ABOUT OUR COVER

Our chemist-collector bought this painting (oil on canvas, 41 x 37cm) at a recent auction in New York purely for the pleasure of looking at it. As Professor David McTavish wrote in his description in *Pictures from the Age of Rembrandt,** this is an "enchanting study of a young woman who wears a type of hooded cape seen in paintings by Jan Steen and others. In pose and format, as well as in the fall of light, the painting is comparable to Vermeer's depictions of the head and shoulders of a girl against a neutral background, although Vermeer's sitters are not shown in contemporary dress and his treatment of form is, of course, very different. Painted with a fluid brush and a keen sense of subtle colour, this picture offers points of comparison with such artists as Michiel Sweerts, Jan de Bray and Gabriel Metsu, but an altogether convincing attribution has yet to be proposed."

To quote one of the great art historians, Max J. Friedländer, "One must summon courage to say 'I do not know', and reflect that he who attributes a painting wrongly reveals his ignorance of two masters — of the author, whom he does not recognize, and of the painter whose name he proclaims".

Even nameless, a thing of beauty is a joy forever.

*Our Catalog No. Z12,794-9

If you would like to have a reproduction of this painting, please do not tear off this cover; we will be happy to send you a full-color print of the painting (suitable for framing) for $2.00, postpaid.

Aldrich

Fine Chemicals

This catalog contains over 20,000 products of which over 4,000 are new. These listings include organic and inorganic chemicals . . . biochemicals . . . stains and dyes . . . deuterated compounds . . . spectrophotometric solvents . . . reagents for hydroboration . . . organometallic reagents . . . polymers . . . catalysts . . . ion-exchange resins and adsorption media . . . atomic absorption standards . . . precious metal salts . . . HPLC solvents . . . pure elements . . . spin labels . . . optically active compounds . . . an expanded specialized glassware and equipment section and several new product lines including gases, chemical standards kits and carbon-13-labeled compounds.

To order
Toll-free USA/ Canada
800-558-9160

Technical inquiries/ other correspondence
Toll-free USA/ Canada
800-231-8327

Telephone	414-273-3850
TWX	910-262-3052 Aldrichem MI
Telex	26 843 Aldrich MI
FAX	414-273-4979

Aldrich Chemical Company, Inc.
940 West Saint Paul Avenue
Milwaukee, Wisconsin 53233 USA

PRICING AND TERMS

PRICES

Prices are shown in U.S. dollars — F.O.B. our shipping point. The freight charges and any special packaging charges will be added to the invoice.

If you place your order by phone, we will confirm our current price with you at that time. Please call us for current prices if you require this information prior to placing your order. We will guarantee our computerized quotations for 30 days. When placing your order, please reference our quoted prices or our pro forma number.

Price increases — Since we try to ship all orders the day of receipt, shipment will be made promptly even if prices have been nominally increased (unless you tell us not to). However, if the increase is significant, we will request permission before shipment.

Price reductions — They will automatically apply to your invoice.

We attempt to fill all orders completely. When complete shipments cannot be made, partial shipment will be made at our discretion.

TERMS

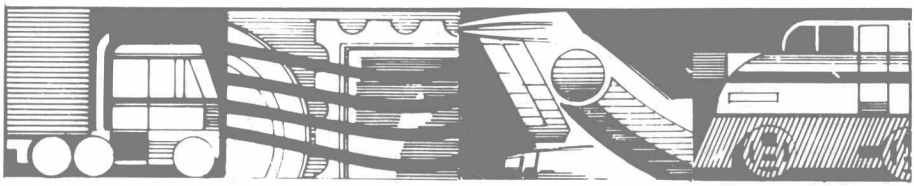
All orders are accepted on the terms and conditions stated on standard Aldrich invoices and packing slips in effect on the date of shipment. The terms and conditions covering transactions as of the date of printing of this Catalog/Handbook are reprinted on page F10.

We reserve the right not to accept cancellation of orders.

CLAIMS FOR LOST OR DAMAGED SHIPMENTS

Our products are generally sold F.O.B. shipping point, fully insured at the buyer's expense. However, if you should need assistance in filing a claim for a lost, incomplete or damaged shipment, we will be happy to help you. Please inspect packages immediately upon receipt and inform our Customer Service Department of any shortage or damage within 5 days of receipt.

DOMESTIC SHIPMENTS



METHODS OF SHIPMENT

We generally ship our chemicals in accordance with the method specified or implied by your order. However, we reserve the right to change this method for certain hazardous chemicals which, when required by regulations or in our judgment, cannot be shipped safely by the method specified or implied.

Shipping regulations are constantly being revised. We make every effort to minimize your shipping costs.

The United States Department of Transportation (D.O.T.) and the United States Postal Service have granted exemptions from certain shipping requirements for transporting small packages of hazardous materials in the United States. Whenever possible we will take advantage of these exemptions.

Limited quantities of Class B Poisons and "Dangerous When Wet" materials may be shipped by U.P.S. when specially packed in a 37-37A Barrier Bag poison package. Also, 1-gallon (3-kg) bottles of hazardous liquids may be shipped by U.P.S. only if overpacked in a metal can. The charges (package plus handling) for the barrier package ($8.50) and the overpack can ($6.50) will be added to your invoice; however, the use of U.P.S. avoids the requirements of slower and more costly truck shipments.

Certain chemicals must be shipped by truck and these are identified with a "†" in the alphabetical section.

Regardless of methods of shipment, the D.O.T. requires the use of wooden boxes for certain hazardous chemicals. Special packaging charges varying with the size of the box needed, will be added to the invoice. We will make every effort possible to consolidate compatible items into wooden boxes when one or more of the items is hazardous, thus reducing this special packaging charge.

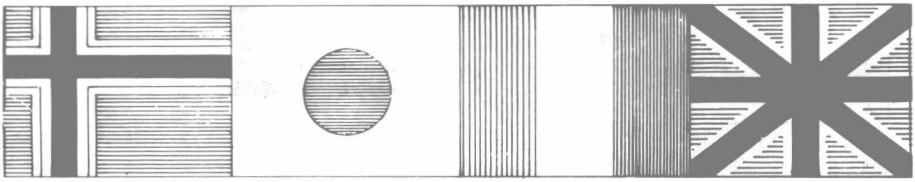
Several of our products are packaged in 8- and 18-liter units in Kilo-Lab metal cylinders that require a $280.00 deposit.

The items listed in this Catalog/Handbook are also stocked in our East Coast warehouse located in Metuchen, New Jersey, to give faster service to our East Coast customers.

RETURN SHIPMENTS

We will not accept return shipments unless we have given prior permission and shipping instructions. We want to be fair and will do our best to cooperate, but the circumstances involving returns are often complicated and require individual attention and specific handling. Unidentified return shipments may be discarded.

INTERNATIONAL SHIPMENTS



We have efficient means of distributing chemicals world-wide, but hazardous items still cause shipping problems and create additional costs. The regulations do not allow us to ship hazardous chemicals by air or surface mail. However, most of these hazardous chemicals may be shipped by air freight.

Please request a free copy of ***A Shipping Guide for Aldrich Products*** which will enable you to determine how each chemical can be shipped.

In order to allow us to do everything possible to minimize shipping costs for air freight, we suggest:

- Consolidate your orders which may originate from several departments in your company or institution. We can bill such orders separately.
- Authorize us to accumulate your orders for hazardous chemicals for shipment when we have a sufficient amount to ship by consolidated air freight.
- Consolidate your orders of hazardous chemicals prior to placing your orders.

We will promptly quote on your needs giving current prices and estimates of insurance, packaging and freight charges. The usual and customary international credit terms are offered.

Service is available from our affiliates

Belgium
Aldrich Chemie N.V./S.A.
6 Rue Caporal Claes
B-1030 Brussels
Telephone: (02) 2428750
Telex: 62302 Alchem B

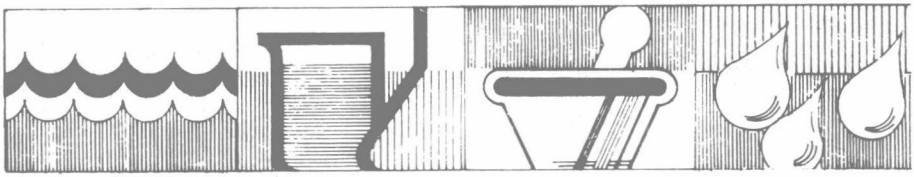
France
Aldrich-Chimie S.a.r.l.
27, Fossé des Treize
F-67000 Strasbourg
Telephone: (88) 327010
Telex: 890076 Aldrich F
FAX: (88) 751283

Japan
Aldrich Japan
Kyodo Bldg. Shinkanda
10 Kanda-Mikuracho
Chiyoda-Ku, Tokyo
Telephone: (03) 258-0155
Telex: 33362 Aldrich J
FAX: (03) 258-0157

United Kingdom
Aldrich Chemical Company Ltd.
The Old Brickyard, New Road
Gillingham, Dorset SP8 4JL
Telephone: (07476) 2211
Telex: 417238 Aldrch G
FAX: (07476) 3779

West Germany
Aldrich-Chemie GmbH & Co. KG
D-7924 Steinheim
Telephone: (07329) 87-0
Telex: 714838 Aldri D
FAX: (07329) 87-39

PURITY AND USE



PURITY

Quality is an essential criterion for every Aldrich product. All chemicals listed are subjected to exacting tests in our own Quality Control Laboratories for determination of purity. The purity and physical constants stated herein and on our labels are typical values; they may vary slightly from batch to batch.

Aldrich offers a comprehensive line of high-purity elements and salts to meet the needs of chemists, metallurgists, physicists and material scientists.

Most high-purity (>99.9%) elements and salts are provided with a data sheet giving an actual lot analysis showing ppm levels of metallic impurities. This forms the basis for the "nines" notation which we use to be consistent with purity designations used in the industry. Most data are collected on our ARL 3510 ICP spectrometer.

Variations in hydration or other factors may affect the gross assay of such products.

The purities of rare-earth products are based on purities relative to other rare earths only. Unavoidable contamination from reducing agents or crucible materials, which may account for as much as several percent, is not included.

If more information is needed concerning quality, please contact our Technical Services Department.

USE

Most of our chemicals are offered for laboratory use only. They are not for drug, household or other uses.

This means that they:

- may NOT be used as drugs
- may NOT be used as cosmetics
- may NOT be used as food additives
- may NOT be used as household chemicals
- may NOT be used as agricultural or pesticidal products.

For certain chemicals we may ask the buyer to provide written assurance that the chemical will neither be purchased nor resold for an improper use.

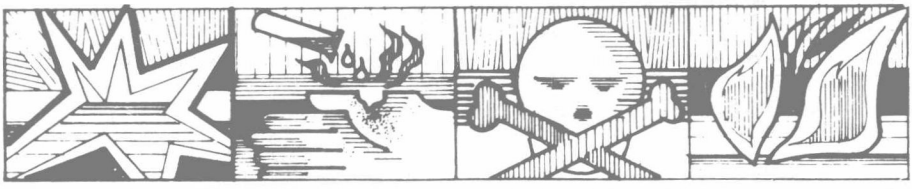
Inquiries for bulk quantities of our products for drug, agricultural or pesticidal testing or manufacturing purposes in accordance with the Federal Food, Drug and Cosmetic Act as amended, or the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended are invited and will be considered on an individual basis.

We will consider requests for commercial use of our products. Please contact our Bulk Sales Department.

Since we cannot be certain of your application of our chemicals, we offer no warranties regarding use, and will not be responsible for any loss involving their use.

Throughout this Catalog/Handbook we list possible uses for certain chemicals as described in the referenced literature. We hope that this information will make this publication a more valuable tool for the research chemist. However, these uses are provided for experimental or technical purposes only; that is, use in the laboratory under supervision of a technically qualified person. We expressly disclaim any warranties of merchantability and fitness for a particular purpose.

HAZARDOUS CHEMICALS



TOXICITY AND HAZARDS

All of our chemicals should be handled only by qualified individuals trained in laboratory procedures and familiar with their potential hazards. Some chemicals are extremely toxic or otherwise hazardous.

In this Catalog/Handbook, we do provide hazard warnings and literature references, such as ***The Sigma-Aldrich Library of Chemical Safety Data,*** the *Merck Index,* and the *Registry of Toxic Effects of Chemical Substances* (RTECS).

We also attempt to provide adequate warnings of possible hazards on our labels, so that the information will be available to the trained technical person using our product.

Material Safety Data Sheets will be provided as required by OSHA's Hazard Communication Law for products which are considered hazardous. They are computer-generated from our data base, thus incorporating the most up-to-date information.

The absence of a warning must not be interpreted as an indication of safety. We emphasize that information is not available on the possible hazards of many compounds.

Waste-disposal methods are also provided for each chemical in this Catalog/Handbook.

TSCA

Section 5 of the Toxic Substances Control Act, PL 9469, October 11, 1976, commonly known as TSCA, requires any person who intends to manufacture or import a new chemical substance for a commercial purpose to submit a premanufacture notification at least 90 days before manufacture and/or importation. A "new" chemical substance is any substance that is not on the inventory of existing substances compiled by the United States Environmental Protection Agency (EPA) under Section 8(b) of TSCA. Products which are currently on the EPA Inventory as of the date of the printing of this Catalog/Handbook have been marked with a star (★) in the alphabetical section.

Please notify our Technical Services Department if you anticipate that a premanufacture notification is necessary for any product purchased from us.

TERMS AND CONDITIONS OF SALE

1. Acceptance governing provisions- Aldrich Chemical Company (Seller) acknowledges receipt of Buyer's order, and accepts Buyer's order expressly conditional on Buyer's assent to the terms and conditions herein contained, whether additional to or different from those contained in Buyer's purchase order or any other form or document heretofore or hereafter supplied by Buyer to Seller. Buyer will be deemed to have assented to these terms and conditions unless Seller receives written notice of any objection within 15 days after Buyer's receipt of this form and in all events prior to any delivery or other performance of Buyer's order. Seller's failure to object to provisions contained in any purchase order or any other form or document from Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provision. This contract and the terms and conditions shall be governed by and construed in accordance with the laws of the State of Wisconsin.

2. Changes, cancellation- No change by Seller of any term or condition of this contract or any of Seller's rights or remedies hereunder shall be binding on Seller, nor shall the order hereby acknowledged be cancelled or changed by Buyer, unless Seller shall expressly consent thereto in writing by Seller's authorized officer. There are no representations, agreements, promises or understandings between Buyer and Seller that are not expressed herein.

3. Delivery, claims, delays- Unless specified differently in writing, all sales are F.O.B. Seller's shipping point. Delivery of goods to the carrier at Seller's plant or other loading point, shall constitute delivery to Buyer and regardless of shipping terms, all risk of loss or damage in transit shall be borne by Buyer. Seller reserves the right to make delivery in installments, all such installments to be separately invoiced and paid for when due per invoice, without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Buyer of Buyer's obligations to accept remaining deliveries.

Immediately upon Buyer's receipt of any goods shipped hereunder, Buyer shall inspect the same and shall notify Seller in writing of any claims for shortages, defects or damages and shall hold the goods for Seller's written instructions concerning disposition. If Buyer shall fail to so notify Seller within five days after the goods have been received by Buyer, such goods shall conclusively be deemed to conform to the terms and conditions hereof and to have been irrevocably accepted by the Buyer.

Seller shall not be liable for any loss, damage or penalty as a result of any delay in or failure to manufacture, deliver or otherwise perform hereunder due to any cause beyond Seller's reasonable control, including, without limitation, unsuccessful reactions, act of Buyer, embargo or other governmental act, regulation or request affecting the conduct of Seller's business, fire, explosion, accident, theft, vandalism, riot, acts of war, strikes or other labor difficulties, lightning, flood, windstorm or other acts of God, delay in transporation, or inability to obtain necessary labor, fuel, materials, supplies or power at current prices.

4. Allocation of goods- If Seller is unable for any reason to supply the total demands for goods specified in Buyer's order, Seller may allocate its available supply among any or all buyers on such basis as Seller may deem fair and practical, without liability for any failure of performance which may result therefrom.

5. Payment- Terms of sale are net 30 days of date of invoice, unless otherwise stated. Materials will be billed at the price in effect at the time shipment is made. If the financial condition of Buyer does not justify the terms of payment specified, Seller may demand full or partial payment in advance before proceeding with the contract. If Buyer defaults in any payment when due, under this or any other order, Seller, at its option without prejudice to its other lawful remedies, may defer delivery or cancel this contract.

6. Taxes and other charges- Any use tax, sales tax, excise tax, duty, custom, inspection or testing fee, or any other tax, fee or charge of any nature whatsoever imposed by any governmental authority, on or measured by the transaction between Seller and Buyer shall be

paid by Buyer in addition to the prices quoted or invoiced. In the event Seller is required to pay any such tax, fee or charge, Buyer shall reimburse Seller therefor; or, in lieu of such payment, Buyer shall provide Seller at the time the order is submitted an exemption certificate or other document acceptable to the authority imposing the tax, fee or charge.

7. Warranties-Seller warrants that its products shall conform to the description of such products as provided in Seller's catalog, Seller's Analytical Information Report or other literature, if furnished to Buyer. **THIS WARRANTY IS EXCLUSIVE, AND SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.** Seller's warranties made in connection with this sale shall not be effective if Seller has determined, in its sole discretion, that Buyer has misused the products in any manner or has failed to use the products in accordance with instructions, if any, furnished by Seller.

Seller's sole and exclusive liability and Buyer's exclusive remedy with respect to products proved to Seller's satisfaction to be defective or nonconforming shall be the replacement of such products without charge or refund of the purchase price, in Seller's sole discretion, upon the return of such products in accordance with Seller's instructions. **SELLER SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES.**

8. Compliance with laws, regulations-Seller certifies that to the best of its knowledge its products are produced in compliance with applicable requirements of the Fair Labor Standards Act, as amended and the Occupational Safety and Health Standards Act of 1970 and regulations, rules and orders issued pursuant thereto. Seller also certifies that to the best of its knowledge it is in compliance with Executive Order 11246 and regulations, rules and orders issued pursuant thereto; that it has a written Affirmative Action Program and annually files Standard Form 100 (EEO-1); that it does not discriminate against any employee or prospective employee because of race, creed, color, national orgin, sex, age or handicap, nor permit discrimination in any form nor maintain segregated facilities for its employees; that it actively pursues employment of minorities, females, handicapped, disabled veterans and veterans of the Vietnam era; and that it uses its best efforts to award contracts to and place purchase orders with minority business enterprises and with labor surplus area concerns and small business concerns.

9.Buyer's use of products-Seller's products are intended primarily for laboratory research purposes and, unless otherwise indicated on the front of Seller's invoice or on product labels, are not to be used for any other purposes, including but not limited to, in-vitro diagnostic purposes, in foods, drugs or cosmetics for humans or animals or for commercial purposes. Buyer acknowledges that the products have not been tested by Seller for safety and efficacy in food, drug, device, cosmetic, commercial or any other use, unless otherwise stated in Seller's literature furnished to Buyer. Buyer expressly represents and warrants to Seller that Buyer will properly test, use, manfacture and market any products purchased from Seller and any final articles made from them in accordance with the practices of a reasonable man who is an expert in the field and in strict compliance with all applicable federal and state food, drug, device, and cosmetic and other relevant laws and regulations, now and hereinafter enacted. Buyer further warrants to Seller that any final articles manufactured from Seller's products shall not be adulterated or misbranded within the meaning of the Federal Food, Drug and Cosmetic Act and shall not be articles which may not, under Sections 404, 505, or 512 of the Act, be introduced into interstate commerce.

Buyer realizes that, since Seller's products are intended primarily for research purposes, they may not be on the Toxic Substances Control Act (TSCA) inventory. Buyer assumes responsibility to assure that the products purchased from Seller are approved for use under TSCA, if applicable.

Buyer has the responsibility to verify the hazards and to conduct any further research necessary to learn the hazards involved in using products purchased from Seller. Buyer also has the duty to warn Buyer's customers and any auxiliary personnel (such as freight handlers, etc.) of any risks involved in using or handling the products. Buyer agrees to comply with instructions, if any, furnished by Seller relating to the use of the products and not misuse the products in any manner. If the products purchased from Seller are to be repackaged, relabeled or used as starting material or components of other products, Buyer will verify Seller's assay of the products. No products purchased from Seller shall be considered to be foods, drugs or cosmetics; nor, except if labeled "For in Vitro Diagnostic Use", to be devices.

Buyer agrees to indemnify and hold Seller harmless from and against any

and all losses, damages and expenses (including attorney's fees and other costs of defending any action) that Seller may sustain or incur as a result of any claim of negligence, breach of implied warranty, strict liability in tort or other theory of law, by Buyer, its officers, agents or employees, its successors and assigns, and its customers, whether direct or indirect, in connection with the use of Seller's products, or by reason of Buyer's failure to perform the obligations contained. Buyer shall notify Seller within 15 days of Buyer's receipt of knowledge of any accident involving Seller's products resulting in personal injury or damage to property, and Buyer shall fully cooperate with Seller in the investigation and determination of the cause of such accident and shall make available to Seller all statements, reports and tests made by Buyer or made available to Buyer by others. The furnishing of such information to Seller and any investigation by Seller shall not constitute an assumption of any liability by Seller.

10. Patent disclaimer-Seller does not warrant that the use or sale of the products delivered hereunder will not infringe the claims of any United States or other patents covering the product itself or the use thereof in combination with other products or in the operation of any process.

11. Returns-Goods may not be returned for credit except with Seller's permission, and then only in strict compliance with Seller's return shipment instructions.

12. Technical Assistance- At Buyer's request, Seller may furnish technical assistance and information with respect to Seller's products. Unless otherwise agreed, all such technical assistance and information will be provided gratis, and Buyer assumes sole responsibility for results obtained in reliance thereon. Seller makes no warranties of any kind or nature with respect to technical assistance or information provided by it. Any suggestions by Seller regarding use, application or suitability of the products shall not be construed as an express warranty unless expressly designated as such in writing signed by Seller.

Table of Abbreviations

A	Absorbance, or optical density
A.C.S.	Used to denote specifications outlined by the American Chemical Society for certain reagent chemicals
as	Asymmetric
Beil.	Reference to *Beilsteins Handbuch der Organischen Chemie; e.g., Beil.* **6**(1), 556 refers to volume 6, 1st supplement, page 556
bp	Boiling point in °C at 760mm pressure, unless otherwise specified
C	Crystal phase of a liquid crystal; centigrade
c	Concentration in g/100ml
ca.	Approximately
CAS	Chemical Abstracts Service registry number
cat.	Catalog
Ch	Cholesteric phase of a liquid crystal
C.I.	Colour Index
cm	Centimeter
d	Dextrorotatory
d	Density of liquid or solid inorganic compound at 20° ± 5°C relative to water at 4°C; for solid organic compounds, density is of liquid at melting-point temperature.
D	Configuration relative to D-glyceraldehyde
dec.	Decomposes
diam.	Diameter
Disp.	Disposal procedures — see "Waste Disposal Procedures," page F16.
DL, *dl*	Racemic mixture (optically inactive)
ea	Each
Fieser	Reference to *Fieser and Fieser's Reagents for Organic Synthesis.* The volume number is in bold type and the page number is in light type.
Fp	Flash point in °F (closed cup). Flash points are determined with the "Set-a-flash" apparatus recommended by the DOT using ASTM Procedures D-3243, D-3278, or the International Standards Organization Procedure #304.
ft	Foot
FT-IR **1**	Reference to the page location of the spectrum in *The Aldrich Library of FT-IR Spectra,* Edition I. The volume number in parentheses and the page location that follows are in light type.
FW	Formula weight based on carbon mass = 12.011. Calculated values in this book include solvent or water of hydration (if degree of solvation or hydration is known).
g	Gram
gal	Gallon

ht.	Height
I	Isotropic phase of a liquid crystal
i.d.	Inner diameter
in	Inch
kg	Kilogram
l	Liter
l	Levorotatory
L	Configuration relative to L-glyceraldehyde
λ(nm)	Wavelength in nanometers
λ*max*	Wavelength, in nanometers, at which the maximum absorption of a stain or dye was observed. The secondary absorption appears in parentheses.
lb	Pound
m	Meter
M	Molarity of solution
μ	Micron
μg	Microgram
μl	Microliter
Merck Index	Reference to *The Merck Index*, 10th edition
mg	Milligram
min	Minute
ml	Milliliter
mm	Millimeter
M.N.	Number average molecular weight of a polymer
mp	Melting point in °C
MSD Book **1**	Reference to the page location of the entry in *The Sigma-Aldrich Library of Chemical Safety Data*, Edition I
M.W.	Weight average molecular weight of a polymer
N	Nematic phase of a liquid crystal
N	Normality of solution
n	Normal (isomer)
n	n_D^{20}, n^{25} - index of refraction for the sodium D line at 20°C and at 25°C (or temperature indicated).
nm	Nanometer
NMR **2**	Reference to the page location of the spectrum in *The Aldrich Library of NMR Spectra*, Edition II. The volume number in parentheses and the page location that follows are in light type.
no.	Number
o.d.	Outer diameter
oz	Ounce
pkg	Package
ppb	Parts per billion
ppm	Parts per million
pr	Pair
prim.	Primary
psi	Pounds per square inch
qt	Quart
rpm	Revolutions per minute
RTECS#	*Registry of Toxic Effects of Chemical Substances* reference number
S	Smectic phase of a liquid crystal
s	Symmetrical
sec	Secondary (isomer)
sq.	Square

std.	Standard
sym	Symmetrical
tech.	Technical grade
tert	Tertiary (isomer)
Tg	Glass transition temperature of a polymer in °C (literature value)
Tm	Melting temperature of a polymer in °C
unsym	Unsymmetrical
U.S.P.	Indicates that a material meets specifications as given in the 20th revision of "The United States Pharmacopeia"
v	Volt
Vol.	Volume
wt.	Weight
yd	Yard

$[\alpha]$	Specific rotation of a compound determined at the temperature and under the conditions indicated using the D line of sodium
⧩	Standard taper
⌐	Catalog entry for which a structure is given at the bottom of the page
★	Denotes that the chemical is in the EPA inventory under TSCA. (See page F9 for definition.)
†	This quantity of chemical cannot be shipped by U.P.S. or parcel post.
[ ]	Italicized numbers within brackets after the chemical name denote the Chemical Abstracts Service (CAS) registry number.
~	Approximately
<	Less than
>	Greater than

Journal references included in catalog comments have been abbreviated according to the *Bibliographic Guide for Editors and Authors*, published by the American Chemical Society.

WASTE-DISPOSAL METHODS

The disposal methods outlined below are intended only as guides. We do not assume responsibility for their use. Careful consideration must be given to the chemical and physical properties of the substance. In addition, local laws and regulations may preclude the use of these methods which are primarily designed for small quantities. Observe all federal, state, and local laws.

The disposal of some chemicals may require deactivation or modification of the material by chemical means. Chemical waste-disposal reactions must be handled with the same care and consideration used with synthetic procedures. Appropriate consideration must be given to reaction conditions, *i.e.*, stoichiometry, order and rate of addition, heat of reaction, evolution of gaseous products, pH, efficiency of stirring, rate of reaction, atmospheric sensitivity, etc.

Chemical waste-disposal reactions should be carried out in a chemical fume hood and in appropriate laboratory glassware. Because those reactions are often vigorous, protective safety equipment such as safety goggles, respirator, gloves, face and/or safety shield and other protective equipment must be used.

Initial reactions in a disposal sequence should be carried out on a small scale (5-10g). The reactant concentrations should not exceed 10% of the reaction volume and the final reaction volume should not exceed 50% of the working capacity of the reaction vessel, regardless of the reaction scale. Larger quantities of the material should be handled in several small-size reactions. To ensure completion of reaction, the waste disposal procedure should be run for at least an additional 4 to 8 hours after all materials have been mixed.

All reactions should be run by technically qualified persons familiar with the potential hazards of the chemical reactions.

A Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

B The material should be ignited in the presence of sodium carbonate and slaked lime (calcium hydroxide). The substance should be mixed with vermiculite and then with the dry caustics, wrapped in paper and burned in a chemical incinerator equipped with an afterburner and scrubber.

C This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber.

D Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable.

E To a solution of the product in water, add an excess of dilute sulfuric acid. Let stand overnight. Remove any insolubles and bury in a landfill site approved for hazardous-waste disposal.

F Cautiously dissolve the material in water. Neutralize immediately with sodium carbonate or, if the material does not dissolve completely, add a little hydrochloric acid followed by sodium carbonate. Add calcium chloride in excess of the amount needed to precipitate the fluoride and/or carbonate. Separate the insolubles and bury in a landfill site approved for hazardous-waste disposal.

G Under an inert atmosphere, cautiously add the material to dry butanol in an appropriate solvent. The chemical reaction may be vigorous and/or exothermic. Provisions must be made for venting of large volumes of highly flammable hydrogen and/or hydrocarbon gases. Neutralize the solution with aqueous acid. Filter off any solid residues for disposal as hazardous waste. Burn the liquid portion in a chemical incinerator equipped with an afterburner and scrubber.

H Neutralize the solution and add filtering agent (10g per 100ml). Evaporate the liquid and bag the residual solid for burial in a landfill site approved for hazardous-waste disposal.

I Dissolve the solid in (or dilute the solution with) a large volume of water. Carefully add a dilute solution of acetic acid or acetone to the mixture in a well ventilated area. Provisions should be made to vent safely the hydrogen gas given off during the decomposition. Check acidity of the solution and adjust to pH 1 if necessary. Let stand overnight. Neutralize the solution (pH 7). Evaporate the solution and bury the residue in a landfill site approved for hazardous-waste disposal.

J Cautiously acidify a 3% solution or a suspension of the material to pH 2 with sulfuric acid. Gradually add a 50% excess of aqueous sodium bisulfite with stirring at room temperature. An increase in temperature indicates that a reaction is taking place. If no reaction is observed on the addition of 10% of the sodium bisulfite solution, initiate it by cautiously adding more acid. If manganese, chromium, or molybdenum is present, adjust the pH of the solution to 7 and treat with sulfide to precipitate for burial as hazardous waste. Destroy excess sulfide, neutralize and flush solution down the drain.

K Please contact the Technical Services Department. Be sure to mention name, catalog number and quantity of the material.

L The material should be dissolved in 1) water, 2) acid solution or 3) oxidized to a water-soluble state. Precipitate the material as the sulfide, adjusting the pH of the solution to 7 to complete precipitation. Filter the insolubles and dispose of them in a hazardous-waste site. Destroy any excess sulfide with sodium hypochlorite. Neutralize the solution before flushing down the drain.

M A slurry of the arenediazonium salt with water can be disposed of by adding it gradually to a stirred solution of 5-10% excess 2-naphthol in 3% aqueous sodium hydroxide at 0-20°C. After 12 hours, the resulting azo dye is filtered and either incinerated or buried in a landfill site approved for hazardous-waste disposal. Neutralize the remaining solution before disposal.

N For small quantities: cautiously add to a large stirred excess of water. Adjust the pH to neutral, separate any insoluble solids or liquids and package them for hazardous-waste disposal. Flush the aqueous solution down the drain with plenty of water. The hydrolysis and neutralization reactions may generate heat and fumes which can be controlled by the rate of addition.

O Bury in a landfill site approved for the disposal of chemical and hazardous waste.

P Material in the elemental state should be recovered for reuse or recycling.

Q Cautiously make a 5% solution of the material in water or dilute acid. There may be a vigorous, exothermic reaction and fumes may be generated due to the hydrolysis of the material. Control any reaction by cooling and by the rate of addition of the material. Gradually add dilute ammonium hydroxide to pH 10. Filter off any precipitate for disposal in a chemical landfill. If there is no precipitation, gradually adjust the pH from 10 to 6, stopping when precipitation occurs.

R Catalysts and expensive metals should be recovered for reuse or recycling.

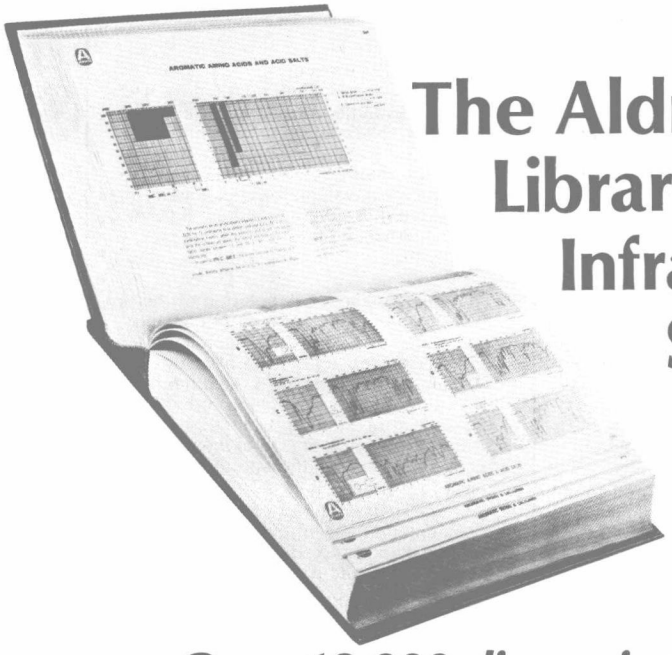
S Treat a dilute basic solution (pH 10-11) of the material with a 50% excess of commercial laundry bleach. Control the temperature by the addition rate of bleach and adjust pH if necessary. Let stand overnight. Cautiously adjust solution to pH 7. Vigorous evolution of gas may occur. Filter any solids for burial in a chemical landfill. Precipitate any heavy metals by addition of sulfide and isolate for burial. Additional equivalents of hypochlorite may be needed if the metal can be oxidized to a higher valence state. For metal carbonyls, the reaction should be carried out under nitrogen.

T Cautiously make a 5% solution of the product in water; vent because of possible vigorous evolution of flammable hydrogen gas. Acidify the solution to pH 1 by adding 1*M* sulfuric acid dropwise. Acidification will cause vigorous evolution of hydrogen gas. Allow the solution to stand overnight. Evaporate the solution to dryness and bury the residue in a landfill site approved for hazardous-waste disposal.

U Take the material (or a solution) and make a 5% solution in tetrahydrofuran. Cautiously add the solution dropwise to an ice-cooled, stirred basic solution of commercial bleach. Oxidation may release flammable hydrocarbon gases which must be vented. Let stand overnight. Adjust the pH to 7 and destroy excess hypochlorite with sodium bisulfite before disposal of the solution.

V Under an inert atmosphere cautiously add dry butanol or a mixture of dry butanol in an appropriate solvent, to a solution of the material in tetrahydrofuran. The chemical reaction may be vigorous and/or exothermic. Provisions must be made for the venting of a large volume of flammable hydrogen gas. When gas evolution ceases, cautiously add a basic hypochlorite solution dropwise to the reaction solution. Let stand overnight. Neutralize the solution and treat with sodium bisulfite to destroy any excess hypochlorite. Filter any solids for burial in a landfill site approved for hazardous-waste disposal.

W Evaporate water from the solution at water-aspirator pressure. Maintain heating bath temperature $<50°C$. Dissolve the residue in a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.



The Aldrich Library of Infrared Spectra

Over 12,000 dispersive IR spectra, linear in wavelength

The library is arranged in order of increasing molecular complexity within the following general categories: non-aromatic hydrocarbons, non-aromatics containing various functionalities (alcohol, aldehyde, amine, acid, etc.), aromatic hydrocarbons, aromatics containing various functionalities, five-membered aromatic, five-membered fused aromatic, six-membered aromatic, and six-membered fused aromatic heterocycles.

There are separate sections on alkynes, stains and dyes, steroids, indole alkaloids, deuterated compounds, silanes, boranes and phosphorus and polymer compounds.

51 chemical classes are represented. Indexed alphabetically and by molecular formula. Each spectrum measures 11.7 × 3.6cm. Eight spectra per page.

The Aldrich Library of Infrared Spectra, Edition III, by Charles J. Pouchert **Z10,750-6** **$275.00**

1850 pages, hardbound, with tearproof jacket. Page size 12 x 9½ in.