



# HANDBOOK OF CHEMISTRY AND PHYSICS

A READY-REFERENCE BOOK OF  
CHEMICAL AND PHYSICAL DATA

THIRTY-SEVENTH EDITION

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IN COLLABORATION WITH A LARGE NUMBER OF PROFESSIONAL  
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1955-1956

## PREFACE

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THE Handbook of Chemistry and Physics, continuing the policy of the past, is being revised at frequent intervals.

The general features and scheme of arrangement, which have received extensive endorsement in former editions have been retained. The aim throughout has been to present in condensed form as large an amount of accurate, reliable and up-to-date information in the fields of chemistry and physics as was consistent with convenience in form and the possibility of wide utility and distribution. A very large proportion of the tables have been compiled especially for the Handbook from various authoritative collections of data and from the current journals.

Since the beginning special consideration has been given to the requests and suggestions of those who have used former editions. In this way it has been hoped to develop the book along lines most acceptable to those interested in a volume of this type. Suggestions and contributions are received each year from many eminent chemists and physicists including members of the teaching profession and those engaged in industrial work. We believe this coöperation to have been of very great value in the growth and development of the work.

An attempt has been made to include material on all branches of chemistry and physics and the closely allied sciences, which would be likely to find any extended use. On the other hand, in order to retain the convenience of moderate dimensions and at the same time allow for natural growth due to the extension of knowledge in these sciences, and logical additions along lines already developed, it has seemed necessary to exclude types of material of use only in certain highly specialized lines of work.

Chemistry and physics, always closely related sciences, have been brought into much more intimate relations by the more recent developments of research. To an increasing extent the student of either science should have a knowledge of the other. It would seem that there should be a large field for a single volume containing the constants and formulæ of the two sciences together with mathematical and conversion tables adequate for

## PREFACE TO THE THIRTY-SEVENTH EDITION

accurate computation. The generous response which the previous editions have met indicates that the volumes have been found useful and it is with the hope of even more completely meeting the needs of the chemists and physicists of the English speaking world that succeeding editions are offered.

CHARLES D. HODGMAN

## PREFACE TO THE THIRTY-SEVENTH EDITION

It is the object of those associated with the Handbook of Chemistry and Physics to publish annually new technical and scientific information which will be of value to those who teach, study, or work with chemistry or physics. To this end certain new tables have been added in the present edition. Among these are:

- Oxidation potentials
- Formulas for Calculating Titration Data
- Ionization Potentials
- Viscosity Conversion Factors
- Dielectric Constants of Water
- Dipole Moments
- Activity Coefficients
- Crystal Ionic Radii of Elements
- Allowable Carrying Capacities of Conductors.

Some new definitions have also been added to supplement the already extensive list included in past editions.

As man's knowledge increases he learns how to obtain better values and to make more nearly exact measurements. This results in revised data becoming available to aid the scientist in further work. For this reason the present edition of the Handbook of Chemistry and Physics contains a considerable quantity of information which must be considered as revised information. Some of this is as follows:

- Gravimetric Factors
- Dissociation Constants of Acids and Bases
- Data for some Industrial Organic Compounds
- Half-wave Potentials for Polarographic Analysis
- Physical Constants for Ozone and Oxygen
- Properties of Plastics
- Photographic Formulas
- Values for Velocity of Light
- Properties of Dielectrics.

In collecting information to be placed in the present edition care was taken to use data which can be considered reliable. No attempt was made to prepare specialized subjects. Rather, a limited selection was made based on the viewpoint of need and interest expressed in suggestions and contributions from chemists and physicists.

CLEVELAND, OHIO,  
September 1, 1955.

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The Publishers and Editor will be grateful to readers of this Handbook who will call their attention to errors which may be discovered. Suggestions for improvement are also welcome.  
CHEMICAL RUBBER PUBLISHING COMPANY



## ANTIDOTES OF POISONS

**Acetic Acid.**—Emetics, magnesia, chalk, soap, oil.

**Acetylene.**—Same as for carbon monoxide.

**Arsenic, Rat Poison, Paris Green.**—Milk, raw egg, sweet oil, lime water, flour and water.

**Carbolic Acid.**—Any soluble non-toxic sulphate, after provoking vomiting with zinc sulphate; uncooked white of egg in abundance, milk of lime, saccharate of calcium, olive or castor oil with magnesia in suspension, ice, washing the stomach with equal parts water and vinegar; give alcohol or whiskey or about four fluid ounces camphorated oil at one dose.

**Carbon Monoxide.**—Remove to fresh air immediately and call for pulmotor; apply artificial respiration for at least one hour or until the pulmotor arrives. Administration of oxygen containing 5% of carbon dioxide is beneficial; inhalation of ammonia or amyl nitrite is often of value.

**Chloroform, Chloral, Ether.**—Dash cold water on head and chest, artificial respiration.

**Ethylene.**—Same as for carbon monoxide.

**Gas (illuminating).**—Same as for carbon monoxide.

**Hydrochloric Acid.**—Magnesia, alkali carbonates, albumen, ice.

**Hydrocyanic or Prussic Acid.**—Hydrogen peroxide internally, and artificial respiration, breathing ammonia or chlorine from chlorinated lime, ferrous sulphate followed by potassium carbonate, emetics, warmth.

**Iodine.**—Emetics, stomach siphon, starchy foods in abundance, sodium thiosulphate.

**Lead Acetate.**—Emetics, stomach siphon, sodium, potassium or magnesium sulphates, milk, albumen.

**Mercuric Chloride or Corrosive Sublimate.**—Zinc sulphate, emetics, stomach siphon, white of egg, milk, chalk, castor oil, table salt, reduced iron.

**Nitrate of Silver.**—Salt and water.

**Nitric Acid.**—Same as for hydrochloric acid.

**Opium, Morphine, Laudanum, Paregoric, etc.**—Strong coffee, hot bath. Keep awake and moving at any cost.

**Phosphoric Acid.**—Same as for hydrochloric.

## ANTIDOTES OF POISONS (Continued)

**Sodium Hydroxide or Potassium Hydroxide.**—Vinegar, lemon juice, orange juice, oil, milk.

**Sulfuric Acid.**—Same as for hydrochloric acid with the addition of soap or oil.

**Sulfurous Acid or Sulfur Dioxide.**—Mustard plaster on chest; narcotics, expectorants.

**Wood Alcohol (Methyl Alcohol or Methanol).**—Emetic or wash out stomach (stomach tube) with a solution of 10 grains sodium citrate per ounce of water. Give milk, white of egg or flour in water; purgative of magnesium sulfate (15 grams); stimulate and combat collapse. In case of cardiac or pulmonary failure use artificial respiration. Physicians may administer atropine, digitalin or strychnine as stimulants; to cause perspiration and elimination of the poison use 0.1 grain of pilocarpine hydrochloride.

## BURNS AND SCALDS

Exclude air by thin paste of starch, flour, or baking soda. Ordinary oils such as Vaseline petroleum jelly, olive or castor oil, lard or cream may also be used except for phosphorus burns. Lime water mixed with an equal part of raw linseed oil makes an excellent dressing. An especially valuable material for all burns is picric acid gauze which may be applied in the form of a compress.

After treatment with any of the above materials, cover with a cloth or with cotton and hold in place with a light bandage.

Apply a freshly prepared 5% tannic acid solution. Place several layers of sterile gauze over the burned area, saturate with the tannic acid solution and bandage loosely.

## CHEMICAL BURNS

With either, wash off as quickly as possible with a large quantity of water. Water from a tap may be allowed to flow over burns.

### Acids

While the injury is being washed, have procured lime water or lime water and raw linseed oil mixed together in equal proportions or a mixture of baking soda and water or soap suds and apply freely. For acid in the eye wash as quickly as possible with water and then with lime water.

### Alkalis

Wash with a large quantity of water as for acid burns. Neutralize with weak vinegar, hard cider or lemon juice. For lime or other strong alkali burns in the eye wash with weak solution of vinegar or with olive oil or a saturated solution of boric acid.

**Bromine.**—Sponge immediately with a strong solution of sodium thiosulfate until all the bromine color is gone, then wash off the mildly poisonous sodium thiosulfate with plenty of water.

## FIRE PRECAUTIONS AND CHEMICAL HAZARDS

**Acetone.**—Dilute with a spray of water to avoid spread of burning liquid. Use suitable gas mask.

**Alcohol.**—See under acetone.

**Ammonia.**—Use water and dilute acid. Use suitable gas mask.

**Benzol or Benzene.**—Use water to cool containers which are endangered; extinguish flame with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

**Calcium Carbide.**—Do not use water as this generates acetylene, an inflammable and explosive gas; cut off electric current to avoid ignition of gas. Remove containers to a dry place. Use gas mask.

**Carbon Disulfide.**—Use water to cool containers which are endangered; extinguish blaze with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

**Carbon Tetrachloride.**—When a carbon tetrachloride type extinguisher is used on a fire in a confined space, the fire should be attacked from outside the enclosure, if possible, or the area should be vacated immediately after the fire is out. No one should return to the enclosure until the air is cleared of smoke and fumes. These precautions should be observed regardless of the means by which the fire is extinguished, however, since fire in a confined space rapidly produces a toxic atmosphere.

Do not put carbon tetrachloride on a sodium fire, violent explosions may be caused.

**Celluloid.**—Use large volumes of water and sand. The smoke contains oxides of nitrogen which are injurious. Use suitable gas mask.

**Chlorine.**—Spray with water. The pungent nature of the gas makes the use of a gas mask imperative.

**Collodion.**—See under carbon disulfide.

**Ether.**—See under carbon disulfide.

**Gasoline.**—See under carbon disulfide.

**Hydrochloric Acid.**—Use large volumes of water also chalk or soda. Use gas mask.

**Hydrocyanic or Prussic Acid.**—Suitable gas mask is essential because of the extremely poisonous nature of the vapors. Provide ventilation.

## **FIRE PRECAUTIONS (Continued)**

**Lacquer Solvents.**—See under carbon disulfide.

**Magnesium.**—Do not use water. Use sand or earth to extinguish flames. Remove containers to a dry place.

**Nitric Acid and Oxides of Nitrogen.**—Use large volumes of water. Do not use sand or earth. Use gas mask.

**Potassium.**—Do not use water. Remove containers to a dry place. Extinguish flames with sand or earth. For storage, potassium is kept immersed in petroleum.

**Potassium Hydroxide.**—Use large volumes of water or dilute acids.

**Phosphorus.**—Use water and wet sand. Use gas mask. For storage, white phosphorus must be kept immersed in water. Red phosphorus is less dangerous.

**Sodium.**—See under potassium.

**Sodium Hydroxide.**—See under potassium hydroxide.

**Sulfur.**—Extinguish with water or sand. Use gas mask.

**Sulfuric Acid.**—See under hydrochloric acid.

**Turpentine.**—See under acetone.

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