add 1/4 inch of Arsenic Test 4 to 1/2 inch of the unknown solution in a test tube.
2. Add a pea-size amount of Arsenic Test 2.
3. A blue/grey/green solution indicates tungsten.
4. Add 1/4 inch of QA-6.
5. A color change from the blue/grey/green to yellow indicates tungsten.
6. Add a pea-size amount of Cobalt Test* (sodium thiocyanate).
7. Add a pea-size amount of Arsenic Test 2.
8. If the solution turns blue/grey/green again, it confirms tungsten.

URANIUM:#
1. Add 1/2 inch of Asbestos A4 to 1/2 inch of the unknown solution in a test tube.
2. Add 1/4 inch of Zinc Test.
3. A red/brown precipitate indicates uranium. (Iron and copper are interferences.)
4. Put a drop of the unknown solution on a QA-10 Filter soaked in Zinc Test.
5. A brown ring appearing outside the blue iron ring indicates uranium.

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VANADIUM:#

1. Add 1/4 inch of Arsenic Test 4 to 1/2 inch of the unknown solution in a test tube.
2. Add 1/4 inch QA-3.
3. A red/brown color indicates the presence of vanadium.
4. Add 1/4 inch of Asbestos Test A1.
5. If the red/brown color persists, it indicates vanadium.

ZINC:

1. Add 1/4 inch of QA-3 to a test tube with 1/4 inch of Zinc Test and allow to stand.
2. Add the Zinc Test/QA-3 solution slowly to 1/2 inch of the unknown solution in a test tube.
3. A thick yellow gel indicates zinc. If the Zinc Test/QA-3 solution has not aged sufficiently, a white and yellow gel indicates zinc.

ZIRCONIUM:#

1. Add a pinch of Alizarin yellow* to 1/2 inch of the unknown solution in a test tube.
2. The solution should turn purple.
3. Add 1/4 inch of Asbestos Test A1.
4. A color change to yellow confirms zirconium.

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III 86 PERIODIC TABLE

I A	II A	III B	IV B	V B	VI B	VII B	VIII			I B	II B	III A	IV A	V A	VI A	VII A	O
1 H 1.00797																1 H 1.00797	2 He 4.0026
3 Li 6.939	4 Be 9.0122											5 B 10.811	6 C 12.01115	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312											13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)															
				58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97
				90 Th 232.038	91 Pa (231)	92 U 238.04	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (254)	103 Lw (257)

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WEAR EYE PROTECTION AND GLOVES WHEN PERFORMING TESTS

CHAR TEST SUMMARY SHEET

This exercise is designed to familiarize the student with Haz-Cat's most powerful test, the Char Test. The purpose of the exercise is to show students that by understanding the results of this test, they can identify hundreds of materials without going further, or they can find shortcuts toward a final test.

It is extremely important to remember two things about the Char Test: in the field **NEVER** start with the Char Test; and because there are many subjective descriptions in the Char Test results, it is necessary to review all the possible results before making a conclusion.

UNKNOWN NUMBER	APPEARANCE OF UNKNOWN	CHAR TEST RESULTS HAIR PIN	CHAR OXID	CHAR pH	BEST GUESS SUGGESTED NEXT TEST
1		green flame	+	N/A	Copper salt
2					
3					
4					
5					
6					
7					
8					
9					

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CHAR TEST SUMMARY SHEET

UNKNOWN NUMBER	APPEARANCE OF UNKNOWN	CHAR TEST RESULTS HAIR PIN	CHAR OXID	CHAR pH	BEST GUESS SUGGESTED NEXT TEST
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

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