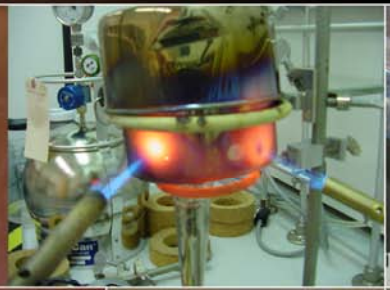
Indicators and Warnings of Improvised Chemical and Biological Agent Production



Second Edition
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The Technical Support Working Group's Chemical, Biological, Radiological, and Nuclear Countermeasures (CBRNC) Subgroup, in cooperation with law enforcement and intelligence agencies, conducts comprehensive assessments of chemical and biological materials, devices, and countermeasures. As part of their efforts, they evaluated the potential effectiveness of production methods found in the form of recipes from open-source improvised production handbooks that may be used by extremists groups. They assessed the skill level required to follow the instructions and determined the availability of the necessary equipment and ingredients.

The purpose of this handbook is to provide information about general indicators and warnings, production setups, and end products that are representative of plausible improvised production methods of chemical and biological agents following methods found in openly available improvised production literature. The handbook contains mock-up pictures to assist security and response personnel in recognizing chemical or biological agent production. The handbook contains specific information on the key indicators of agent production, including chemicals required for production. It will be noted if a chemical required for production is also regulated by the Drug Enforcement Administration (DEA) as a List I or List II chemical (U.S. Department of Justice. DEA, *Chemical Handlers Manual,* January, 2004). List I and II chemicals are those that, in addition to having legitimate uses, are used in manufacturing a controlled substance in violation of the Controlled Substances Act. List I chemicals generally are precursors and have been determined by the DEA to require a level of control greater than other listed chemicals. List II chemicals generally are reagents and solvents.

The information in this handbook should be used in conjunction with previous training and experience.

PURPOSE

This handbook contains 14 color-coded sections. There is one section for each of 13 agents and one for improvised binary dissemination techniques. For each agent there is a list of key indicators and warnings as well as a description of the production methods, equipment, and likely product.

DISCLAIMER

The pictures in this book are mock-ups intended to illustrate potential methods for agent production. Setups may vary and production methods can change the product outcome.

The following examples may look similar to laboratory setups used for legitimate purposes or clandestine drug production.

Ricin - Indicators and Warnings

Ricin is extracted from castor seeds, which come from the ricin plant *Ricinus communis.*

Key Indicators

- Castor seeds (not kidney shaped)
- Marbles, beaker
- pH paper
- Lab filter paper or coffee filters with white powder
- Dead animals in the area
- Gloves and face mask
- Basic equipment, such as blenders, jars, and pliers that can be easily obtained (local hardware store, laboratory supply house, high school laboratory).
- Chemicals such as acetic acid (vinegar), acetone, bleach, carbon tetrachloride, hexane, hydrochloric acid (muriatic acid, DEA List II Regulated Chemical), magnesium sulfate (Epsom salts), sodium carbonate, sodium chloride (table salt), sodium hydroxide (NaOH, lye), sodium sulfate, and sulfuric acid (battery acid, DEA List II Regulated Chemical)

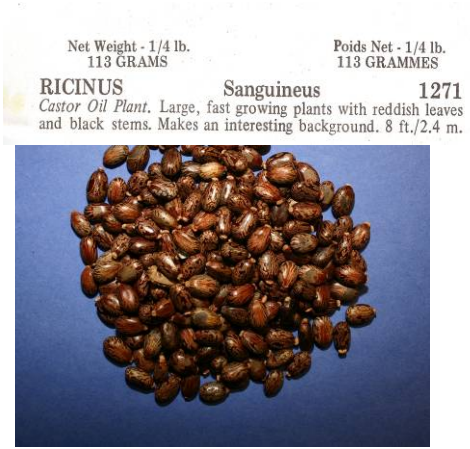
Ricin Plant

Raw Castor Seeds

Castor seeds can be readily purchased over the Internet or from a local plant and garden store.

Castor Seeds Procured from Commercial Industry

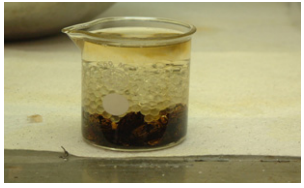
Commercial Seed Packet



Ricinus sanguineus

Ricinus zanzibariensis

Ricin is extracted from castor seeds.



Castor Seeds and Glass Beads in Soaking Solution

De-shelling of Castor Seeds After Soaking

Mock-up of Bean Pulp After Blending

A typical castor bean plant has an average of 1,300 seeds. On average one cup contains 500 seeds, weighs 130 grams, and may yield up to 3 grams of pure ricin within the crude product.

Filtering Materials

Ricin toxin can be in the form of a liquid or a “white powder.” The “white powder” more commonly associated with the toxin is indicative of a purer product. Crude ricin powder may have discoloration due to impurities, but the particle size may still be within the respirable range.

Simulated Crude Ricin Extract
Colored Specks are Indicative
of a Crude Product

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Cyanides - Indicators and Warnings

The cyanides described here include potassium and sodium cyanide salts (KCN and NaCN) and hydrogen cyanide (HCN). In the absence of access to the purchase of commercially available cyanide salts, one of several improvised production methods may be followed.

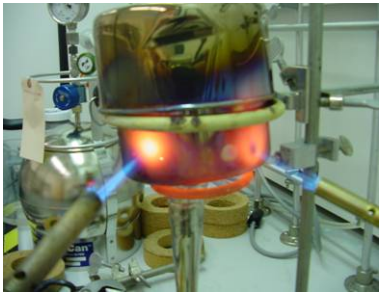
Key Indicators

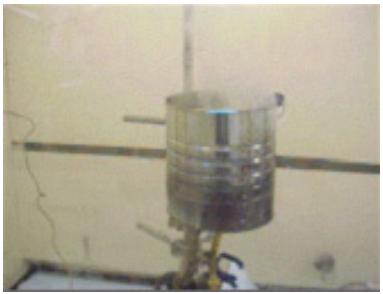
- Distillation equipment
- Propane torch, improvised furnace
- Basic starting ingredients such as ashes, rust, leather, charcoal, washing soda, and blackboard chalk, blood
- Basic laboratory equipment (stirring device, beakers, pH paper, hot plate, etc.)
- Chemicals such as baking soda, calcium carbonate, calcium chloride, hydrochloric acid (muriatic acid, DEA List II Regulated Chemical), iron oxide, potassium carbonate, potassium cyanide, sodium carbonate, and sodium cyanide, sodium thiosulfate (cyanide antidote), and sulfuric acid (battery acid, DEA List II Regulated Chemical)

Rust Shavings

Magnetic Stirring Device

Improvised Heating Devices





Distillation Equipment

pH Paper

Hydrogen cyanide (HCN) is a colorless gas or bluish-white to purple liquid with a bitter almond odor. When purified, liquid HCN is clear to pale yellow in color. Crude cyanide salts are crystalline solids that vary in color from white to blue-green. Commercial grade salts vary in color from white to pale yellow.

Crude Liquid HCN

Crude Cyanide Salt

Color Variability of Commercially Available Potassium and Sodium Cyanide Salts (KCN, NaCN)

Pure

White **Pale Yellow**

Sarin - Indicators and Warnings

Sarin (GB) is difficult to produce, requiring ground glass jointed glassware and posing a danger to the operator due to its high toxicity. Some of the laboratory equipment can be improvised and/or purchased from laboratory supply houses. Sarin is a volatile chemical that presents both a liquid and vapor hazard when disseminated.

Key Indicators

- Laboratory glassware
- Improvised distillation equipment including vacuum distillation equipment and oil bath (cooking oil, motor oil, etc.)
- Stirring and shaking devices
- Improvised safety equipment such as rubber gloves and masks
- Dry ice
- Chemicals such as acetone (DEA List II Regulated Chemical), aluminum chloride, bleach, isopropyl alcohol, methylchloride (chloromethane), methylene chloride (dichloromethane or methylene dichloride), phosphorus trichloride, sodium fluoride, and sodium hydroxide (lye)

Distillation Equipment

Variability of Color

Pure sarin is a colorless liquid. Sarin can range in color from pale yellow to straw to amber.

Pure

Colorless/Clear Straw Amber

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Botulinum Toxin - Indicators and Warnings

The bacterium that produces botulinum toxin, *Clostridium botulinum*, can be extracted from soil and grown in a fatty beef media in the absence of oxygen.

Key Indicators

- Canning jars
- Pressure cooker
- Soil
- Raw Meat
- Putrid smell of rotting meat
- Hydrochloric acid (muriatic acid)–DEA List II Regulated Chemical

Pressure Cooker

Canning Jar

The extracted toxin can vary in color depending on what purification has taken place. The toxin may be part of a liquid slurry or be refined to a powder. Because production uses rotting meat, the product will exude a foul odor.

Simulated Bacterial Growth and Botulinum Toxin Accumulation in Rotting Meat

Mock-Up of Inoculated (Right) and Uninoculated (Left) Jars After Incubation

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Phosgene - Indicators and Warnings

Phosgene (CG) is a toxic gas that was used extensively during World War I as a choking agent. Phosgene is a major industrial chemical used to make plastics and pesticides.

Key Indicators

- Binary components (e.g., device containing two liquid-filled glass jars)
- Container of liquid on heating device
- Chemicals such as carbon tetrachloride, sulfuric acid (battery acid, DEA List II Regulated Chemical), and hydrochloric acid (muriatic acid, DEA List II Regulated Chemical)

Production - It is unlikely that phosgene would be produced by following the typical improvised production recipe.

Product - At room temperature, phosgene is a poisonous gas that may appear colorless or as a white to pale yellow cloud. At low concentrations, it has a pleasant odor of newly mown hay or green corn; but, its odor may not be noticeable. At high concentrations, the odor may be strong and unpleasant.

Sulfuric and Hydrochloric Acid Reagent Bottles

Mustard - Indicators and Warnings

Mustard (HD, sulfur mustard) is a blister agent that was one of the most widely used military chemical agents in World War I. It is a viscous liquid at room temperature and poses a contact and vapor hazard. Mustard has no commercial uses. One of its precursors and degradation products, a commonly used industrial chemical, is used in the manufacture of inks and dyes.

Key Indicators

- Basic laboratory equipment (flasks, heaters, condensers, vacuum aspirators, drying tubes, etc.)
- Improvised distillation equipment
- Improvised safety equipment such as rubber gloves and masks
- Chemicals, such as acetone, calcium hypochlorite, 2-chloroethanol (ethylene chlorohydrin), ethanol, ethylene, hydrochloric acid (muriatic acid, DEA List II Regulated Chemical), petroleum ether, sodium hydroxide (lye), sodium sulfide nonahydrate, powdered sulfur, sulfur dichloride, sulfuric acid, and thiodiglycol (battery acid, DEA List II Regulated Chemical)

Simulated Laboratory Setup for Preparation of Mustard from Thiodiglycol

Mustard synthesis requires some ground glass jointed glassware. All of the laboratory equipment is readily available from commercial sources.

Simulated Laboratory Setup

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Variability of Color

Pure mustard is a liquid at room temperature and varies in color from colorless to pale yellow. Impure mustard can vary in color from pale yellow to dark brown or black with pieces of yellow elemental sulfur. Mustard has a garlic-like odor. In impure forms, it has a garlic-horseradish odor. It is viscous at room temperature.

Pure Impure

Colorless/Clear Pale Yellow Dark Brown/Black

Typical Appearance of Crude Mustard

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Anthrax - Indicators and Warnings

Bacillus anthracis is the disease-causing agent of anthrax. It is a naturally occurring, spore-forming soil bacterium that be can cultured and grown in quantity in a laboratory setting.

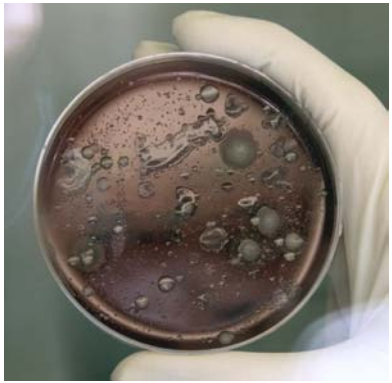
Key Indicators

- Basic laboratory equipment and glassware
- Microbiological equipment such as agar, growth medium, cell spreader, microspatula, incubator, petri plates, and pipettes
- Biohazard bags
- Filters or equivalent (e.g., cheesecloth)
- Glove box
- Improvised safety equipment such as latex gloves and masks
- Antibiotics
- Mortar and pestle
- Bleach
- Chemicals such as acetone, bleach and hydrochloric acid (muriatic acid, DEA List II Regulated Chemical)

Incubator

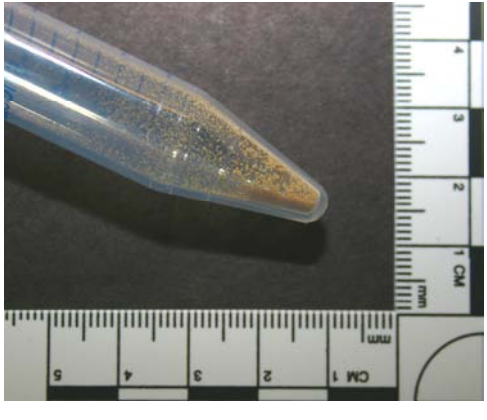
Generation of anthrax begins with obtaining the bacterium from an existing culture or isolation from the environment, then growing the bacterium in a growth medium. After inducing sporulation, the spores are harvested and processed for dissemination.

Glove Box



Growth Media with Simulated Anthrax

Laboratory-generated anthrax spores appear as a white to gray powder. A crude powder may have differing color or texture depending on the methods of growth and processing.



Simulated Crude Anthrax Powder

Arsine - Indicators and Warnings

Arsine is a highly toxic colorless gas.

Key Indicators

- Laboratory glassware
- Bunsen burner
- Dry ice
- Chemicals such as arsenic trioxide, hydrochloric acid (muriatic acid, DEA List II Regulated Chemical), sulfuric acid (battery acid, DEA List II Regulated Chemical), zinc arsenide, and zinc powder (glittery bluish-white solid)

Laboratory Setup

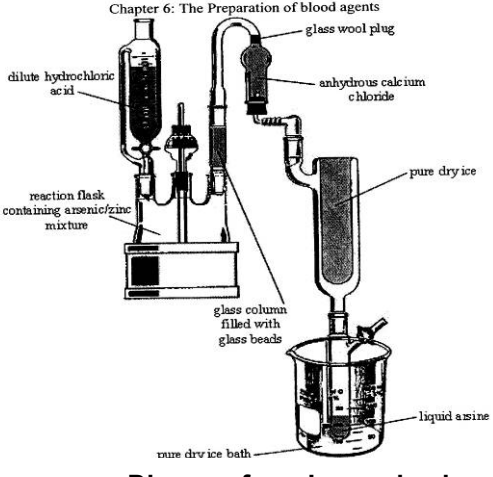


Diagram from Improvised Production Literature Showing Laboratory Setup

Production

Arsine gas is generated through a reaction of combining various chemicals with acid. Some production setups are complex, requiring ground glass jointed laboratory glassware, whereas others are relatively simple binary reactions that can be carried out on-site and at a larger scale.

Simulated Laboratory Setup

Product

Arsine is a colorless gas, but the production method may generate a cloudy vapor. Arsine has a strong garlic or onion odor at high concentrations but this may not serve as a useful warning property.

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Phosphine - Indicators and Warnings

Phosphine is a toxic gas.

Key Indicators

- Laboratory glassware
- Nitrogen or carbon dioxide gas cylinder
- Chemicals such as aluminum phosphide, calcium phosphide, hydrochloric acid (muriatic acid, DEA List II Regulated Chemical), sodium hydroxide (NaOH, lye), sulfuric acid (battery acid, DEA List II Regulated Chemical), white phosphorus (DEA List I Regulated Chemical), and zinc phosphide

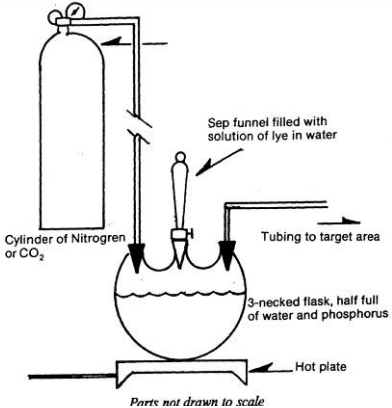

Diagram from Improvised Production Literature Showing Laboratory Setup

Production

Phosphine gas is generated through a reaction of combining various chemicals with an acid or water. Some production setups are complex, requiring ground glass jointed laboratory glassware, whereas others are relatively simple binary reactions that can be carried out on-site and at a larger scale.

Product

Phosphine is unstable and therefore difficult to store and deliver. It is a fire and explosion hazard. It is generated in place when used as a commercially available fumigant against grain insects. At room temperature, phosphine is a colorless gas that may smell like garlic. At high concentrations, it has the foul odor of rotten fish.

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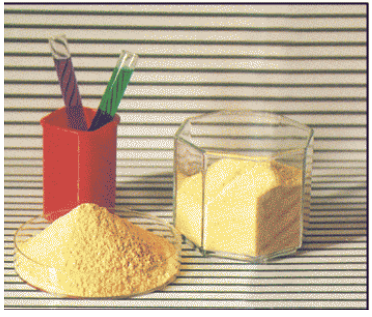
Hydrogen Sulfide - Indicators and Warnings

Hydrogen sulfide is also known as sewer gas and naturally occurs in swamps, marshes, or sewer lines.

Key Indicators

- Laboratory glassware
- Portable gas monitor
- Sulfur-Containing Compound

Portable Gas Monitor



Sulfur-Containing Compound

Production

Hydrogen sulfide is readily generated and involves minimal setup.

Product

At room temperature, hydrogen sulfide is a colorless gas that smells like rotten eggs.

V Series Nerve Agents - Indicators and Warnings

V series nerve agents affect the functioning of the nervous system. They are primarily a contact hazard, but in very warm temperatures they can present an inhalation hazard as well.

Key Indicators

- Sophisticated laboratory equipment and setup
- Easily procured chemicals such as ethyl alcohol, ethyl ether and hydrochloric acid (muriatic acid, DEA Class II Regulated Chemical) and additional difficult to procure precursors

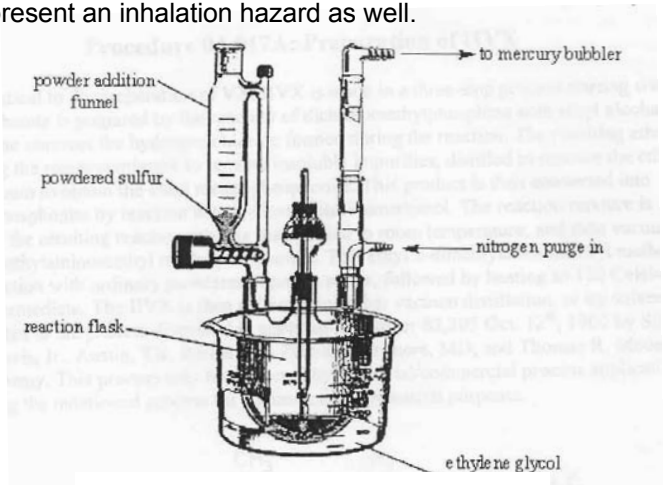


Diagram from Improvised Production Literature Showing Laboratory Setup

VX production, as detailed in improvised production literature, is a relatively difficult three-step process requiring ground glass jointed glassware and posing a danger to the operator due to its high toxicity and requires a skilled chemist. Some of the laboratory equipment can be improvised and/or purchased from laboratory supply houses.

Simulated Laboratory Setups for VX Production

Variability of Color

Pure VX appears as a colorless, oily liquid. Impure VX appears as an oily liquid with a consistency similar to dishwashing liquid and can range in color from straw to amber.

Pure

Colorless/Clear Straw Amber

V nerve agents have no distinct odor in the pure form. In an impure form, there may be odors from residual solvents not removed during the production process.

Nicotine - Indicators and Warnings

Nicotine is an inhalation and contact poison that readily absorbs through skin and mucous membranes. Nicotine sulfate is sold as a 40 percent nicotine sulfate concentrate under trade names that include Black Leaf 40 or Tender Leaf Plant Insect spray.

Key Indicators

- Improvised distillation equipment
- Laboratory glassware
- Mortar and pestle
- Filters
- Cigarettes, chewing tobacco, snuff
- Black Leaf 40 (pesticide)
- Chemicals such as calcium hydroxide solution (lime water), ethyl ether (DEA List II Regulated Chemical) and isopropyl alcohol

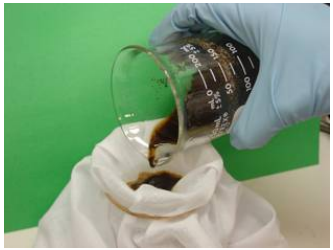
Cigarettes

Chewing Tobacco

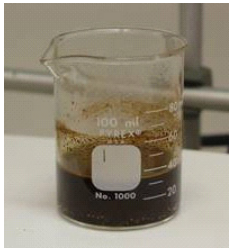
Nicotine can be isolated from tobacco products by extracting and then filtering the mixture.

Chewing Tobacco

Heating



Filtration



Filtered Extract

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Variability of Color

In its pure state, nicotine can be colorless to yellow in color, but the product of an improvised laboratory may be darker in color.

Pure

Colorless/Clear

Brown

Residue from Isolating Nicotine from Cigarettes

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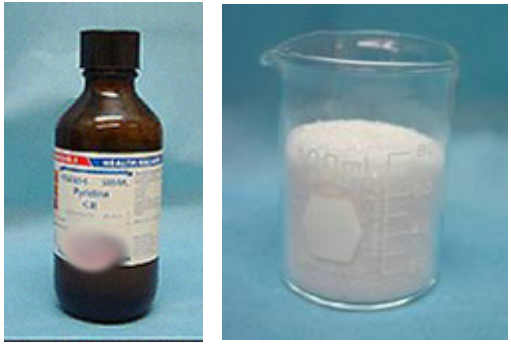
Adamsite - Indicators and Warnings

Adamsite (DM) is a riot control agent that induces vomiting.

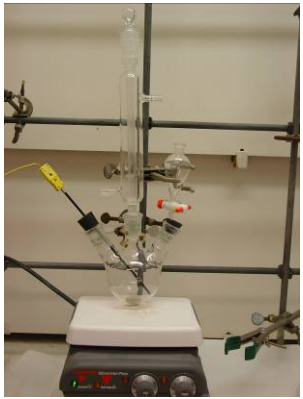
Key Indicators

- Laboratory glassware
- Mass Balance
- Condenser, funnel
- Hot plate, oil bath or heating mantel
- Ice bath
- Thermometer or temperature probe
- Filters
- Chemicals, such as arsenic trichloride, benzene, diphenylamine, hydrochloric acid (muriatic acid, DEA List II Regulated Chemical) and pyridine



Pyridine and Diphenylamine

In this improvised production method, adamsite is created through a chemical reaction involving combining several chemicals, heating, cooling, and filtering.



Simulated Reaction Setup

Filtering

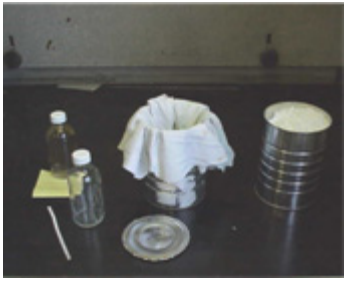
At room temperature, pure adamsite is a yellow crystalline solid. Crude adamsite can appear green or beige.

Variable Appearances of Crude Adamsite

Improvised Binary Dissemination Techniques - Indicators and Warnings

Key Indicators:

- Presence of an acid
- Proximity of two chemicals (two liquid containers or a liquid and a solid)
- Larger concealed packages
- Beakers or glass bottles
- Tin cans or other containers



A number of improvised production manuals describe the combination of two chemicals to create arsine, cyanide, phosgene, or phosphine gases.

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