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DELAWARE GEOLOGICAL SURVEY
LABORATORY PROCEDURES MANUAL

COMPILED AND EDITED

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WITH CONTRIBUTIONS BY THE
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May 1987

ADDENDA

Amendments (1990) to this manual (starting with the blue page insert) by C. T. Smith follow p. 43. They comprise revised and added sections that replace the original Separation of Pollen from Unconsolidated Rock (p. 26-29) and Preparation of Clay Slides for X-Ray Analysis (p. 34 and 37) sections.

CONTENTS

	Page
INTRODUCTION.....	1
LABORATORY SAFETY.....	1
EMERGENCY PHONE NUMBERS.....	2
GENERAL LABORATORY INSTRUCTIONS.....	2
SAMPLE NUMBERING AND RECORD KEEPING.....	3
General Procedure.....	3
Sample Handling.....	3
Catalog Book Entries.....	4
SIZE ANALYSIS BY DRY SIEVING.....	5
Sample Preparation.....	5
Seiving Procedure.....	6
SIZE ANALYSIS BY WET SIEVING.....	6
Sample Preparation.....	6
Seiving Procedure.....	7
MECHANICAL AND MINERALOGICAL ANALYSIS OF SANDS, SILTS, AND CLAYS.....	8
Procedure for Sieving.....	8
Dry Sieving.....	8
Wet Sieving.....	8
Hydrometer Analysis.....	8
Mechanical Analysis Using the Sedimentation Balance.....	9
Drying Samples.....	9
Preliminary Disaggregation.....	9
Splitting.....	9
Mechanical Analysis.....	9
Mineralogical Analysis.....	12
SIZE ANALYSIS OF UNCONSOLIDATED SEDIMENTS.....	13
Preliminary Treatment.....	13
Moisture Determination.....	13
Size Analysis.....	13
HYDROMETER ANALYSIS.....	14
Sample Preparation.....	14
Hygroscopic Moisture.....	14
Dispersion of the Sample.....	14
Hydrometer Test.....	15

	Page
Calculations.....	15
PIPETTE ANALYSIS.....	20
Sample Preparation.....	20
Analysis.....	20
MICROFOSSIL SEPARATION.....	22
Washing.....	22
Quantitative Method.....	22
Procedure for CCl ₄ Float.....	22
Quaternary "O".....	23
Separation of Radiolarians.....	25
Recipe for "Rad Cocktail".....	26
SEPARATION OF POLLEN FROM UNCONSOLIDATED ROCK.....	26
Sample Preparation.....	27
Separation.....	27
Slide Preparation.....	29
HEAVY MINERAL SEPARATION.....	29
Seiving.....	29
Cleaning.....	30
Separation.....	30
Method 1.....	31
Method 2.....	32
Tetrabromoethane Recovery.....	32
Slides.....	33
SEPARATION OF MAGNETIC MINERALS.....	33
Sample Preparation.....	33
Separation.....	33
PREPARATION OF CLAY SLIDES FOR X-RAY ANALYSIS.....	34
Sample Preparation.....	34
Separation of Silt-Sized Material.....	34
Preparation of Clay Slides.....	37
PROCEDURE FOR STAINING FELDSPARS.....	37
Reagents.....	37
Procedure.....	38
PROCEDURES FOR MAKING PETROGRAPHIC SLIDES	
FROM SAND SAMPLES.....	38
Sample Preparation.....	38
Slide Preparation.....	39

	Page
INSTRUCTIONS FOR MAKING THIN SECTIONS.....	40
Cutting Chips.....	40
Mounting Chips.....	40
Lapping.....	41
Polishing.....	41
Sections from a Grain Mount.....	42
REFERENCES.....	43
APPENDICES.....	44

ILLUSTRATIONS

Figure 1. General laboratory sediment samples flow chart.....	11
Figure 2. Hydrometer reading versus correction coefficient graph.....	19
Figure 3. Side slope, current, and mass susceptibility for the Frantz isodynamic separator.....	36

TABLES

Table 1. Sample numbers corresponding to sample types..	4
Table 2. Specific gravity constants for hydrometer analysis.....	17
Table 3. Grain diameter versus sedimentation time for hydrometer analysis.....	18
Table 4. Grain diameter versus sedimentation time for pipette analysis.....	21
Table 5. Current and slope settings for common heavy minerals.....	35

APPENDICES

	Page
APPENDIX A. DELAWARE FIELD INVESTIGATIONS DATA SHEET...	45
APPENDIX B. SAMPLE RECORDING DATA SHEET.....	46
APPENDIX C. DRY SIEVE ANALYSIS DATA SHEET.....	47
APPENDIX D. WET SIEVE ANALYSIS DATA SHEET.....	48
APPENDIX E. HYDROMETER ANALYSIS DATA SHEET (Part A)....	49
APPENDIX E (continued). HYDROMETER ANALYSIS DATA SHEET (Part B).....	50
APPENDIX F. PIPETTE ANALYSIS DATA SHEET (Part A).....	51
APPENDIX F (continued). PIPETTE ANALYSIS DATA SHEET (Part B).....	52
APPENDIX G. MECHANICAL ANALYSIS DATA SHEET.....	53
APPENDIX H. HEAVY MINERAL ANALYSIS DATA SHEET.....	54
APPENDIX I. MATERIAL SAFETY DATA SHEETS (MSDS).....	55

DELAWARE GEOLOGICAL SURVEY LABORATORY PROCEDURES MANUAL

Michael G. Kramer

INTRODUCTION

Laboratory analyses of geologic samples are performed on a regular basis at the Delaware Geological Survey (DGS). These analyses produce valuable information used to assist the production of geologic and hydrologic maps and reports. Procedures used by the DGS for analyzing various aspects of geologic samples are described in this manual. The purpose of this manual is to standardize and document these procedures.

Care and skill in laboratory operations are essential to the quality of the resulting interpretations. All members of the DGS are expected to be familiar with this manual. All samples will be treated according to these procedures unless specific exception is made and noted.

LABORATORY SAFETY

For information on emergency procedures and standard University procedures dealing with hazardous materials refer to the Hazardous Material Safety Manual that is displayed for public view in DGS laboratories. For information about radiation hazards and precautions refer to the Radiation Safety Manual that is also displayed in DGS laboratories.

Laboratory analyses involving hazardous materials will not be performed unless the person performing the analyses has completed Right-to-Know training and has read the Material Safety Data Sheets (MSDS) pertaining to the substances to be used. These sheets are displayed for public inspection in DGS laboratories. All containers must be properly labeled.

EMERGENCY PHONE NUMBERS

FIRE and AMBULANCE.....	911
UNIVERSITY POLICE.....	2222
UNIVERSITY AMBULANCE.....	2222
UNIVERSITY SAFETY DIVISION.....	8475
UNIVERSITY STUDENT HEALTH SERVICE.....	2226
POISON INFORMATION CENTER.....	655-3389

GENERAL LABORATORY INSTRUCTIONS

All laboratory procedures should be conducted with care to ensure the accuracy of the results. This will also ensure that experimental results remain reliable and reproducible.

Guard against contamination of samples. Make sure samples are clearly labeled and in proper containers before making assumptions about their origins. Clean fume hoods and lab benches well before starting work. Be sure the equipment to be used is clean.

Specify the type of splitting used to obtain a representative portion of sample. The "Otto"-type splitter is preferred; quartering is acceptable as an option but it must be noted when used.

Place processed samples in proper containers and label them with the DGS sample number and the type of process used.

When weighing sample and reagents, use powder paper to ensure accuracy after weighing. When using small portions of fine-grained material, powder paper ensures transfer of all weighed material from the balance.

Keep careful notes when processing samples. Use data sheets when possible. Record all observation pertinent to processing.

SAMPLE NUMBERING AND RECORD KEEPING

General Procedure

To enter samples into the DGS Sample Library and database, first plot the site where the samples were obtained, either on the DGS base maps in Room 103 Penny Hall (for samples from borings or wells) or locate the site on the appropriate topographic map quadrangle (for outcrop samples). Then, fill out the appropriate sample catalog book (on a shelf in Room 103, Penny Hall) and annotate the sample numbers to an appropriate well schedule form (except for outcrop samples) as detailed in DGS Special Publication No. 11 (Instructions for Preparation of Delaware Geological Survey Data Base Schedules, Talley and Windish, 1981). Well schedule forms are in Room 101 Penny Hall. Completed well schedules should be given to the DGS Secretary in charge of data entry who will make provisions for entry into the DGS computer database. After completing entries in the sample catalog books, the books should be returned to the appropriate shelf in Room 103.

Sample Handling

Samples should be taken to the sample receiving room, (Room 019, Penny Hall Annex I) and one of the DGS technicians should be notified of their presence. All samples should be properly labeled by the person who obtained them to ensure accuracy of labeling. Unlabeled samples will be discarded. Wet samples should be air dried before storage. All samples (except cores) should be transferred to the one-pint, lidded, paper containers stocked for uniform storage size. Paper containers should then be marked with the sample number and sample depth. The containerized sample should then be placed on the appropriate shelf of the DGS Sample Library (Room 018, Penny Hall Annex I).

Core samples can be placed in the paper containers if the size of the core permits. Larger core samples should be placed in a plastic or wooden core box. Numbering and labeling are the same for cores as for other samples, except that the top and bottom directions of the core are to be marked. Cores are also stored in Room 018, Penny Hall Annex I.

In all cases take care to avoid contamination of samples.

Catalog Book Entries

Determine the proper book to use by distinguishing initially between in-state and out-of-state samples, and then breaking down the in-state samples according to their method of recovery (e.g. cores, ditch-auger, or outcrop). Use the criteria in Table 1 for entry.

Table 1. Sample numbers corresponding to sample types.

<u>Sample Type</u>	<u>Sample Number Series</u>
In-state: cores	20,000
In-state: auger-ditch	80,000
	(continued from 30,000)
In-state: outcrops	40,000
Out-of-state	50,000

All sample catalog book entries should be as complete as possible. As laboratory analyses are performed on a sample the sample book containing that entry should be updated. Outcrop samples should have the latitude and longitude of the sampling site entered in the sample book. Most out-of-state samples will not have a DGS well number, but they may be referenced to another State's system.

The information to be entered is:

1. Sample number: Assign the next unused number in the book's sequence to the sample.
2. Date: Record the sample's date of entry into the books.
3. Location
 - a. Delaware 5' quad - the 5-minute topographic quadrangle of the site where the sample was obtained
 - b. Geographic location - the most exact descriptive location of the sample's site of origin (e.g. 10 feet north of a specific crossroad).

4. Well number: Record the letter-number designation of the sample's site of origin as plotted on the DGS base maps. This is not entered for outcrop samples and can not be entered in for out-of-state samples.
5. Depth below land surface: Enter the depths as accurately as possible, although a range of depths is acceptable (e.g. 4.5-6.0' for a split spoon core sample; 2-4' for ditch or auger samples).
6. Land surface elevation: If available use surveyed-in data; if not, use elevation data from a topographic map.
7. Sampling method: List the method such as augering, ditch sampling, hand sample, split spoon, Shelby tube, diamond core, carbide core, etc. by which the sample was obtained.
8. Project: Specify the project for which the sample was collected. If the sample is not associated with a project, enter "DGS" to indicate general information gathering.
9. Comments: List pertinent comments about sample.
10. Laboratory operations: List tests done to samples (e.g., microfossil separation, heavy minerals, size analysis, etc.) as they are completed.

SIZE ANALYSIS BY DRY SIEVING

This method is used when the sample is of such a nature that aggregates of clay will readily break up and pass through the sieves. If the clay cannot be satisfactorily disaggregated, employ wet sieving.

Sample Preparation

1. Select an uncontaminated sample of approximately 100 grams.
2. Dry the sample in an oven at no greater than 60°C.
3. Record the weight of the sample to the nearest 0.01 gram.

4. Disaggregate the sample by gentle crushing of the clay and silt aggregates. A rubber hammer or pestle should be used. Be careful not to break the natural sand grains.

Sieving Procedure

1. Weigh each clean, dry sieve to be used to nearest 0.01 gram.
2. Place sample in a nest of sieves made up of
2000 (μ) micron
1000 μ
500 μ
250 μ
125 μ
62 μ

(unless otherwise specified). Be certain that the sieves are clean.
3. Place in Ro-Tap (or specify other shaking device) for 10 minutes.
4. Weigh each sieve again and obtain the amount of sample on each sieve by subtracting the weight of the sieve. Record weights to nearest 0.01 gram. (The sum of weights on each sieve and pan must agree within at least $\pm 1\%$ of the original sample weight.)
5. Pour the material from each sieve onto a separate large brown piece of paper and then into a separate sand envelope. Turn the sieve upside down and strike the rim down evenly onto the paper to remove any remaining material. Place this in the envelope also. Label each envelope as to sample number, size range, and weight.

SIZE ANALYSIS BY WET SIEVING

Sample Preparation

1. Select a sample of approximately 100 grams. Be certain that sample is clean and uncontaminated.

2. Dry sample in an oven at no greater than 60°C.
3. Weigh sample to 0.01 gram and record.
4. Soak sample for 12-24 hrs. in a solution of 1 milliliter 10% hexametaphosphate per 225 milliliters of distilled water. Use only 100 milliliters of this solution. Disaggregate sample in dispersion jar (mixer) for 2-10 minutes.

Sieving Procedure

1. Weigh each sieve to be used to the nearest 0.01 gram.
 2. Place sample in a nest of sieves made up of
 - 2000 μ
 - 1000 μ
 - 500 μ
 - 250 μ
 - 125 μ
 - 62 μ
- and wash thoroughly with water until all clay lumps are broken up and washed through.
3. Thoroughly dry sample retained on each sieve at <60°C.
 4. Weigh each sieve and obtain the weight of sample on each sieve by subtracting the weight of the sieve. Record the weights to the nearest 0.01 gram.
 5. Pour the contents of each sieve onto a separate large brown piece of paper, and then into a separate envelope. Turn the sieve upside down and strike the rim down evenly onto the paper to remove any remaining material. Place this in the envelope also. Label each envelope as to sample number, size range and weight.

MECHANICAL AND MINERALOGICAL ANALYSIS
OF SANDS, SILTS, AND CLAYS
(Jordan, R. R., 1965)

It is essential to the success of any laboratory operation that great care be exercised. Contamination must be avoided by actively guarding against it. Splitting and weighing must be done carefully and precisely. Label samples and record all results promptly. No variation in procedure is to be made unless specifically approved.

There are three primary methods for mechanical sample analysis. These are:

- a. Sieving - dry and wet.
- b. Hydrometry.
- c. Gallenkamp sedimentation balance.

There are many variations of these methods by using one or more together such as hydrometry and wet or dry sieving, or Gallenkamp sedimentation balance with dry or wet sieving.

Procedure for Seiving

Dry Sieving

Follow procedure described in Size Analysis by Dry Sieving (page 5).

Wet Sieving

Follow procedure described in Size Analysis by Wet Sieving (page 6).

Hydrometer Analysis

Follow procedure described in Hydrometer Analysis (page 14).

Mechanical Analysis Using the Sedimentation Balance
(GallenKamp)

Drying Samples

1. Samples on which mechanical analysis or X-ray diffraction are to be performed must not be heated above 80°C or treated with flocculants. Means of removing large quantities of water include:
 - a. Filter candle-vacuum filtration
 - b. Paper filter-vacuum filtration
 - c. Long-term settling and decantation
 - d. Evaporation at low temperatures
 - e. Combinations of the above.
2. Samples which are not dispersed in water may be oven-dried at temperatures under 80°C.
3. Carefully weigh dried sample and record to the nearest 0.01 gram.

Preliminary Disaggregation

1. Disaggregate to fine powder by crushing. Use hands in Saran Wrap, rubber mortar and glass pestle stir rod with rubber policeman, or other gentle technique.

Splitting

1. Fractions for mechanical analysis, X-ray and petrography, and reserve are required for full analysis. Use clean splitter with great care.

Mechanical Analysis

1. Mechanical analysis of small samples will be done with the Gallenkamp Sedimentation Balance. Very large samples may also be analyzed by hydrometry according to AASHTO procedures as discussed earlier. Do not attempt to use the sedimentation balance unless you are thoroughly familiar with the apparatus and receive permission.

NOTE: Two identical samples are required - treatment of both samples must be the same.

2. Sample Preparation

- a. Soak samples for 24 hours in 10 milliliters distilled H_2O with hexametaphosphate.
- b. Disperse sample in 200 milliliters of hexametaphosphate water (1 milliliters of 10% hexametaphosphate per each 225 milliliters of distilled water).
- c. Transfer to the dispersion cup and stir for 1 minute mechanically.
- d. Transfer sample for sedimentation balance to transfer tube, add distilled water until the 225 milliliters mark is reached, then shake and introduce to the balance. Proceed as per balance directions, Section II of this manual.

3. Control Sample

- a. This is only used in the short method.
- b. Prepare in the same manner as the sample for the balance.
- c. Transfer control sample to tube identical to balance tube, bring volume up to 225 milliliters plus 2.5 centimeters.
- d. Place in water bath and control temperature to equal that of balance water jacket.
- e. After 2 hours and 8 minutes, siphon off suspension to within 2.5 centimeters of the bottom.
- f. Remove, dry in an evaporating dish with Saran Wrap and weigh sample remaining in the control tube.
- g. After completion of mechanical analysis, thoroughly clean all apparatus. Record all data and complete calculations promptly.

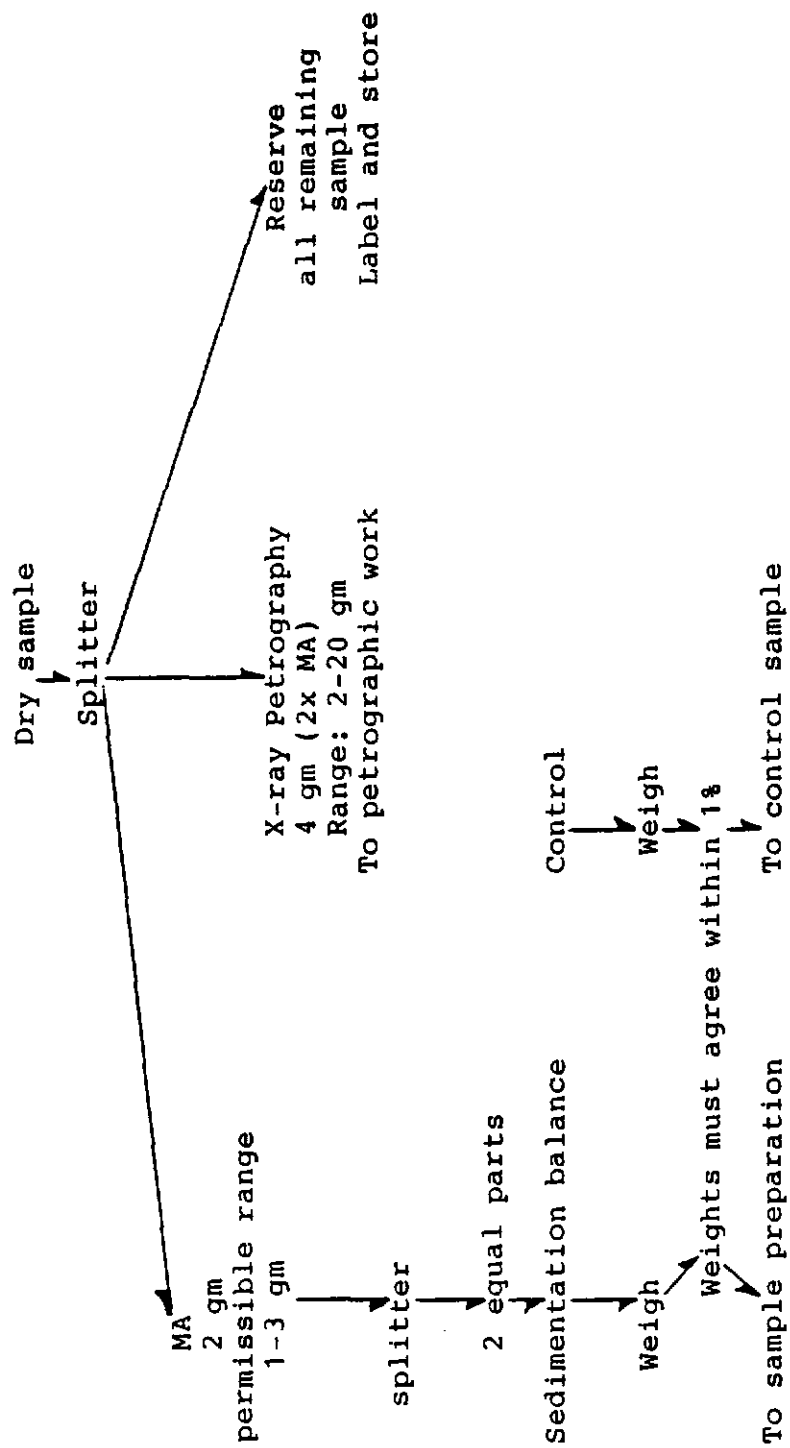


Figure 1. General laboratory sediment samples flow chart.
(After Jordan, R. R., 1965)

Mineralogical Analysis

1. The split of the sample for X-ray and petrographic analysis is to be treated in the following manner. If the sample contains considerable carbonate, it will be necessary to remove this by special treatment. Otherwise, proceed as indicated.
2. Follow the procedures described in Preparation of Clay Slides for X-Ray Analysis (page 34).
3. Clay X-Ray Procedure

CAUTION: WEAR A RADIATION MONITORING FILM BADGE

Do not attempt to use the X-ray unit (Phillips) unless you are thoroughly familiar with its operation. Log use of instrument.

Major machine settings are to be maintained for all samples. Any variation is to be recorded. Use Cu radiation and 2°/minute goniometer speed (low-high).

- a. X-ray Mg slide to 40° 2 θ
- b. Saturate Mg slide in ethylene glycol
- c. Place in 60° oven for 1 hour
- d. Cool in desiccator
- e. X-ray Mg-ethylene glycol saturated slide to 40° 2 θ
- f. X-ray AI slide to 40° 2 θ
- g. If dioctahedral vermiculite is indicated from step 5 (above), and to check for kaolinite:
- h. Heat 12 hours at 400°C
- i. Prevent rehydration and X-ray to 30° 2 θ
- j. Heat for 12 hours at 550°C

k. X-ray to $30^{\circ} 2\theta$

4. Petrographic Slide

Follow procedure described in Procedures For Making Petrographic Slides from Sand Samples (page 38).

SIZE ANALYSIS OF UNCONSOLIDATED SEDIMENTS

Preliminary Treatment

1. Dry sample in air or in an oven at 40°C for one hour.
2. Break all clumps using fingers and rubber pestle, do not use a porcelain pestle.
3. Mix and split 100-200 grams if mainly sand, 25-75 grams if mainly silt and fine sand, 15-25 grams if mainly clay.
4. Split out a 10-25 grams sample to use for moisture determination if sample was not dried in an oven.
5. Weigh splits in steps 3 and 4 to the nearest 0.01 gram.

Moisture Determination

1. Dry the split to be used for moisture determination at 100°C for one hour.
2. Immediately weigh to 0.01 gram.
3. Compute percent moisture and correct weight of main sample (to ± 0.3 gram) for moisture content.

Size Analysis

1. Follow the procedure described in Size Analysis by Wet Sieving (page 6).

2. For the material that passes the 62-micron sieve, follow the procedure described in Pipette Analysis (page 20).
- * An alternate method to this procedure is described in Hydrometer Analysis.

HYDROMETER ANALYSIS (A.A.S.H.O. Designation: T 88-49)

Sample Preparation

1. Weigh out approximately 150 grams of sample.
2. Sieve the sample as described in the procedure Size Analysis by Dry Sieving, (page 6) collecting what passes through the 2000 micron sieve in a pan.
3. Weigh the portion on the pan and on the sieve.

Hygroscopic Moisture

1. Weigh out approximately 10 grams of the portion which passes through the 2000 micron sieve.
2. Dry this portion at 110°C (230°F) until a constant weight is obtained.
3. Record this final weight.

Dispersion of the Samples

1. Weigh out approximately 50 grams (100 grams if sample is very sandy) of the portion that passed through the 2000 micron sieve.
2. Place the sample in a 400-milliliter beaker and add 250-milliliter of hexametaphosphate solution (or "Calgon," note commercial "Calgon" is not hexametaphosphate) (1 milliliter of 10% hexametaphosphate per 225 milliliter of distilled H₂O). Stir thoroughly and soak overnight.
3. Pour the suspension in a mixer dispersion cup and disperse for 5 minutes.

4. Transfer the sample to a specially scribed 1000 milliliter graduate cylinder. Add enough hexametaphosphate solution to the cylinder to bring the level up to 1000 milliliter. (The solution added must have a temperature of 67° F).

Hydrometer Test

1. Place the graduated cylinder in a constant temperature bath of 67° F until the contents of the cylinder reach this temperature. Remove the cylinder from the bath and shake the contents for 1 minute (use the palm of the hand as a stopper).
2. At the conclusion of the shaking, place the cylinder in the bath and record the time. Take reading with the hydrometer at the end of two minutes. The hydrometer shall be read at the top of the meniscus formed by the suspension around its stem. Read the hydrometer to the nearest 0.5 gram per liter (or 0.0005 specific gravity). Readings shall also be taken at 2, 5, 15, 30, 60, 250, and 1140 minutes.
3. After each reading the hydrometer should be very carefully removed from the suspension and placed with a spinning motion in a graduate cylinder containing clean distilled water. About 25 or 30 seconds before each reading the hydrometer should be placed in the suspension without disturbing it. Take the reading when the hydrometer has come to rest.
4. At the conclusion of the final reading, the suspension can be dried in the oven at a temperature less than 60°C and then dry sieved, or it can be wet sieved immediately after the final reading. In order to save fines settle until clear and add flocculant NaOH.

Calculations

1. Calculate the percentage of hygroscopic moisture using the following equation:

$$pm = \frac{w-w_1}{w_1} \times 100$$

where:

w = weight of sample after air drying

w₁ = weight of sample after oven drying

To correct the weight of the portion undergoing hydrometer analysis, multiply its weight by the expression:

$$100 + \frac{100}{\text{percentage of hygroscopic moisture}}$$

2. Calculate the percentage of the dispersed soil remaining in solution at each interval using equations:

for a hydrometer that reads density

$$P = \frac{Ra}{W} \times 100$$

for a hydrometer that reads specific gravity

$$P = \frac{1606 (R-1)a}{W} \times 100$$

where:

P = percentage of originally dispersed soil remaining in suspension.

R = hydrometer reading (corrected if temperature was not 67°F).

W = weight in grams of soil originally dispersed minus the hygroscopic moisture, and

a = constant depending on the density of the suspension.

The value of a for a hydrometer that reads density is given by:

$$a = \frac{2.6500 - 0.9984}{2.6500} \times \frac{G}{G - 0.9984}$$

where:

G = specific gravity of the soil dispersed.

The value of a for a hydrometer which reads specific gravity is given by:

$$a = \frac{2.6500 - 1.0000}{2.6500} \times \frac{G}{G - 1.0000}$$

where:

G = specific gravity of the soil dispersed

Some values of a are shown in Table 2.

Table 2. Specific gravity constants for hydrometer analysis.

<u>Specific Gravity, G</u>	<u>Constant, a</u>
2.95	0.94
2.85	0.96
2.75	0.98
2.65	1.00
2.55	1.02
2.45	1.05
2.35	1.08

3. Calculate the maximum grain diameter in suspension corresponding to each period of sedimentation. A first approximation is given in Table 3.
4. Apply the correction factor needed to compensate for the position of the hydrometer in the suspension (the distance through which the particles fall changes with the position of the hydrometer). For the particular hydrometer used, a graph should be drawn which determines the correction factor. Using the following equation a graph of hydrometer readings versus correction factors is obtained.

Table 3. Grain diameter versus sedimentation time
for hydrometer analysis.

<u>Time (min.)</u>	<u>Max. Grain Diameter (mm.)</u>
2	0.041
5	0.026
15	0.015
30	0.011
60	0.0074
250	0.0037
1440	0.0015

$$K_L = \sqrt{\frac{\text{distance to center of volume of hydrometer}}{17.5}}$$

A typical graph is shown in Figure 2.

The corrected grain diameter is then given by the equation:

$$d = d' \times K_L$$

where:

d' = grain diameter obtained from table of values
(Calculated for specific gravity or density
hydrometer from equations on page 16).

5. Convert the percentages of soil in suspension to percentages of total test sample (including percentage that remained on the 2000 micron sieve).

First calculate the percentage which remained on the 2000 micron sieve using the following equation:

$$P_c = \frac{W_c}{W_t} \times 100$$

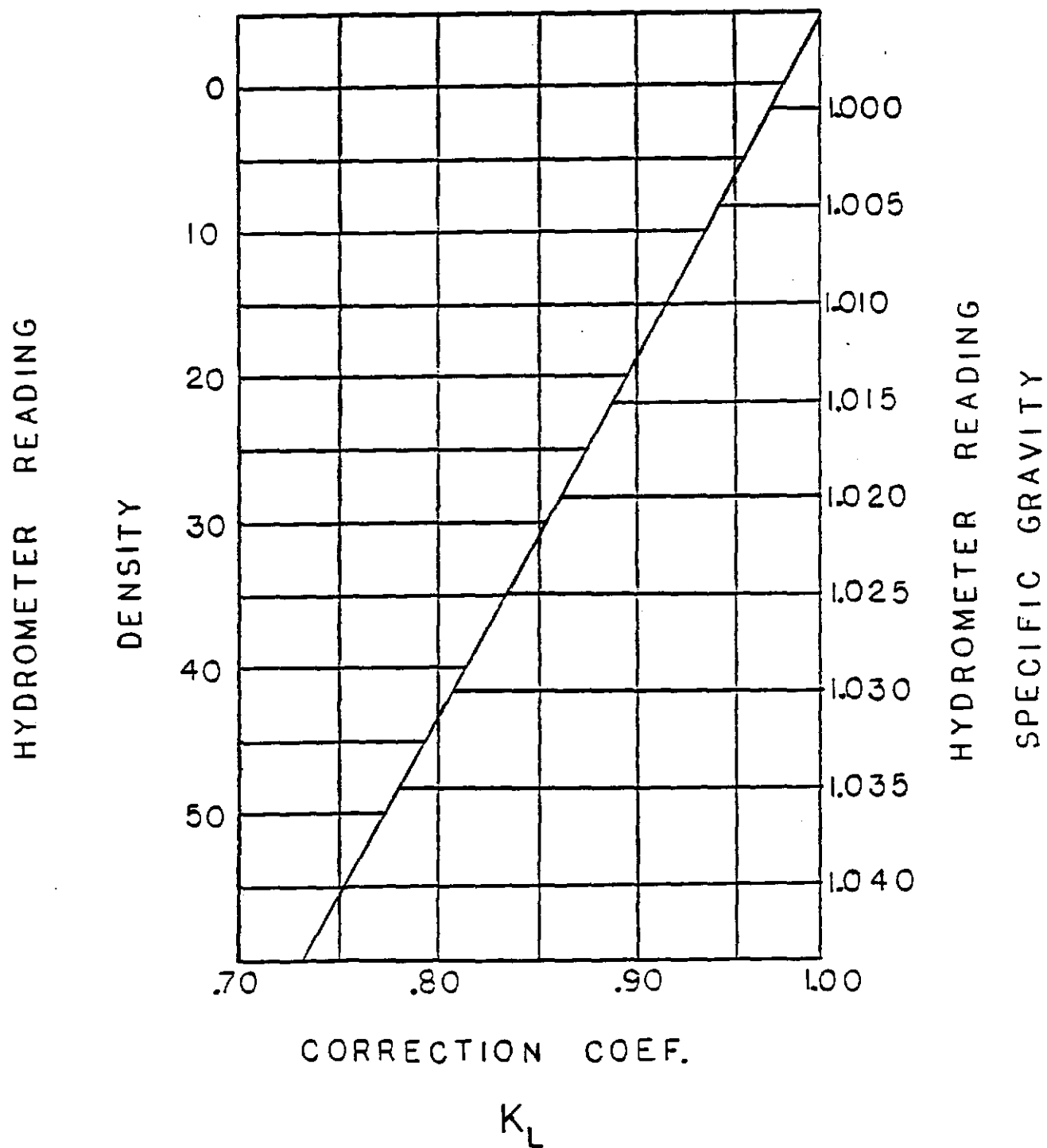


Figure 2. Hydrometer reading versus correction coefficient graph. (After A.A.S.H.O. Designation: T88-49.)

where:

W_c = weight of portion remaining on 2000 micron sieve

W_t = total weight of sample sieved.

From this multiply the percentage in suspension by the expression:

$$\frac{100 - P}{100} c$$

to obtain the percentage of total test sample.

PIPETTE ANALYSIS

Sample Preparation

1. Isolate the fines (less than 62 microns) by dry or wet sieving (see other procedure descriptions) depending on the characteristics of the sample:
 - a. Use dry sieving if the clay can be disaggregated satisfactorily by hand (mortar and rubber pestle).
 - b. Use wet sieving when clay can not be disaggregated.

Analysis

1. Determine the weight of the fine fraction produced by the sieve procedure and record to the nearest 0.01 gram.
2. Place the fines in a 1000 milliliter graduate cylinder and fill to the 500 milliliter mark with distilled water. Add 5.5 grams of dispersing agent (Na hexametaphosphate).
3. Shake well by hand (with hand over opening) (2-10 minutes) then fill the graduate cylinder to 1000 milliliter with distilled water.

4. Shake cylinder vigorously by hand (with hand over opening) for one minute.
5. At the end of one minute, set the cylinder down and start timing.
6. One minute before settling time is complete, lower the tip of a 20-milliliter pipette to the proper depth. Brace the pipette against the side of the cylinder and fill it at the proper time according to Table 4.
7. Each time a sample is taken, empty the pipette into a separate labeled and weighed 50-milliliter beaker. Wash the inside of the pipette with approximately 10 milliliters of distilled water and empty this into the beaker also.
8. Dry the contents of each beaker in an oven at 60°C for 24 hours.

Table 4. Grain diameter versus sedimentation time for pipette analysis.

Size Finer than	Depth (centimeters)	Time elapsed since start of sedimentation
4 Ø	20	0:01:00
5 Ø	10	0:02:59
6 Ø	10	0:11:59
7 Ø	10	0:47:51
8 Ø	10	3:12:--
9 Ø	7	8:58:--
10 Ø	5	25:43:--
11 Ø	5	106:50:--

This is based on Wadell's modification of Stokes' Law for a temperature of 25°C; therefore the analysis must be done at this temperature.

9. Weigh each beaker after it has cooled and come to equilibrium with the moisture in the room. All weights should be recorded to the nearest 0.01 gram.

MICROFOSSIL SEPARATION

The following sections can be used in a stepwise manner, or separately depending on the type of fossils sought.

Washing

1. Soak approximately 100 grams of the sample in water to break up clumps and disperse.
2. Wash the sample through a 63-micron sieve.
3. Fines smaller than 63-micron need not be saved unless requested by the investigator.

Quantitative Method

1. Split approximately 30 grams of sample and weigh.
2. Place the sample in a beaker with two tablespoons of NaCO_3 and add deionized water until the beaker is one-half to two-thirds full.
3. Boil the sample for two hours on low heat while maintaining the proper water level. Stir occasionally to disperse sample.
4. Wash sample with tap water in a 63-micron sieve and transfer to a paper towel and air dry, or wash the sample back into a beaker, decant, and dry under a heat lamp.
5. Cool and weigh the sample. Subtract the weight of the beaker to determine the sample weight to the nearest 0.01 gram.

Procedure for CCl_4 Float

**CAUTION: DO NOT INHALE CCl_4 ,
USE UNDER HOOD,
WEAR GLOVES AND EYE PROTECTION**

1. Slowly introduce the sample, while stirring, into a 400 milliliters beaker filled 3/4 full of CCl_4 . Forams will float in the CCl_4 .

2. Filter forams by pouring (decanting) with sudden action into a filter paper. Be sure to save the CCl_4 during this procedure. Filter only the material that is floating.
3. Dry the material, weigh (to the nearest 0.01 gram), and place in a glass vial or on a micropaleo slide.
- a 4. Filter the heavy material, dry, and weigh. Place in sand envelope and label "residue."
5. Put the CCl_4 back into the stock bottle.

THIS WHOLE PROCEDURE MUST BE CONDUCTED UNDER A HOOD!

Carbon Tetrachloride causes poisoning by inhalation, ingestion, or skin absorption. It can result in liver and kidney damage as well as visual disturbances. CCl_4 has also been found to be carcinogenic.

WEAR GLOVES AND EYE PROTECTION

Quaternary "O"

Purpose: This technique works well on most non-calcareous or only slightly calcareous shales. Preparation time per sample is reduced when numerous samples are processed at once.

1. Equipment Needed:

- a. Supply of Quaternary "O"
- b. One washing pan
- c. Beakers
- d. One rubber washing pad
- e. One 250-mesh washing screen with backing
- f. One Waring (or other type) blender
- g. Large hot plate (with temperature control)
- h. Supply of Solox "Alcohol" (standard methanol is OK)
- i. One measuring cup (metric graduates can be used - convert using 30 milliliters/ounce)
- j. "Coke" bottle with sprinkler head

2. Procedure: for a full batch (or a half batch).

- a. Place 1-1/2 cups denatured alcohol (or "Solox") in blender (3/4 cup or 180 milliliters).
- b. Add 2 cups Quaternary "O" - mix at slow speed (1 cup or 240 milliliters of Quaternary "O").
- c. Add 1 cup Quaternary "O" - thoroughly mix at slow speed, for 5 minutes (1/2 cup or 120 milliliters).
- d. Add 20 ounces of above mixture to one gallon distilled water. This is, and will be referred to as, the Standard Solution*. (You have ±18 ounces of Quaternary "O" + methanol, so put this into about 3400-3500 milliliters of tap water in a brown glass jug.)
- e. Rinse drilling mud from samples.
- f. Place approximately 75 grams of sample in beaker.
- g. Add 300 milliliters standard solution to beaker - add enough to cover ("motor oil consistency").
- h. Heat until shale has disintegrated - do not leave unattended; check on amount of disintegration after 1 to 2 hours. You can always wash it, then recrush what's left and boil again - no need to dry it out first. Add standard solution as necessary to keep samples immersed. Stir occasionally with a glass stirring rod. Do not allow sample to boil dry. Do not permit temperature to exceed 123°C (adjust hot plate to medium).

* It has become necessary to vary the concentration referred to in 2.d. due to an apparent lack of quality control in the manufacture of Quaternary "O." Users of this substance have added as little as 15 ounces of the 2.c mixture per gallon of fresh water and as much as 25 ounces. This control is determined by observing the viscosity of the solution after the heating process is complete.

- i. Transfer sample to 250-mesh washing screen and wash with rubber washing pad. Add methanol from "sprinkler bottle" when necessary to reduce sudsing.
- j. Place sample in washing pan and dry in oven at 450°F or under a heat lamp.
- k. Remove metal particles with magnet.
- l. Place sample in labeled vial for examination and filing (Figure 8).

CAUTIONS:

WEAR GLOVES AND LAB COAT
 DON'T INHALE FUMES. DO OPERATIONS UNDER THE HOOD.
 STORE SOLUTION UNDER THE HOOD.

If you get Quaternary "O" on:

skin - flush with running water immediately.
eyes - flush with running water for 15 minutes,
 call the University Health Service.
clothes - wash before wearing again.

Separation of Radiolarians

DO NOT INHALE CCl_4 ,
 USE UNDER HOOD,
 WEAR GLOVES AND EYE PROTECTION

1. Heat sample to dryness if necessary. Sample will not react with solution very readily unless it is dry. To facilitate chemical treatment of a highly indurated sample, break it into small pieces (less than pea-size) if it is highly indurated.
2. Weigh sample to nearest 0.1 gram (optional; check with investigator).
3. Add sample to "Rad cocktail" in 600 milliliter beaker. Use enough of the "Rad cocktail" to cover the sample with 1-2 centimeters of liquid.

Recipe for "Rad Cocktail":

Equal parts of:

- (a) Deionized water with commercial hexameta-phosphate added (enough to make a solution of 1 gram hexametaphosphate/liter).
- (b) 27-30% H_2O_2 (hydrogen peroxide). Be extremely careful with this strong oxidant.

Allow sample to react to completeness. Much frothing will occur; to prevent spilling cover beaker with watch glass and place in a large pan or dish so any spills can be recovered. A wash bottle of deionized water can be used to spray down the foam. Stir mixture frequently.

- 4. Wet sieve (use fine spray of a hose from water tap) through screen with mesh opening of 0.063 millimeters (63 microns). Use spray from hose to break down clay lumps. Examine residue under microscope; if clay has not broken down, return residue to evaporating dish and dry it under infrared lamps. Heat dry sample and add to "Rad cocktail" thus repeating steps 3 and 4.
- 5. Follow the steps on page 22 for "Procedure for CCl_4 Float."

Carbon Tetrachloride causes poisoning by inhalation, ingestion, or skin absorption. It can result in liver and kidney damage as well as visual disturbances. CCl_4 has also been found to be carcinogenic.

**DO NOT INHALE CCl_4 ,
USE UNDER HOOD,
WEAR GLOVES AND EYE PROTECTION**

SEPARATION OF POLLEN FROM UNCONSOLIDATED ROCK

This procedure can only be applied to samples that are easily disaggregated by soaking in water.

Sample Preparation

1. Select a single piece of the sample weighing 15 to 20 grams. Remove the outer layer by scraping the sample with a metal spatula.
2. Crush the sample into several smaller pieces with a mortar and pestle. The mortar and pestle must be cleaned with an abrasive cleanser and dried with compressed air before they are used.
3. Label and weigh a 50-milliliter plastic centrifuge tube. Use tweezers to place 10 to 15 grams of sample into the tube. Weigh the tube and subtract the weight of the tube when empty to determine the sample weight to the nearest 0.01 gram. Record this weight along with the sample number. If more than one sample is being processed, number the centrifuge tubes, caps, and stir rods to prevent interchanging these between samples. Record this number along with the sample number and weight.
4. Add 20 milliliters of distilled water. Let the sample soak (overnight if possible) to disaggregate the sample. Cap the tube to avoid contamination.
5. Stir the sample vigorously to break up all clumps.
6. Centrifuge (International) the sample at 3000 rpm for 5 minutes. This time and rpm will be the standard throughout the entire procedure. If supernatant is not free of suspended particles after 5 minutes, repeat this procedure. After centrifugation decant the supernatant fluid.

Separation

**WEAR GLOVES, FACE SHIELD, AND WORK UNDER A HOOD.
PLASTIC CENTRIFUGE TUBES AND STIR RODS MUST BE USED.
DO NOT DISPOSE OF HF. STORE IN PLASTIC CONTAINERS
WITH PROPER WASTE LABELS AND CALL SAFETY FOR DISPOSAL**

1. Add 20 milliliters of 10% KOH solution. Stir vigorously, centrifuge, and decant. Add 30 milliliters of distilled water, stir, centrifuge, and decant.

2. Add 10 milliliters of 10% HCl and 5 milliliters of ethanol. Stir very slowly, this reaction may boil out of the tube. If this begins to happen add distilled water using a wash bottle. Centrifuge and decant. If the initial reaction was very vigorous it may be necessary to repeat this step to ensure removal of all carbonate material.
3. Add 10 milliliters of 52% HF (or a concentration close to this) and 10 milliliters of distilled water. Stir very slowly. Fill the tube with distilled water, centrifuge, and decant.
4. Repeat step 3, without adding the 10 milliliters of distilled water (unless reaction becomes violent) 3 to 4 more times. During the last two repetitions, place the sample in a hot water bath (boiling) to speed the reaction. A beaker placed on a hot plate works well.
5. Add 20 milliliters of 10% HCl and 10 milliliters of ethanol, stir, centrifuge, and decant.
6. Add 30 milliliters of distilled water, stir, centrifuge, and decant.
7. Add 20 milliliters of glacial acetic acid, stir, centrifuge, and decant.
8. Place 18 milliliters of acetic anhydride into a beaker. Slowly add 2 milliliters of concentrated H_2SO_4 . Multiply these proportions by the number of samples being processed.
9. Add 10 milliliters of the solution from step 8 and stir slowly. Have a wash bottle with distilled water ready to guard against boil-over. When the reaction has slowed add 10 milliliters more of the step 8 solution. Stir slowly, centrifuge, and decant into the mixing beaker.
10. Add 20 milliliters of glacial acetic acid, stir, centrifuge and decant into the mixing beaker. Slowly dispose of this down the drain with running water.
11. Fill the tube with distilled water, stir, centrifuge, and decant.

12. Fill the tube with distilled water. Add 10 drops of safranin solution (stain), stir, centrifuge, and decant.
13. Transfer the extraction to a 25 milliliter plastic bottle using a stir rod and distilled water. Use as little water as possible. Cap and label the bottle.

Slide Preparation

1. Place a small drop of glycerin on a No. 0 cover slip. Place a small drop of the extraction (taken from the bottom of the storage bottle) in the center of the glycerin. Mix well. Drive off the water by heating the cover slip slowly on a hot plate. Observe the viscosity of the solution on the cover slip; when it returns to the viscosity of glycerin, remove the cover slip from the heat and allow it to cool.
2. Label the slide with the sample number. Place one edge of the cover slip down on the slide and slowly rotate the other edge down onto the slide to avoid forming bubbles. Seal the cover slip with nail polish or similar substance.

HEAVY MINERAL SEPARATION (R. R. Jordan, 1968)

Sieving

Because the size distribution of different minerals in a sediment varies, a standard size range must be used. The standard size range is 62-500 μ unless otherwise specified.

1. Disaggregate the sample by crushing with a mortar and rubber pestle.
2. Sieve 50-100 grams (generally) on 500 μ and 62 μ sieves. Shake dry for at least 10 minutes.
3. Unless otherwise directed, discard the greater than 500 μ and the less than 62 μ fractions. These are the fractions in the pan and on the 500 μ sieve.

4. If mechanical analysis is performed, steps 1-3 above may be omitted by selecting the fractions on the sieves between the pan and the 500 μ sieve.
5. Weigh this size range and split to approximately 20 grams and then weigh the split to the nearest 0.01 gram.

Cleaning

In order to remove surface coatings which modify the bulk grain density and complicate the optical identification a cleaning process is necessary.

1. Boil (gently) the size range sample in 10:1 HCl for 10 minutes. The HCl should just cover the sample.

**CAUTION: WEAR GLOVES, WEAR EYE PROTECTION,
WORK UNDER A HOOD.**

2. Wash thoroughly with water until all of the acid is removed as indicated by litmus paper. Be careful not to wash out any mineral grains.
3. Boil the sample in 10:1 HNO₃ for 10 minutes.
4. Wash with water until the acid is removed as indicated by a litmus paper test.
5. Dry the sample under the infrared lights and cool.
6. Weigh the cleaned sample.

Separation

Two methods of separation are outlined. The choice of methods will be specified for each sample. Tetrabromoethane, with a permissible density range of 2.90-2.96, will be used as the heavy liquid. Be careful as it is light sensitive. Methanol is the only solvent to be used.

Method 1

**CAUTION: WEAR GLOVES, WEAR EYE PROTECTION
WORK UNDER A HOOD**

1. Large funnel with rubber tube is placed on funnel rack. Clamp the rubber tube, then fill funnel with tetrabromoethane.
2. Place approximately 20 grams (not more in order to avoid clogging) in the funnel. Record the weight of this portion to the nearest 0.01 gram.
3. Stir sample at 5-10-minute intervals for first hour, then every hour until the separation is complete.
4. Place the funnel over filter paper marked in pencil with sample number and heavies.
5. Tap bottom of funnel for heavies by opening the clamp. Do not leave clamp open too long as some lights may be sucked down into the heavies.
6. The filter paper is transferred to another funnel over a wash bottle marked tetrabromoethane and methanol. Wash sample with methanol. Place filter paper in third funnel over wash bottle marked methanol and acetone. Wash sample with acetone, dry, and weigh. Be careful not to mix acetone-methanol wash bottle with methanol-tetrabromoethane wash bottle. The uncontaminated tetrabromoethane can be returned to stock bottle. The (t-m) wash material is placed in a large brown wash bottle for separation. The methanol-acetone wash material can be discarded.
7. Place the funnel containing the tetrabromoethane and light minerals over filter paper marked with sample number and light minerals. The filter paper is placed in a funnel over a wash bottle of pure tetrabromoethane. The clamp is released and the material is allowed to flow into the filter paper. To prevent clogging, stir while the clamp is open.
8. Place the uncontaminated tetrabromoethane in the stock bottle.

9. Place the filter containing the lights in the funnel for tetrabromoethane methanol and wash the lights still in the separating funnel into the filter paper using methanol. Wash the light minerals using the procedure in step 6. Dry them and place in a sand envelope marked with sample number and light minerals. Place heavies (weighed to the nearest 0.01 gram) in a vial.

Method 2

**CAUTION: WEAR GLOVES, WEAR EYE PROTECTION
WORK UNDER A HOOD**

1. Almost fill a 40 milliliters heavy-duty glass centrifuge tube with tetrabromoethane. Add no more than 5 grams of sample per tube. Stir and place in centrifuge.
2. Alternate 2-minute centrifuge runs with stirring of samples at least 5 times or until separation is complete.
3. Remove tubes and freeze lower half of each tube in solid CO₂. Wash light fraction out of top with methanol into filter. Retain wash fluid.
4. Allow tetrabromoethane to melt and wash heavy fraction into another filter with methanol. Retain wash fluid.
5. Wash light and heavy fractions with additional methanol. Wash heavy fraction again with acetone. Dry and weigh each fraction to the nearest 0.01 gram.
6. Place heavy fraction in labeled vial. Place light fraction in labeled sand envelope and return to mechanical analysis splits if available.

Tetrabromoethane Recovery

1. Place all wash in large brown bottles. When a bottle is 1/4 full add distilled water and shake. Let settle 24-48 hours.

2. Decant the water-methanol mixture to near interface with tetrabromoethane. Place remainder in separatory funnel and drain off tetrabromoethane through filter partially filled with Fuller's Earth.
3. Determine the density of the tetrabromoethane and, if s.g. >2.90, place in appropriate stock bottle. Make sure all tetrabromoethane is recovered.

Slides

1. Follow instructions described in Procedures for Making Petrographic Slides from Sand Samples (page 38).

SEPARATION OF MAGNETIC MINERALS

Sample Preparation

1. Separate the sand fraction from the sample to be tested by sieving. Obtain the -1 ϕ to 4 ϕ size range, then weigh total sample and sand fraction and record to the nearest 0.01 gram.
2. Place sand fraction in a beaker and add distilled water.
3. Place the beaker in an ultrasonic cleaner for 10 minutes.
4. Decant the suspension from the beaker leaving the sand fraction behind.
5. Dry the sand fraction using an infrared lamp.

Separation

(Hess, H. H., 1959)

1. Turn the magnetic separator on (two switches on the side). Caution: powerful electromagnet - remove ferrous objects, watches, electronic items, etc. from vicinity.
2. Make sure the two grain catchers are attached to the lower left end of the magnetic separator.

3. Start feeding sand into the small metal funnel. Do not feed too many grains at a time. Adjust the intensity of the magnetic field (large black knob on the side of the separator) and read the intensity on the dial. Refer to the charts at the end of this section for the proper settings (Table 5 and Figure 3). Adjust the vibrator (small knob in front) until there is an even flow of grains.
4. Run the sample two or three times for best results.
5. Weigh the separated fractions to the nearest 0.01 gram and record.

PREPARATION OF CLAY SLIDES FOR X-RAY ANALYSIS
(Spoljaric, N., 1971)

Sample Preparation

1. Separate the clay and silt fraction from the rest of the sample by sieving. the material that passes through the #230 sieve should be collected in a pan. This is the clay and silt fraction.
2. Prepare a suspension with this material in a 400-milliliter beaker using distilled water. The sample should be completely submerged. Add a few drops of 10% hexametaphosphate solution.

Separation of Silt-Sized Material

1. Place the suspension in an electronic mixer (ultrasonic separator) for approximately 20 minutes.
2. Immediately centrifuge the suspension for 40 seconds at 2100 rpm (Fletcher Size 12, 2100 RPM Centrifuge). The silt-size material will be removed while the less than 2-micron fraction will remain in suspension.

Side Slope 20°					Side Slope 5°	
A	B	C	D	E	F	
Hand magnet	magnetic at 0.4 Amps	magnetic at 0.8 Amps	magnetic at 1.2 Amps	magnetic at 1.2 Amps	nonmagnetic at 1.2 Amps	
Magnetite Pyrrhotite	Ilmenite Garnet Olivine Chromite Chloritoid	Hornblende Hypersthene Augite Actinolite Staurolite Epidote Biotite Chlorite Tourmaline (dark)	Dioptase Tremolite Enstatite Spinel Staurolite (light) Muscovite Zoisite Clinzoisite Tourmaline (light)	Sphene Leucoxene Apatite Andalusite Monazite Xenotime	Zircon Rutile Anatase Brookite Pyrite Corundum Topaz Fluorite Kyanite Sillimanite Anhydrite Beryl	

Table 5. Current and slope settings for common heavy minerals (Hess, 1959).

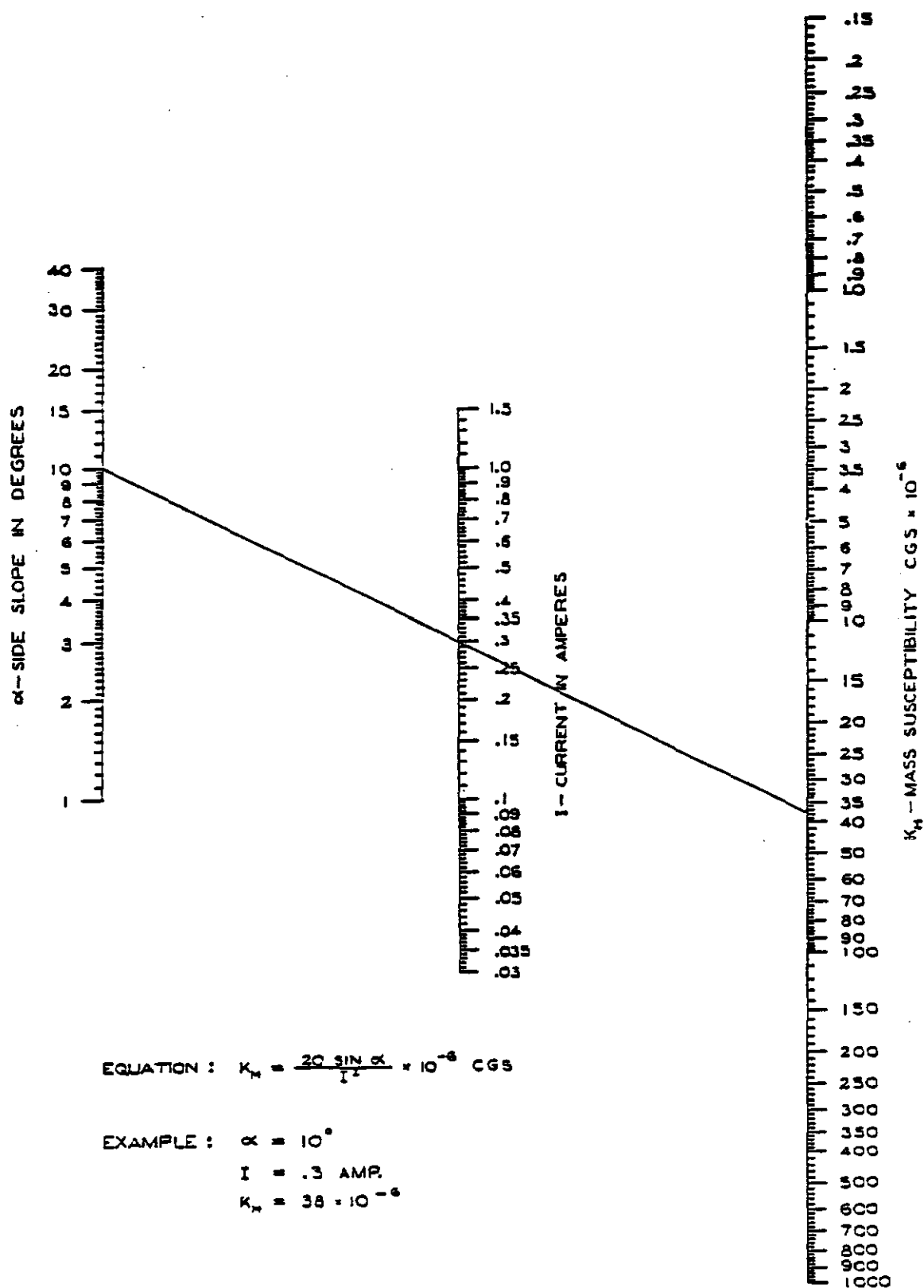


Figure 3. Side slope, current, and mass susceptibility for the Frantz isodynamic separator. (H. H. Hess, 1959).

Preparation of Clay Slides

1. Decant the centrifuged suspension into a clean beaker and again mix for 15 to 20 minutes.
2. Fold a piece of aluminum foil several times to make a square piece approximately 1" x 1". Place this in the bottom of a flat-bottom centrifuge tube. Place the clay slide (27 x 46 mm), with the sample number etched on it, on top of this. Add the clay-size suspension to the centrifuge tube and centrifuge for 5 to 10 minutes at 2100 rpm.
3. After centrifuging, decant the remaining suspension and remove the clay slide.
4. Place the clay slide in a desiccator under a vacuum for 2 to 5 minutes. Remove the air slowly otherwise the coating on the slide may be disturbed.

PROCEDURE FOR STAINING FELDSPARS (Bailey, E. H., and Stevens, R. E., 1960)

This procedure can be used for petrographic slides and thin sections which have not had the cover slip applied. This can also be used best for large rock samples that have been cut and have a flat surface.

Reagents

Hydrofluoric acid, concentrated, 52% HF.
Barium chloride solution, 5%.
Sodium cobaltinitrite solution, saturated.
Rhodizonate reagent. Dissolve 0.05 grams of rhodizonie acid dipotassium salt in 20 milliliters of distilled water. Make fresh daily in small dropping bottle, as the reagent is unstable.

Procedure

**CAUTION: WEAR GLOVES, EYE PROTECTION,
AND WORK UNDER A HOOD.
DO NOT DISPOSE OF HF.
CONTAIN IN PLASTIC BOTTLES
(PROPERLY LABELED)
AND CALL SAFETY FOR DISPOSAL**

1. Etch the rock surface by leaving it face down for 3 minutes over hydrofluoric acid. (Note: Rinsing the surface after etching causes the stains to be uneven.)
2. Immerse the slide in the saturated sodium cobaltinitrite solution for 30 seconds. The K-feldspar is evenly stained light yellow.
3. Rinse the slide briefly in tap water to remove all of the cobaltinitrite.
4. Dip the slide quickly in and out of the barium chloride solution.
5. Rinse the slide briefly with tap water and then with distilled water.
6. Cover the rock surface with the rhodizonate reagent from a brown dropping bottle. Allow to stand for 10 seconds. When the plagioclase feldspar has become red, rinse the slide in tap water.
7. Allow the slide to dry at room temperature and cover it in the usual way.

PROCEDURES FOR MAKING PETROGRAPHIC SLIDES FROM SAND SAMPLES

Sample Preparation

1. The sample is split several times to ensure that a truly representative sample is obtained and the size of the sample to be sieved is reduced.

2. The sample is sieved using a #200 and a #230 sieve, the slide being made from particles that pass through the #200 but are retained on the #230. This retains particles of 63 microns to 74 microns diameter.

NOTE: Before proceeding, it is wise to check and see that the sample is representative. If there is any chance of the sample being biased, then the sample to be studied must be split several times in a micro splitter until the fractions are reduced to a size which is just enough to make a slide. This process ensures that the mounted sample will accurately reflect the characteristics of the whole.

Slide Preparation

1. Heat slide on a hot plate according to the instructions for the resin being used (Canada balsam, Lakeside, CR4).

NOTE: Canada balsam is preferred because it is the least hazardous.

2. Place a small drop of resin onto the slide and allow 3 to 5 minutes for it to spread out. The resin should cover an area about $\frac{1}{3}$ smaller than the cover glass before it spreads out and covers an area slightly larger than the cover glass after spreading.
3. Sprinkle a representative portion of the sample onto the slide taking care not to overload the slide.
4. Place the cover slip (using tweezers) on the slide to one side of the resin. Drag the cover slip slowly across the slide into the resin. At this point, only one edge of the cover slip is touching the resin. Now swing the other end of the cover slip slowly down onto the slide taking care not to trap air bubbles.
5. Heat the slide according to the instructions for the resin being used. When cooled, Canada balsam must be brittle.

INSTRUCTIONS FOR MAKING THIN SECTIONS

Cutting Chips

1. Rocks thicker than around 3 cm should be cut on the 20-inch self-feeding saw.
2. Be certain that the rock is fastened securely in the chuck.
3. Rocks that are less than 3-cm thick may be sized into chips on the trim saw in the thin section room.
4. See that there is enough water in the saw to keep the blade lubricated.
5. Chips should then be polished on the 45-micron plate and finally on the 15-micron plate on the horizontal polishing wheel.
6. Again, it is important to make sure that there is enough water in the water bath to circulate and to lubricate the plates. A circular motion of the chip will ensure that scratches will be kept to a minimum.

Mounting Chips

1. Chips should have a fine, glassy finish. They should then be heated 10 to 15 minutes to drive off moisture and air.
2. Mix epoxy or balsalm on the slide or on the chip (balsalm preferred) at approximately two parts A (clear) to one part B (amber).
3. Place the chip on the slide and work it around until the air bubbles are worked out.
4. Put this cemented conglomerate in the frying pan or on the hot plate (at around 300° F) for around 10 minutes to make sure that the chip does not drift off the slide. Then place it in drying oven at the temperature specified by the manufacturer for 1-1½ hours.
5. Mark the bottom of the slide with the diamond-tipped engraver before proceeding further.

Lapping

1. Place slide in the chuck and turn lapping saw motor and water jet on.
2. Holding the chip with the right hand, feed the assembly against the cut-off saw blade firmly and evenly with the left hand.
3. While getting close to finishing the cut, overlap a finger or two over the chuck and against the blade so that when the cut is finished the slide does not go shooting off into the saw housing.
4. Secure the slide in the little brass vise of the lapping wheel and redirect the water of the lapping system toward the lapping wheel.
5. Be sure that the vise assembly is well clear of the wheel before attempting to grind the slide.
6. Very slowly advance the assembly closer to the plate.
7. Move the slide assembly back and forth so that when it is in contact with the plate grooves are minimized.
8. Because the machine cuts a slight wedge, reverse the slide end-for-end in the vise at about 10 on the gauge.
9. At around 5 to 4 on the gauge stop, and go on to the next step which is polishing.

Polishing

1. Either using the 15-micron plate of the polishing assembly or 600 grit on the glass plate, polish the slide to the desired thickness.
2. This must be checked from time to time on the microscope in the lab (check birefringence of quartz or plagioclase to determine thickness; generally black to white without yellow or amber colors is correct).

Sections from a Grain Mount

1. Separate the sand from the silt and clay fraction using the procedure described in Size Analysis by Dry Sieving (page 5). Obtain the fraction of the sample that falls between 2000 microns and 62 microns diameter.
2. Make a cardboard mold the size of a petrographic slide in length and width and at least one-quarter of an inch deep.
3. Fill the mold with a representative portion of the sand fraction. Saturate this with Canada balsam or another resin.
4. Follow the instructions for the resin used as to heating and curing procedures.
5. Remove the cardboard mold from the slab by peeling and lapping with a coarse abrasive powder.
6. Finish the slide by proceeding from step 3 of part A.

REFERENCES

- American Association of State Highway Officials, Standard methods of mechanical analysis of soils designation: T88-49, p. 95-104.
- Bailey, E. H., and Stevens, R. E., 1960, Selective staining of K-feldspar and plagioclase on rock slabs and thin sections: American Mineralogist, v. 45, p. 1020-1025.
- Friedman, G. M., and Johnson, K. G., 1982, Exercises in sedimentology: John Wiley and Sons, Inc., New York, NY, p. 44-48.
- Gallenkamp, Instructions, sedimentation balance, PC-650.
- Hess, H. H., 1959, Notes on operation of the Frantz Isodynamic Magnetic Separator: Princeton University, Princeton, NJ, p. 1-6.
- Jordan, R. R., 1968, Heavy mineral separation, DGS notes.
- Jordan, R. R., 1965, Mechanical and mineralogical analysis of silts and clays, DGS notes.
- Spoljaric, N., 1971, Quick preparation of slides of well-orientated clay minerals for X-ray diffraction analyses: Journal of Sedimentary Petrology, June, 1971, 1 p.

AMENDMENTS TO
DELAWARE GEOLOGICAL SURVEY
LABORATORY PROCEDURES MANUAL
SPECIAL PUBLICATION NO. 15

by

Charles T. Smith

September 1990

PREFACE

The amendments presented in this section of the notebook are procedures that should entirely replace Separation of Pollen from Unconsolidated Rock (p. 26-29) and Preparation of Clay Slides for X-Ray Analysis (p. 34 and 37). These sections have been revised to simplify the clay slide process and to improve the pollen separation technique.

Additional procedures are also presented in the amendments that did not appear previously in Special Publication No. 15.

CONTENTS

	Page
SEPARATION OF POLLEN FROM UNCONSOLIDATED ROCK.....	1
Preface.....	1
Sample Preparation.....	1
Separation.....	2
THE PRESERVATION OF FRESH POLLEN SAMPLES FOR REFERENCE.....	5
BLEACHING OF POLLEN SAMPLES.....	6
THE MAKING OF POLLEN SLIDES.....	6
PREPARATION OF CLAY SLIDES FOR X-RAY ANALYSIS.....	7
Sample Preparation.....	7
Separation of Silt-Sized Material.....	7
Preparation of Clay Slides.....	8
PREPARATION OF POWDERS FOR X-RAY ANALYSIS.....	9

SEPARATION OF POLLEN FROM UNCONSOLIDATED ROCK

Preface

The following technique for the separation of pollen from unconsolidated rock is one which will achieve results with most samples. Once experience has been gained with the procedure and if recognition of the composition of the various types of clay is possible, some of the steps of the procedure may be omitted and good results still achieved.

An excellent reference for a detailed laboratory description and further study of palynomorph processing can be found in Paleopalynology (A. Traverse, 1988: Boston, Unwin Hyman, 600 p.). The forty-page chapter dedicated to laboratory techniques provides both insight into the techniques and alternate approaches which could be applied to samples.

Review MSDS sheets and read procedure before starting.

Sample Preparation

DAY 1

It is noteworthy that it takes approximately 3 days to batch process 10 samples.

1. Select a single dry piece of the sample weighing 15 to 20 grams. Remove the outer layer by scraping the sample with a metal spatula.
2. Crush the sample into several smaller pieces with a mortar and pestle. The mortar and pestle must be cleaned with an abrasive cleanser and dried with compressed air before they are used.
3. Label and weigh a 50-milliliter plastic centrifuge tube. Use tweezers to place 7 to 8 grams of sample into the tube. Weigh the tube and subtract the weight of the tube when empty to determine the sample weight to the nearest 0.01 gram. Record this weight along with the sample number. If more than one sample is being processed, number the centrifuge tubes, caps, and stir rods to prevent interchanging these between samples. Record this number along with the sample number and weight.
4. Add distilled water and fill tube. Let the sample soak (overnight if possible) to disaggregate the sample. Cap the tube to avoid contamination.
5. Stir the sample vigorously to break up all clumps. Place sample in small beaker; ultrasonically mix to disaggregate all lumps for 15 minutes. Transfer back to centrifuge tubes with distilled water.

6. Centrifuge (International) the sample at 3000 rpm for 5 to 7 minutes. This time and rpm will be the standard throughout the entire procedure. If supernatant is not free of suspended particles after 5 to 7 minutes, repeat this procedure. After centrifugation decant the supernatant fluid. (Note: On our centrifuge 3000 rpm = full power. Allow samples 3 minutes to come to a stop. Do not use the brake as it will again suspend particles.)

Separation

The chemicals used in the pollen separation procedure as designated by the MSDS sheets are corrosive to skin and will attack underlying tissue and bone. Safety is stressed and all precautions should be instituted to avoid contact with liquids and vapors.

WEAR GLOVES, FACE SHIELD, AND WORK UNDER A FUME HOOD. NALGENE CENTRIFUGE TUBES AND STIR RODS MUST BE USED. DO NOT DISPOSE OF HF. STORE IN PLASTIC CONTAINERS WITH PROPER WASTE LABELS AND CALL THE OCCUPATIONAL HEALTH AND SAFETY DEPARTMENT FOR DISPOSAL.

7. Slowly add 20 ml of a solution of 10 ml distilled water and 10 ml 10% HCl to remove carbonates. Stir slowly (to avoid excessive carbonation) and thoroughly. Centrifuge and then decant.

DAY 2

8. Slowly add 20 ml 10% HCl; stir; centrifuge; decant.
9. Wash samples with distilled water by filling tube, stirring, centrifuging, and decanting. Repeat wash until the sample shows neutral with pH test paper. (Usually this will take about 6 washes).

NOTE

- a. This helps prevent a violent reaction with HF.
 - b. This helps prevent the formation of CaF_2 precipitate which is almost impossible to get rid of.
 - c. Without washing out HCl, HF will not attack mineral matter without many HF baths.
10. Add 10 ml of distilled water and stir. Slowly add 52% HF and stir until the tube is about 1/2 full. **BEWARE OF REACTION** while introducing HF and stirring. It may boil over - take your time and **BE CAREFUL!!** To control excessive reaction, rinse down outside of tube to cool down reaction.

NEVER ADD WATER TO ACID!!!

Stir tube to promote reaction (note heat given off from tube). When tube no longer becomes warm when stirred, cap, centrifuge, and decant HF into reserve vessel to be disposed of by University Safety.

11. Slowly add 52% HF until tube is 1/2 full. Again CAREFUL!! Stir, centrifuge, and decant into reserve vessel.
12. Slowly add 52% HF, stir, heat at least 5 minutes in 98°C water bath and stir again. (Heat will promote reaction of HF and the bath may be used in step 11 if tube doesn't warm when stirred). Centrifuge and decant. Repeat this step at least 3 more times or until no sand is present (grit felt as stirring rod passes over the bottom of tube). It is advisable to let samples sit in HF overnight for the third of the above baths.

DAY 3

13. Centrifuge off HF; decant.
14. Slowly add distilled water and fill tube (about 3/4 to 7/8 full), stir, centrifuge, decant into reserve vessel. Repeat wash (you may now decant in drain) until neutral by pH test paper. (Again, this takes about 6 baths.)
- 14a. (Optional) Heavy Liquid Separation.

Note: The DGS has achieved results without application of this technique and has not worked out the specific centrifuge times for the procedure.

If minerals dominate the organic residue, remove them by using a slightly acidic zinc chloride solution. The ZnCl_2 solution used should have a specific gravity of approximately 1.2 and should have a few drops of concentrated HCl added to make it acidic.

Add the ZnCl_2 solution to the test tube containing the sample. Stir the solution thoroughly and centrifuge to separate the suspension. The organic residue will remain suspended toward the top of the tube and can be removed with an eye dropper for further processing.

It may be necessary to repeat this process in order to remove all the organics if the suspension is thick.

After the organics have been removed, add 10% HCl to the solution, stir, and centrifuge. Next, wash the residue with distilled water until it remains neutral.

15. Wash with 10% KOH (approximately 20 ml or 1/2 test tube), stir, centrifuge, decant into sink.

NOTE: 10% KOH solution = 1 gram KOH + 9 grams distilled H_2O

16. Add 10% HCl (20 ml); stir, hot water bath; stir, centrifuge, and decant into drain. (NOTE: if ZnCl_2 heavy mineral separation is used as above, this step may not be necessary.)
17. Wash with distilled water until neutral (again about 6 times).
18. Add 20 ml acetic acid (Glacial); stir, centrifuge, decant into reserve beaker.
19. In a separate clean beaker, SLOWLY add 2 ml H_2SO_4 to 18 ml acetic anhydride. (Multiples of this mixture may be made if processing more than 1 sample). Be careful! An exothermic reaction will occur as mixing takes place. Allow to sit and cool momentarily.
20. Add 20 ml of the solution from step 19 to sample tube SLOWLY while stirring. A violent REACTION (boil over) may occur so be prepared. (Cooling the tube may control excessive reaction). The more material present, usually the greater the initial reaction. After the solution has been stirred thoroughly and the tube is cool, place in hot water bath for 5 minutes. Stir, centrifuge, and decant into the reserve beaker containing waste acetic acid from step 18. Reserve beaker waste can now be disposed of safely in drain with water.
21. Add 20 ml acetic acid, stir, centrifuge, and decant.
22. Wash with 2 ml ethyl alcohol and distilled water, stir, centrifuge, and decant.
23. Wash with distilled water, stir, centrifuge, and decant.
24. Add distilled water and 5 drops of safranin stain. Stir, allow to sit 5 minutes, centrifuge, and decant.
25. Using a slight amount of distilled water, transfer to a bottle, label, make slide.

THE PRESERVATION OF FRESH POLLEN SAMPLES FOR REFERENCE

Fresh pollen can be collected and preserved so that a reference collection can be made. The following technique should be used.

1. Pollen-containing plant parts should be collected from the plant and labeled, preferably in a glass vial. As soon as possible after collection, acetic acid (glacial) should be introduced to the vial to prevent oxidation of the organic specimens.
2. Transfer the plant material to a 30 ml nalgene centrifuge tube using acetic acid. Stir the sample, cap it, then centrifuge it at 3000 rpm for 3 minutes. Decant the acid into a reserve vessel to be disposed of later.
3. In a separate clean beaker, slowly add 2 ml H_2SO_4 (concentrated) to 18 ml acetic anhydride. This solution will be used for acetolysis. Be careful because mixing the solution will create an exothermic reaction.
4. Transfer the acetolysis solution to the centrifuge tube containing the organic sample. Next place the tube in a 70-80°C hot water bath and slowly bring the water temperature to the boiling point. At the boiling point remove the tube from the bath and stir the contents with a glass rod. Cap the tube.
5. Centrifuge the tube at 3000 rpm for 30 seconds.
6. Decant the liquid slowly from the tube (such that the pollen will remain) into the reserve vessel in step 2. The contents of the reserve vessel can now be disposed of safely in the drain with running water.
7. Add distilled water to about the 10 cc line of the tube, cap, and shake tube until the contents foam. Add a few drops of acetone or alcohol to get rid of the foam. Cap the tube, centrifuge (3 minutes at 3000 rpm), then decant.
8. Wash the sediment with distilled water again.
9. Because treating the pollen as above will essentially leave them clear, it is desirable to stain them with safranin stain so they can be viewed under a microscope. Add 5 drops of safranin with 20 ml of distilled water, stir, cap, centrifuge, decant.
10. Transfer the sediment to a vial using distilled water. Cap and label the vial.
11. Slides can now be made.

BLEACHING OF POLLEN SAMPLES

Purpose:

To be performed if pollen are too dark due to excessive staining.

Procedure:

1. Pour 5 ml of Clorox bleach (sodium hypochlorite) in a vial. Let it set 5 minutes in sunlight or until it appears to have a yellow tint.
2. Transfer specimen material from its storage vial into a centrifuge tube. Centrifuge (3 minute, 3000 rpm), decant distilled water.
3. Add 5 ml of Clorox from step 1.
4. After soaking about 1 minute, centrifuge off Clorox, and wash sediment with distilled water.
5. Centrifuge off wash water, transfer the pollen back into labeled storage vial.

THE MAKING OF POLLEN SLIDES

1. Label slide with diamond or carbide scriber.
2. For fresh pollen or with sparse material in vial, use open end (1.5-1.8 x 100 mm Kimax 51) capillary tube to obtain sample from bottom of vial containing settled pollen.

For vial containing dense material: shake vial, use capillary tube to obtain random sample (don't hold finger over capillary tube end as the capillary tube is placed in the vial).
3. Empty capillary tube in center of slide and use tube to spread material uniformly over approximately 3/4 inch of center slide (enough so cover slide will be filled).
4. Place wet slide in 60°C oven until slide is dry.
5. Place one drop of Norland UV optical adhesive in the center of the cover slip. Invert cover slip and place on slide. Gently press down cover slip to spread adhesive. Place slide under a UV lamp for 2 to 3 minutes.
6. Place paper label on slide so that it can quickly and easily be read.

PREPARATION OF CLAY SLIDES FOR X-RAY ANALYSIS

Sample Preparation

1. Place 10 to 15 ml of unconsolidated sample in a 50-ml beaker. Add distilled water to the 30 ml mark and also add a few drops of 10% Na-hexametaphosphate solution, (a few Alconox flakes may be substituted as Alconox currently is produced containing Na-hexametaphosphate). This will help to bring the clay into suspension.
2. Use a stirring rod to agitate the sample and then ultrasonically agitate the sample 5-10 minutes.
3. Decant the suspension into a 150-ml beaker, leaving the heavier material in the 50-ml beaker. Add 15-20 ml of distilled water to the 50-ml beaker and agitate with a stirring rod so as to wash it. Repeat decanting and saving the suspension in the 150-ml beaker until you have at least 100 ml of suspension.

Separation of Silt-Sized Material

Stir the clay suspension and decant it into two 50-ml centrifuge tubes. Immediately centrifuge the suspension 40 seconds at 2100 rpm (Fletcher size 12, 2100 RPM Centrifuge). Silt-sized material will settle while 2-micron fraction will remain in suspension.

Preparation of Clay Slides

1. Decant the centrifuged suspension into a clean 150-ml beaker and ultrasonically mix for 5-10 minutes.
2. Place a paper clip into the bottom of a flat bottomed centrifuge tube. Now lay a 1 x 1 1/2-inch glass slide with the sample number etched on it upon the paper clip. Repeat this in a second matching centrifuge tube. Add the clay suspension to the tubes and centrifuge about 5 minutes at 2100 rpm for a heavy suspension. For weak clay suspensions 15-20 minutes is recommended.
3. After centrifuging, decant the remaining suspension and remove the clay slide.
4. Three methods can be used to dry the clay slide.
 - a. Place it for 2 to 5 minutes in a vacuum desiccator, slowly removing the air.
 - b. Place the slide in a 40°C oven for approximately 10 to 15 minutes.
 - c. Set the slide on a table in the lab (not recommended because contamination could be a problem).

PREPARATION OF POWDERS FOR X-RAY ANALYSIS

The Philips Compact X-ray Diffraction Analyses System #PW 1840 that is in the DGS lab can accommodate powder samples. A homogeneous sample with grain sizes from 1 to 25 μm and in which no preferred orientation or any micro- or macro-crystalline change has been created is the preferred "ideal" sample.

The penetration of the x-ray beam is on the order of 20 μm , so the grains should be ground to a size of 5 to 10 μm to ensure that sufficient grains of the various compounds present contribute to the beam reflection.

Two methods can then be used to mount the powder to be analyzed. The first technique is found in the Philips operating manual #949930023711, 840601 section 4-1. This entails the use of the Philips sample holder as described.

The second technique which will be described here is also acceptable. Take a 1 x 1.5-inch glass slide and apply a thin, uniform coating of UV curable adhesive along 7/8 inch of its length. The adhesive can be spread evenly using a second slide.

Next apply a thin coating of powder upon the adhesive. Inverting the slide and dipping into the powder may work. A 1/32-inch thick uniform coating is adequate.

Cure the adhesive from beneath the glass such that the adhesive faces the UV lamp and not the powder. Proper curing time should take a few minutes (Norland UV; 2 to 3 minutes).

Now the sample can be loaded into the x-ray unit for analysis.

APPENDICES

APPENDIX A
DELAWARE GEOLOGICAL SURVEY
DELAWARE FIELD INVESTIGATIONS
DATA SHEET

DGS Location: _____
Sample Number(s): _____
Nearest Town: _____
County: _____
Formation(s): _____
Date: _____
Investigator: _____
Investigation: Final ____ or more needed ____ (check one)
Location Map: _____ Scale: _____

Geologic Sketch: _____ Scale: _____

Geologic Description and Preliminary Interpretation:

DELAWARE GEOLOGICAL SURVEY

[illegible]

APPENDIX C
 DELAWARE GEOLOGICAL SURVEY
 DRY SIEVE ANALYSIS
 DATA SHEET

Sample Number _____

Sample Weight _____

Sieve Size	Sieve Weight	Sieve + Fraction Weight	(Sieve + Fraction) - Sieve Weight = Fraction Weight
2000 μ			
1000 μ			
500 μ			
250 μ			
125 μ			
62 μ			
Pan			

APPENDIX D
DELAWARE GEOLOGICAL SURVEY
WET SIEVE ANALYSIS
DATA SHEET

Sample Number _____

Sample Weight _____

Sieve Size	Sieve Weight	Sieve + Fraction Weight	(Sieve + Fraction) - Sieve Weight = Fraction Weight
2000 μ			
1000 μ			
500 μ			
250 μ			
125 μ			
62 μ			
Pan			

APPENDIX E
DELAWARE GEOLOGICAL SURVEY

HYDROMETER ANALYSIS
DATA SHEET
(Part A)

Sample Number _____

Sample Weight _____

Results Obtained From Sieve Analysis:

Weight of Fraction
>2000 μ _____

Weight of Fraction
<2000 μ _____

Hygroscopic Moisture Analysis:

Weight of Sample Before
Drying _____ = w

Weight of Sample After
Drying _____ = w_1

Weight of Analysis Sample _____ = W_{AS} Start Time _____

Elapsed Time	Time t	Reading R	Temperature T
2 min.			
5			
15			
60			
250			
1440			

Quantity	Formula	Value
Percent Hygroscopic Moisture	$pm = \frac{w - w_1}{w_1} \times 100$	
Corrected Weight of Analysis Sample	$W = \frac{W_{AS} \times 100}{100 + pm}$	
Specific Gravity of Sample	G	
Constant "a" (gm/l scale)	$a = \frac{2.6500 - 0.9984}{2.6500} \times \frac{G}{G - 0.9984}$	
Constant "a" (S. G. scale)	$a = \frac{2.6500 - 1.0000}{2.6500} \times \frac{G}{G - 1.0000}$	
Percent of Sample Remaining in Suspension	$P = \frac{R \cdot a}{W} \times 100 \text{ (gm/l scale)}$	
Percent of Sample Remaining in Suspension	$P = \frac{1606(R-1)a}{W} \times 100 \text{ (S.G. Scale)}$	

APPENDIX E (continued)

DELAWARE GEOLOGICAL SURVEY

HYDROMETER ANALYSIS
DATA SHEET
(Part B)

Elapsed Time	Max. Diameter in Suspension	Correction Factor	Percentage of Course Material in Sample	Percent of Size Fraction in Analysis Sample
2 min.				
5				
15				
30				
60				
250				
1440				

APPENDIX F
DELAWARE GEOLocal SURVEY

PIPETTE ANALYSIS
DATA SHEET
(Part A)

Sample Number _____

Sample Weight _____

Results Obtained From Sieve Analysis:

Total Weight of Fractions

Total Weight of Fractions

> 0.0625mm _____

< 0.0625mm _____

Weight of Analysis Sample _____

Start Time

Phi Class	Beaker Number	Beaker Weight	Time	Elapsed Time	Beaker + Sample Weight (after drying)
4				00:01:00	
5				00:02:59	
6				00:11:59	
7				00:47:51	
8				03:12:--	
9				08:58:--	
10				25:43:--	
11				106:50:--	

APPENDIX F (continued)

DELAWARE GEOLOGICAL SURVEY
PIPETTE ANALYSIS
DATA SHEET
(Part B)

Phi Class	Beaker Number	Beaker + Sample Weight (after drying) = A	Beaker + Dispersent Weight = B	(A - B) x 50 = Weight of Fraction
4				
5				
6				
7				
8				
9				
10				
11				

*Dispersent weight per beaker = dispersent added to cylinder

APPENDIX G
DELAWARE GEOLOGICAL SURVEY
MECHANICAL ANALYSIS DATA SHEET

Dry Weight _____ Weight Sieved _____
 Dry _____ Oven _____ Temp. _____ Heat Lamp _____
 Color _____ Shell _____ Organic _____ FeO _____
 Other _____
 Unprocessed Sample Remaining _____ Wt. _____

Sample No. _____ Office _____
 Field _____
 Date _____
 Operator _____
 Location _____

Sieve Size	φ Size	Weight	Percent	Cumu. Weight	Cumu. Percent	Remarks
16 mm	-4.0					
8 mm	-3.0					
4 mm	-2.0					
2 mm	-1.0					
1.41 mm	-0.5					
1 mm	0					
0.71 mm	0.5					
0.50 mm	1.0					
0.35 mm	1.5					
0.250 mm	2.0					
0.177 mm	2.5					
0.125 mm	3.0					
0.088 mm	3.5					
0.0625 mm	4.0					
<0.0625 mm						

Parameters		
Modal Class	1	
2nd Mode		
3rd Mode		

Symbol	Formula	Value
φ95		
φ84		
φ50		
φ16		
φ 5		
Mφ	$\frac{\phi 16 + \phi 84}{2}$	
σφ	$\frac{\phi 84 - \phi 16}{2}$	
αφ	$\frac{\phi 16 + \phi 84 - 2\phi 50}{\phi 84 - \phi 16}$	
βφ	$\frac{(\phi 95 - \phi 5) - (\phi 84 - \phi 16)}{\phi 84 - \phi 16}$	
M _z	$\frac{\phi 16 + \phi 50 + \phi 84}{3}$	
σ _I	$\frac{(\phi 84 - \phi 16)}{4} + \frac{(\phi 95 - \phi 5)}{6.6}$	
Sk _I	$\frac{\phi 84 + \phi 16 - 2\phi 50}{2(\phi 84 - \phi 16)} + \frac{\phi 95 + \phi 5 - 2\phi 50}{2(\phi 95 - \phi 5)}$	
KG	$2.4 \pm (\phi 75 - \phi 25)$	

APPENDIX H

DELAWARE GEOLOGICAL SURVEY

HEAVY MINERAL ANALYSIS DATA SHEET

Field number _____
 Office number _____
 Date of Count _____
 Size fraction: 62-500 _____
 other _____

Boiled: HCl _____
 HNO₃ _____
 Other _____
 Heavy liquid: tetrabromo _____
 Other _____

Separation by _____
 Count by _____

Separation: centrifuge _____
 funnel _____
 other _____

Total % HM (weight) _____
 Number non-opaque grains _____
 Number opaque grains _____ %: . _____

Total number grains counted _____

MINERAL	COUNT	PERCENT	COLOR	SHAPE	ROUND	COMMENTS
AMPHIBOLE						
ANDALUSITE						
CHLORITOID						
EPIDOTE zoisite						
GARNET						
KYANITE						
PYROXENE						
RUTILE anatase brookeite titanite						
SILLIMANITE fibrolite						
STAUROLITE						
TOURMALINE						
ZIRCON						
OTHERS						
OPAQUE						

APPENDIX I. MATERIAL SAFETY DATA SHEETS (MSDS)

pk

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855



No. 327
ACETIC ACID, GLACIAL
(Revision C)

Issued: December 1980
Revised: April 1986

SECTION 1. MATERIAL IDENTIFICATION

MATERIAL NAME: ACETIC ACID, GLACIAL

OTHER DESIGNATIONS: Ethanoic Acid, Anhydrous Acetic Acid, Methane Carboxylic Acid, Pyroigneous Acid, CH₃COOH, CAS #0064-19-7

MANUFACTURER/SUPPLIER: Fisher Scientific Co., PO Box 375, 1 Reagent Lane, Fair Lawn, NJ 07410; Telephone: (201) 796-7100

HMIS

H: 2

F: 2

R: 0

PPE*

*See Sect. 8

R 1

I 4

S 4

K 2

SECTION 2. INGREDIENTS AND HAZARDS

Acetic Acid, CAS #0064-19-7

%

>99.5

HAZARD DATA

8-hr TWA: 25 mg/m³
or 10 ppm*

Human, Oral, TDLo:
1470 µg/kg

Human, Inhalation, TCLo:
816 ppm/3 min.

* Current OSHA PEL and ACGIH (1985-86) TLV.

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm ... 244°F (118°C)
Vapor Pressure @ 25°C, mm Hg ... 14.8
Water Solubility ... Soluble
Vapor Density (Air = 1) ... 2.07

Specific Gravity (H₂O = 1) ... 1.05
Melting Point ... 62°F (16.6°C)
Percent Volatile by Volume ... 100
Molecular Weight ... 60.06

Appearance and odor: A clear, colorless, mobile liquid with a characteristic sharp and pungent vinegarlike odor that is perceptible (unfatigued) at above 1 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
112°F (44.5°C) TCC	800°F (427°C)	% by Volume	4	16

EXTINGUISHING MEDIA: Use water spray, dry chemical, alcohol foam, or CO₂. Water spray can be used to flush spills away from exposures and to dilute spills to nonflammable mixtures. Use water to keep fire-exposed containers cool. Glacial acetic acid is a combustible liquid.

UNUSUAL FIRE/EXPLOSION HAZARDS: Diluted with water, acetic acid can react with metals to produce hydrogen gas.

SPECIAL FIRE-FIGHTING PROCEDURES: Fire fighters must use self-contained breathing apparatus to protect them against suffocation and corrosive vapors when this material is burning.

SECTION 5. REACTIVITY DATA

Glacial acetic acid is stable. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES: This material may react violently with strong oxidizing agents, ammonium nitrate, phosphorous trichloride, potassium hydroxide, and other alkaline materials. It reacts readily with most common metals (except aluminum), basic salts, and amines, etc., to form water-soluble salts. It reacts with alcohol to form esters. Nitric acid or chromic acid can explode with acetic acid if not kept cold. Mixing acetic acid with chlorosulfonic acid, 2-aminoethanol, oleum, or ethylene diamine in a closed container can cause an increase in the temperature and pressure of any of these materials.

CONDITIONS TO AVOID: Protect glacial acetic acid from freezing. It expands when it is frozen.

HAZARDOUS DECOMPOSITION PRODUCTS may include carbon dioxide and carbon monoxide.

APPENDIX I
MSDS SHEET INDEX

Acetic acid, glacial

Acetic anhydride

Acetone

Acetylene tetrabromide

Ammonium hydroxide

Anhydrous ammonia

Canada balsam

Ethylene glycol

Fluorocarbon liquid (Refractive Index Liquid) Series AAA

Glycerin

Hydrochloric acid

Nitric acid

Hydrogen peroxide

Sulfuric acid

Methyl alcohol

Imidozolium

Index liquids Series A, Series B, EH, FH, GH, H, M

Sodium pyrophosphate

Xylene

Ethyl alcohol

Hydrofluoric acid

Sodium hypochlorite

Potassium hydroxide

Norland Optical (UV) Adhesive 60

SECTION 6. HEALTH HAZARD INFORMATION

Glacial acetic acid is not listed as a carcinogen by the NTP, IARC, or OSHA.

SUMMARY OF RISKS: Inhalation of this material's vapors at concentrations of over 50 ppm is intolerable, resulting in irritation of the eyes, nose, throat, and lungs. Repeated exposure to high concentrations of this material may produce congestion of the pharynx. Neither odor nor degree of irritation are adequate to indicate concentration of vapor. Skin contact can produce deep burns with skin destruction. High concentrations of vapor may blacken the skin, produce skin sensitization, conjunctivitis, and erosion of exposed teeth. Eye contact will cause immediate burns and possible permanent damage. Ingestion is improbable because the odor would be extremely irritating; but severe intestinal irritation would result in burns to the mouth and the upper respiratory tract. **TARGET ORGANS:** Respiratory system, eyes, skin, and teeth. **PRIMARY ENTRY:** Inhalation, skin. **ACUTE EFFECTS:** Irritation of eyes, skin, and respiratory tract. **CHRONIC EFFECTS:** Erosion of tooth enamel. **FIRST AID:** **EYE CONTACT:** Immediately flush eyes, including under the eyelids, with plenty of running water for at least 15 minutes. Speed in diluting and rinsing with water is extremely important if permanent eye damage is to be avoided. Get medical help.* **SKIN CONTACT:** Immediately flush affected areas with water, removing contaminated clothing under the safety shower. Continue washing with water and get medical help.* **INHALATION:** Remove victim to fresh air. Restore and/or support his breathing. Get medical help.* **INGESTION:** Rinse victim's mouth with water. Dilute acid immediately with large amounts of milk or water. Get medical help.* Do not induce vomiting; if it occurs spontaneously, give victim more fluid. Never give anything by mouth to someone who is unconscious. * GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Handle major acetic spills by following a predetermined plan. Contact your supplier for assistance in this planning, in meeting local regulations, and for disposing of large amounts. Notify safety personnel of spills. Provide optimum ventilation to handle corrosive fumes. Fumes can affect neighboring materials. Cleanup personnel need protection against inhalation or contact. Keep upwind of spilled or leaking material. Contain spill. Minor leaks or spills can be diluted with much water and neutralized with soda ash or lime.

DISPOSAL: Place neutralized waste in a landfill. Follow Federal, state, and local regulations.

EPA Clean Water Act, Reportable Spill Quantity: 1,000 lbs/454 kg.

SECTION 8. SPECIAL PROTECTION INFORMATION

Respirators should be available for nonroutine or emergency use. Where fumes are below 500 ppm, a chemical-cartridge organic-vapor respirator with a full facepiece or a self-contained breathing apparatus with a full facepiece is warranted; fumes up to 1000 ppm require a Type C air-supplied respirator with a full facepiece operated in pressure-demand mode. For levels above 1000 ppm, use a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode.

Provide adequate exhaust ventilation to meet TLV requirements. Exhaust hoods should have a minimum air velocity of 100 fpm (linear feet per minute).

Wear rubber gloves, aprons, etc., to prevent skin contact. Splash-proof goggles or a full face shield should be worn to prevent any eye contact. Splash-proof, gas-tight goggles may also be required to prevent irritation of the eyes from fumes. Eyewash stations and showers must be readily available where this material is handled.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store glacial acetic acid in suitable tightly closed containers in a well-ventilated area having acid-resistant floors with controlled drainage. Prevent freezing in storage. Keep temperature above 62°F (16.6°C) to avoid rupture of carboys and glass containers. Protect containers against physical damage. Detached storage is preferred for this material. Store it in sealed containers away from oxidizing agents and combustible materials. Glass, polyethylene, and Type 316 stainless steel containers are suitable. Exhaust ducts for ventilation should be acid resistant. Use whatever ventilation is needed to keep fumes or mist below TLV levels. Avoid breathing acetic acid fumes. Do not get it in eyes, or on skin or clothing. Do not ingest it. Practice good personal hygiene. Never add water to acid. Do not smoke. Use nonsparking tools and vapor-proof electrical fixtures. Prevent skin and eye contact because this acid is highly corrosive to body tissue. Olfactory detection at 1 ppm is well below the TLV; however, documentation shows that workers can tolerate up to 200 ppm, probably because of olfactory fatigue. Suspected areas of high or variable concentrations of acetic acid should be tested before employee exposure. Acetic acid is designated as a hazardous substance by the EPA (40 CFR 116).

DOT Classification: Corrosive. DOT No. UN2789. Label: Corrosive.

Data Source(s) Code: 2-12, 15, 23-26, 31, 34, 37-39, 42, 43, 47, 54, 55, 58, 59, 82, CK

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Approvals *J.O. Acersner, 1/87.*

Indust. Hygiene/Safety *JW 1-87*

Medical Review *[Signature]*

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

Phone: (518) 385-4085

DIAL COMM 8*235-4085

MATERIALS SERVICES INFORMATION

No. 434

ACETIC ANHYDRIDE

Date May 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ACETIC ANHYDRIDE

DESIGNATIONS: Acetic Oxide, Acetyl Oxide, Ethanoic Anhydride, (CH₃CO)₂O, CAS #000 108 247

MANUFACTURERS: Material is available from several suppliers, including:

Ashland Chemical Co.

Industrial Chemicals & Solvents Div.

Box 2219, Columbus, OH 43216

(614) 889-3333

Union Carbide Corp.

270 Park Avenue

New York, New York

(212) 551-3263

SECTION II. INGREDIENTS AND HAZARDS

Acetic Anhydride

>95

8-hr TWA 5 ppm*
or 20 mg/m³
Ceiling level

*Current (1979) ACGIH TLV; OSHA standard is 5 ppm
(no Ceiling).

Rat, oral
LD₅₀ 1780 mg/kg

SECTION III. PHYSICAL DATA

Boiling point, 760 mm Hg, deg C — 140

Vapor pressure, at 20 C, mm Hg — 4

Vapor density (Air=1) — 3.5

Water solubility — Soluble (Reacts!)

Specific gravity, 20/20 C — 1.083

Melting point, deg C — -73.1

Evaporation rate (BuAc=1) — 0.46

Viscosity at 20 C, cps — 0.90

Molecular weight — 120.1

Appearance & Odor: Colorless, very mobile, liquid with a very pungent irritating acetic acid-like odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method

120 F (CC)

Autoignition Temp.

734 F

Flammability Limits In Air

% by Vol.

LOWER UPPER

2.7

10.3

Extinguishing Media: Use CO₂ or dry chemical for small fires; alcohol foam for large, unconfined fires. Abundant water spray can be used to dilute spills to noncombustible mixtures and extinguish fire (20:1 of water needed to solubilize and absorb heat of reaction with water), and to cool fire-exposed closed containers. Avoid directing water into containers of acetic anhydride.

Vapors may flow along surfaces to distant ignition sources and flash back.

Firefighters need self-contained breathing equipment, eye protection and full protective clothing.

SECTION V. REACTIVITY DATA

This combustible liquid is stable in closed containers at room temperature. Polymerization does not occur. It can react with water to generate acetic acid and much heat.

It is incompatible with amines, alkaline materials and oxidizing agents. Water, alcohols and glycerine give exothermic reactions which can be especially dangerous when acidic catalysts are present.

Thermal-oxidative degradation products can include carbon dioxide, carbon monoxide, hydrocarbons, and acid fumes.

SECTION VI. HEALTH HAZARD INFORMATION	TLV Ceiling 5 ppm (See Sect. II)
<p>Acetic anhydride is a corrosive to human tissue. Vapors can cause burns as well as irritation of the eyes; liquid contact can cause severe eye injury. Vapor inhalation is irritating and damaging to the respiratory passages and lungs. Though not highly toxic, ingestion of this material is expected to result in severe burns of the mouth, throat and stomach lining. Prolonged liquid contact can produce severe burns of the skin.</p> <p>FIRST AID:</p> <p><u>Eye Contact:</u> Flush promptly with lots of running water for 15 minutes or more, including under the eyelids. Then get immediate medical attention!</p> <p><u>Skin Contact:</u> Flush exposed area with lots of water for 15 minutes. (Remove contaminated clothing under a safety shower for gross exposure!) Wash with soap and water. Get medical help if large areas contacted or if irritation persists.</p> <p><u>Inhalation:</u> Remove victim to fresh air. Restore and/or support breathing as required; have trained person administer oxygen. Keep warm and at rest. Get medical help!</p> <p><u>Ingestion:</u> Give conscious victim water to drink for dilution and milk of magnesia to neutralize. Do not induce vomiting! Get medical attention for additional treatment, support and observation.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel of spills and leaks. Provide explosion-proof ventilation. Remove sources of heat and ignition. Clean-up personnel need protection against contact with liquid & vapor or mist inhalation. Stop leaks at source. (Water spray has been suggested to disperse vapors and protect those who are stopping leak.)</p> <p>Contain spill. Absorb residues or small spills on paper or other absorbent solid. Collect material in suitable closed containers for disposal. Cover contaminated surfaces with soda ash or sodium bicarbonate and spray on a little water to neutralize residues. Wash site with soda ash solution and flush to drain with much water.</p> <p><u>DISPOSAL:</u> Absorbed material or waste liquid can be burned in an approved incinerator. Use of an afterburner has been suggested for complete combustion. Acetic anhydride can be toxic to fish. Prevent direct discharge to surface waters. Follow Federal, State and Local regulations.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide adequate exhaust ventilation to keep vapor or mist in the workplace below 5 ppm exposure limit. Approved, full facepiece respirator is needed for nonroutine and emergency situations where mist or vapors cannot be adequately controlled.</p> <p>Use rubber gloves and apron and safety goggles. Additional protection against contact with liquid (such as face shield, rubber boots, and impervious clothing) may be needed if splashing can occur.</p> <p>Provide eyewash stations and safety showers in handling and use areas.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in a cool, dry, well-ventilated area, away from sources of heat and ignition. Protect containers against physical damage. Inside storage to be in a standard flammable liquids storage room. Outside or detached storage preferred.</p> <p>Residues in recently emptied containers present a hazardous situation.</p> <p>Exclude from exposure those individuals with diseases of eyes, lungs, and skin until approved by physician to work with this material.</p> <p>Aluminum and stainless steel are commonly used for piping and valves. Steel, galvanized iron, tinned iron, copper and copper alloys should not be used.</p>	
<p>DATA SOURCE(S) CODE: 1,2,4-12,18,23,25,26,31</p> <p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranty, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<p>APPROVALS: MIS CRD <i>J.M. Nihilin</i></p> <p>Industrial Hygiene and Safety <i>JW 5-29-80</i></p> <p>MEDICAL REVIEW: June 1980</p>

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT
120 ERIE BOULEVARD
SCHENECTADY, N.Y. 12305



NO. 300

ACETONE
Revision C

DATE June 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ACETONE

OTHER DESIGNATIONS: Dimethyl Ketone, 2-Propanone, CH_3COCH_3 , GE Material D5B24, ASTM D329, CAS #000 067 641

MANUFACTURER: Available from many suppliers, including:

The Dow Chemical Company
2020 Dow Center

Midland, MI 48640

Emergency telephone: (517) 636-4400

Eastman Chemical Products, Inc.

Kingsport, TN 37662

Tel: (615) 247-0411

SECTION II. INGREDIENTS AND HAZARDS

Acetone

*ACGIH (1983) TLV; STEL 1000 ppm. Current OSHA PEL is 1000 ppm. NIOSH (1978) recommended a 10-hr TWA of 250 ppm or 590 mg/m^3 and defined the "action level" at half this exposure.

%

ca 100

HAZARD DATA

8-hr TWA 750 ppm
or 1780 mg/m^3 *

Rat, Oral

LD₅₀ 9.75 g/kg

Rabbit, Skin

LD₅₀ 20 g/kg

Human, Inhalation

TCLo 500 ppm

Eye Irritation &

Eye systemic effects

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C ----- ~56

Vapor pressure, mm Hg, at 20 C -- 180

at 25 C -- 226

Vapor density (Air=1) ----- 2.0

Water solubility ----- Miscible

Specific gravity (20/4 C) ----- 0.79

Volatiles, % ----- ca 100

Melting point, deg C ----- -95

Evaporation rate (n-BuAc=1) ----- ~7.7

Molecular weight ----- 58.09

Appearance & Odor: A clear, colorless, volatile liquid with a characteristic, pleasant sweetish odor. Odor recognition threshold (100% of test panel) 100-150 ppm (also reported between 200 and 400 ppm); distinct odor at 680 ppm.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
-4 F (-20C) (TCC)**	>538 C	% by volume**	2.79 (at 77F)	13.2 (at 75F)

Extinguishing media: CO_2 , alcohol foam, dry chemical or water spray. Water spray may not be effective in extinguishing.* Use water to cool fire-exposed containers and to dilute and reduce fire intensity. Class B fires; use a blanketing effect to smother flame. Dangerous fire hazard and moderate explosion hazard when exposed to heat and flame. Firefighters should use self-contained breathing apparatus.

*10% solution of acetone in water is reported to have ~80F flash point.

**Higher closed cup flash points, lower LEL and lower UEL also are reported.

SECTION V. REACTIVITY DATA

Acetone is stable in closed container under normal storage and use conditions. It does not undergo hazardous polymerization.

This OSHA Class IB flammable liquid reacts vigorously with strong oxidizing agents, such as nitrates and perchlorates or concentrated sulfuric acid. Incompatible with nitric and sulfuric acid mixture (can be explosive) and with nitric and acetic acid mixture. Ignition on reaction with potassium *t*-butoxide.

Thermal-oxidative degradation can include carbon monoxide.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 750 ppm (See Sect II)
<p>Acetone is a low toxicity solvent. Irritation of mucous membranes, dryness of the mouth & throat, headache, nausea, dizziness, and narcosis can result from excessive exposure to vapors. Prolonged or repeated skin contact has a defatting effect, causing drying, irritation and mild dermatitis. Absorption through intact skin is not expected to cause systemic injury; however, possible skin absorption should be considered in meeting TLV requirements. Eye contact is irritating and can be damaging. Do not ingest.</p>	
<p>FIRST AID:</p> <p><u>Eye Contact:</u> Flush promptly with plenty of running water for 15 minutes, including under eyelids. Contact a physician if irritation persists.</p> <p><u>Skin Contact:</u> Wash off with water. Remove contaminated clothing. Get medical assistance if irritation persists or if large body areas are contacted.</p> <p><u>Inhalation:</u> Remove to fresh air. If effects are more severe than a headache, contact a physician. Restore and/or support breathing if required. Consider oxygen therapy.</p> <p><u>Ingestion:</u> Give water to drink to dilute. If victim is alert and large amount ingested, induce vomiting. Contact a physician!</p>	
<p>SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES</p>	
<p>Report large spills to safety personnel. Provide maximum explosion-proof ventilation and eliminate sources of ignition. Clean-up personnel need protection against inhalation and liquid contact. Flush with water spray to clear area of acetone (flush to open ground, <u>not</u> to drains, sewers or surface water courses), or dilute with >200 parts of water and pick up with nonsparking tools for disposal.</p>	
<p>DISPOSAL: Incineration is a recommended method to dispose of scrap acetone. Reduce burning hazards by mixture with less flammable liquid for incineration. Follow Federal, State, and Local regulations. When amounts warrant it, consider reclaiming.</p> <p>EPA (RCRA) HW No. U002 (40 CFR 261)</p>	
<p>SECTION VIII. SPECIAL PROTECTION INFORMATION</p>	
<p>Provide explosion-proof general and local exhaust ventilation to meet TLV requirements. For nonroutine or emergency exposure above the TLV, use approved chemical cartridge or canister, gas mask (up to 5000 ppm) or self-contained respirator with full facepiece (up to 20,000 ppm).</p> <p>Safety glasses and butyl rubber or polyvinyl acetate gloves are recommended to avoid contact with liquid acetone. (Protective creams can also be used). Additional protective clothing may be required (boots, apron, etc.) as work conditions indicate to prevent contact with liquid. Remove contaminated clothing promptly (fire and health hazard) and clean and dry before reuse.</p> <p>An eyewash station and safety shower should be available near the workplace where splashing is possible.</p> <p>Sprinkler fire protection is desirable in areas of storage, handling and use.</p> <p>NIOSH recommends preplacement and medical exams for those regularly exposed above "action level".</p>	
<p>SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS</p>	
<p>Store in closed containers (carbon steel recommended) in a cool, clean, well-ventilated fire-resistant area, away from oxidizing agents and sources of heat or ignition. Bond and ground containers and equipment for transfers to avoid static sparks. Use labeled safety cans for small amounts. Protect containers from physical damage.</p> <p>Acetone must be stored and handled as an OSHA Class IB flammable liquid. Electrical services must meet codes. No smoking in storage or use areas.</p> <p>Use with adequate ventilation. Avoid prolonged or repeated contact with liquid.</p> <p>DOT Classification: FLAMMABLE LIQUID I.D. No. UN1090 Label: FLAMMABLE LIQUID</p>	
<p>DATA SOURCE(S) CODE: 1-12, 14, 16, 19-21, 23-26, 31, 38, 47</p>	
<p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<p>APPROVALS: MIS/CRD <i>J. M. Nielsen</i></p> <p>INDUST. HYGIENE/SAFETY <i>JW 6-8-84</i></p> <p>MEDICAL REVIEW: 15 June 1984</p>



Fisher Scientific Company

Chemical Manufacturing Division
P. O. Box 375, 1 Reagent Lane
Fair Lawn, NJ 07410

MATERIAL SAFETY DATA SHEET (Adapted from USDL Form LSD-005-4)

(201) 796-710

SECTION I. IDENTIFICATION OF PRODUCT

CHEMICAL NAME

S-Tetra-bromoethane

FORMULA

$\text{CHBr}_2\text{CHBr}_2$

SYNONYM OR CROSS REFERENCE

Acetylene tetrabromide

SECTION II. HAZARDOUS INGREDIENTS

MATERIAL

S-Tetra-bromoethane

NATURE OF HAZARD

Irritant

SECTION III. PHYSICAL DATA

BOILING POINT

151°C @ 54mm

MELTING POINT

-1°C

VAPOR PRESSURE(mm Hg)

0.02

SPECIFIC GRAVITY

2.96

VAPOR DENSITY (AIR = 1)

11.9

PERCENT VOLATILE BY VOLUME (%)

100%

WATER SOLUBILITY

insoluble

EVAPORATION RATE

(ether) = 1) greater than 1

APPEARANCE

clear yellow liquid

SECTION IV. FIRE AND EXPOSURE HAZARD DATA

FLASH POINT (method used)

NA

FLAMMABLE LIMITS

NA

Uel

LeI

(°F)

FIRE EXTINGUISHING MEDIA

CO_2 , dry chemical, water foam

SPECIAL FIRE-FIGHTING PROCEDURES

wear self contained breathing apparatus

UNUSUAL FIRE AND EXPLOSION HAZARD

when heated, emits toxic fumes of carbonyl bromide

SECTION V. HEALTH HAZARD

THRESHOLD LIMIT VALUE

air: 1ppm

HEALTH HAZARDS

Harmful if swallowed. Causes irritation.

FIRST AID PROCEDURES

If swallowed, induce vomiting. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Call a physician.

See Disclaimer on reverse side.

SECTION VI. REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	

INCOMPATIBILITY (material to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS ~~When heated, emits toxic fumes of carbonyl bromide~~

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII. SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Absorb on vermiculite. Scoop up and place in a suitable container.

WASTE DISPOSAL METHOD

DISPOSE OF BY MEANS AS TO COMPLY WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS
OR CONTACT AN APPROVED AND LICENSED DISPOSAL AGENCY.

SECTION VIII. PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)

face mask with organic vapor cannister

VENTILATION	LOCAL	SPECIAL
	MECHANICAL (general) preferred	OTHER

PROTECTIVE GLOVES
RubberEYE PROTECTION
Safety glasses

OTHER PROTECTIVE EQUIPMENT

SECTION IX. HANDLING AND STORAGE PRECAUTIONS

STORAGE AND HANDLING

SECTION X. MISCELLANEOUS INFORMATION

INFORMATION FURNISHED BY:
Gaston L. PilloriTITLE
Manager of Quality Assurance

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REV. NO. 0 DATE: 7/2/80

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

Phone: (518) 385-4085

DIAL COMM 8*235-4085

MS
MATERIALS
INFORMATION SERVICES

No. 1A

AMMONIUM HYDROXIDE
(28-30%)

Date April 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: AMMONIUM HYDROXIDE (28-30%)

OTHER DESIGNATIONS: Aqua Ammonia, Ammonium Hydrate, Ammonia Water (Strong),
"Spirit of Hartshorn", NH_4OH , GE Material D4B2, CAS #001 336 216

MANUFACTURER: Available from many suppliers, including:

J.T. Baker Chemical Corp.

222 Red School Lane

Philipsburg, NJ 08865

Canadian Industries Limited

Chemicals, Box 10

Montreal, QUE., Canada H3C 2R3

SECTION II. INGREDIENTS AND HAZARDS

Ammonia, Anhydrous (See MSDS #1)

Water

Material is prepared by dissolving ammonia in water under controlled conditions. Purity depends on the purity of the ammonia and of the water used.

*Current OSHA value; ACGIH (1979) TLV is 25 ppm. NIOSH has proposed a ceiling level of 50 ppm for ammonia.

HAZARD DATA

28-30 8-hr TWA 50 ppm*
or 35 mg/m³

70-72

Human, oral LDLo
43 mg/kg

Human, inhalation
LCLo 5000 ppm

Rat, oral
LD₅₀ 350 mg/kg

SECTION III. PHYSICAL DATA

Temperature at which solution is saturated

with NH_3 at 1 atm, deg F ----- ca 80-85

Vapor pressure of NH_3 , 15.5 C, mm Hg - 420-475

Water solubility ----- Completely Soluble

Specific gravity (15.5/4 C) - 0.90

Formular weight, NH_4OH ----- 35.05

Moles NH_3 /liter of solution - ca 13

Freezing point, deg C ----- >-73

Appearance & Odor: A clear, colorless liquid with a strong, pungent odor of ammonia. The odor, which is detectable at 5 ppm and irritating at 25-50 ppm of NH_3 , provides a warning of hazardous concentrations in air.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
N/A	1204 F (as NH_3)	Volume % (NH_3)	16	27

Extinguishing Media: Use media appropriate to surrounding fire conditions. Use cold water spray to control vapors and cool fire-exposed containers.

When heated, material will emit NH_3 vapors which necessitates respiratory and eye protection for firefighters. Use protective clothing.

SECTION V. REACTIVITY DATA

Material is stable in cool storage in closed containers. It does not polymerize.

Ammonium hydroxide is strongly alkaline and is incompatible with acid materials and with copper, tin, zinc, aluminum, and their alloys and with galvanized surfaces.

Violent reactions can occur, for example, with dimethyl sulfate, or fluorine. Explosive materials can result from reaction with iodine or with several silver compounds.

Adding NaOH to this material and/or heating will volatilize NH_3 .

GENERAL ELECTRIC

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SECTION VI. HEALTH HAZARD INFORMATION	TLV 25 ppm/50 ppm (See Sect. II)
<p>Ammonium hydroxide is irritating and corrosive to body tissues. Excessive inhalation of vapors is irritating to the mucous membranes of the respiratory tract and can result in headache, coughing, severe lung congestion (edema and difficulty in breathing). Skin contact with liquid can irritate, redden and cause burns. Liquid contact with the eye can be severely damaging and can result in loss of vision. Ingestion is corrosive to the digestive tract.</p>	
<p>FIRST AID:</p>	
<p><u>Eye Contact:</u> Immediately flush with lots of running water for at least 15 min., including under the eyelids; then contact physician immediately, preferably an ophthalmologist. Speed and thoroughness in rinsing eyes is important to avoid permanent injury.</p>	
<p><u>Skin Contact:</u> Immediately flush with lots of water while removing contaminated clothing and shoes. Get medical help promptly if large areas are affected or irritation persists.</p>	
<p><u>Inhalation:</u> Remove to fresh air. Restore breathing if required and/or have trained person administer oxygen if breathing is difficult. Keep warm and at rest. Contact physician promptly.</p>	
<p><u>Ingestion:</u> If conscious, promptly give lots of water or dilute vinegar or citrus juice to drink, followed by milk. Do not induce vomiting. Contact physician.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Prepare written plans for emergency. Inform safety personnel of large spills and evacuate area. Provide ventilation. Those involved in clean up need protection against contact with liquid and inhalation of mist or vapors. Contain spill for recovery when feasible or flush with water to holding area for neutralization (do not flush directly to sewer or surface water.)</p>	
<p>DISPOSAL: Follow Federal, State and Local regulations for pH, NH_3 content, and salts content for effluents. Ammonium hydroxide can be diluted with water, neutralized as required with dilute HCl or dilute H_2SO_4, and then lightly diluted with water for discharge. Suitable scrap ammonium hydroxide might be considered for use in neutralizing acidic wastes. If desired, aqueous NH_3 can be recovered from scrap for use or sale.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide general and local exhaust ventilation as required to meet TLV. For emergency and nonroutine conditions above the TLV a chemical cartridge respirator with a full-facepiece respirator is suitable for exposures below 300 ppm; above 300 ppm or if concentration unknown use approved self-contained respirator with full facepiece.</p>	
<p>Use splash-proof, chemical safety goggles, and where needed, a faceshield or mask to protect against splashes and from mists and NH_3. Use a rubber suit, boots, gloves, apron, or other protective clothing as required for workplace conditions to prevent contact with ammonium hydroxide solutions.</p>	
<p>An eyewash station and a safety shower must be immediately accessible to workers where this material is used or handled. Washing facilities and large amounts of clean water must be available for emergency use where spills may occur.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in a cool (below 80 F to avoid pressurization above 1 atm) area in closed containers, away from sources of heat, direct sunlight, and incompatible materials (see, for example, Sec. V). Handle as a corrosive liquid. Prevent damage to containers. Above 50 F, the ammonia vapor from this material can be a serious hazard in a spill situation. Use caution in opening sealed containers for proper pressure relief. Drain emptied containers well & flush with water before discarding.</p>	
<p>Work practices and equipment must be arranged to prevent contact of ammonium hydroxide with the worker's body and to avoid inhalation of vapors. Train workers in proper handling of ammonium hydroxide.</p>	
<p>Preplacement and periodic medical exam is recommended for ammonia workers and additional exams should be provided if excessive exposure occurs. Keep records. Preclude from exposure workers with eye or pulmonary diseases.</p>	
<p>DATA SOURCE(S) CODE: 1-12, 14, 34</p>	<p>APPROVALS: MIS, <i>J. H. Wilson</i> Industrial Hygiene and Safety</p>
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>	<p>MEDICAL REVIEW: June 1980</p>

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
P.O. BOX 1436, SCHENECTADY, NY 12301 USA
(518) 385-2577



No. 1

ANHYDROUS AMMONIA
REVISION B

Date November 1979

SECTION I. MATERIAL IDENTIFICATION			
MATERIAL NAME: ANHYDROUS AMMONIA DESCRIPTION: Liquid or gaseous, depending on temperature and pressure conditions. Supplied pressurized in cylinders or tanks. OTHER DESIGNATIONS: NH_3 , Ammonia Gas, GE Material D27A1, CAS #007 664 417 MANUFACTURER: Available from many suppliers.			
SECTION II. INGREDIENTS AND HAZARDS		x	HAZARD DATA
Anhydrous Ammonia *Current OSHA TLV; NIOSH has proposed a 50 ppm Ceiling Limit (4 minute sampling time). The current ACGIH TLV is 25 ppm.		>99.5	8-hr TWA 50 ppm* or 35 mg/m ³ Human, inhalation TLo 20 ppm, irritation Rat, inhalation LLo 2000 ppm/4 hr
SECTION III. PHYSICAL DATA			
Boiling point, 1 atm, deg F (C) ---- -28 (-33.4) Specific gravity 60/60 F -- 0.62 Vapor pressure at 60 F, mm Hg ----- 4800 Volatiles, % ----- ca 100 Vapor density (Air=1) ----- 0.6 pH of 1% water solution --- 11.7 Solubility in water, g/100 cc: At 0 C ----- 89.9 Melting point, deg F (C) -- -108 At 100 C ----- 7.4 Molecular weight ----- 17.03 Appearance & Odor: Liquid at low temperature, moderate pressure. Colorless gas at moderate temperature, low pressure. Strong, pungent odor, detectable at 5 ppm, irritating at 25-50 ppm; odor provides a warning of hazard.			
SECTION IV. FIRE AND EXPLOSION DATA			LOWER UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	
Gaseous at room conditions	1204 F (iron present)*	Vol. %	16 25
Extinguishing media: Water (spray or fog) is best. Stop flow gas. Use water to keep fire-exposed containers cool and protect men affecting shut off. It is a moderate fire and explosion hazard when exposed to heat or flame. If gas is leaking or tanks are heavily exposed to heat, evacuate the area and the area downwind. Heat exposed tanks should vent at 250 psi. Violent rupture can occur if relief valves fail. Firefighters need self-contained breathing apparatus with full-facepiece and full protective clothing.			
*If iron catalyst absent, autoignition is above 1562 F (850 C).			
SECTION V. REACTIVITY DATA			
Contained anhydrous NH_3 at room temperature is stable. If heated above 450 C, decomposition to H_2 and N_2 begins. It is an alkaline gas which reacts with acids with much heat evolution; it reacts with CO_2 from the air. Contact of NH_3 with chemicals such as mercury, chlorine, iodine, bromine, silver oxide, or hypochlorites can form explosive compounds. Do not use copper, brass, bronze or galvanized steel in contact with ammonia. Welded joints are preferred to threaded joints in ammonia service. Do not use brazed joints.			

SECTION VI. HEALTH HAZARD INFORMATION

TLV 25-50 ppm (See Sect. II)

Ammonia is not a "poison", but its alkalinity is corrosive to body tissues. The gas can be suffocating and is extremely irritating to the eyes, mucous membranes and lung tissue. It can cause permanent injury or death in prolonged exposure at high concentrations. Skin damage can occur from repeated, prolonged, or high concentration contact. Above 700 ppm in air causes severe eye injury and possible loss of vision if not treated immediately. Burning and blistering of the skin, as well as serious lung edema, occur quickly above 1700 ppm in air. Contact with liquid ammonia will produce frostbite in addition to corrosive damage.

FIRST AID:

Eye Contact: Flush with lots of running water immediately and continue at least 15 min., including under the eyelids. Then contact physician immediately, preferably an ophthalmologist. Speed and thoroughness in rinsing eyes is important to avoid permanent injury.

Skin Contact: Immediately flush with water and remove contaminated clothing. Thaw frozen clothing before removal. Get medical help if irritation persists or large area affected.

Inhalation: Remove promptly to fresh air. Restore and/or support breathing if required; keep warm and at rest. Call physician. Have trained person administer oxygen. (NOTE: Rescuer requires proper respirator equipment to prevent his becoming a victim also.)

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Establish written plans for emergency. Evacuate area of leak (and possibly downwind also). Exclude all except properly equipped (see Sect. VIII) and trained personnel with emergency assignments. Eliminate ignition sources and provide ventilation. Use a cold water spray to absorb NH_3 . An open bottle of Conc. HCl can be used to detect sources of small leaks. When possible, leakage should be adjusted to discharge gas, not liquid NH_3 . Do not try to neutralize liquid NH_3 spills with acid! Gaseous NH_3 may be discharged into cold water for collection; do not directly discharge this solution to municipal sewers, confined drains, or surface waters. **DISPOSAL:** Solutions of NH_3 in pure water may be used or sold. For discharge, follow Federal, State and local regulations. Limited amounts of NH_3 gas may be released to the atmosphere under appropriate conditions. Also limited amounts of ammonia solution can be highly diluted with water (neutralized?) for discharge. The receiving stream must not exceed established limits for NH_3 or salts.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation and exhaust ventilation to meet TLV requirements. (In buildings use explosion-proof electrical services for NH_3 .) For emergency and nonroutine conditions a chemical cartridge respirator with full-facepiece can be used for limited periods below 300 ppm; above 300 ppm or for unknown exposures, approved, full-facepiece self-contained breathing apparatus should be available.

To prevent skin contact use rubber suit, boots, gloves, apron, etc. as appropriate for workplace conditions. Use safety goggles and faceshield to protect eyes from gas and direct splashing of solutions.

An eyewash station and safety shower must be immediately accessible to workers where ammonia is used or handled. Washing facilities and large amounts of clean water must be available for emergency use. (See also ANSI/CGA G2.1-1972, formerly ANSI K61.1, on storage and handling of anhydrous ammonia.)

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store cylinders or tanks in a cool, well-ventilated, fire-resistant location, away from oxidizing agents, combustible materials, and sources of heat or ignition. Special external storage, out of direct sunlight, is preferred. See also CFR 29, Chapter XVII, Part 1910.111 for regulations on containment and handling of anhydrous ammonia. Follow good practices for compressed gas in cylinders.

Monitor workplace to be sure of ammonia exposures of workers. Work practices and equipment must be designed to prevent any contact of liquid ammonia or ammonia solutions with a worker's body.

Preplacement and periodic medical examination is recommended for ammonia workers, and examinations should be provided when excessive exposure conditions occur. Keep records.

Provide training to workers on safe handling.

DATA SOURCE(S) CODE: 2-8,12,17,19,20,24,26,31

APPROVALS: MIS, CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: 12/79

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Fisher Scientific Company

Chemical Manufacturing Division
P. O. Box 375, 1 Reagent Lane
Fair Lawn, NJ 07410

MATERIAL SAFETY DATA SHEET (Adapted from USDL Form LSD-005-4)

(201) 796-7100

SECTION I. IDENTIFICATION OF PRODUCT

CHEMICAL NAME

Canada Balsam

FORMULA

a) natural resin

b) concentrated resin in xylene

SYNONYM OR CROSS REFERENCE

a) B-10

b) SO-C-30

SECTION II. HAZARDOUS INGREDIENTS

MATERIAL

Canada Balsam

NATURE OF HAZARD

b) Flammable

SECTION III. PHYSICAL DATA

BOILING POINT

unknown

MELTING POINT

unknown

VAPOR PRESSURE(mm Hg)

a) NA b) 10 (xylene)

SPECIFIC GRAVITY

a) 0.99 b) 0.95

DENSITY (AIR = 1)

a) NA b) 3.6 (xylene)

PERCENT VOLATILE BY VOLUME (%)

a) nil b) 40%

WATER SOLUBILITY

insoluble

EVAPORATION RATE

(ether = 1) greater than 1

APPEARANCE

Yellow liquid

SECTION IV. FIRE AND EXPOSURE HAZARD DATA

FLASH POINT (method used)

a) NA b) 96°F

(°F)

FLAMMABLE LIMITS

unknown

Uel

Lei

FIRE EXTINGUISHING MEDIA

alcohol foam, dry chemical, CO₂

SPECIAL FIRE-FIGHTING PROCEDURES

UNUSUAL FIRE AND EXPLOSION HAZARD

SECTION V. HEALTH HAZARD

THRESHOLD LIMIT VALUE

none listed

HEALTH HAZARDS

b) vapor harmful. Irritating to eyes and skin

FIRST AID PROCEDURES

Inhalation: Remove to fresh air. Give artificial respiration if necessary. Skin & eyes: flush with water for at least 15 minutes. For eyes: Contact a physician.

See Disclaimer on reverse side.

SECTION VI. REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	

INCOMPATIBILITY (material to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII. SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Absorb on vermiculite. Scoop up and place in a suitable container.

WASTE DISPOSAL METHOD

DISPOSE OF BY MEANS AS TO COMPLY WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS
OR CONTACT AN APPROVED AND LICENSED DISPOSAL AGENCY.

SECTION VIII. PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)

b) Face mask with organic vapor canister.

VENTILATION	LOCAL b) acceptable	SPECIAL
	MECHANICAL (general) b) preferred	OTHER

PROTECTIVE GLOVES

rubber

EYE PROTECTION

safety glasses

OTHER PROTECTIVE EQUIPMENT

SECTION IX. HANDLING AND STORAGE PRECAUTIONS

STORAGE AND HANDLING

SECTION X. MISCELLANEOUS INFORMATION

INFORMATION FURNISHED BY:

Gaston L. Pillori

TITLE

Manager of Quality Assurance

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REV. NO. 0 DATE: February 3, 1981

Form No. 7
11-79

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

Phone: (518) 385-4085

DIAL COMM 8*235-4085



NO. 323

ETHYLENE GLYCOL

REVISION B

Date November 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ETHYLENE GLYCOL

OTHER DESIGNATIONS: Glycol, 1,2-Ethanediol, HOCH₂CH₂OH, ASTM D2693, GE Material D5B38
CAS #000 107 211

MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Ethylene glycol

ca 100

*Current ACGIH (1980) TLV; Intended Changes List has a ceiling value for vapors at 50 ppm or 125 mg/m³.

Vapor*
TLV 100 ppm or
250 mg/m³

Particulate
TEV 10 mg/m³

Human, oral LDLo
710 mg/kg

Human, inhalation
TCLO 10 g/m³

Toxic irritant effects

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C)	387 (197)	Specific gravity (H ₂ O=1)	1.12
Vapor pressure @ 20 C, mm Hg	0.06	Evaporation rate (CCl ₄ =1)	1
Vapor density (Air=1)	2.1	Refractive index at 25 C	1.430
Viscosity @ 35 C (95 F), cp	12.3	Freezing point, deg C	-12.7
Solubility in water @ 20 C	Complete	Molecular weight	62.08

Appearance & Odor: Colorless, sweet-tasting (Poisonous!) hygroscopic liquid.
Practically odorless.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
232 F (TCC) 245 F (OC)	752 F	% by Vol.	3.2	15.3

Extinguishing Media: CO₂, water, dry chemical or alcohol foam (especially for large fires). Cool fire-exposed containers with water. Spills may be flushed and diluted with water to reduce flammability. Water or foam may cause frothing.

Ethylene glycol, when heated or misted into the air, becomes a moderate fire and explosion hazard.

Firefighters should use self-contained breathing equipment and proper protective clothing.

SECTION V. REACTIVITY DATA

Ethylene glycol is a noncorrosive, stable material. It is hygroscopic.

Ignition in air will generate oxides of carbon and nitrogen.

Lowers the freezing point of water; f.p. at eutectic composition, 60% ethylene glycol, is -49 C. Is miscible with water, ether, low aliphatic alcohols, aldehydes and ketones; partially soluble in hydrocarbons.

Mixing with chlorosulfonic acid, or oleum, or 96% sulfuric acid in a sealed container causes the temperature and pressure to increase.

It is incompatible with strong oxidizing agents.

SECTION VI. HEALTH HAZARD INFORMATION

TLV particulate: 10 mg/m³
vapor: 100 ppm or 250 mg/m³

Inhalation of high ethylene glycol concentrations produces symptoms similar to ethyl alcohol intoxication; pulmonary edema may also develop. The single lethal oral dose for humans is about 3-4 ounces or about 1.4 ml/kg. Sub-lethal ingestion can produce intoxication and coma. Symptoms may include: lack of appetite, spasmodic motion of the eyeball, dizziness, abdominal pain, CNS stimulation followed by depression, respiratory arrest or cardiovascular collapse, acute renal failure with uremia. Eye contact may cause irritation and iridocyclitis. Skin absorption may also contribute to intoxication.

FIRST AID:

Eye Contact: Wash with plenty of running water for 15 minutes.

Skin Contact: Rinse off with water; then wash area with soap and water.

Inhalation: Remove victim to fresh air. Restore or support breathing as required.

Ingestion: Give 3 glasses milk or water and induce vomiting at once! Gastric lavage recommended. Support respiration.

In all cases of excessive exposure get prompt medical help for further treatment, support, and observation.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel. Provide adequate ventilation. (Normal ventilation may be satisfactory if liquid is at room temperature and not misted into the air). Those handling spill emergencies should use proper protective equipment. Recover as much spilled material as feasible for disposal. Wash residue or small spills to the sewer with copious water.

DISPOSAL: Large quantities of liquids may be disposed of by mixing with more flammable solvents and atomizing into an incinerator. Follow Federal, State, and Local regulations.

Aquatic toxicity rating TLM 96:1000-100 ppm.

SECTION VIII. SPECIAL PROTECTION INFORMATION

When ethylene glycol is heated, or agitated, or sprayed, proper exhaust hoods with 100 fpm face velocities should be used. Rubber gloves should be worn to prevent skin contact. Respirators should be available for nonroutine or emergency use above the TLV.

Safety glasses or goggles should be worn in areas of use where splashing is possible. Eyewash stations should be available.

Preemployment and annual medical exam to include kidney and liver function tests.

Preclude from exposure individuals with diseases of liver, kidneys, lungs and central nervous system.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store material in mild steel, except where color requirements are most critical. Then store in resin-coated steel, glass, aluminum or stainless steel containers. Close containers tightly to avoid moisture. Separate from oxidizing materials.

Do not take internally! Poisonous! Toxic concentration of ethylene glycol are unlikely to occur at room temperature due to its unique vapor pressure. Poisoning resulting from vapor usually occurs only if ethylene glycol liquid is heated. Heated and agitated solutions should have proper exhaust ventilation of area to prevent inhalation liquid particles and vapors.

Do not eat or drink in work areas.

DATA SOURCE(S) CODE: 2-11,23-25,26,34,37,39

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APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: December 5, 1980

Supersedes
Prior Dated
MSDS For
This Material

Cargille

Issued: April 9, 1985

MATERIAL SAFETY DATA SHEET

RECEIVED

DEC 3 1985

THIS OSHA-20 FORMAT MODIFIED BY CARGILLE LABS. OCT. 5, 1983 DELAWARE GEOLOGIC SURVEY

SECTION I

MANUFACTURER'S NAME R.P. Cargille Laboratories, Inc.		EMERGENCY TELEPHONE NO. 201-239-6633
ADDRESS (Number, Street, City, State, and ZIP Code) 55 Commerce Road, Cedar Grove, NJ 07009		Range n _D 1.300 - 1.395
CHEMICAL NAME AND SYNONYMS Fluorocarbon Liquids	TRADE NAME AND SYNONYMS Refractive Index Liquids Series AAA	
CHEMICAL FAMILY	FORMULA Proportional Blend	

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SECTION II - HAZARDOUS INGREDIENTS

	%
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	+345°F	SPECIFIC GRAVITY (H ₂ O=1)	1.9
VAPOR PRESSURE (mm Hg.)	77°F	PERCENT VOLATILE BY VOLUME (%)	95%
VAPOR DENSITY (AIR=1)	approx 75	EVAPORATION RATE (ether = 1)	Less than 1
SOLUBILITY IN WATER	approx 23		
APPEARANCE AND ODOR	Nil		
Oily, colorless liquid			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	None	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA	Not flammable			
SPECIAL FIRE FIGHTING PROCEDURES				
	None			
UNUSUAL FIRE AND EXPLOSION HAZARDS				
	None			

SECTION V - HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	N.A.
EFFECTS OF OVEREXPOSURE	N.A.
EMERGENCY AND FIRST AID PROCEDURES	
If eyes involved, flush with water - obtain medical attention.	
If skin involved, wash with soap and water.	

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATIBILITY (Materials to avoid) Molten alkali metals			
HAZARDOUS DECOMPOSITION PRODUCTS Temperature of 600 F may produce toxic fumes			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Absorb, then wash affected area with soap and water.	
WASTE DISPOSAL METHOD In accordance with local, state, county and federal regulations.	

SECTION VIII - SPECIAL PROTECTION INFORMATION			
RESPIRATORY PROTECTION (Specify type) *			
VENTILATION	LOCAL EXHAUST *	SPECIAL	
	MECHANICAL (General) *	OTHER	
PROTECTIVE GLOVES desirable		EYE PROTECTION *	
OTHER PROTECTIVE EQUIPMENT *NOT NECESSARY EXCEPT AS GOOD LABORATORY INDUSTRIAL PRACTICE			

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
None	
OTHER PRECAUTIONS	Avoid eye contact

GLYCERIN
 GLYCERIN
 GLYCERIN
 GLYCERIN

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
 CHEMICAL DIVISION
 1 REAGENT LANE
 FAIR LAWN NJ 07410
 (201) 796-7100

EMERGENCY CONTACTS
 GASTON L. PILLORI
 (201) 796-7100

DATE: 05/28/86
 PO NBR: N/A
 ACCT: 201082-01
 INDEX: 06-8614-10497
 CAT NO: G33500

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 56-81-5

SUBSTANCE: **GLYCERIN**

TRADE NAMES/SYNONYMS: GLYCEROL; GLYCERIN ANHYDROUS; GLYCERINE; GLYCERITOL; GLYCYL ALCOHOL; 1,2,3-PROPANETRIOL; SYNTHETIC GLYCERIN; GLYCERIN, SYNTHETIC; 90 TECHNICAL GLYCERINE; TRIHYDROXYPROPANE; 1,2,3-TRIHYDROXYPROPANE; G-31; G-33

CHEMICAL FAMILY:
 HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C3-H8-O3 MOL WT: 92.11

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=1 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

PERCENT: 99.9 COMPONENT: GLYCERIN

EXPOSURE LIMITS:
 10 MG/M3 ACCIH TWA (VAPOR)

PHYSICAL DATA

DESCRIPTION: COLORLESS OR PALE YELLOW, HYGROSCOPIC, ODORLESS, SYRUPY

LIQUID WITH A WARM, SWEET TASTE. BOILING POINT: 290 F (143 C)

MELTING POINT: 64 F (18 C) SPECIFIC GRAVITY: 1.3

VAPOR PRESSURE: 0.0025 MMHG @ 50 C PH: NEUTRAL

SOLUBILITY IN WATER: SOLUBLE

SOLVENT SOLUBILITY: ALCOHOL, ETHYL ACETATE, ETHYL ETHER VAPOR DENSITY: 3.1

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT FIRE/NEGLECTIBLE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: 390 F (199 C) LOWER EXPLOSION LIMIT: 0.9%

AUTOIGNITION TEMP.: 698 F (370 C) FLAMMABILITY CLASS(OSHA): IIIA

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

WATER OR FOAM MAY CAUSE FROTHING (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TOXICITY

126 MG EYE-RABBIT MILD IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 12,600 MG/KG ORAL-RAT LD50; 26 GM/KG ORAL-MOUSE LD50;
7750 MG/KG ORAL-GUINEA PIG LD50; 75 MG/KG INTRAPERITONEAL-RAT LD50;
100 MG/KG SUBCUTANEOUS-RAT LD50; 5566 MG/KG INTRAVENOUS-RAT LD50;
63 MG/KG INTRAPERITONEAL-MOUSE LD50; CARCINOGEN STATUS: NONE.
GLYCERIN IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:

IRRITANT.
ACUTE EXPOSURE- INHALATION IS UNLIKELY DUE TO THE LOW VAPOR PRESSURE BUT FUMES MAY CAUSE IRRITATION AND DEHYDRATION OF THE MUCOUS MEMBRANES.

GLYCERIN
CHRONIC EXPOSURE- NO EFFECTS REPORTED IN HUMANS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE- MAY CAUSE IRRITATION AND DEFATTING OF THE SKIN.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE A STRONG STINGING AND BURNING SENSATION, AND LACRIMATION, BUT NO INJURY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
IRRITANT.

ACUTE EXPOSURE- MAY CAUSE HEADACHE, RESTLESSNESS, INSOMNIA, DIZZINESS, VOMITING, NAUSEA, DIARRHEA, AND FEVER. LARGE DOSES MAY CAUSE HEMOLYSIS, HEMOGLOBINURIA, HYPERGLYCEMIA, GLYCOSURIA, RENAL FAILURE, CONVULSIONS, NARCOSIS, AND PARALYSIS.

FIRST AID- IF VICTIM IS CONSCIOUS AND NOT CONVULSIVE, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. FROM SITTING POSITION, HEAD MUST BE LOWER THAN HIPS TO PREVENT ASPIRATION. KEEP PATIENT WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:

GLYCERINE
NITRIC ACID: EXPLOSIVE REACTION.
SULFURIC ACID: EXPLOSIVE REACTION.
CHLORINE: EXPLOSIVE REACTION AT 70-80 C.
HYDROFLUORIC ACID: EXPLOSIVE REACTION.

GLYCERIN

CALCIUM HYPOCHLORITE: EXPLOSIVE REACTION.
 POLYPROPYLENE: EXPLOSIVE REACTION.
 PERCHLORIC ACID: EXPLOSIVE REACTION ON IMPACT.
 LEAD OXIDE: EXPLOSIVE REACTION ON IMPACT.
 ANILINE: EXPLOSIVE REACTION.
 SODIUM PEROXIDE: EXPLOSIVE REACTION.
 POTASSIUM PEROXIDE: EXPLOSIVE REACTION.
 CHROMIUM OXIDE: EXPLOSIVE REACTION.
 CHROMIUM TRIOXIDE: EXPLOSIVE REACTION.
 POTASSIUM CHLORATE: EXPLOSIVE REACTION.
 POTASSIUM PERMANGANATE: EXPLOSIVE REACTION.
 STRONG OXIDIZERS: EXPLOSIVE REACTION.
 ACETIC ANHYDRIDE: VIOLENT REACTION BY PHOSPHORUS OXYCHLORIDE CATALYST.
 ANILINE: VIOLENT REACTION WITH NITROBENZENE WITH FERROUS SULFATE AS CATALYST.
 PERCHLORATE AND LEAD OXIDE: VIOLENT REACTION.
 CHROMIC ANHYDRIDE: VIOLENT REACTION.
 SILVER PEROXIDE: VIOLENT REACTION.
 CALCIUM HYPOCHLORATE: IGNITION REACTION.
 LEAD OXIDE AND FLUORINE: IGNITION REACTION.
 ANILINE AND SODIUM OR POTASSIUM PEROXIDE: IGNITION REACTION.
 POTASSIUM TRIIODIDE: IGNITION REACTION.
 SODIUM HYDRIDE: INTENSE EXOTHERMIC REACTION.

DECOMPOSITION:
 COMBUSTION RELEASES CORROSIVE FUMES OF ACROLEIN.

POLYMERIZATION:
 NONE KNOWN.

 CONDITIONS TO AVOID

CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS. TEMPERATURES IN THE VICINITY OF THE BOILING POINT, 143 C.

 SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
 ABSORB WITH VERMICULITE OR OTHER SUITABLE MATERIAL. PLACE IN A SUITABLE CONTAINER (PLASTIC), FOR LATER DISPOSAL.

 PROTECTIVE EQUIPMENT

VENTILATION:
 PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET
 -- PERMISSIBLE EXPOSURE LIMITS.

RESPIRATOR:
 1000 MG/M3- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE
 WITH A FULL FACEPIECE.

FIRE FIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
 EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT

GLYCERIN
REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 04/24/85 REVISION DATE: 04/29/85

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MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT
120 ERIE BOULEVARD
SCHENECTADY, N.Y. 12305



NO. 30A

HYDROCHLORIC ACID
Revision A

DATE June 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: HYDROCHLORIC ACID

DESCRIPTION: This material is a water solution of hydrogen chloride gas.

OTHER DESIGNATIONS: Muriatic Acid, Concentrated Hydrochloric Acid, GE Material D4A3,
CAS# 007 647 010, Aqueous Hydrochloric Acid

MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Hydrogen Chloride (HCl)
Impurities (depends on acid grade)
Water

%	HAZARD DATA
<38	8-hr TWA 5 ppm or 7 mg/m ³ (C)*
Traces	Human, Inhalation LCLO 1300ppm/30 M
Balance	Rabbit, Oral LD50 900 mg/kg
	Rat, Oral (200Be') LD50 700 mg/kg
	Rabbit, Skin (200Be') LD50 >5g/kg, 24 H-C

*Current OSHA PEL and ACGIH (1983) TLV Ceiling Level.

SECTION III. PHYSICAL DATA

	18° Be'	20° Be'	22° Be'	23° Be'
Weight % HCl	27.9	31.5	35.2	37.1
Boiling pt, 1 atm, deg F	208	182	144	123
Freezing point, deg F (approx)	-43	-63	-86	-101
Specific gravity, 60/60 F	1.142	1.162	1.179	1.189
Vap. Press., 25C, HCl/Total, mm Hg	~7/15	~25/33	~87/92	~186/190

All materials are completely water soluble with ~100% volatiles and pH <1.

Appearance & Odor: Clear, colorless to lt. yellow, fuming* liquid with a pungent, irritating odor. 1-5 ppm HCl detected by smell; 5-10 ppm is disagreeable.

*Higher conc. tend to be fuming liquids at room temperature.

SECTION IV. FIRE AND EXPLOSION DATA

	Lower	Upper
Flash Point and Method		
Autoignition Temp.		
Flammability Limits in Air		
N/A	-	-

Extinguishing media: Select that suitable for surrounding fire. Use a water spray to cool fire exposed containers to prevent rupture.

Nonflammable, but acid can react with many metals, such as iron, to produce flammable hydrogen gas. (Flammable conc. may accumulate inside metal equipment.) Neutralize acid with limestone, slaked lime or soda ash to minimize formation of potentially explosive hydrogen gas.

Firefighters should use full protective clothing and self-contained breathing apparatus when this material is involved in a fire situation.

SECTION V. REACTIVITY DATA

This material is stable when properly contained and handled. It is a strong mineral acid and is, thus, highly reactive with materials such as metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. It is highly corrosive to many materials; it must have proper containment for handling and storage.

It liberates significant levels of HCl gas by vapor pressure at room temperature when concentrated and large amounts of HCl when heated.

Reaction with most metals will produce flammable hydrogen gas.

Incompatible with materials such as cyanides, sulfides, sulfites and formaldehyde (may release HCN, H₂S, SO₂, bischloromethyl ether, respectively).

SECTION VI. HEALTH HAZARD INFORMATION	TLV 5 ppm Ceiling Level (as HCl)
<p>Aqueous HCl and its vapors are strong irritants of the eyes, mucous membranes, and skin. Severity of eye injury from splashes [from irritation to severe burns] depends on quantity, conc. and duration of contact. Excessive acute exposure to HCl vapors/mists promptly irritates the upper respiratory tract and can result in coughing, burning of the throat, choking sensation and, if inhaled deeply, pulmonary edema. Prolonged or repeated low level exposure may cause teeth erosion. Skin exposure can cause burns; repeated or prolonged exposure to dilute soln. may cause dermatitis. Ingestion can cause severe burns and possible laryngeal spasm.</p> <p>FIRST AID: <u>Eye Contact:</u> Contact physician! <u>Immediately</u> flush with running water for 15 min. including under eyelids. <u>Skin Contact:</u> Flush affected area well with water. Remove grossly contaminated clothing under safety shower. Get medical help if large skin area contacted or if irritation persists. <u>Inhalation:</u> Remove to fresh air. Restore and/or support breathing as needed. Use O₂ therapy for coughing, difficult breathing. Get medical help. Keep warm and at rest. <u>Ingestion:</u> If victim is conscious, give 2-3 glasses of water, then milk of magnesia or limewater. Contact physician! <u>Do not induce vomiting!</u></p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Report large spills to safety personnel. Evacuation may be needed; keep upwind. Remove sources of ignition if H₂ is a hazard. Provide optimum ventilation. Those involved in clean-up of large spills must use full protective clothing, boots, and self-contained breathing apparatus.</p> <p>Small spills and residues can be covered with excess of a mixture of soda ash and slaked lime to neutralize, and the slurry picked up for landfill burial or flushed with much water.</p> <p>Contain large spills. Collect or flush with water to holding area for neutralization. Do not flush directly to sewer or surface waters.</p> <p>DISPOSAL: Dispose of acid via licensed contractor or neutralize with limestone, soda ash or slaked lime. Flushing to sewer depends on allowable neutral salt concentrations in effluent water. Follow Federal, State and Local regulations. Consider use of waste acid to neutralize alkaline wastes. EPA (CWA) RQ is 5000 lb. (40 CFR 117)</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide adequate exhaust ventilation to meet TLV requirements. Face velocity of hoods should exceed 100 fpm. Use approved respirator or self-contained breathing apparatus for emergency or non-routine conditions with full facepiece above 50 ppm.</p> <p>Those handling hydrochloric acid should use protective clothing and equipment to prevent body contact with the liquid. Use rubber gloves or gauntlets, apron, boots, long sleeved shirt, body suit, etc. Use chemical safety goggles and/or face shield for eye protection against splashing of acid.</p> <p>An eyewash station, washing facilities, and safety shower must be readily available to areas of use and handling.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store closed containers out of direct sunlight, in a clean, cool, open or well-ventilated area, away from oxidizing agents, away from alkaline material and sources of heat. Area should have acid resistant floor and approved drainage. Protect containers from physical damage. Use nonsparking tools in areas around tanks and pipes where hydrogen might be generated.</p> <p>Use with good ventilation. Avoid inhalation of HCl vapors. Odor of HCl gives adequate warning for a prompt voluntary withdrawal from excessive exposure. Do not get in eyes or on skin or clothing. Wash thoroughly after handling.</p> <p>Provide emergency neutralization materials and equipment near storage and use areas.</p> <p>DOT Classification: CORROSIVE MATERIAL I.D. No. UN1789 Label: CORROSIVE IMO Class 8</p> <p>DATA SOURCE(S) CODE: 1-12, 14-16, 27, 31, 34, 37, 38, 47-49</p>	
<p>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</p>	APPROVALS: MIS/CRD <i>J. M. Nielsen</i>
	INDUST. HYGIENE/SAFETY <i>DPV 6-7-84</i>
	MEDICAL REVIEW: 15 June 1984

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

Phone: (518) 385-4085

DIAL COMM 8*235-4085

MS
MATERIALS
SERVICES
INFORMATION

No. 7

NITRIC ACID 55-70%

REVISION B

Date October 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: NITRIC ACID (55-70%)

OTHER DESIGNATIONS: Aqua Fortis, Hydrogen Nitrate, HNO_3 , GE Material D4A4,
CAS #007 697 372

DESCRIPTION: A solution of HNO_3 in water with properties dependent on concentration.
(See Sections II and III)

MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Hydrogen nitrate (HNO_3)

Water

*68% nitric acid (42°Be) is the constant boiling,
concentrated nitric acid of commerce; 56.5%
nitric acid (38°Be) is commercially available.

**NIOSH has proposed a 10-hr TWA for this same level.
TLV was set at a level to prevent irritation and the
erosion of the teeth.

%

HAZARD DATA

55-70*

8-hr TWA 5 mg/m³ or
2 ppm **

Balance

Human, Oral
LDLo 430 mg/kg

SECTION III. PHYSICAL DATA

	56.5% Acid	68% Acid	100% Acid (Unstable)
Boiling point, 1 atm, deg F (C) --	251 (121.6)	186.9 (86)	186.9 (86)
Specific gravity 20/4 C -----	1.36	1.41	1.50
Baume scale, density @ 60 F -----	38°Be	42°Be	--
Melting point, deg F (C) -----	-4 (-20)	ca -30 (-34)	-43.6 (-41.6)
Vapor pressure, mm Hg @ 25 C -----	--	--	ca 45
Volatiles @ 122 C -----	ca 100%	ca 100%	ca 100%
Water solubility: -----	Complete	Complete	Complete
Appearance & Odor: Water white to slightly yellow liquid with a characteristic NO ₂ odor. (Darkens to brownish color on aging and exposure to light.)			

SECTION IV. FIRE AND EXPLOSION DATA

	LOWER	UPPER
Flash Point and Method		
Autoignition Temp.		
Flammability Limits In Air		
Nonflammable	N/A	N/A

Nitric acid is nonflammable; however it is a strong oxidizing agent and can react with combustible materials to cause fires. (Use water on fires involving nitric acid to dilute the acid and to absorb liberated oxides of nitrogen.) It can also react with metals to liberate flammable hydrogen gas.

Self-contained breathing apparatus should be used by firefighters in an enclosed area with full protective clothing when nitric acid is involved in the fire.

SECTION V. REACTIVITY DATA

This material is stable under normal storage and handling conditions. It is hygroscopic (when concentrated), a strong mineral acid, and a strong oxidizing agent. Contact with organic materials such as wood, paper, alcohol, turpentine, hydrogen sulfide, etc., may cause fires. Combustible materials can have an increased flammability after contact with nitric acid.

Various nitrogen oxides, including NO, NO₂, N₂O₃, and N₂O -- all mixed with nitric acid mist and vapor -- can be produced upon decomposition or reaction of nitric acid. All are toxic. (See also MSDS #47, Nitrogen Dioxide.)

SECTION VI. HEALTH HAZARD INFORMATION	TLV 2 ppm or 5 mg/m ³
<p>This material is corrosive to all body tissues! Inhalation of nitric acid mist or fumes at 2 to 25 ppm, over an 8 hour period, may cause pulmonary irritation and symptoms of lung damage. The onset of symptoms following inhalation may be delayed for several hours. Concentrations over 200 ppm can cause severe pulmonary damage and may be fatal (in 5-10 hours) after several minutes of exposure. Eye or skin contact will produce immediate burns, with a yellow skin discoloration; eyes may be permanently damaged. Ingestion will produce burns of the digestive tract.</p> <p>FIRST AID:</p> <p><u>Skin Contact:</u> Wash immediately with soap and water. (Remove contaminated clothing promptly, under a safety shower for gross contact.) Get medical attention.</p> <p><u>Eye Contact:</u> Immediately wash with water for at least 15 min. Get medical attention.</p> <p><u>Inhalation:</u> Remove victim to fresh air. Administer oxygen, if needed, by authorized personnel. Get medical attention. Observe 4 to 30 hours after exposure for pulmonary edema. Hospitalization may be required.</p> <p><u>Ingestion:</u> Give 3 or more glasses of milk or water. Do not induce vomiting. Get medical attention.</p>	
<p>SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES</p> <p>Notify safety personnel. Provide adequate ventilation. Eliminate sources of ignition. Self-contained breathing apparatus should be used by personnel when cleaning up spills. Neoprene gloves and body shields should be used to prevent skin and clothing contact. Surfaces contaminated from spills should be covered with sodium bicarbonate or soda ash to neutralize the acid. Wash the neutralized slurry down the drain with excess water.</p> <p>DISPOSAL: Federal, State and Local regulations must always be considered prior to sewer disposal. If necessary, neutralized spill may be picked up by use of absorbents and disposed of as solid waste in a landfill. Use clean sand or vermiculite as absorbent solid.</p> <p>NOTE: When gaseous NO_x forms from a spill, <u>evacuate area</u>. Specially trained workers must handle the spill.</p>	
<p>SECTION VIII. SPECIAL PROTECTION INFORMATION</p> <p>Use with proper ventilation; exhaust hoods should maintain a face velocity of 100 lfm minimum. Gaseous oxides are heavier than air, hoods and downdraft exhaust systems to be used where general ventilation is inadequate. Where fumes are up to 250 mg/m³, a Type C supplied air respirator in pressure demand mode with full facepiece is recommended. Exhaust ducts should be fiberglass or other acid resistant material.</p> <p>Neoprene gloves and body shields should be used where splashing may occur. Chemical safety showers and eyewash stations must be readily available in areas of storage and handling of nitric acid. Preplacement and annual medical examinations with emphasis on respiratory tract, skin irritations, dental erosion, and lung function tests, should be provided workers frequently exposed to nitric acid. Workers must receive training before handling nitric acid in the workplace. Experienced workers need refresher training periodically.</p>	
<p>SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS</p> <p>Store in a clean, cool, well-ventilated area, away from organic chemicals, strong bases, metal powders, carbides, sulfides, and any readily oxidizable material. Protect from direct sunlight. Protect against physical damage. (NFPA #43A, Code for Oxidizer Storage)</p> <p>Nitric acid is a corrosive material and will attack skin, metals and many organic substances. The nitrogen oxides produced from the acid are all toxic, and proper ventilation should always be used.</p> <p>Neutralizing & absorbing materials such as soda ash and sand should be readily available to areas of use and storage of nitric acid. Electrical fixtures to be vapor-proof. Violations are considered serious when concentrations are above 4 ppm.</p> <p>DOT labeling - OXIDIZER and CORROSIVE.</p>	
<p>DATA SOURCE(S) CODE 2-12, 15, 19, 25-27, 31, 34, 37-39</p> <p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<p>APPROVALS: MIS CRD <i>J.M. Nelson</i></p> <p>Industrial Hygiene and Safety <i>DM</i> 10-30-80</p> <p>MEDICAL REVIEW: 11/18/80</p>

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

Phone: (518) 385-4085

DIAL COMM 8*235-4085

MS
MATERIALS SERVICES
INFORMATION

No. 44B

HYDROGEN PEROXIDE

(27-52%)

Date December 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: HYDROGEN PEROXIDE (27-52%)

DESCRIPTION: A solution of hydrogen peroxide in very pure water with a small amount stabilizer (or, in the case of an electronic grade hydrogen peroxide, a very small amount of stabilizer).

OTHER DESIGNATIONS: H₂O₂ Solution, CAS# 007 722 841

MANUFACTURER: Material is available from several suppliers, including FMC Corporation and Pennwalt Corporation

SECTION II. INGREDIENTS AND HAZARDS

Hydrogen Peroxide (H₂O₂)

Water (H₂O)

Proprietary Stabilizer

(such as acetanilide, sodium stannate or other)

Wt. %

27-52
73-48
Small
amount

HAZARD DATA

8-hr TWA 1 ppm*

Rat, inhalation
LCLo 100 ppm
(pulmonary edema)

*Current TLV for OSHA and ACGIH (1978). Material increases in hazards as H₂O₂ concentration increases.

SECTION III. PHYSICAL DATA

	27.5%	30%	35%	50%
Boiling point at 1 atm, deg C	105.6	106.0	107.8	113.9
Vapor pressure at 30 C, mm Hg	25.5	24.8	23.3	18.3
Partial pressure H ₂ O ₂ at 30 C, mm Hg	0.2	0.23	0.28	0.56
Specific gravity (20/4 C)	1.10	1.11	1.13	1.20
Approx. freezing point, deg C	-22	-25	-33	-51
Volume oxygen produced/1 volume solution	100	110	130	197
Water solubility	MISCIBLE			

Appearance & Odor: A clear, colorless to light blue, water-like liquid without odor (or with a characteristic slightly acidic odor).

SECTION IV. FIRE AND EXPLOSION DATA

	Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
	None	None	None		

Extinguishing Media: Use water in large amounts to fight fire in which this material is involved. Hydrogen peroxide is non-flammable, but it provides oxygen to facilitate or initiate burning of surrounding combustibles. It can be a dangerous fire hazard.

Use large amounts of water to dilute and/or flush away hydrogen peroxide spills or cool containers in a fire situation. Heated containers can rupture violently.

Firefighters must use self-contained breathing equipment and must have eye protection to fight fires involving this material.

SECTION V. REACTIVITY DATA

H₂O₂ is a high energy material which is stabilized for commercial use and storage with inhibitors and by keeping cool and free of contaminants. It does not polymerize but can decompose with rapid release of heat and oxygen. Containers must be vented to allow escape of oxygen resulting from slow decomposition. Keep away from sources of heat. Keep pure. Keep this powerful oxidizing agent away from any contact with combustibles including lubricants and graphite. Spontaneous combustion may occur on standing in contact with readily flammable materials. Violent, catalytic decomposition will occur in contact with certain metals such as: iron, copper, chromium, brass, bronze, lead, silver manganese or their salts. Decomposed by alkalis and even ordinary dust or rust. It must be handled in compatible containers and equipment and kept free from contamination.

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SECTION VI. HEALTH HAZARD INFORMATION	TLV 1 ppm H ₂ O ₂ (See Sect. II)						
<p>Inhalation of excessive levels of vapors causes irritation and inflammation of the respiratory tract. It is irritating in contact with the skin. Solutions of over 35% H₂O₂ can readily cause blistering of the skin. The eyes are particularly sensitive to injury by contact with this material. Do not ingest! solutions > 3% H₂O₂ should never be allowed to come in contact with the mouth!</p> <p>FIRST AID:</p> <p><u>Eye contact:</u> Flush out eyes thoroughly with running water for 15 minutes. Promptly contact a physician.</p> <p><u>Skin contact:</u> Wash off the contact area immediately with plenty of water. Remove contaminated clothing promptly. If burns have occurred, or if irritation persists, get medical help. (Immerse contaminated clothing in water until laundered).</p> <p><u>Inhalation:</u> Remove to fresh air. If irritation persists, get medical help.</p> <p><u>Ingestion:</u> Give water to drink to dilute; encourage vomiting. Give lukewarm water freely and encourage belching if there is evidence of distension. Contact physician.</p>							
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES							
<p>Prepare in advance for emergency situations! Have source of plenty of water available for dilution and flushing of spills; have available drainage free from incompatible chemicals. Safety personnel should be given prompt notification of significant spills. Immediately dilute spills with copious amounts of water; flush away from combustible materials. Provide maximum ventilation; eliminate sources of ignition. evacuate area except for clean-up personnel, who must use protective equipment. (See Sect. VIII). Flush to holding area for dilution with more water.</p> <p>DISPOSAL: Follow Federal, State and local regulations for disposal. Small spills and residues can be highly diluted with water and flushed to the drain. Large amounts may require partial or total decomposition of active oxygen in addition to dilution before discharge.</p>							
SECTION VIII. SPECIAL PROTECTION INFORMATION							
<p>Provide general ventilation and local exhaust ventilation to meet TLV requirements. Local exhaust ventilation and/or hoods should be used where mist or vapors may be generated. Approved respirators and self-contained breathing apparatus must be available for non-routine and emergency use.</p> <p>Prevent contact with the skin by use of gloves, apron, boots, etc., as required, of suitable protective material.</p> <p>Chemical safety goggles and/or a face shield must be used for eye protection. An eyewash station and safety shower must be readily available.</p> <p>Provide special training of employees working with H₂O₂ on body protection, emergency procedures and first aid.</p>							
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS							
<p>Store in original container (or in approved container of compatible material) in a cool, fire resistant place, away from any combustibles, direct sunlight, catalytic metals, and sources of heat. A source of <u>ample water</u> must be available for handling spills. Protect containers from physical damage and from contamination. <u>Do not return material to storage container after removal!</u> Ventilation must be good. Containers must be covered and vented. Workers handling hydrogen peroxide must be specially trained for the assignment. Procedures must maintain the high purity of stored material. All equipment used to handle hydrogen peroxide solutions must be of approved composition and properly cleaned and passivated before use. Obtain and follow supplier recommendations. Avoid contact with any combustible materials.</p> <p>DOT Classification - OXIDIZER (yellow label)</p> <p>DATA SOURCE(S) CODE: 1,2,5-9,12,20</p>							
<p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">APPROVALS: MIS, CRD</td> <td style="padding: 2px; text-align: right;"><i>J. M. Nielsen</i></td> </tr> <tr> <td style="padding: 2px;">Industrial Hygiene and Safety</td> <td style="padding: 2px; text-align: right;"><i>Q. L. White</i></td> </tr> <tr> <td style="padding: 2px;">Corporate Medical Staff</td> <td style="padding: 2px; text-align: right;"><i>Long F. Martin M.D.</i></td> </tr> </table>	APPROVALS: MIS, CRD	<i>J. M. Nielsen</i>	Industrial Hygiene and Safety	<i>Q. L. White</i>	Corporate Medical Staff	<i>Long F. Martin M.D.</i>
APPROVALS: MIS, CRD	<i>J. M. Nielsen</i>						
Industrial Hygiene and Safety	<i>Q. L. White</i>						
Corporate Medical Staff	<i>Long F. Martin M.D.</i>						

Material Safety Data Sheet

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855



No. 9
SULFURIC ACID,
CONCENTRATED
Revision C
Issued: October 1980
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION

MATERIAL NAME: SULFURIC ACID, CONCENTRATED

OTHER DESIGNATIONS: Oil of Vitriol, Hydrogen Sulfate; H_2SO_4 ; CAS #7664-93-9

MANUFACTURER/SUPPLIER: Available from many suppliers, including:

Allied Corporation, PO Box 2064R, Morristown, NJ 07960; Telephone: 800 631-8050

HMS

H:3

F: 0

R: 2

PPE: *

* See Sect. 8

R 1

I 3

S 4

K 0

SECTION 2. INGREDIENTS AND HAZARDS

%

HAZARD DATA

Hydrogen Sulfate (H_2SO_4)

Water

93-98

Balance*

8-hr TWA: 1 mg/m³

Human, Mist Inhalation,
TCLo: 3 mg/m³, 24 wk.
(Toxic Mouth Effects)

Rat, Oral,
LD₅₀: 2140 mg/kg

* Material is obtained by the reaction of SO_3 and water. Can contain low impurity levels, such as 0.02% max of iron as Fe. Properties vary with H_2SO_4 content.

Current OSHA standard and ACGIH (1985-86) TLV. NIOSH has a 10-hr TWA, 40-hr. work week, of 1 mg/m³.

SECTION 3. PHYSICAL DATA

	93.19% H_2SO_4	98.33% H_2SO_4	100% H_2SO_4
Boiling Point, 1 atm, deg C	ca 281	ca 338	ca 330 (dc)
Specific Gravity (60/60°F)	1.8354	1.84	1.84
Volatiles, % @ 340°C	ca 100	ca 100	ca 100
Melting Point, deg C	ca -34	ca 3	10.4

Water Solubility ... Complete Miscible
Vapor Pressure, mm Hg @ 100°F ... <1 (93.19% H_2SO_4); Deg. Baume ... 66 (93.19% H_2SO_4) - Density of H_2SO_4 is often reported in degrees Baume Be). Formula is Be=145 [145/sp gr for liquids heavier than water].

Appearance and odor: Clear, colorless, hygroscopic, oily liquid with no odor. Mists greater than 1 mg/m³ are easily recognizable. Those at 5 mg/m³ are distinctly objectionable.

SECTION 4. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None - Nonflammable	NA	NA	NA	NA

Sulfuric acid is nonflammable; however, it is a strong oxidizing agent and may cause ignition by contact with combustible materials. Small fires may be smothered with suitable dry chemical. Cool exterior of storage tanks of H_2SO_4 with water to avoid rupture if exposed to fire. Do not add water or other liquid to the acid! The acid, especially when diluted with water, can react with metals to liberate flammable hydrogen gas.

Sulfuric acid mists and vapors from a fire area are corrosive (see sect. 5).

Fire fighters must wear self-contained breathing equipment and fully protective clothing.

SECTION 5. REACTIVITY DATA

Sulfuric acid is stable under normal conditions of use and storage. It does not undergo hazardous polymerization. It is a strong mineral acid reacting with bases and metals. The concentrated acid is also a dehydrating agent, picking up moisture readily from the air or other materials. Hydrogen gas may be generated within a H_2SO_4 container. Vent drums cautiously.

This material reacts exothermically with water. (Acid should always be added slowly to water. Water added to acid can cause boiling and uncontrolled splashing of the acid.) Sulfur oxides can result from decomposition and from oxidizing reactions of sulfuric acid.

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

MATERIALS INFORMATION SERVICES

No. 354

METHYL ALCOHOL

Revision B

Methanol

Date September 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: METHYL ALCOHOL

DESCRIPTION: Industrial solvent

OTHER DESIGNATION: Methanol, Wood alcohol, Carbinol, Wood naphtha, GE Material D5B51, ASTM D1152, CH₃OH, CAS #000 067 561

MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Methyl Alcohol -----

ca 100

HAZARD DATA

8-hr TWA 200 ppm*(Sk
or 260 mg/m³

*Current OSHA Standard; ACGIH (1981) TLV adds (skin) notation.

NIOSH has recommended a 10-hr TWA of 200 ppm with a ceiling of 800 ppm (15 minute sample).

Human

Eye: 5 ppm

Primary irritation d

Oral: LDLo 340 mg/k

Inhalation:

TCLo 8600 mg/m³

Toxic irritant

effects (systemic)

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C --- 64.5

Vapor density (Air=1) ----- 1.1

Vapor pressure @ 21.2°C, mm Hg -- 100

Water solubility ----- Totally miscible

Viscosity @ 20°C, cps ----- 0.59

Specific gravity (20°/4°C) ---- 0.791

Melting point, deg C ----- -97.8

Volatiles, % ----- ca 100

Evaporation rate (n-BuAc=1) --- 4.6

Molecular weight ----- 32.04

Appearance & Odor: A clear, colorless liquid with a characteristic alcohol odor.

The odor recognition threshold (100% of test panel) is 53.3 ppm.

SECTION IV. FIRE AND EXPLOSION DATA

			LOWER	UPPER
Flash Point and Method	Autoignition Temp.	Flammability Limits In Air		
54°F (12°C) (closed cup)	867°F (465°C)	% by Volume	6	36.5

Extinguishing media: CO₂, dry chemical, alcohol foam, and water mist or fog. Methyl alcohol fires are Class IB fires, use a blanketing effect to smother fire.

It is a moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames and can react vigorously with oxidizing agents.

Firefighters should use self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode. Wear full protective clothing.

SECTION V. REACTIVITY DATA

Methyl alcohol is a flammable material, but it is stable under normal storage and use conditions. It does not undergo hazardous polymerization.

Avoid contact with strong oxidizing agents such as nitrates, perchlorates or sulfuric acid.

Oxidation products in air include oxides of carbon and nitrogen.

SECTION VI. HEALTH HAZARD INFORMATION

TLV 200 ppm (Skin) or 260 mg/m³

Methanol is a poisonous, narcotic chemical that may exert its effects through inhalation, skin absorption or ingestion. Body elimination of methanol is slow, and the toxic effects can be compounded by repeated excessive exposures over several days. Toxic effects are exerted upon the CNS, especially the optic nerve. Ingestion can produce blindness. Symptoms of overexposure include dizziness, visual impairment, nausea, respiratory failure, muscular incoordination and narcosis. Prolonged or repeated skin contact will cause dermatitis, erythema, and scaling. Ingestion of 100-250 ml can be fatal.

FIRST AID:

Skin Contact: Remove contaminated clothing. Wash affected area with soap and water; apply skin lotions.

Eye Contact: Irrigate with running water for 15 minutes. Get medical help.

Inhalation: Remove victim to fresh air and prevent further exposure for 7 days.

Obtain medical assistance if victim is not fully normal within 10 minutes.

Ingestion: Drink 3 glasses milk, water or 4% sodium bicarbonate. Gastric lavage by medical personnel. Repeat NaHCO₃ treatment after lavage.

(NIOSH recommends inducing vomiting if victim is conscious).

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel. Remove all sources of ignition; provide adequate ventilation.

Absorb on vermiculite, paper or other absorbent. Burn in an approved incinerator or open pit away from buildings and people.

Spills in sensitive areas may be diluted and flushed to ground with a water spray. Do not flush to sewer.

Dispose of large quantities of waste via a licensed waste solvent disposal company, or reclaim via filtration and distillation procedures. It can be incinerated.

Follow Federal, State and local regulations.

Aquatic toxicity rating: TLm 96: over 1000 ppm.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate ventilation to meet TLV requirements. Exhaust ventilation with 100 lfpm minimum should be used where vapor exposure is likely. Engineering controls shall be sparkproof and explosion proof.

Use air-supplied or self-contained breathing apparatus when conc. is above TLV, but less than 2,000 ppm. A full facepiece is required above 10,000 ppm.

Prevent skin contact by wearing rubber gloves. Protective aprons, boots and face shields should be used where splashing may occur. Use safety glasses in other areas of use.

Eye wash stations and safety showers should be available in areas of use.

No smoking in areas of use.

Provide suitable training to those working with methanol. Monitor the workplace. Keep records.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a well-ventilated, fire proof area, away from sources of heat, open flame and ignition. Ground and electrically interconnect containers for transfer. Use spark-proof tools. Use with adequate ventilation. No smoking in areas of storage or use. Avoid prolonged or repeated breathing of vapor or contact with skin. Avoid contact with eyes. This material is poisonous when introduced into the body metabolism. Do not ingest!

Provide preplacement medical exams for industrially exposed workers, periodic medical surveillance, with emphasis on neurological and visual functions, liver and kidney systems.

DOT Classification: Flammable liquid
DATA SOURCE(S) CODE: 2,4-12,16,19,20,23-26,31,
34,37-39,43,47

Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: 8 October 1981

Dyestuffs & Chemicals Division

CIBA-GEIGY Corporation
P.O. Box 18300
Greensboro, North Carolina 27419-8300
Telephone 919 292 7100

PAGE 1

MATERIAL SAFETY DATA SHEET

EMERGENCY TELEPHONE NO.
(919) 292-7100

TRADE NAME : QUATERNARY O

CHEMICAL FAMILY : IMIDAZOLIUM

OSHA HAZARDOUS : | | YES |X| NO
SUBSTANCE

SECTION I - HAZARDOUS INGREDIENTS

INGREDIENT

. NONE

PERCENT OSHA PEL ACGIH TLV

SECTION II - PHYSICAL DATA

APPEARANCE AND ODOR

. PASTE, ODORLESS

BOILING POINT

. NOT EVALUATED

EVAPORATION RATE

. NOT EVALUATED

PERCENT VOLATILE

. NOT EVALUATED

PH

. NOT EVALUATED

SOLUBILITY IN WATER

. SOLUBLE

SPECIFIC GRAVITY

. NOT EVALUATED

VAPOR DENSITY

. NOT EVALUATED

VAPOR PRESSURE

. NOT EVALUATED

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PAGE 2

SECTION III - FIRE, EXPLOSION AND REACTIVITY INFORMATION**PHYSICAL HAZARD(S)**

- . NONE

FLASH POINT

- . NOT EVALUATED

FLAMMABLE LIMITS IN AIR-LOWER

- . NOT EVALUATED

FLAMMABLE LIMITS IN AIR-UPPER

- . NOT EVALUATED

EXTINGUISHING MEDIA

- . CARBON DIOXIDE, DRY CHEMICAL, FOAM, WATER.

SPECIAL FIRE FIGHTING PROCEDURES

- . NONE REQUIRED.

HAZARDOUS DECOMPOSITION PRODUCTS

- . BURNING MAY PRODUCE OXIDES OF CARBON, NITROGEN OR SULFUR.

FIRE AND EXPLOSION HAZARDS

- . NO UNUSUAL HAZARDS.

STABILITY

- . STABLE

INCOMPATIBILITY

- . NONE KNOWN.

HAZARDOUS POLYMERIZATION

- . WILL NOT OCCUR.

DOT STATUS

- . NOT REGULATED

SECTION IV - HEALTH HAZARD INFORMATION**HEALTH HAZARD**

- . NONE KNOWN

HEALTH HAZARD REFERENCE

- . NONE

LIMITS OF EXPOSURE

- . NONE ESTABLISHED

EFFECTS OF OVEREXPOSURE

- . NOT KNOWN

ACUTE TOXICITY DATA - INGESTION

- . NOT EVALUATED

- EYE

- . NOT EVALUATED

- SKIN

- . NOT EVALUATED

- INHALATION

- . NOT EVALUATED

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PAGE 3

ADDITIONAL DATA

. NONE

SECTION V - EMERGENCY AND FIRST AID PROCEDURES

EYES

- . IMMEDIATELY FLUSH EYES WITH WATER FOR AT
- . LEAST 15 MINUTES. GET MEDICAL ATTENTION.

SKIN

- . REMOVE CONTAMINATED CLOTHING AND FLUSH SKIN WITH LARGE
- . AMOUNTS OF WATER. IF IRRITATION PERSISTS, CONTACT PHYSICIAN.

INHALATION

- . REMOVE TO FRESH AIR.

INGESTION

- . SEEK IMMEDIATE MEDICAL ATTENTION.

PHYSICIAN'S COMMENTS

. NONE

SECTION VI - PRECAUTIONS FOR SAFE HANDLING

HANDLING, SHIPPING AND STORING PRECAUTIONS

- . IN ACCORDANCE WITH GOOD INDUSTRIAL PRACTICE, HANDLE WITH
- . DUE CARE AND AVOID UNNECESSARY PERSONAL CONTACT.
- . FOR INDUSTRIAL USE ONLY

SECTION VII - SPILL AND DISPOSAL PROCEDURES

SPILL PROCEDURES

- . SOAK UP WITH INERT ABSORBENT MATERIAL. SHOVEL INTO
- . CLOSABLE CONTAINER FOR DISPOSAL. WEAR PROTECTIVE
- . EQUIPMENT SPECIFIED ABOVE (SEC. VI).

WASTE DISPOSAL METHOD

- . BURY OR INCINERATE IN APPROVED SITE OR FACILITY IN
- . ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

RCRA STATUS

- . NOT A HAZARDOUS WASTE UNDER RCRA (40 CFR 261).

CONTAINER REUSE

- . THE EMPTY CONTAINER MAY CONTAIN RESIDUES OF THE PRODUCT AND
- . SHOULD NOT BE REUSED FOR ANY PURPOSE WITHOUT RECONDITIONING.

Dyestuffs & Chemicals Division

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PAGE 4

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION

- . IN CASES WHERE THERE IS A LIKLIHOOD OF INHALATION
- . EXPOSURE TO THE POWDER (DUST), WEAR A NIOSH APPROVED
- . DUST RESPIRATOR.

PROTECTIVE GLOVES

- . WEAR IMPERVIOUS GLOVES AS A STANDARD HANDLING PROCEDURE.

EYE PROTECTION

- . WEAR SPLASH-PROOF CHEMICAL GOGGLES.

OTHER PROTECTIVE EQUIPMENT

- . WEAR APPROPRIATE EQUIPMENT TO PREVENT PROBABILITY
- . OF EXPOSURE AND PERSONAL CONTACT. DELUGE SAFETY SHOWER
- . AND EYE WASH SHOULD BE LOCATED NEAR WORK AREA.

VENTILATION

- . LOCAL EXHAUST RECOMMENDED, MECHANICAL EXHAUST
- . ACCEPTABLE.

SECTION IX - ENVIRONMENTAL DATA

BOD 5

- . < 0.01

COD

- . 2.40

FISH TOXICITY

- . (BLUEGILL) LC50 = 0.84 MG/L

SEED TOXICITY

- . MODERATE INHIBITION @ 300 MG/L

PREPARATION DATE: 11/14/85

PREPARED BY : J. T. DUKES

FOR FURTHER INFORMATION, PLEASE CONTACT : JOHN T. DUKES, JR.
(919) 292-7100

THE INFORMATION AND RECOMMENDATIONS CONTAINED HEREIN ARE BASED UPON DATA BELIEVED TO BE CORRECT. HOWEVER, NO GUARANTEE OR WARRANTY OF ANY KIND EXPRESSED OR IMPLIED IS MADE WITH RESPECT TO THE INFORMATION CONTAINED HEREIN. THIS MATERIAL SAFETY DATA SHEET WAS PREPARED TO COMPLY WITH THE OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200). THIS SUPERCEDES ANY PREVIOUS INFORMATION.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME R.P. Cargille Laboratories, Inc.		EMERGENCY TELEPHONE NO. 201-239-6633
ADDRESS (Number, Street, City, State, and ZIP Code) 55 Commerce Road, Cedar Grove, N.J. 07009		Range n_D 1.460 - 1.640
CHEMICAL NAME AND SYNONYMS Natural Aliphatic Hydrocarbons, Hydrogenated Terphenyl, Brominated Naphthalene		TRADE NAME AND SYNONYMS Refractive Index Liquids Series A
CHEMICAL FAMILY	FORMULA Proportional Blends	

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
Not Known					

SECTION III - PHYSICAL DATA

BOILING POINT (°F.) at 760 mm	+550°F	SPECIFIC GRAVITY (H ₂ O=1)	approx. 1.15
VAPOR PRESSURE (mm Hg.) approx.	2	PERCENT. VOLATILE BY VOLUME (%)	99%
VAPOR DENSITY (AIR=1) approx.	1	EVAPORATION RATE (H ₂ O=1) at 23°C	Nil
SOLUBILITY IN WATER at 23°C	Nil		
APPEARANCE AND ODOR Oily, light yellow liquid, clear			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	C.C.C. +310°F	FLAMMABLE LIMITS	Let	Uel
EXTINGUISHING MEDIA Dry powder, foam on petroleum grease fire				
SPECIAL FIRE FIGHTING PROCEDURES None				
UNUSUAL FIRE AND EXPLOSION HAZARDS None				

SECTION V - HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	Not Known
EFFECTS OF OVEREXPOSURE	Not Known - prolonged or repeated skin contact may cause skin irritation.
EMERGENCY AND FIRST AID PROCEDURES	Wash affected area with soap and water, call physician especially if swallowed or in contact with eyes.

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	Avoid temperature above 500°F
INCOMPATIBILITY (Materials to avoid)		May react with strong oxidizers	
HAZARDOUS DECOMPOSITION PRODUCTS		Bromine, smoke, soot, CO, CO	
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Treat as petroleum lubrication oil	
WASTE DISPOSAL METHOD	Absorb large spills and dispose of in accordance with Local, State, and Federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION			
RESPIRATORY PROTECTION (Specify type)			
VENTILATION	LOCAL EXHAUST	None	SPECIAL
	MECHANICAL (General)	Yes	OTHER
		Yes	
PROTECTIVE GLOVES		EYE PROTECTION	
Yes		Yes	
OTHER PROTECTIVE EQUIPMENT			

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
Good industrial practice as to housekeeping, personal hygiene,	
OTHER PRECAUTIONS	avoidance of prolonged and repeated skin contact and splashing in eyes
is indicated.	

Supersedes
Prior Dated
MSDS For
This Material

Cargille

Issued: November 13, 1985

MATERIAL SAFETY DATA SHEET

THIS OSHA-20 FORMAT MODIFIED BY CARGILLE LABS. OCT. 5, 1983

SECTION I

MANUFACTURER'S NAME R.P. Cargille Laboratories, Inc.	EMERGENCY TELEPHONE NO. 201-239-6633
ADDRESS (Number, Street, City, State, and ZIP Code) 55 Commerce Rd., Cedar Grove, NJ 07009	
CHEMICAL NAME AND SYNONYMS Hydrogenated Terphenyl	TRADE NAME D-1.642-1.700
Brominated Ring, Iodated Ring, Sulfur	Refractive Index Liq. Series B
CHEMICAL FAMILY	FORMULA Blend

THE INFORMATION SUPPLIED IS BASED ON DATA AVAILABLE TO US AND IS BELIEVED TO BE CORRECT. HOWEVER, NO GUARANTEE OR WARRANTY OF ANY KIND EXPRESSED OR IMPLIED, IS MADE WITH RESPECT TO THE INFORMATION PRESENTED AND CARGILLE LABORATORIES ASSUMES NO RESPONSIBILITY FOR THE RESULTS OF THE USE OF THIS PRODUCT. THIS INFORMATION IS FURNISHED UPON THE CONDITION THAT THE PERSON RESPONSIBLE FOR ITS USE SHALL MAKE HIS OR HER OWN DETERMINATION OF THE SUITABILITY OF THE MATERIAL FOR HIS OR HER PARTICULAR PURPOSE.

SECTION II - HAZARDOUS INGREDIENTS

	%
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	
N.A.	

SECTION III - PHYSICAL DATA

	Average	Average
BOILING POINT (°F.)	+335	SPECIFIC GRAVITY (H ₂ O=1) 1.30
VAPOR PRESSURE (mm Hg.)	1	PERCENT VOLATILE BY VOLUME (%) 98%
VAPOR DENSITY (AIR=1)	.9	EVAPORATION RATE (H ₂ O=1) Nil
SOLUBILITY IN WATER	Nil	
APPEARANCE AND ODOR	Light yellow, oily liquid.	

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	+335°F C.O.C.	FLAMMABLE LIMITS	LC	UL
EXTINGUISHING MEDIA	Dry powder, foam As petroleum fire			
SPECIAL FIRE FIGHTING PROCEDURES	None			
UNUSUAL FIRE AND EXPLOSION HAZARDS	None			

SECTION V - HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	Not known
EFFECTS OF OVEREXPOSURE	Not known
EMERGENCY AND FIRST AID PROCEDURES	
If eyes involved, flush with water, obtain medical attention.	
Skin contact - wash with soap and water.	

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	Temp. above 335°C
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Absorb, then wash area with soap and water.	
WASTE DISPOSAL METHOD All chemical disposal must be in accordance with local, state, county and federal regulations.	

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION (Specify type) *		
VENTILATION	LOCAL EXHAUST *	SPECIAL
	MECHANICAL (General) *	OTHER
PROTECTIVE GLOVES		EYE PROTECTION *
OTHER PROTECTIVE EQUIPMENT * Advisable not necessary except as good laboratory industrial practice.		

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	Avoid eye contact. No other special precautions appear necessary: good industrial practice as to housekeeping, personal hygiene, avoidance of vapors and prolonged and repeated skin contact.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

OSHA No. 44 41327

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME R. P. Cargille Laboratories, Inc.		EMERGENCY TELEPHONE NO. 201-239-6633
ADDRESS (Number Street City, State, and ZIP Code) 55 Commerce Road, Cedar Grove, N. J. 07009		
CHEMICAL NAME AND SYNONYMS Arsenic Tribromide, Disulfide and Selenium		TRADE NAME AND SYNONYMS Refractive Index Liquids EH, FH, GH
CHEMICAL FAMILY Arsenicals	FORMULA Blends	FORMULA Blends

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS N.A.			BASE METAL N.A.		
CATALYST N.A.			ALLOYS N.A.		
VEHICLE N.A.			METALLIC COATINGS N.A.		
SOLVENTS N.A.			FILLER METAL PLUS COATING OR CORE FLUX N.A.		
ADDITIVES N.A.			OTHERS N.A.		
OTHERS N.A.					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
N.A.					

SECTION III - PHYSICAL DATA

	Average		Average
BOILING POINT	+428 ^{OF}	SPECIFIC GRAVITY (H₂O=1)	> 3.5
VAPOR PRESSURE (mm Hg.) 77 ^{OF}	< 1	PERCENT VOLATILE BY VOLUME (%)	90
VAPOR DENSITY (AIR=1)	+1	EVAPORATION RATE (H₂O=1)	< 1
SOLUBILITY IN WATER	Slight	M. P.	
APPEARANCE AND ODOR Red brown viscose liquid, odor characteristic			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) C.O.C. +600 ^{OF}	FLAMMABLE LIMITS	Let	Uet
EXTINGUISHING MEDIA Water			
SPECIAL FIRE FIGHTING PROCEDURES Ventilate area			
UNUSUAL FIRE AND EXPLOSION HAZARDS			
Avoid toxic fumes			

SECTION V / HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	As arsenic compounds
EFFECTS OF OVEREXPOSURE	As arsenic compounds
EMERGENCY AND FIRST AID PROCEDURES	Wash affected area with soap and water. Scrub to remove all traces.

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	-
INCOMPATIBILITY (Materials to avoid)		<u>Leaded optical glasses</u>	
HAZARDOUS DECOMPOSITION PRODUCTS		<u>HR</u> <u>Arsenic oxides</u>	
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Absorb - Wash affected area with soap and water
WASTE DISPOSAL METHOD
Treat as <u>arsenic</u> compounds in accordance with local, state and federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION (Specify type) <u>Work in fume removing hood</u>		
VENTILATION	LOCAL EXHAUST <u>Yes</u>	SPECIAL
	MECHANICAL (General)	OTHER
PROTECTIVE GLOVES <u>Yes</u>		EYE PROTECTION
OTHER PROTECTIVE EQUIPMENT		

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
	None
OTHER PRECAUTIONS	<u>Avoid breathing vapors.</u> <u>Avoid all direct contact with skin.</u>

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME R. P. Cargille Laboratories, Inc.		EMERGENCY TELEPHONE NO. 201-239-6633
ADDRESS (Number Street, City, State, and ZIP Code) 55 Commerce Road, Cedar Grove, N. J. 07009		
CHEMICAL NAME AND SYNONYMS Arsenic Tribromide, Disulfide, Brominated Ring		TRADE NAME AND SYNONYMS Refractive Index Liquid Series H
CHEMICAL FAMILY Arsenicals	FORMULA Blend	

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS N.A.			BASE METAL N.A.		
CATALYST N.A.			ALLOYS N.A.		
VEHICLE N.A.			METALLIC COATINGS N.A.		
SOLVENTS N.A.			FILLER METAL PLUS COATING OR CORE FLUX N.A.		
ADDITIVES N.A.			OTHERS N.A.		
OTHERS N.A.					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
N.A.					

SECTION III - PHYSICAL DATA

	Average		Average
BOILING POINT	+428 ^{OF}	SPECIFIC GRAVITY (H₂O=1)	> 3.5
VAPOR PRESSURE (mm Hg.) 77 ^{OF}	< 1	PERCENT, VOLATILE BY VOLUME (%)	90
VAPOR DENSITY (AIR=1)	+1	EVAPORATION RATE (<u>850</u> = 1)	< 1
SOLUBILITY IN WATER	Slight	M.P.	
APPEARANCE AND ODOR Yellow-Brown Liquid, odor characteristic			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) C.D.C. +600 ^{OF}	FLAMMABLE LIMITS	Let	Uel
EXTINGUISHING MEDIA Water			
SPECIAL FIRE FIGHTING PROCEDURES Ventilate area			
UNUSUAL FIRE AND EXPLOSION HAZARDS			
Avoid toxic fumes			

SECTION V - HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	As arsenic compounds
EFFECTS OF OVEREXPOSURE	" " "
EMERGENCY AND FIRST AID PROCEDURES	Wash affected area with soap and water

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATIBILITY (Materials to avoid) <u>Leaded optical glasses</u>			
HAZARDOUS DECOMPOSITION PRODUCTS <u>HA, Arsenic Oxides</u>			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Absorb - Wash affected area with soap and water	
WASTE DISPOSAL METHOD	Treat as <u>arsenic</u> compounds, in accordance with local, state and federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION (Specify type) <u>Work in fume removing hood</u>		
VENTILATION	LOCAL EXHAUST <u>Yes</u>	SPECIAL
	MECHANICAL (General)	OTHER
PROTECTIVE GLOVES <u>Yes</u>	EYE PROTECTION	
OTHER PROTECTIVE EQUIPMENT		

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	None
OTHER PRECAUTIONS	<u>Avoid breathing vapors.</u> <u>Avoid all direct contact with skin</u>

Supersedes
Prior Dated
MSDS For
This Material

Cargille

Issued: March 25, 1985

MATERIAL SAFETY DATA SHEET

THIS OSHA-20 FORMAT MODIFIED BY CARGILLE LABS. OCT. 5, 1983

SECTION I

MANUFACTURER'S NAME R.P. Cargille Laboratories, Inc.		EMERGENCY TELEPHONE NO. 201-239-6633
ADDRESS (Number, Street, City, State, and ZIP Code) 55 Commerce Rd., Cedar Grove, NJ 07009		Range n _D 1.705 - 1.800
CHEMICAL NAME AND SYNONYMS Hydrogenated Terphenyl, Diiodomethane		TRADE NAME AND SYNONYMS Refractive Index Liquid, Series M
CHEMICAL FAMILY Sulfur, Tin Iodide	FORMULA Blend	

THE INFORMATION SUPPLIED IS BASED ON DATA AVAILABLE TO US AND IS BELIEVED TO BE CORRECT. HOWEVER, NO GUARANTEE OR WARRANTY OF ANY KIND EXPRESSED OR IMPLIED, IS MADE WITH RESPECT TO THE INFORMATION PRESENTED AND CARGILLE LABORATORIES ASSUMES NO RESPONSIBILITY FOR THE RESULTS OF THE USE OF THIS PRODUCT. THIS INFORMATION IS FURNISHED UPON THE CONDITION THAT THE PERSON RESPONSIBLE FOR ITS USE SHALL MAKE HIS OR HER OWN DETERMINATION OF THE SUITABILITY OF THE MATERIAL FOR HIS OR HER PARTICULAR PURPOSE.

SECTION II - HAZARDOUS INGREDIENTS

	%	
N/A		
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES		

SECTION III - PHYSICAL DATA

	Average		Average
BOILING POINT (°F.) 181°C	358°F	SPECIFIC GRAVITY (H ₂ O=1)	3.09
VAPOR PRESSURE (mm Hg.)	1	PERCENT VOLATILE BY VOLUME (%)	98%
VAPOR DENSITY (AIR=1)	+1	EVAPORATION RATE (H ₂ O=1)	<1
SOLUBILITY IN WATER	Nil		
APPEARANCE AND ODOR Light yellow liquid, odor characteristic			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) 338°F	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA Dry powder, foam - Treat as oil fire			
SPECIAL FIRE FIGHTING PROCEDURES None			
UNUSUAL FIRE AND EXPLOSION HAZARDS Avoid fumes			

SECTION V - HEALTH HAZARD DATA			
THRESHOLD LIMIT VALUE - 50 - 100 ppm			
EFFECTS OF OVEREXPOSURE Unknown, probable irritant and narcotic in high concentrations.			
EMERGENCY AND FIRST AID PROCEDURES Obtain medical aid			
1) Vapors inhaled; remove from exposure, rest and keep warm.			
2) Eyes; irrigate thoroughly with water.			
3) Swallowed; wash out mouth with water, give emetic			
SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS Toxic fumes of iodides			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Absorb, wash area with soap and water	
WASTE DISPOSAL METHOD	
Chemical land fill. Disposal must be carried out in accordance with County, Federal, State and Local laws.	

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION (Specify type)		
VENTILATION	LOCAL EXHAUST <u>Mandatory</u>	SPECIAL
	MECHANICAL (General) <u>Mandatory</u>	OTHER
PROTECTIVE GLOVES	<u>Mandatory</u>	EYE PROTECTION <u>Mandatory</u>
OTHER PROTECTIVE EQUIPMENT *Not necessary except as good laboratory industrial practice.		

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Store away from light	
OTHER PRECAUTIONS <u>Minimize skin contact.</u>	

Supersedes
Prior Dated
MSDS For
This Material



Issued: November 12, 1985

MATERIAL SAFETY DATA SHEET

THIS OSHA-20 FORMAT MODIFIED BY CARGILLE LABS. OCT. 5, 1983

SECTION I

MANUFACTURER'S NAME
R.P. Cargille Laboratories, Inc.

EMERGENCY TELEPHONE NO.
201-239-6633

ADDRESS (Number, Street, City, State, and ZIP Code)

55 Commerce Rd., Cedar Grove, N.J. 07009

CHEMICAL NAME AND SYNONYMS

Silicone and natural aliphatic hydrocarbons

TRADE NAME ~~as~~ 1,400-1,458

Index of Refraction Series AA

CHEMICAL FAMILY

FORMULA

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SECTION II - HAZARDOUS INGREDIENTS

%

N.A.

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

N.A.

SECTION III - PHYSICAL DATA

BOILING POINT (°F) Over 150°C	> 300°F	SPECIFIC GRAVITY (H ₂ O=1)	.94-.99
VAPOR PRESSURE (mm Hg.)	—	PERCENT VOLATILE BY VOLUME (%)	98
VAPOR DENSITY (AIR=1)	< 1	EVAPORATION RATE (H ₂ O=1)	Nil
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	Clear, Characteristic		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	C.D.C. approx. 325°F	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA	CO ₂ , Foam			
SPECIAL FIRE FIGHTING PROCEDURES	None			
UNUSUAL FIRE AND EXPLOSION HAZARDS	None			

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE non-toxic

EFFECTS OF OVEREXPOSURE None

EMERGENCY AND FIRST AID PROCEDURES

None

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Collect, absorb, and discard.

WASTE DISPOSAL METHOD

All chemical disposal must be in accordance with federal, state, county and local regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) *		
VENTILATION	LOCAL EXHAUST *	SPECIAL
	MECHANICAL (General) *	OTHER
PROTECTIVE GLOVES *		EYE PROTECTION
		<u>Safety Glasses</u>
OTHER PROTECTIVE EQUIPMENT		
* <u>not necessary except as good laboratory industrial practice.</u>		

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING No special precautions appear necessary; good industrial practice as to housekeeping, personal hygiene.

OTHER PRECAUTIONS avoidance of vapors, prolonged and repeated skin contact and splashing in eyes.



MATERIAL SAFETY DATA SHEET

J. T. Baker Chemical Co., 222 Red School Lane, Phillipsburg, N.J. 08865

SECTION I . IDENTIFICATION OF PRODUCT

CHEMICAL NAME Sodium Pyrophosphate, 10 Hydrate	FORMULA $\text{Na}_4\text{P}_2\text{O}_7 \cdot 10\text{H}_2\text{O}$
SYNONYM OR CROSS REFERENCE Tetrasodium Pyrophosphate, Decahydrate	CAS NO: 7722-88-5

SECTION II . HAZARDOUS INGREDIENTS

MATERIAL	NATURE OF HAZARD
----------	------------------

SECTION III . PHYSICAL DATA

BOILING POINT N/A	MELTING POINT 79.5°C.
VAPOR PRESSURE N/A	SPECIFIC GRAVITY 1.82
VAPOR DENSITY (AIR=1) N/A	PERCENT VOLATILE BY VOLUME (%) N/A
WATER SOLUBILITY 6.23 g/100ml at 20°C.	EVAPORATION RATE (_____ = 1) N/A

APPEARANCE
Crystals, slight efflorescence in dry air

SECTION IV . FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (method used) Not flammable	FLAMMABLE LIMITS N/A	Lower	Upper
FIRE EXTINGUISHING MEDIA N/A			
SPECIAL FIRE-FIGHTING PROCEDURES N/A			
UNUSUAL FIRE AND EXPLOSION HAZARD N/A			

SECTION V . HEALTH HAZARD

THRESHOLD LIMIT VALUE	
Oral-rat LD ₅₀ = 4000 mg/kg	TLV-air = 5 mg/m ³
HEALTH HAZARDS	
Harmful if swallowed.	
FIRST AID PROCEDURES	If swallowed, if conscious, immediately induce vomiting.
Call a physician.	

SECTION VI . REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID N/A
	STABLE	X	

INCOMPATIBILITY (materials to avoid)

None

HAZARDOUS DECOMPOSITION PRODUCTS

None

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID N/A
	WILL NOT OCCUR	X	

SECTION VII . SPILL AND DISPOSAL PROCEDURES

SPILLS

Flush small amounts with plenty of water.

DISPOSAL

Dispose in approved landfill in accordance with all applicable regulations.

SECTION VIII . PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)

Dust respirator

VENTILATION	LOCAL	SPECIAL
	MECHANICAL (general) X	OTHER
PROTECTIVE GLOVES Rubber gloves	EYE PROTECTION Safety glasses	

OTHER PROTECTIVE EQUIPMENT

None

SECTION IX . HANDLING AND STORAGE PRECAUTIONS

STORAGE & HANDLING

Keep in tightly closed container.

SECTION X . MISCELLANEOUS INFORMATION

Date issued: 1/84

Approved by R. B. Kanter
Manager, Quality Assurance

Revision No. & Date issued:

The information provided in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the users responsibility to determine the suitability of this information for the adoption of safety precautions as may be necessary. We reserve the right to revise Material Safety Data Sheets from time to time as new technical information becomes available. The user has the responsibility to contact the company to determine that the sheet is the latest one issued.

MATERIAL SAFETY DATA SHEET

CORPORATE RESEARCH & DEVELOPMENT

SCHENECTADY, N. Y. 12305

Phone: (518) 385-4085

DIAL COMM 8*235-4085



No. 318

XYLENE
(mixed isomers)

Revision C

Date November 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: XYLENE (mixed isomers)

OTHER DESIGNATIONS: Xylol, Dimethylbenzene, $C_6H_4(CH_3)_2$; ASTM D843, D845 and D846;
GE Material D5B9, CAS #001 330 207.

MANUFACTURER: Available from many suppliers, including EXXON Company USA and
Shell Chemical Company.

SECTION II. INGREDIENTS AND HAZARDS

Xylene (o, m, p-isomers)
Other C_7 to C_9 Hydrocarbons*

*Material may contain ethylbenzene (8-hr TWA 100 ppm) and traces of toluene and C_9 aromatic and aliphatic hydrocarbons. Some commercial products may contain over 10% non-xylene hydrocarbons, mostly ethylbenzene.

**Current OSHA standard and ACGIH (1980) TLV. NIOSH has proposed a 10-hr TWA of 100 ppm with a 200 ppm ceiling level (10 min. sample).

STATUS: NCI bioassay for carcinogenesis study 9/78. TLV set to prevent irritant effects and CNS depression.

x	HAZARD DATA
>90	8-hr TWA 100 ppm (skin)** or 435 mg/m ³
<10	<u>Xylene Typical</u> Human, inhalation TCLo 200 ppm (Irritation Effects) Rat, oral LD ₅₀ 4.3 g/kg Human, oral LDLo 50 mg/kg

SECTION III. PHYSICAL DATA

Boiling range, 1 atm, deg C	135-145*	Specific gravity ($H_2O=1$)	0.86-0.87
Vapor pressure at 20 C, mm Hg	ca 6	Volatiles, %	ca 100
Vapor density (Air=1)	3.7	Evaporation rate (BuAc=1)	0.6
Solubility in water	Negligible	Molecular weight	106.18

Appearance & Odor: Light colored or colorless, mobile liquid with an aromatic odor.
The recognition threshold (100% of test panel) is about 0.3 ppm in air (unfatigued) for xylene.

*Wider and narrower boiling range materials are commercially available.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
>77 F (TCC)	867 F	Volume %	1	7

Extinguishing Media: Use dry chemical, foam, CO_2 , and water fog or steam to provide a smothering effect on fire. A water stream can scatter flames. A spray of water may be used to cool fire-exposed containers.

This flammable liquid is a dangerous fire hazard and a moderate explosion hazard when exposed to heat or flame. Heavier-than-air vapors can flow along surfaces to distant ignition sources and flash back.

Firefighters should use self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

This material is stable in closed containers at room temperature. It does not polymerize.

It is flammable (OSHA Class IC liquid) and can form explosive mixtures with air. Keep away from sources of heat, sources of ignition and strong oxidizing agents. Thermal-oxidative degradation in air can produce toxic vapors and gases, including carbon monoxide and oxides of nitrogen.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 100 ppm or 435 mg/m ³
<p>Inhalation of xylene at the TLV may cause mild irritation and dizziness in sensitive persons. Concentrations from 100-200 ppm may cause nausea, headache and depression. Vapor levels >200 ppm can have an anesthetic effect. Skin contact may produce mild irritation and skin defatting. Eye contact may cause burning and irritation. Ingestion of xylene may cause poisoning. One ounce or more may be fatal. Aspiration can be a hazard if this material is swallowed.</p> <p>FIRST AID:</p> <p><u>Eye Contact:</u> Irrigate with water for 15 minutes. Get medical attention!</p> <p><u>Skin Contact:</u> Wash with soap and water. Remove contaminated clothing promptly. Replace lost skin oils with approved lotions or creams.</p> <p><u>Inhalation:</u> Remove victim to fresh air. Restore breathing if required. Get medical attention if symptoms persist or if nausea or collapse has occurred.</p> <p><u>Ingestion:</u> Get medical attention immediately! Give white mineral oil demulcent and saline cathartic, but <u>do not</u> induce vomiting unless directed by a physician. Maintain observation of patient for possible delayed onset of pulmonary edema.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel. Remove all ignition sources. Provide adequate ventilation. Use vermiculite or sand to absorb spill; scrape up with nonsparking tools and place in a covered metal container. The absorbed material may be burned in an open pit, or placed in cardboard boxes and burned in an incinerator. Spilled liquid can be flushed away from sensitive locations with a water stream; flush to open area <u>not</u> to sewer!</p> <p>DISPOSAL: Scrap liquid may be atomized into an approved incinerator, or it may be disposed of via a licensed solvent disposal company. When large amounts are involved reclamation procedures may prove economical. Follow Federal, State, and Local regulations.</p> <p>Aquatic toxicity rating TLM 96: 100-10 ppm.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide general ventilation and efficient exhaust ventilation (explosion-proof equipment) to meet TLV requirements and to control heavier-than-air vapors. Use >100 lfm face velocity for exhaust hoods. Use approved organic vapor canister respirators for short periods of nonroutine work or emergency situations at up to 1000-2000 ppm and approved self-contained respirators for higher and unknown vapor levels. Full facepiece required. Buna-N rubber gloves and aprons should be worn to prevent contact of xylene with the skin. Safety glasses or goggles should be used for eye protection and eyewash stations should be readily accessible to use areas.</p> <p>Comprehensive preplacement and biennial medical examinations to be directed toward, but not limited to, liver, kidney, gastrointestinal disorders, skin irritation, and the central nervous system.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in closed containers in a clean, cool, well-ventilated area, away from sources of heat, sources of ignition and strong oxidizing agents. Protect containers from physical damage. Bond and ground metal containers when transferring liquid. Use metal safety cans for small amounts. Use nonsparking tools for work in solvent areas. No Smoking in areas of use or storage.</p> <p>Prevent skin contact and remove contaminated clothing promptly. Avoid repeated or prolonged breathing of vapor. Do not ingest!</p>	
<p>DATA SOURCE(S) CODE: 1-12,19-21,23,26,31,34,37-39</p> <p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, General Electric Company extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<p>APPROVALS: MIS CRD <i>J.M. Nelson</i></p> <p>Industrial Hygiene and Safety <i>JHW 11-26-80</i></p> <p>MEDICAL REVIEW: December 5, 1980</p>

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DATE: 01/05/90
CUST#: 2-015-17990
PO#: 100594-3

M A T E R I A L S A F E T Y D A T A S H E E T

PAGE 1

IDENTIFICATION

PRODUCT #: NAME: ETHYL ALCOHOL 200 PROOF USP
CAS #: 64-17-5
MF: C2H6O

SYNONYMS

ABSOLUTE ETHANOL * AETHANOL (GERMAN) * AETHYLALCOHOL (GERMAN) *
ALCOHOL * ALCOHOL, ANHYDROUS * ALCOHOL DEHYDRATED * ALCOOL ETHYLIQUE
(FRENCH) * ALCOOL ETILICO (ITALIAN) * ALGRAIN * ALKOHOL (GERMAN) *
ALKOHOLU ETYLOWEGO (POLISH) * ANHYDROL * COLOGNE SPIRIT * COLOGNE
SPIRITS (DOT) * ETANOLD (ITALIAN) * ETHANOL * ETHANOL (DOT, OSHA) *
ETHANOL, SOLUTION (DOT) * ETHANOL 200 PROOF * ETHANOL, SOLUTION (DOT)
* ETHYL ALCOHOL (ACGIH, DOT, OSHA) * ETHYLALCOHOL (DUTCH) * ETHYL
ALCOHOL ANHYDROUS * ETHYL HYDRATE * ETHYL HYDROXIDE * ETYLOWY ALKOHOL
(POLISH) * FERMENTATION ALCOHOL * GRAIN ALCOHOL * JAYSOL * JAYSOL S *
METHYLCARBINOL * MOLASSES ALCOHOL * NCI-C03134 * POTATO ALCOHOL * SD
ALCOHOL 23-HYDROGEN * SPIRITS OF WINE * SPIRT * TECSOL * UN 1170 (DOT)
*

TOXICITY HAZARDS

RTECS NO: KQ6300000

ETHYL ALCOHOL
IRRITATION DATA

SKN-RBT 400 MG OPEN MLD
SKN-RBT 20 MG/24H MOD
EYE-RBT 79 MG
EYE-RBT 500 MG/24H MLD
EYE-RBT 100 MG/4S RINSE MOD

TOXICITY DATA

ORL-CHD LD01:2000 MG/KG
ORL-HMN LD01:1400 MG/KG
SCU-INF LD01:19440 MG/KG
ORL-RAT LD50:7060 MG/KG
IHL-RAT LC50:20000 PPM/10H
IPR-RAT LD50:3600 UG/KG
IVN-RAT LD50:1440 MG/KG
IAT-RAT LD50:11 MG/KG
ORL-MUS LD50:3450 MG/KG
IHL-MUS LC50:39 GM/M3/4H
IPR-MUS LD50:933 MG/KG
SCU-MUS LD50:8285 MG/KG
IVN-MUS LD50:1973 MG/KG
ORL-RBT LD50:6300 MG/KG
IPR-RBT LD50:963 MG/KG
IVN-RBT LD50:2374 MG/KG
ORL-GPG LD50:5560 MG/KG
IPR-GPG LD50:3414 MG/KG
IPR-HAM LD50:5068 MG/KG
IPR-MAM LD50:4300 MG/KG

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 1000 PPM

UCDS** 7/22/70
85JCAE -, 189,86
AJOPAA 29,1363,46
85JCAE -, 189,86
FCT007 20,573,82

ATXKAB 17,183,58
NPRI* 1,44,74
AJCPAI 5,466,35
TXAPA9 16,718,70
NPRI* 1,44,74
PHMGBN 2,27,69
TXAPA9 18,60,71
TXAPA9 18,60,71
GISAAA 32(3),31,67
GTPZAB 26(8),53,82
SCCUR* -,5,61
FAQNAU 48A,99,70
HBTXAC 1,128,55
HBTXAC 1,130,55
EVHPAZ 61,321,85
EVHPAZ 61,321,85
JIHTAB 23,259,41
EVHPAZ 61,321,85
EVHPAZ 61,321,85
TXAPA9 13,358,68

85INAB 5,242.2,86

CONTINUED ON NEXT PAGE



M A T E R I A L S A F E T Y D A T A S H E E T

PAGE 2

CUST#: 2-015-17990
PO#: 100594-3

PRODUCT #:
CAS #: 64-17-5
MF: C2H5O

NAME: ETHYL ALCOHOL 200 PROOF USP

----- TOXICITY HAZARDS -----

IARC CANCER REVIEW: ANIMAL INADEQUATE EVIDENCE IMEMDT 44,35,88
MSHA STANDARD-AIR: TWA 1000 PPM (1900 MG/M3)
DTLVS* 3,103,71
OSHA PEL: 8H TWA 1000 PPM (1900 MG/M3)
FEREAC 54,2923,89
OSHA PEL FINAL: 8H TWA 1000 PPM (1900 MG/M3)
FEREAC 54,2923,89
EPA GENETOX PROGRAM 1988, POSITIVE: RODENT DOMINANT LETHAL
EPA GENETOX PROGRAM 1988, NEGATIVE: ASPERGILLUS-FORWARD MUTATION;
SHE-CLONAL ASSAY
EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-RLV F344 RAT EMBRYO
EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO CYTOGENETICS-NONHUMAN;
MAMMALIAN MICRONUCLEUS
EPA GENETOX PROGRAM 1988, NEGATIVE: N CRASSA-ANEUPLOIDY; HISTIDINE
REVERSION-AMES TEST
EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO SCE-HUMAN LYMPHOCYTES; IN
VITRO SCE-HUMAN
EPA GENETOX PROGRAM 1988, NEGATIVE: IN VITRO SCE-NONHUMAN; SPERM
MORPHOLOGY-MOUSE
EPA GENETOX PROGRAM 1988, NEGATIVE/LIMITED: CARCINOGENICITY-MOUSE/RAT
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0786-0617
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, SEPTEMBER 1989
NIOSH ANALYTICAL METHODS: SEE ALCOHOLS I, 1400;
NIOSH ANALYTICAL METHODS: SEE 2-BUTANONE, ETHANOL, AND TOLUENE IN
BLOOD, 8002

TARGET ORGAN DATA

BEHAVIORAL (SLEEP)
BEHAVIORAL (CHANGE IN MOTOR ACTIVITY)
BEHAVIORAL (ATAXIA)
BEHAVIORAL (ANTIPSYCHOTIC)
BEHAVIORAL (HEADACHE)
BEHAVIORAL (CHANGE IN PSYCHOPHYSIOLOGICAL TESTS)
LUNGS, THORAX OR RESPIRATION (CHRONIC PULMONARY EDEMA OR CONGESTION)
LUNGS, THORAX OR RESPIRATION (DYSPPNAE)
GASTROINTESTINAL (ALTERATION IN GASTRIC SECRETION)
GASTROINTESTINAL (HYPERMOTILITY, DIARRHEA)
GASTROINTESTINAL (NAUSEA OR VOMITING)
GASTROINTESTINAL (OTHER CHANGES)
LIVER (TUMORS)
BLOOD (LYMPHOMA INCLUDING HODGKIN'S DISEASE)
PATERAL EFFECTS (TESTES, EPIDIDYMIS, SPERM DUCT)
EFFECTS ON FERTILITY (FEMALE FERTILITY INDEX)
EFFECTS ON FERTILITY (MALE FERTILITY INDEX)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (OTHER MEASURES OF FERTILITY)
EFFECTS ON EMBRYO OR FETUS (EXTRA EMBRYONIC STRUCTURES)

CONTINUED ON NEXT PAGE



M A T E R I A L S A F E T Y D A T A S H E E T

PAGE 3

CUST#: 2-015-17990
PO#: 100594-3

PRODUCT #:
CAS #: 64-17-5
MF: C2H6O

NAME: ETHYL ALCOHOL 200 PROOF USP

----- TOXICITY HAZARDS -----

EFFECTS ON EMBRYO OR FETUS (CYTOLOGICAL CHANGES)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (EYE, EAR)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CRANIOFACIAL)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
EFFECTS ON NEWBORN (GROWTH STATISTICS)
TUMORIGENIC (EQUIVOCAL TUMORIGENIC AGENT BY RTECS CRITERIA)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS)
DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

----- HEALTH HAZARD DATA -----

ACUTE EFFECTS
MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER
RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
CAN CAUSE CNS DEPRESSION.
EXPOSURE CAN CAUSE:
NAUSEA, HEADACHE AND VOMITING
NARCOTIC EFFECT
TARGET ORGAN(S):
NERVES
LIVER
ACUTE
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
IN CASE OF SKIN CONTACT, FLUSH WITH COPIOUS AMOUNTS OF WATER
FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND
SHOES. CALL A PHYSICIAN.
IF INHALED, REMOVE TO FRESH AIR. IF BREATHING BECOMES DIFFICULT,
CALL A PHYSICIAN.
IN CASE OF CONTACT WITH EYES, FLUSH WITH COPIOUS AMOUNTS OF WATER
FOR AT LEAST 15 MINUTES. ASSURE ADEQUATE FLUSHING BY SEPARATING
THE EYELIDS WITH FINGERS. CALL A PHYSICIAN.

----- PHYSICAL DATA -----

BOILING PT: 78 C TO 79 C
SPECIFIC GRAVITY: 0.801
APPEARANCE AND ODOR
COLORLESS LIQUID

----- FIRE AND EXPLOSION HAZARD DATA -----

FLASHPOINT: 55 F

CONTINUED ON NEXT PAGE



M A T E R I A L S A F E T Y D A T A S H E E T

PAGE 4

CUST#: 2-015-17990
PD#: 100594-3

PRODUCT #:
CAS #: 64-17-5
MF: C2H6O

NAME: ETHYL ALCOHOL 200 PROOF USP

----- FIRE AND EXPLOSION HAZARD DATA -----

EXTINGUISHING MEDIA

CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO
PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS

VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND
FLASH BACK.
FLAMMABLE LIQUID.

----- REACTIVITY DATA -----

STABILITY

STABLE.

CONDITIONS TO AVOID

KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.

INCOMPATIBILITIES

OXIDIZING AGENTS
PEROXIDES
ACIDS
ACID CHLORIDES
ACID ANHYDRIDES
ALKALI METALS
AMMONIA
MOISTURE

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

HAZARDOUS POLYMERIZATION

WILL NOT OCCUR.

----- SPILL OR LEAK PROCEDURES -----

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY
RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR
DISPOSAL.
USE NONSPARKING TOOLS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND
SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY
FLAMMABLE.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

CONTINUED ON NEXT PAGE

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M A T E R I A L S A F E T Y D A T A S H E E T

PAGE 5

CUST#: 2-015-17990
PO#: 100594-3

PRODUCT #:
CAS #: 64-17-5
MF: C2H6O

NAME: ETHYL ALCOHOL 200 PROOF USP

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
MECHANICAL EXHAUST REQUIRED.
IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.
KEEP AWAY FROM SOURCES OF IGNITION. NO SMOKING.
IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.
WEAR SUITABLE PROTECTIVE CLOTHING.
TARGET ORGAN(S):
NERVES
LIVER

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CUST # 180505 P.O. # 8227737

M A T E R I A L S A F E T Y D A T A S H E E T PAGE: 1

IDENTIFICATION

PRODUCT # 24427-9 NAME: HYDROFLUORIC ACID, A.C.S. REAGENT
CAS # 7664-39-3

TOXICITY HAZARDS

RTECS # MW7875000

HYDROFLUORIC ACID

TOXICITY DATA

IHL-HMN LC50:50 PPM/30M

IHL-RAT LC50:1276 PPM/1H

IHL-MUS LC50:342 PPM/1H

IHL-MKY LC50:1774 PPM/1H

IHL-GPG LC50:4327 PPM/15M

34Z1AG -,318,69

AIHAAP 33,661,72

JCTODH 3,61,76

AMRL** TR-70-77,70

AIHAAP 24,253,63

REVIEWS, STANDARDS, AND REGULATIONS

MSHA STANDARD-AIR:TWA 3 PPM (2 MG/M3) DTLVS* 3,131,71

OSHA STANDARD-AIR:TWA 3 PPM FEREAC 39,23540,74

NIOSH REL TO HF-AIR:TWA 2.5 MG(F)/M3;CL 5.0 MG(F)/M3/15M MMWR** 34(1S)

,19S,85

EPA GENETIC TOXICOLOGY PROGRAM, JANUARY 1984

REPORTED IN EPA TSCA INVENTORY, 1983

"NIOSH MANUAL OF ANALYTICAL METHODS, 3RD ED." SEE: METHODS 7902 AND 7903

MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS

MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.

MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.

INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.

SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.

TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.

IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

CALL A PHYSICIAN.

WASH CONTAMINATED CLOTHING BEFORE REUSE.

DISCARD CONTAMINATED SHOES.

ADDITIONAL INFORMATION

BOTH THE LIQUID AND THE VAPOR CAN CAUSE SEVERE BURNS WHICH MAY NOT BE IMMEDIATELY PAINFUL OR VISIBLE. SOLUTIONS LESS THAN 2% MAY CAUSE BURNS. THE FULL EXTENT OF TISSUE DAMAGE MAY NOT EXHIBIT ITSELF FOR 12-24 HOURS AFTER EXPOSURE. HYDROGEN FLUORIDE WILL PENETRATE THE SKIN

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M A T E R I A L S A F E T Y D A T A S H E E T

PAGE: 2

CATALOG # 24427-9

NAME: HYDROFLUORIC ACID, A.C.S. REAGENT

AND ATTACK THE UNDERLYING TISSUES AND BONE. PROFOUND HYPOCALCEMIA CAN OCCUR WITH SOMETIME FATAL RESULTS. CHRONIC EFFECTS: CAUSES CHANGES IN BONES AND JOINTS IN HUMANS. REPORTED TO BE EMBRYOTOXIC IN THE RAT AT AN EXPOSURE LEVEL OF 0.47 TO 4.98MG/M3/4 HR DAILY DURING THE PERIOD OF GESTATION. FIRST AID: FOR SKIN CONTACT FLUSH WITH LARGE QUANTITIES OF COOL WATER WHILE REMOVING ANY CONTAMINATED CLOTHING. PAY ESPECIAL ATTENTION TO SKIN UNDER THE NAILS. FOLLOW BY APPLYING 0.20% BENZALKONIUM CHLORIDE SOLUTION, ICED 70% ALCOHOL OR AN ICE-COLD SATURATED SOLUTION OF MAGNESIUM SULFATE(EPSOM SALT). IF THESE SOLUTIONS ARE NOT AVAILABLE, CONTINUE WASHING UNTIL MEDICAL ATTENTION IS OBTAINED. A PHYSICIAN SHOULD BE CALLED IMMEDIATELY IN CASE OF CONTACT OR SUSPECTED CONTACT. IF SWALLOWED DO NOT GIVE EMETICS OR BAKING SODA. IF CONSCIOUS, GIVE WATER, MILK OF MAGNESIA, MILK OR WHITES OF EGGS BEATEN WITH WATER.

-----PHYSICAL DATA-----

SPECIFIC GRAVITY: 1.150

-----FIRE AND EXPLOSION HAZARD DATA-----

EXTINGUISHING MEDIA

DRY CHEMICAL POWDER.

SPECIAL FIRE FIGHTING PROCEDURES:

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSION HAZARDS

EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

-----REACTIVITY DATA-----

INCOMPATIBILITIES

STRONG BASES

DO NOT STORE IN GLASS.

AVOID CONTACT WITH METALS.

LIGHT-SENSITIVE.

STORE AWAY FROM HEAT AND DIRECT SUNLIGHT.

ALKALI METALS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

HYDROGEN FLUORIDE

-----SPILL OR LEAK PROCEDURES-----

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

EVACUATE AREA.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY

RUBBER GLOVES.

ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR

DISPOSAL.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD

CAUTIOUSLY DISSOLVE THE MATERIAL IN WATER. NEUTRALIZE IMMEDIATELY WITH

SODIUM CARBONATE, OR FIRST ADD A LITTLE HYDROCHLORIC ACID FOLLOWED BY

SODIUM CARBONATE IF MATERIAL DOES NOT DISSOLVE COMPLETELY.

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.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

WEAR APPROPRIATE OSHA/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

USE ONLY IN A CHEMICAL FUME HOOD.

SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).

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FORM 020 REV 2-86



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M A T E R I A L S A F E T Y D A T A S H E E T

PAGE: 3

CATALOG # 24427-9

NAME: HYDROFLUORIC ACID, A.C.S. REAGENT

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
POISON
CORROSIVE.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

----- ADDITIONAL PRECAUTIONS AND COMMENTS -----

ADDITIONAL INFORMATION

CONTACT WITH GLASS, CONCRETE AND OTHER SILICON-BEARING MATERIALS YIELD SILICON TETRAFLUORIDE GAS. CONTACT WITH CYANIDES AND SULFIDES PRODUCES HIGHLY TOXIC GASES OF HYDROGEN CYANIDE AND HYDROGEN SULFIDE. REACTION WITH CARBONATES PRODUCES VIGOROUS EVOLUTION OF CARBON DIOXIDE. VIOLENT REACTION WITH N-PHENYLAZOPIPERIDINE, POTASSIUM PERMANGANATE, BISMUTHIC ACID, FLUORINE, METAL OXIDES AND WATER-REACTIVE MATERIALS. CONTACT WITH COMMON METALS WILL PRODUCE HYDROGEN GAS CREATING A FIRE AND EXPLOSION HAZARD. MIXTURES(1:1) OF HYDROFLUORIC ACID AND NITRIC ACID WITH GLYCEROL, LACTIC ACID OR PROPYLENE GLYCOL BUILD UP PRESSURE IN CLOSED CONTAINERS SUFFICIENT TO SHATTER THE CONTAINER(TIME OF REACTION IS FROM 30 MINUTES TO 12 HRS).

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FORM 020 REV 2/86

DATE: 07/26/90
INDEX: 01892680047

ACCT: 201082-01
CAT NO: 882901

PAGE: 1
PO NBR: N/A

SODIUM HYPOCHLORITE SOLUTION, 5.5%
SODIUM HYPOCHLORITE SOLUTION, 5.5%
SODIUM HYPOCHLORITE SOLUTION, 5.5%

MATERIAL SAFETY DATA SHEET

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CHEMICAL DIVISION
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SUBSTANCE IDENTIFICATION

SUBSTANCE: ***SODIUM HYPOCHLORITE SOLUTION, 5.5%***

CAS-NUMBER 7681-52-9

TRADE NAMES/SYNONYMS:
SO-S-291; ACC40179

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: CL-H-O-NA MOL WT: 75.45

CERCLA RATINGS (SCALE 0-3): HEALTH=U FIRE=0 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=U FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: SODIUM HYPOCHLORITE PERCENT: 5.5

COMPONENT: WATER PERCENT: 94.5

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NO OCCUPATIONAL EXPOSURE LIMITS ESTABLISHED BY OSHA, ACGIH, OR NIOSH.

PHYSICAL DATA

DESCRIPTION: CLEAR, PALE GREENISH-YELLOW LIQUID WITH AN ODOR OF BLEACH

BOILING POINT: DECOMPOSES MELTING POINT: 32 F (0 C)

SPECIFIC GRAVITY: 1.1 VAPOR PRESSURE: 14 MMHG (WATER)

EVAPORATION RATE: (ETHER = 1) >1 SOLUBILITY IN WATER: SOLUBLE

VAPOR DENSITY: 0.7 (WATER)

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLECTIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: NON-FLAMMABLE

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 60).

EXTINGUISH USING AGENTS INDICATED; DO NOT USE WATER DIRECTLY ON MATERIAL. IF LARGE AMOUNTS OF COMBUSTIBLE MATERIALS ARE INVOLVED, USE WATER SPRAY OR FOG IN FLOODING AMOUNTS. USE WATER SPRAY TO ABSORB CORROSIVE VAPORS. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND.

TRANSPORTATION DATA

DATE: 07/26/90
INDEX: 01892680047

ACCT: 201082-01
CAT NO: 882901

PAGE: 2

PO NBR: N/A

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
ORM-B

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND
SUBPART E:
NONE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.510
EXCEPTIONS: 49 CFR 173.505

TOXICITY

SODIUM HYPOCHLORITE:

IRRITATION DATA:

SODIUM HYPOCHLORITE: 10 MG/KG EYE-RABBIT MODERATE.
PENTAHYDRATE: 500 MG/24 HOURS SKIN-RABBIT MODERATE; 100 MG EYE-RABBIT
MODERATE.

TOXICITY DATA:

SODIUM HYPOCHLORITE:

8910 MG/KG ORAL-RAT LD50 (BIOFX); 1 GM/KG ORAL-WOMAN TCLO; >10.5 MG/L
INHALATION-RAT LCLO; >10,000 MG/KG SKIN-RABBIT LDLO; MUTAGENIC DATA
(RTECS).

PENTAHYDRATE:

8910 MG/KG ORAL-RAT LD50.

CARCINOGEN STATUS: NONE.

LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYE.

ACUTE TOXICITY LEVEL: SLIGHTLY TOXIC BY INGESTION.

TARGET EFFECTS: SENSITIZER- DERMAL.

HEALTH EFFECTS AND FIRST AID

INHALATION:

SODIUM HYPOCHLORITE:

CORROSIVE.

ACUTE EXPOSURE- MAY CAUSE SEVERE BRONCHIAL IRRITATION, SORE THROAT WITH
POSSIBLE BLISTERING, COUGHING, STOMATITIS, NAUSEA, LABORED BREATHING,
SHORTNESS OF BREATH AND PULMONARY EDEMA. 10-20 MG/M3 CAUSES BURNING OF THE
NOSE AND THROAT; 40-60 MG/M3 MAY BE FATAL. IF SUFFICIENT AMOUNTS ARE
ABSORBED, MAY CAUSE EFFECTS AS DETAILED IN ACUTE INGESTION.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING
HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD
PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND
AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN
SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION
IMMEDIATELY.

SKIN CONTACT:

SODIUM HYPOCHLORITE:

CORROSIVE.

ACUTE EXPOSURE- EXTENT OF DAMAGE DEPENDS ON CONCENTRATION, PH, VOLUME OF
SOLUTION AND DURATION OF CONTACT. MAY CAUSE REDNESS, PAIN, BLISTERING,
ITCHY ECZEMA AND CHEMICAL BURNS. SENSITIZATION REACTIONS ARE POSSIBLE IN
PREVIOUSLY EXPOSED PERSONS.

CHRONIC EXPOSURE- EFFECTS DEPEND ON CONCENTRATION AND DURATION OF EXPOSURE.
REPEATED OR PROLONGED CONTACT WITH CORROSIVE SUBSTANCES MAY RESULT IN
DERMATITIS OR EFFECTS SIMILAR TO ACUTE EXPOSURE.

EYE CONTACT:

SODIUM HYPOCHLORITE:

CORROSIVE.

ACUTE EXPOSURE- MAY CAUSE REDNESS, PAIN, AND BLURRED VISION. SOLUTIONS OF 5%
SPASHED IN HUMAN EYES HAVE CAUSED A BURNING SENSATION AND LATER ONLY
SLIGHT SUPERFICIAL DISTURBANCE OF THE CORNEAL EPITHELIUM WHICH CLEARED
COMPLETELY IN THE NEXT DAY OR TWO WITHOUT SPECIAL TREATMENT. HOWEVER, ONE
ANIMAL STUDY REPORTS A 5% SOLUTION CAUSING ONLY MODERATE IRRITATION WITH
CLEARING WITHIN 7 DAYS. A HIGHER CONCENTRATION OF 15% TESTED ON
RABBIT EYES CAUSED IMMEDIATE SEVERE PAIN, HEMORRHAGES, RAPID ONSET OF
GROUND-GLASS APPEARANCE OF THE CORNEAL EPITHELIUM, MODERATE BLUISH EDEMA
OF THE WHOLE CORNEA, CHEMOSIS AND DISCHARGE FOR SEVERAL DAYS. SUCH EYES
HAVE SOMETIMES HEALED IN 2-3 WEEKS WITH SLIGHT OR NO RESIDUAL CORNEAL
DAMAGE BUT THEY HAD NEOVASCULARIZATION OF THE CONJUNCTIVA AND DISTORTION
OF THE NICTITATING MEMBRANE BY SCARRING.

CHRONIC EXPOSURE- DEPENDING ON CONCENTRATION AND DURATION OF EXPOSURE,
SYMPTOMS MAY BE AS THOSE OF ACUTE EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY
LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT
LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH
HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET
MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

SODIUM HYPOCHLORITE:

CORROSIVE.

ACUTE EXPOSURE- MAY CAUSE IRRITATION AND EROSION OF THE MUCOUS MEMBRANES.

DATE: 07/26/90
INDEX: 01892680047

ACCT: 201082-01
CAT NO: 882901

PAGE: 3

PO NBR: N/A

VOMITING (POSSIBLY BLOODY) AND ABDOMINAL PAIN AND SPASMS. A DROP IN BLOOD PRESSURE, SHALLOW RESPIRATION, EDEMA (POSSIBLY SEVERE) OF PHARYNX, LARYNX, AND GLOTTIS, CONFUSION, CONVULSIONS, DELIRIUM AND COMA MAY OCCUR. CYANOSIS AND CIRCULATORY COLLAPSE ARE POSSIBLE. ESOPHAGEAL OR GASTRIC PERFORATION AND STRICTURES ARE RARE. DEATH MAY OCCUR, USUALLY DUE TO COMPLICATIONS OF SEVERE LOCAL INJURY SUCH AS: TOXEMIA, SHOCK, PERFORATIONS, HEMORRHAGE, INFECTION AND OBSTRUCTION. MASSIVE INGESTIONS MAY PRODUCE FATAL HYPERCHLOREMIC METABOLIC ACIDOSIS OR ASPIRATION PNEUMONITIS. CHRONIC EXPOSURE- SENSITIZATION REACTIONS ARE REPORTED IN INDIVIDUALS WHO ARE EXPOSED IN SMALL AMOUNTS THROUGH THEIR WATER SUPPLY. HIGH DOSES HAVE CAUSED SPERM ABNORMALITY IN MICE.

FIRST AID- IF CONSCIOUS, GIVE MILK, MELTED ICE CREAM, OR BEATEN EGGS. DO NOT USE EMESIS OR GASTRIC LAVAGE OR ACID ANTIDOTES. ANTACIDS SUCH AS MILK OF MAGNESIA OR ALUMINUM HYDROXIDE GEL ARE ALSO USEFUL. MAINTAIN AIRWAY, RESPIRATION, AND BLOOD PRESSURE. GET MEDICAL ATTENTION IMMEDIATELY. (DREISBACH, HANDBOOK OF POISONING, 12TH. ED.) AVOID USE OF SODIUM BICARBONATE.

ANTIDOTE:

THE FOLLOWING ANTIDOTE HAS BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE MADE BY QUALIFIED MEDICAL PERSONNEL.

HYPOCHLORITE POISONING:

IF AVAILABLE, A FEW OUNCES OF 1% SODIUM THIOSULFATE SOLUTION MAY BE INGESTED AND LEFT IN THE ALIMENTARY TRACT. (GOSSELIN, CLINICAL TOXICOLOGY OF COMMERCIAL PRODUCTS, 5TH ED.)

REACTIVITY

REACTIVITY:

STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:

SODIUM HYPOCHLORITE

SELF-REACTIVE: THE ANHYDROUS FORM OBTAINED FROM THE PENTAHYDRATE IS UNSTABLE AND WILL DECOMPOSE VIOLENTLY WITH HEAT OR FRICTION.

METHANOL: EXPLOSIVE REACTION.

ACIDIFIED BENZYL CYANIDE: EXPLOSIVE REACTION.

CELULOSE: VIOLENT REACTION.

ORGANIC AND COMBUSTIBLE MATERIAL: VIOLENT REACTION.

ACIDS: VIOLENT REACTION.

REDUCING AGENTS: VIOLENT REACTION.

NITROGEN COMPOUNDS: FORM N-CHLORO COMPOUNDS WHICH ARE EXPLOSIVE.

PRIMARY AMINES: FORM CHLOROAMINES WHICH ARE EXPLOSIVE.

AZIRIDINE: FORMS N-CHLORO COMPOUND WHICH IS EXPLOSIVE.

ETHYLENEIMINE: FORMS 1-CHLOROETHYLENEIMINE WHICH IS EXPLOSIVE.

AMMONIUM ACETATE: RAPID DECOMPOSITION.

AMMONIUM CARBONATE: RAPID DECOMPOSITION.

AMMONIUM NITRATE: RAPID DECOMPOSITION.

AMMONIUM OXALATE: RAPID DECOMPOSITION.

AMMONIUM PHOSPHATE: RAPID DECOMPOSITION.

OXALIC ACID: INTENSE REACTION.

ALUMINUM, ZINC, MOST METALS: CORROSIVE ACTION.

DECOMPOSITION:

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC AND CORROSIVE FUMES OF CHLORINE.

POLYMERIZATION:

HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

***** CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. MAY IGNITE COMBUSTIBLES (WOOD, PAPER, OIL, ETC.).

***** SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:

DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL: PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:

PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:

DATE: 07/26/90
INDEX: 01892680047

ACCT: 201082-01
CAT NO: 882901

PAGE: 4
PO NBR: N/A

HIGH LEVELS- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE
OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT
TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS
SUBSTANCE.

EYE PROTECTION:

EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT
EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY
BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH
FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 07/22/85 REVISION DATE: 04/13/90

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DATE: 06/30/90
INDEX: 01901790098

ACCT: 201082-07
CAT NO: P2503

PAGE: 1
PO NBR: P53107

POTASSIUM HYDROXIDE (DRY SOLID, FLAKE, BEAD OR GRANULAR)
POTASSIUM HYDROXIDE (DRY SOLID, FLAKE, BEAD OR GRANULAR)
POTASSIUM HYDROXIDE (DRY SOLID, FLAKE, BEAD OR GRANULAR)

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

SUBSTANCE: **POTASSIUM HYDROXIDE (DRY SOLID, FLAKE, BEAD OR GRANULAR)**
CAS-NUMBER 1310-58-3

TRADE NAMES/SYNONYMS:
POTASSIUM HYDRATE; POTASSIUM HYDROXIDE, DRY SOLID, FLAKE, BEAD OR GRANULAR;
POTASSA; CAUSTIC POTASH; P-250; P-251; P-246; STCC 4935225; UN 1813; HKO;
ACC19431

CHEMICAL FAMILY:
INORGANIC BASE

MOLECULAR FORMULA: K-O-H

MOLECULAR WEIGHT: 56.11

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: POTASSIUM HYDROXIDE
CAS# 1310-58-3 PERCENT: >85

COMPONENT: WATER PERCENT: <15

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
POTASSIUM HYDROXIDE:
2 MG/M3 OSHA CEILING
2 MG/M3 ACGIH CEILING

1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: ODORLESS, WHITE TO SLIGHTLY YELLOW, DELIQUESCENT, LUMPS, RODS,
PELLETS, FLAKES OR RHOMBOHEDRAL CRYSTALS. BOILING POINT: 2408 F (1320 C)

MELTING POINT: 681 F (360 C) SPECIFIC GRAVITY: 2.044

VAPOR PRESSURE: 1 MMHG @ 719 C PH: 13.5 (0.1 M SOLN)

SOLUBILITY IN WATER: 107% (REACTS)

SOLVENT SOLUBILITY: VERY SOLUBLE IN ALCOHOL*, GLYCERINE; SLIGHTLY SOLUBLE
IN ETHER; INSOLUBLE IN AMMONIA

MELTING POINT: 716 F (380 C) (ANHYDROUS)
*SEE INCOMPATIBILITIES

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLECTIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

DATE: 06/30/90
INDEX: 01901790098

ACCT: 201082-07
CAT NO: P2503

PAGE: 2
PO NBR: P53107

FIREFIGHTING:

MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 60).

EXTINGUISH USING AGENTS SUITABLE FOR TYPE OF SURROUNDING FIRE. USE FLOODING AMOUNTS OF WATER AS FOG. APPLY FROM AS FAR A DISTANCE AS POSSIBLE.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
CORROSIVE MATERIAL

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND SUBPART E:
CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.245B
EXCEPTIONS: 49CFR173.244

TOXICITY

POTASSIUM HYDROXIDE:

50 MG/24 HOURS SKIN-HUMAN SEVERE IRRITATION; 50 MG/24 HOURS SKIN-RABBIT SEVERE IRRITATION; 50 MG/24 HOURS SKIN-GUINEA PIG SEVERE IRRITATION; 1 MG/24 HOURS RINSED EYE-RABBIT MODERATE IRRITATION; 273 MG/KG ORAL-RAT LD50; MUTAGENIC DATA (RTECS).

CARCINOGEN STATUS: NONE.

POTASSIUM HYDROXIDE IS TOXIC AND A SEVERE EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:

POTASSIUM HYDROXIDE:
CORROSIVE.

ACUTE EXPOSURE- INHALATION OF DUST OR MIST MAY CAUSE SYMPTOMS OF RESPIRATORY TRACT IRRITATION POSSIBLY INCLUDING COUGHING, CHOKING, PAIN IN THE NOSE, MOUTH, AND THROAT. LESIONS OF THE NASAL SEPTUM, AND BURNS OF THE MUCOUS MEMBRANES. IF SUFFICIENT QUANTITIES ARE INHALED, PULMONARY EDEMA MAY DEVELOP, OFTEN WITH A LATENT PERIOD OF 5-72 HOURS. THE SYMPTOMS MAY INCLUDE TIGHTNESS IN THE CHEST, DYSPNEA, FROTHY SPUTUM, CYANOSIS, AND DIZZINESS. PHYSICAL FINDINGS MAY INCLUDE WEAK, RAPID PULSE, HYPOTENSION, HEMOCONCENTRATION, AND MOIST RALES.

CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION AND DURATION OF EXPOSURE, REPEATED OR PROLONGED EXPOSURE TO CORROSIVE SUBSTANCES MAY CAUSE INFLAMMATORY AND ULCERATIVE CHANGES IN THE MOUTH AND POSSIBLY BRONCHIAL AND GASTROINTESTINAL DISTURBANCES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

POTASSIUM HYDROXIDE:
CORROSIVE.

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE SEVERE PAIN, BURNS, AND POSSIBLY BROWNISH STAINS. THE CORRODED AREAS ARE SOFT, GELATINOUS AND NECROTIC, AND THE TISSUE DESTRUCTION MAY BE DEEP.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS OR EFFECTS SIMILAR TO ACUTE EXPOSURE. FREQUENT APPLICATIONS OF AQUEOUS SOLUTIONS (3-6 PERCENT) OF POTASSIUM HYDROXIDE TO THE SKIN OF MICE FOR 46 WEEKS PRODUCED TUMORS IDENTICAL TO THOSE FROM COAL TAR; WARTS OCCURRED FIRST AND THEN SKIN TUMORS DEVELOPED.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

POTASSIUM HYDROXIDE:
CORROSIVE.

ACUTE EXPOSURE- DIRECT CONTACT WITH SOLID OR SOLUTIONS MAY CAUSE PAIN AND BURNS, POSSIBLY SEVERE. THE DEGREE OF INJURY DEPENDS ON THE CONCENTRATION AND DURATION OF CONTACT. THERE MAY BE EDEMA, DESTRUCTION OF EPITHELIUM, CORNEAL OPAECIFICATION, AND IRITIS. WHEN DAMAGE IS LESS THAN EXCESSIVE, THESE SYMPTOMS TEND TO AMELIORATE. IN SEVERE BURNS, THE FULL EXTENT OF THE INJURY MAY NOT BE IMMEDIATELY APPARENT. LATE COMPLICATIONS MAY INCLUDE PERSISTENT EDEMA, VASCULARIZATION, AND SCARRING OF THE CORNEA. PERMANENT OPAECITY, STAPHYLOMA, CATARACT, AND SYMBLEPHARON.

CHRONIC EXPOSURE- EFFECTS DEPEND ON CONCENTRATION AND DURATION OF EXPOSURE.

DATE: 06/30/90
INDEX: 01901790098

ACCT: 201082-07
CAT NO: P2503

PAGE: 3
PO NBR: P53107

REPEATED OR PROLONGED EXPOSURE TO VAPORS AND/OR FUMES MAY RESULT IN CONJUNCTIVITIS OR EFFECTS AS IN ACUTE EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

POTASSIUM HYDROXIDE:
CORROSIVE/TOXIC.

ACUTE EXPOSURE- INGESTION OF 273 MG/KG OF POTASSIUM HYDROXIDE WAS LETHAL TO RATS TESTED. INGESTION OF STRONG ALKALIES MAY BE FOLLOWED BY SEVERE PAIN, VOMITING, DIARRHEA, AND COLLAPSE. THE VOMITUS CONTAINS BLOOD AND DESQUAMATED MUCOSAL LINING. IF DEATH DOES NOT OCCUR IN THE FIRST 24 HOURS, THE PATIENT MAY IMPROVE FOR 2-4 DAYS AND THEN HAVE A SUDDEN ONSET OF SEVERE ABDOMINAL PAIN, BOARDLIKE ABDOMINAL RIGIDITY, AND RAPID FALL OF BLOOD PRESSURE INDICATING DELAYED GASTRIC OR ESOPHAGEAL PERFORATION. DAMAGE TO THE ESOPHAGUS AND STOMACH AFTER INGESTION MAY PROGRESS FOR 2-3 WEEKS. DEATH FROM PERITONITIS MAY OCCUR AS LATE AS 1 MONTH AFTER INGESTION. EVEN THOUGH THE PATIENT RECOVERS FROM THE IMMEDIATE DAMAGE, ESOPHAGEAL STRICTURE MAY OCCUR WEEKS, MONTHS OR EVEN YEARS LATER TO MAKE SWALLOWING DIFFICULT.

CHRONIC EXPOSURE- THE FOOD AND DRUG ADMINISTRATION LIST POTASSIUM HYDROXIDE AS A DIRECT FOOD SUBSTANCE AFFIRMED AS GENERALLY RECOGNIZED AS SAFE AT LEVELS NOT TO EXCEED CURRENT GOOD MANUFACTURING PRACTICES.

FIRST AID- DILUTE THE ALKALI BY GIVING WATER OR MILK IMMEDIATELY AND ALLOW VOMITING TO OCCUR. AVOID GASTRIC LAVAGE OR EMETICS. ESOPHAGOSCOPY IS THE ONLY WAY TO EXCLUDE THE POSSIBILITY OF CORROSION IN THE UPPER GASTROINTESTINAL TRACT; IF CORROSION IS SUSPECTED, ESOPHAGOSCOPY SHOULD USUALLY BE PERFORMED WITHIN 24 HOURS (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). MAINTAIN AIRWAY AND TREAT SHOCK. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:

NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:

VIGOROUS, EXOTHERMIC REACTION WITH WATER.

INCOMPATIBILITIES:

POTASSIUM HYDROXIDE:

ACETIC ACID: REACTS VIOLENTLY.

ACIDS: VIOLENT REACTION.

ACROLEIN: VIOLENT POLYMERIZATION.

ACRYLONITRILE: VIOLENT POLYMERIZATION.

ALCOHOLS: DISSOLVES EXOTHERMICALLY.

ALUMINUM: CORROSIVE IN THE PRESENCE OF MOISTURE.

AMMONIUM HEXACHLOROPLATINATE: FORMATION OF EXPLOSIVE PRODUCT.

AMMONIUM SALTS: EVOLUTION OF AMMONIA GAS.

BENZOYL CHLORIDE + SODIUM AZIDE: VIOLENT EXOTHERMIC REACTION.

P-BIS(1,2-DIBROMOETHYL)BENZENE: HIGHLY EXOTHERMIC REACTION.

BROMOFORM: VIOLENT, EXOTHERMIC REACTION.

BROMOFORM + CYCLIC POLYETHYLENE OXIDES: POSSIBLE EXPLOSIVE REACTION.

CALCIUM CARBIDE + CHLORINE: FORMATION OF EXPLOSIVE DICHLOROACETYLENE.

CHLORINE: EXPLOSIVE REACTION.

CHLORINE DIOXIDE: EXPLOSION ON CONTACT.

CHLORINE + HYDROGEN PEROXIDE: PRODUCES RED LUMINESCENCE DURING REACTION.

CHLOROFORM + METHANOL: INTENSE EXOTHERMIC REACTION.

CYCLOPENTADIENE: VIGOROUS EXOTHERMIC RESIN FORMATION.

1,2-DICHLOROETHYLENE: FORMATION OF EXPLOSIVE AND SPONTANEOUSLY FLAMMABLE

CHLOROACETYLENE.

GERMANIUM: INCANDESCENT REACTION.

GLASS: SLOWLY ATTACKED.

HYDROCARBONS (HALOGENATED): VIOLENT REACTION.

HYPONITROUS ACID: IGNITION REACTION.

LEAD: CORROSIVE IN THE PRESENCE OF MOISTURE.

MALEIC ANHYDRIDE: DECOMPOSES EXOTHERMICALLY OR EXPLOSIVELY.

METALS: CORROSIVE REACTION WITH FORMATION OF FLAMMABLE HYDROGEN GAS.

N-METHYL-N-NITROSOUREA + METHYLENE CHLORIDE: EXPLOSIVE REACTION.

NITRIC TRICHLORIDE: EXPLOSIVE REACTION.

NITROALKANES: FORMATION OF EXPLOSIVE SALTS.

NITROBENZENE + METHANOL (TRACE): VIOLENT, EXOTHERMIC REACTION.

NITROETHANE: FORMATION OF EXPLOSIVE SALT.

NITROGEN TRICHLORIDE: EXPLOSIVE REACTION.

NITROMETHANE: FORMATION OF EXPLOSIVE SALT.

O-NITROPHENOL (MOLTEN): REACTS VIOLENTLY.

NITROPROPANE: FORMATION OF EXPLOSIVE SALT.

N-NITROSOMETHYLUREA + N-BUTYL ETHER: FORMATION OF EXPLOSIVE COMPOUND.

PHOSPHORUS: EVOLUTION OF FLAMMABLE PHOSPHINE.

POTASSIUM PEROXODISULFATE: IGNITION REACTION.

POTASSIUM PERSULFATE + WATER: EXOTHERMIC REACTION.

SUGARS: EVOLVE CARBON MONOXIDE AT OR ABOVE 84° C.

TETRACHLOROETHANE: FORMATION OF FLAMMABLE CHLOROACETYLENE GAS.

2,2,3,3-TETRAFLUOROPROPANOL: EXOTHERMIC REACTION.

DATE: 06/30/90
INDEX: 01901790098

ACCT: 201082-07
CAT NO: P2503

PAGE: 4
PO NBR: P53107

TETRAHYDROFURAN (PEROXIDISED): POSSIBLE EXPLOSIVE REACTION.
THORIUM DICARBIDE: INCANDESCENT REACTION ON HEATING.
TIN: CORROSIVE IN THE PRESENCE OF MOISTURE.
TRICHLOROETHYLENE: FORMATION OF EXPLOSIVE DICHLOROACETYLENE ON HEATING.
2,4,6-TRINITROTOLUENE + METHANOL: FORMATION OF EXPLOSIVE PRODUCT.
ZINC: CORROSIVE IN THE PRESENCE OF MOISTURE.

DECOMPOSITION:

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE CORROSIVE FUMES OF POTASSIUM OXIDE.

POLYMERIZATION:

HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

****STORAGE****

PROTECT AGAINST PHYSICAL DAMAGE. STORE IN A DRY PLACE; PROTECT AGAINST MOISTURE AND WATER. SEPARATE FROM ACIDS, METALS, EXPLOSIVES, ORGANIC PEROXIDES, AND EASILY IGNITABLE MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

****DISPOSAL****

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262, EPA HAZARDOUS WASTE NUMBER D001.

100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. MAY IGNITE COMBUSTIBLES (WOOD, PAPER, OIL, ETC.).

SPILL AND LEAK PROCEDURES

SOIL SPILL:

DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

ADD DILUTE ACID TO NEUTRALIZE.

AIR SPILL:

APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKED FOR CONTAINMENT.

WATER SPILL:

NEUTRALIZE WITH DILUTE ACID OR REMOVABLE STRONG ACID.

OCCUPATIONAL SPILL:

DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1000 POUNDS

THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:

PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:

THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN

DATE: 06/30/90
INOEX: 01901790098

ACCT: 201082-07
CAT NO: P2503

PAGE: 5
FO NBR: PS3107

ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND
IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND
BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND
HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

TYPE "C" SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE,
HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE
DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND
OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY
SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER
POSITIVE PRESSURE MODE.

CLOTHING:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT
TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:

EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS
SUBSTANCE.

EYE PROTECTION:

EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A
FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

EMERGENCY WASH FACILITIES:

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE
EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN
AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

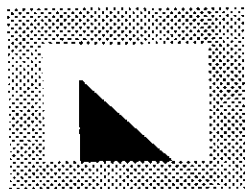
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MATERIAL SAFETY DATA SHEET

Date prepared September 29, 1988



NORLAND PRODUCTS INCORPORATED

695 JOYCE KILMER AVENUE, NEW BRUNSWICK, N. J. (201) 545-7828
MAILING ADDRESS • P. O. BOX 145 • NORTH BRUNSWICK, N. J. 08902

For information or emergency
Telephone 201/545-7828

I. PRODUCT INFORMATION

TRADE NAME: Norland Optical Adhesive 60

SYNONYMS: NOA 60

II. HAZARDOUS COMPONENTS

Components	CAS#	OSHA PEL	ACGIH TLV	OTHER LMTS. RECOM.	HAZARDS
Mercaptan ester*	NA	NE	NE	NE	Sensitizer, eye irritant, skin irritant

NA = Not Applicable NE = Not Established

*Specific identity is being withheld as a trade secret. None of the ingredients are listed as carcinogens in NTP, IARC or OSHA or on any state's list of chemicals known to cause reproductive toxicity.

III. PHYSICAL DATA

BOILING POINT: NA SPECIFIC GRAVITY (H₂O=1): 1.2
VAPOR PRESSURE: NA MELTING POINT: Liquid at room temperature.
VAPOR DENSITY (AIR=1): NA EVAPORATION RATE (BA=1): NA
SOLUBILITY IN H₂O: Insoluble
APPEARANCE AND ODOR: Clear liquid with sulfurous odor.

IV. FIRE AND EXPLOSION DATA

FLASH POINT: 175°C/350°F open cup.
FLAMMABLE LIMITS: Nonflammable in cured state.
EXTINGUISHING MEDIA: Carbon dioxide, foam or dry chemical.
SPECIAL FIRE FIGHTING PROCEDURES: Use self-contained breathing apparatus.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Could generate carbon monoxide and hydrogen sulfide. A small amount of HCN will be generated at incomplete combustion.

V. REACTIVITY DATA

STABILITY: Product is stable. Avoid temperatures above 150°F/65°C.

Oxidizers or actinic radiation may cause nonhazardous polymerization.

HAZARDOUS DECOMPOSITION PRODUCTS: None.

HAZARDOUS POLYMERIZATION: Will not occur.

VI. HEALTH HAZARD DATA

ROUTES OF ENTRY: Inhalation, skin or ingestion.

HEALTH HAZARDS:

ACUTE: May cause dermatitis, shortness of breath, fainting, nausea and headaches.

CHRONIC: Repeated contact may cause sensitization in some individuals.

CARCINOGENICITY: NTP? No. IARC MONOGRAPHS? No. OSHA REGULATED? No.

SIGNS AND SYMPTOMS OF EXPOSURE: Skin rash in area of contact.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Skin allergies, asthma, bronchitis, emphysema and any other respiratory disorders.

EMERGENCY AND FIRST AID PROCEDURES: If contact on skin, immediately wash area with soap and water. If implanted in eyes, immediately wash the eyes with copious amounts of water. Occasionally lifting the lower and upper eyelids. Continue for 15 minutes. Get medical attention. If swallowed, dilute with milk or water. Get medical attention.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED: Wipe up with absorbent material and rinse with non-polar solvent or polymerize with uv light and peel off.

WASTE DISPOSAL METHOD: Cure to a solid with uv light. Cured material may be disposed of in landfill. Comply with Federal, State and Local regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: This material should not be ingested or taken internally. Spraying as aerosol or mist not recommended. If this is done, protection must be taken against inhalation.

VIII. CONTROL MEASURES

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT:

RESPIRATORY PROTECTION: Not required under normal operating conditions.

EYE PROTECTION: Wear safety glasses.

PROTECTIVE GLOVES: Wear impervious gloves (Nitrile or Butyl Rubber).

VENTILATION REQUIREMENTS: Use local and mechanical exhaust.

WORK HYGIENIC PRACTICES: If clothing gets contaminated, wash before rewearing. Practice good housekeeping and vigorous personal hygiene to minimize contact with material.