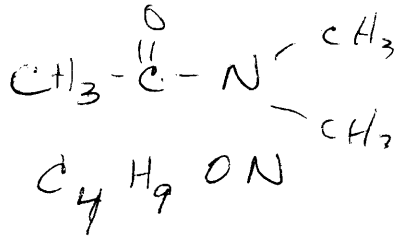


C_4H_9ON

N N dimethyl acetamide

$MW = 87.12$

$\lambda_{max}^{heptane} \simeq 218$

m.p. $-20°C$

b.p. 165^{758}

84^{32}

$\rho = .9366_4^{25}$

$n_D^{20} = 1.4380$

Beilstein 4^2, 564

∞ Soluble in virtually anything from water to benzene

$n = a + ib$

Dimethyl Acetamide

Trichloressigsäure-methylamid, 2,2,2-Trichlor-*N*-methyl-acetamid $C_3H_4Cl_3NO$ = CCl_3-CO-NH-CH_3 (H 58).

Konstante der binären Assoziation und der ternären Assoziation in Benzol bei 25°, 35° und 49°: *Davies, Thomas*, J. phys. Chem. **60** [1956] 767, 769.

2,2,2-Trichlor-*N*-methyl-acetamidin $C_3H_5Cl_3N_2$ = HN=C(CCl_3)-NH-CH_3 und Tautomeres.

Über die Tautomerie s. *Grivas, Taurins*, Canad. J. Chem. **37** [1959] 795, 798.

B. Aus Trichloracetonitril beim Behandeln einer Lösung in Benzol mit Methylamin (*Backer, Wanmaker*, R. **70** [1951] 638, 640) sowie beim Behandeln mit wss. Methylamin-Lösung (*Grivas, Taurins*, Canad. J. Chem. **36** [1958] 771, 773).

Kp_{60}: 129° (*Gr., Ta.*, Canad. J. Chem. **36** 773). Assoziation im flüssigen Zustand: *Gr., Ta.*, Canad. J. Chem. **37** 797. IR-Banden im Bereich von 3400 cm^{-1} bis 1150 cm^{-1}: *Gr., Ta.*, Canad. J. Chem. **37** 797; s. a. *Grivas, Taurins*, Canad. J. Chem. **37** [1959] 1260, 1264.

Die Protonierung erfolgt am Imino-Stickstoff (*Gr., Ta.*, Canad. J. Chem. **37** 1263).

Hydrochlorid $C_3H_5Cl_3N_2$·HCl; 2,2,2-Trichlor-*N*-methyl-acetamidinium-chlorid. Krystalle; F: 229° [Zers.] (*Gr., Ta.*, Canad. J. Chem. **37** 1263). IR-Banden im Bereich von 3100 cm^{-1} bis 1500 cm^{-1}: *Gr., Ta.*, Canad. J. Chem. **37** 1263.

Picrat $C_3H_5Cl_3N_2$·$C_6H_3N_3O_7$; 2,2,2-Trichlor-*N*-methyl-acetamidinium-picrat. Krystalle (aus W.); F: 163–164° (*Ba., Wa.*).

2,2,2-Trichlor-*N*,*N'*-dideuterio-*N*-methyl-acetamidin $C_3H_3Cl_3D_2N_2$ = DN=C(CCl_3)-ND-CH_3 und Tautomeres.

IR-Absorptionsmaxima: 2570 cm^{-1} und 2465 cm^{-1} (*Grivas, Taurins*, Canad. J. Chem. **37** [1959] 1260, 1264).

2,2,2-Trichlor-*N*,*N*,*N'*-trideuterio-*N'*-methyl-acetamidinium-chlorid $C_3H_2Cl_3D_3N_2$·Cl. IR-Absorptionsmaximum: 2260 cm^{-1}.

Azidoessigsäure-methylamid, 2-Azido-*N*-methyl-acetamid $C_3H_6N_4O$ = N_3-CH_2-CO-NH-CH_3.

B. [illegible] A. **613** [1958] 84, 91 [illegible]

Krystalle [illegible]

Essigsäure-dimethylamid, *N*,*N*-Dimethyl-acetamid C_4H_9NO = CH_3-CO-N(CH_3)$_2$ [illegible] E II 564, E III 124.

[illegible]

[illegible] *Pagerey et al.*, Trans. ASME **78** [1956] 1169, 1172. $n^{20}_{656,3}$: 1,4357; n^{20}_{D}: 1,4365 (*Le., Ge.*). ^{1}H-NMR-Spektrum von unverdünntem *N*,*N*-Dimet[illegible] [illegible]*sky, Holm*, J. chem. Physics **25** [1956] 1228, 1231. ^{1}H-NMR-Absorpti[illegible] [illegible]tem *N*,*N*-Dimethyl-acetamid bei 249–322 K: *Gu., Holm*, l. c. S. 1232; [illegible] [illegible]uteriumoxid und in wss. Perchlorsäure gelöstem *N*,*N*-Dimethyl-aceta[illegible] [illegible]peratur: *Fraenkel, Niemann*, Pr. nation. Acad. U.S.A. **44** [1958] 688, 689. [illegible]15 μ) von dampfförmigem und flüssigem *N*,*N*-Dimethyl-acetamid: *Gie*[illegible] [illegible] [1953] 644, 646, 647. Intensität der C=O-Valenzschwingungsband[illegible] [illegible]0 cm^{-1} und 1653 cm^{-1}: *Thompson, Jameson*, Spectrochim. Acta **13** [illegible] [illegible]-Spektrum (W.; 200–230 nm): *Saidel*, Am. Soc. **77** [1955] 3892, 3893, 7[illegible] [illegible]-Absorptionsmaximum (Heptan): 218 nm (*Schorygin et al.*, Izv. Akad. [illegible] [illegible]. **1959** 2208, 2209; engl. Ausg. S. 2103, 2104). Statische Dielektrizitäts[illegible] [illegible]: **40,09**; bei 20°: 38,93; bei 25°: 37,78; bei 30°: 36,81; bei 35°: 35,83 [illegible] [illegible]5732). Elektrische Leitfähigkeit: *Lester et al.*, J. phys. Chem. **60** [1956] [illegible] [illegible]ungsgleichgewicht in wss. Schwefelsäure: *Goldfarb et al.*, Am. Soc. **77** [illegible]

[illegible] *N*,*N*-Dimethyl-acetamid ist mit flüssigem Kohlendioxid bei 21–26° 65 a[illegible] [illegible]chbar (*Francis*, J. phys. Chem. **58** [1954] 1099, 1101, 1103). Lösungs[illegible] [illegible]hlendioxid und Acetylen bei −25 bis +60°: *Schay et al.*, Period. po[illegible] [illegible]g. **2** [1958] 1, 19. Löslichkeitsdiagramm des ternären Systems mit Koh[illegible] [illegible]ptan bei 21–26° 65 at: *Fr.*, l. c. S. 1110. Azeotrop mit Essigsäure: *Craig* [illegible] [illegible] Sci. **6** [1951] 13, 17; *Monsanto Chem. Co.*, D.B.P. 910295 [1951]. Volu[illegible] [illegible]im Vermischen mit Glutaronitril: *Phibbs*, J. phys. Chem. **59** [1955] 346, 3[illegible] [illegible]s Vermischens mit Glutaronitril: *Ph.*, l. c. S. 349; mit Kohlendioxid und [illegible] [illegible]*hay et al.* Assoziation mit 1,4-Benzochinon (Addukt 4:1) und mit Azob[illegible] [illegible]l) in Toluol: *[illegible] et al.*, Soc. **1956** 72, 73.

[illegible] Massenspektrum (Elektronenstoss): *Gilton*, Anal. Chem. **31** [1959] 935, [illegible]

[illegible]wärmen mit Benzol und Phosphorylchlorid ist Acetessigsäure-dimethylam[illegible] [illegible] *et al.*, B. **92** [1959] 1456, 1458), beim Behandeln mit Benzol, Phosphor[illegible] anschliessenden Erwärmen mit Anilin ist *N*,*N*-Dime[illegible] (*Bredereck et al.*, B. **92** [1959] 837, 847) erhalten worden. Reaktion mit Be[illegible] Gegenwart von [illegible] Bildung von 3-Hydroxy-3,3-[illegible] dimethylamid [illegible] B. **1958** 1586, 1590.

Charak[illegible] 119–120 [illegible] *side*, J. [illegible] **24** [1959] 1238.

Verbi[illegible] die an der [illegible] 144–146 [illegible] pillare]: [illegible] **607** [1957] 35, 42.

Verbi[illegible] F: 82° (*B.[illegible]* [illegible] 1965).

1,1-Dichlor-1-dimethylamino-äthan, [1,1-Dichlor-äthyl]-dimethyl-amin [illegible] äthyliden [illegible] S. 183 [illegible]

N'-[2,2-Dicyan-1-methoxy-vinyl]-*N*,*N*-dimethyl-acetamidin $C_9H_{12}N_4O$ [illegible]

B. [illegible] acetimi[illegible] *Pont de* [illegible] 1956 [illegible]

Kry[illegible]

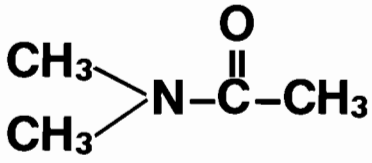
Difluor[illegible] 2,2-Difluor-*N*,*N*-dimethyl-acetamid [illegible] CHF_2-CO[illegible]

B. [illegible]

DU PONT

DATA SHEET

DIMETHYLACETAMIDE



N,N-Dimethylacetamide (DMAC) is a powerful and versatile industrial solvent featuring wide organic and inorganic solubility, water miscibility, high boiling point, low freezing point and good stability. DMAC is not "photochemically reactive" as defined in Los Angeles County's Rule 66, Section k. Some states control all volatile organic compounds irrespective of their photochemical reactive nature. Consult the appropriate state pollution control regulations.

The Chemical Abstracts index name for DMAC is acetamide, N,N-dimethyl-, (CAS Registry Number 127-19-5). Du Pont offers high purity DMAC for industrial use only. Table I lists specifications and typical analyses of Du Pont DMAC. Du Pont also sells a closely related amide solvent, N,N-dimethylformamide (DMF).

PROPERTIES

Solvency—DMAC is an essentially neutral, non-hydroxylic, aprotic solvent with a high dielectric constant. Its solvent power is due in part to having three pairs of available electrons for hydrogen bonding.

Solubility—DMAC is completely miscible in water, ether, esters, ketones and aromatic compounds. DMAC is generally soluble in unsaturated aliphatic compounds and more soluble than DMF in saturated aliphatics.

Stability—Dimethylacetamide is stable up to its atmospheric boiling point in the absence of acidic and alkaline materials. It distills essentially unchanged with no color or acid formation. Above 350 C (662 F), degradation to dimethylamine and acetic acid occurs.

TABLE I
SPECIFICATIONS AND TYPICAL ANALYSES
DU PONT DIMETHYLACETAMIDE
TECHNICAL GRADE

	Specifications	Typical Analyses*
Water, %	0.05 max.	0.02
Color (APHA)	10 max.	2
Conductivity, 25 C (77 F) 20% aq sol'n		
micromhos/cm	25 max.	12
μS/m	2500 max.	1200
Distillation range for 1 to 95 vol %, (at 760 mm Hg and includes 166.0 C ± 0.2 C), C	2.0 max.	0.6
pH at 25 C (77 F), 20% aq sol'n	4.0-7.0	4.7

**This column gives typical analyses based on historical production performance. Du Pont does not make any express or implied warranty that all future production will demonstrate or continue to possess these typical properties.*

Hydrolysis—DMAC shows only a slight tendency to hydrolyze in aqueous solutions at elevated temperatures. The hydrolysis rate increases in the presence of acids or alkalis.

NOTICE: DMAC is harmful if inhaled or absorbed through the skin. See Personal Safety and First Aid on page 2 and the Caution For Distributors, Resellers, Formulators and Users of DMAC on page 6.

Solvolysis—Like other aprotic solvents (e.g. tetrahydrofuran, dimethylformamide, dimethyl sulfoxide), DMAC is capable of influencing substitution and elimination reactions. DMAC strongly stabilizes cations through dipole-cation interactions and minimizes the electrostatic attraction between anion and cation. Its electrical insulating action retards ion aggregation.

Hazardous Chemical Reactions—With halogentated compounds, DMAC acts as a dehydrohalogenation reagent. With certain highly halogenated compounds like carbon tetrachloride or benzene hexachloride, the reaction is highly exothermic and may become violent, particularly in the presence of iron. It is recommended that mixtures of DMAC and halogenated compounds never be used or stored in metal containers without first testing the particular system. Mixtures of DMAC and sodium hydride have been reported to generate heat and should be considered potentially hazardous.

Extreme caution must be exercised if strong oxidizing agents are to be mixed with DMAC. Use of DMAC as a reaction solvent is known to increase the rate and heat evolution of many organic reactions. It is therefore recommended that any evaluation of DMAC be initially carried out on a small scale, with gradual scale-up to thoroughly familiarize operating personnel with the characteristics of a particular reaction. Furthermore, once safe operating conditions have been established, care must be taken to see that they are not altered without first evaluating the new conditions on a small scale.

PERSONAL SAFETY AND FIRST AID

Health Hazards

DMAC is capable of producing systemic injury when inhaled or absorbed through the skin in sufficient quantities over a prolonged period of time. The principal effect is cumulative damage to the liver. DMAC has a low order of acute toxicity when swallowed or upon brief contact of the liquid or vapor with the eyes or skin. The LD_{50} (oral, male rats) for DMAC is 5809 mg/kg.

Although DMAC is not a skin sensitizer, it is irritating to the skin and eyes. DMAC has shown embryotoxic properties in test animals. See the paragraph below on Embryotoxicity.

The U.S. Department of Labor (OSHA) has ruled that an employee's exposure to dimethylacetamide in any 8-hour work shift of a 40-hour work week shall not exceed a time-weighted average of 10 ppm DMAC vapor in air by volume or 35 mg of DMAC per cubic meter of air. They also caution that, since both the liquid and vapor of DMAC are capable of penetrating the skin and mucous membranes, control of vapor inhalation alone may not be sufficient to prevent absorption of an excessive dose (29 CFR 1910.1000 Air Contaminants).[a]

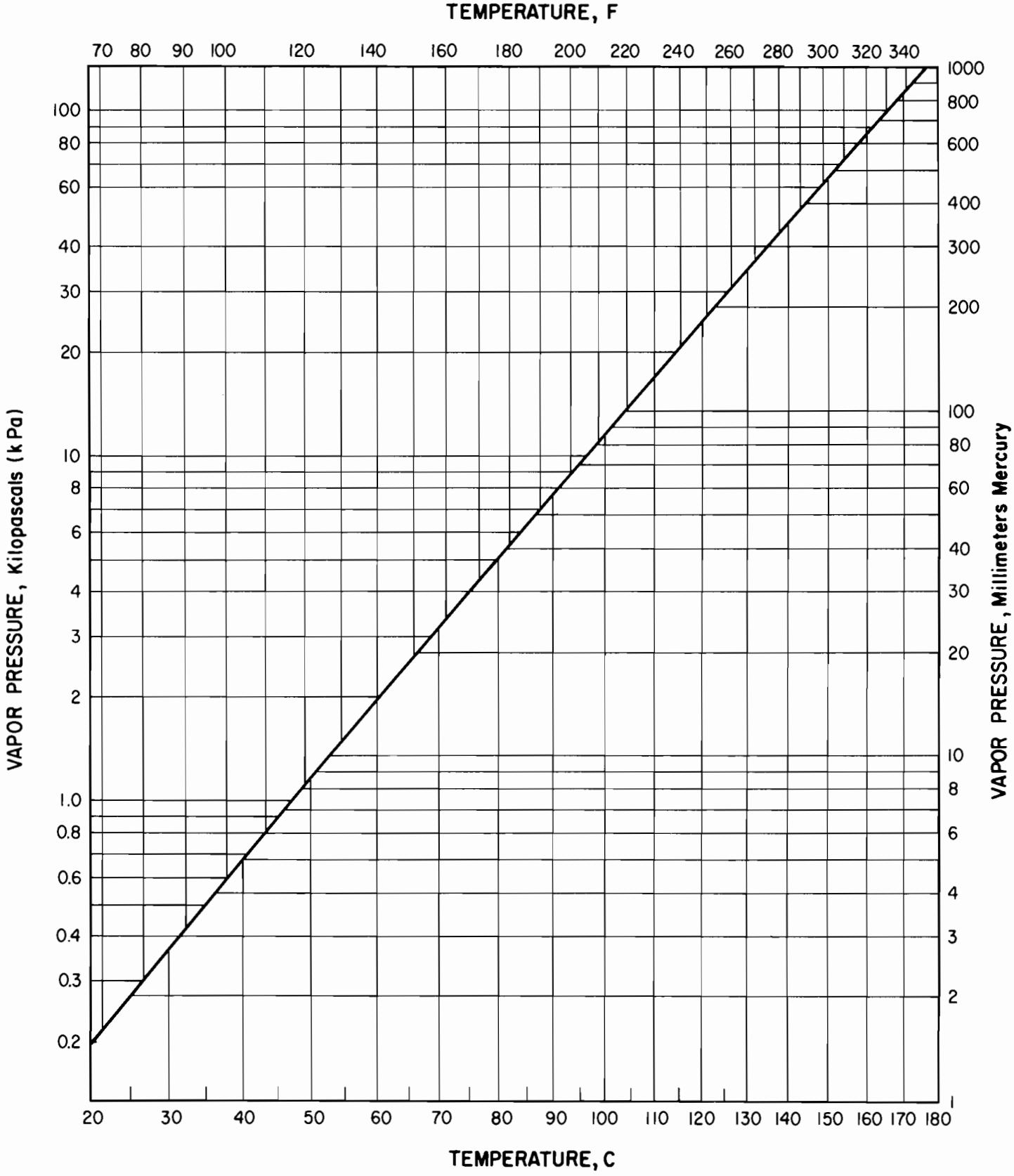
TABLE II
PROPERTIES* OF
DIMETHYLACETAMIDE (DMAC)

Molecular weight		87.12
Boiling point (760 mm Hg),	C	166.1
	F	331
Freezing point,	C	−20
	F	−4
Vapor pressure, 25 C (77 F),	mm Hg	2.0
(See Figure 1)	psia	0.04
	kPa	0.27
37.8 C (100 F),	mm Hg	4.4
	psia	0.09
	kPa	0.59
Density, 15.6 C (60 F),	g/mL (Mg/m^3)	0.945
(See Figure 2)	lb/gal	7.88
Viscosity, 25 C (77 F), cP (mPa·s)		0.92
Surface tension, 30 C (86 F), dyn/cm (mN/m)		32.43
Refractive index, n_D^{25}		1.4356
Heat of vaporization (at bp),	kcal/g·mol	10.36
	Btu/lb	214
	kJ/kg	498
Heat of combustion ($-\Delta H_c^\circ$), 20 C (68 F)		
	kcal/g·mol	608
	Btu/lb	12,562
	MJ/kg	29.20
Thermal conductivity, 22.2 C (72 F)		
	kcal·m/m^2·h·C	0.1579
	Btu·ft/ft^2·h·F	0.1005
	W/m·K	0.1742
Flash point (TOC),	C	70
	F	158
(TCC),	C	63
	F	145
Autoignition temperature,	C	490
	F	914
Flammability limits in air, vol %		
lower, 100 C (212 F)		1.8
200 C (392 F)		1.5
upper, 160 C (320 F)		11.5
Critical temperature,	C	385
	F	725
Critical pressure,	atm	39.7
	MPa	4.02
Dielectric constant, ϵ, 10 kHz, 25 C (77 F)		37.8
Dipole moment, μ, 20 C (68 F) Debye units		4.60
Solubility parameter, δ		10.8
Hydrogen-bonding index, ∂		6.6

*These property data are drawn from various DuPont and literature sources. DuPont does not make any express or implied warranty that the commercial product will have these properties.

[a] Due to changing governmental regulations such as those of the Department of Transportation, Department of Labor, U.S. Environmental Protection Agency and the Food and Drug Administration, references herein to governmental requirements may be superseded. Each user should consult and follow the current governmental regulations, such as Hazard Classifications, Labeling, Food Use Clearances, Worker Exposure Limitations and Waste Disposal Procedures for the up-to-date requirements for dimethylacetamide.

FIGURE 1 VAPOR PRESSURE OF DIMETHYLACETAMIDE



Embryotoxicity

In laboratory tests, application of DMAC to the skin of pregnant rats has caused fetal deaths when the dosages where close to the lethal dose level for the mother. Embryonal malformations have been observed at dose levels 20% of the lethal dose and higher. However, embryotoxicity has not been reported at dose levels comparable to the inhalation dose a woman could receive from air contaminated with DMAC to the maximum level allowed by the Department of Labor. (See Health Hazards.) Women of childbearing potential may be employed in operations where the air concentration is within the limits set by the Department of Labor and there is no opportunity for liquid contact.

Safety Precautions

Adequate ventilation must be provided by keep DMAC vapor concentrations within the time-weighted average of 10 ppm prescribed by the Department of Labor. Contact of DMAC liquid or mixtures containing DMAC with the eyes, skin, and clothing should be avoided. If contact is unavoidable, appropriate personal protective equipment, including chemical safety goggles, butyl rubber gloves, rubber or neoprene-coated clothing, and respirators supplied with fresh air should be worn.

First Aid

If inhaled, remove patient to fresh air. If breathing has stopped, give artificial respiration, preferably mouth to mouth. If breathing is difficult, give oxygen. Call a physician.

In case of contact with DMAC liquid, immediately flush eyes or skin with water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. Destroy contaminated shoes.

Personal Protective Equipment

The following personal protective equipment should be available and worn as needed:

- Hard hat with brim
- Safety spectacles (side shields preferred)
- Chemical splash goggles
- Full length face shield
- DMAC-resistant butyl rubber gauntlet gloves[b]
- DMAC-resistant butyl rubber apron
- DMAC-resistant butyl rubber boots
- Appropriate respiratory protection[c]

[b] Available from NORTON SAFETY PRODUCTS DIVISION, 2000 Plainfield Pike, Cranston, RI 02920.

[c] See "A Guide to Industrial Respiratory Protection," HEW Pub. No. (NIOSH) 76-189.

A full DMAC-resistant butyl rubber suit (jacket, pants and hood) with breathing air supply will provide protection from DMAC contact and inhalation. This suit must be worn not only in emergencies but also when performing work where there is substantial possibility of direct repeated contact with DMAC.

Neoprene is abrasion resistant, and therefore, neoprene gloves are recommended for DMAC area operations. However, neoprene coated cotton gloves offer only fair protection from DMAC. Neoprene coated gloves which have contacted liquid DMAC should be discarded.

Butyl rubber gloves such as Norton Style B-161R or B-324R[b] are resistant to DMAC solvency and offer good protection from DMAC. Butyl rubber gloves should be worn in all operations where contact with liquid DMAC is likely. These gloves are designed to protect against accidental contact and are not intended for routine immersion in DMAC or continuous handling of DMAC-wetted parts. Butyl rubber is not very resistant to cuts or abrasion. Therefore, butyl gloves should be frequently inspected and discarded when they show cuts, tears, pinholes or signs of wear.

Design of DMAC facilities should avoid routine gloved contact with DMAC liquid or parts wetted with DMAC.

Special Safety Facilities

The following safety facilities should be readily accessible in all areas where DMAC is handled or stored:

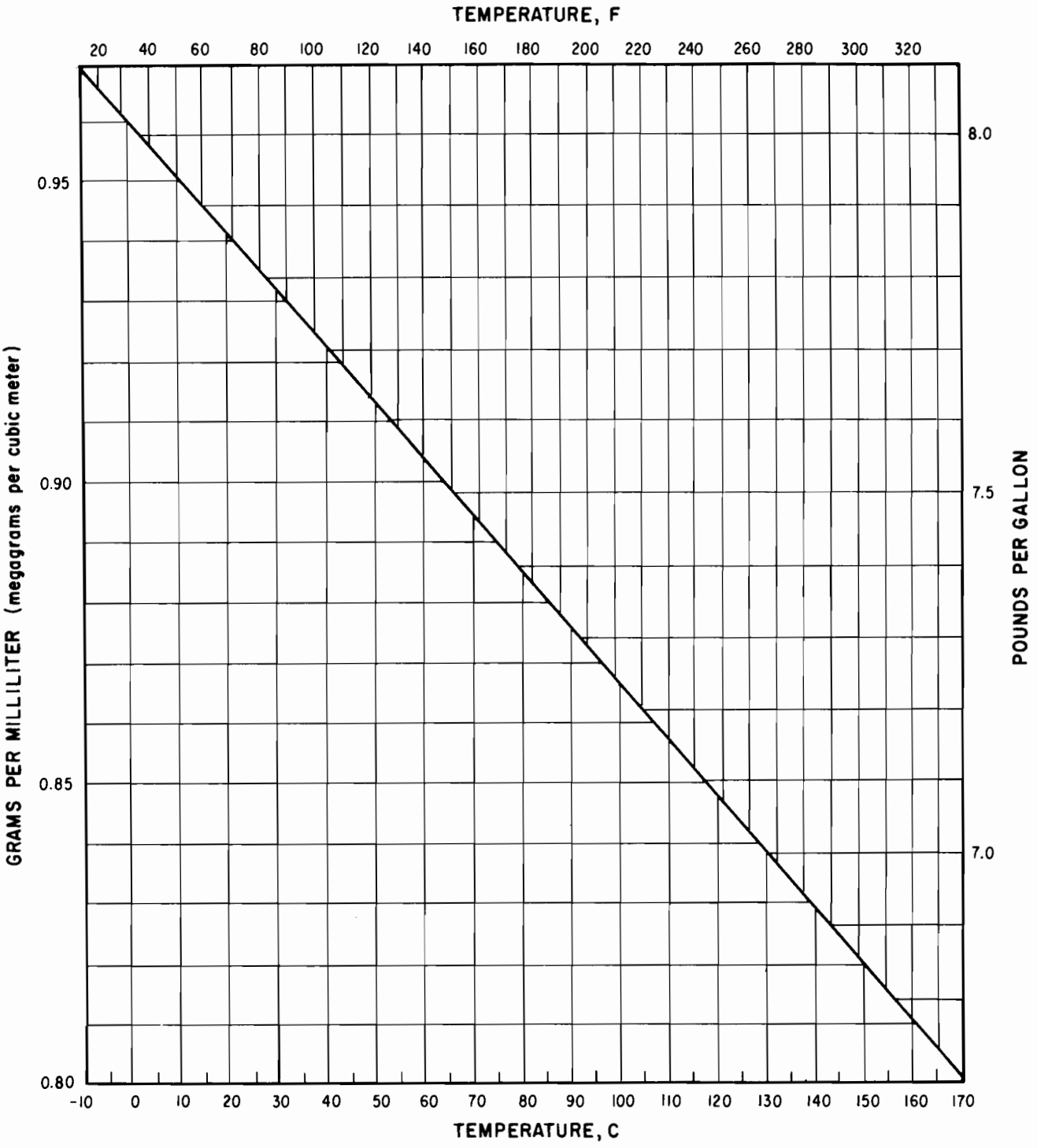
- safety showers—or water hoses connected to spigots with quick opening valves which stay open
- eye wash fountains—or other means for washing the eyes with a gentle flow of filtered, moderately warm tap water.

Determination of DMAC in Air

The measurement of DMAC in air can be accomplished by passing a known amount of air through water in a gas-scrubbing vessel and analyzing the solution chemically or by gas chromatography. Chemical analysis involves hydrolysis to dimethylamine. For determination by gas chromatography, the solution may be injected directly into a suitable column. An acceptable gas chromatography technique for DMAC is NIOSH Method No. S254 (NIOSH Manual of Analytical Methods, Volume 3, U.S. Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health). The NIOSH Method uses adsorption on silica gel followed by desorption with methanol.

DMAC in air can also be measured by infrared absorption or by colorometric analysis of a pyrolyzed air

FIGURE 2 DENSITY OF DIMETHYLACETAMIDE



sample. The colorimetric technique measures concentrations of 5-80 ppm DMAC in air using the MSA Universal Tester (complete with Air Sampling Pump, Pyrolyzer and Part Number 91624 Organic Nitrogen Detector Tubes available from Mine Safety Appliances Company, 408 Penn Center, Pittsburgh, PA 15235).

USES

DMAC is a uniquely versatile and powerful solvent with the following properties:

- Wide Liquid Range
- Thermal Stability
- Chemical Stability
- Water Miscibility
- Wide Organic and Inorganic Solvency
- High Polarity

Many hard-to-dissolve materials are soluble in DMAC. In some cases, the material is dissolved in a relatively small amount of DMAC and then the mixture is taken up in a large volume of second solvent. Sometimes the final solution contains only a small percentage of DMAC. But even when DMAC is only a minor ingredient in the solution, the cautionary information covered in the PERSONAL SAFETY and FIRST AID section above still applies.

DMAC in Mixtures and Consumer Products—DMAC is sold by Du Pont for industrial use only. It should *not* be used in consumer products.

In combinations of DMAC with other solvents and chemicals, the partial vapor pressure of DMAC will be lower than for pure DMAC and the rate of absorption through the skin may be slower than for pure DMAC. Nevertheless, it must be recognized that even when DMAC is a relatively minor component of a formulation, it may in some circumstances still contribute more than 10 ppm vapor to the air (exceeding the OSHA limit) and can still be absorbed through the skin in case of skin contact. This is especially pertinent if the formulation is spread in a thin film, over a large surface area having limited ventilation. Processing at elevated temperatures also requires special attention to adequate ventilation.

Other factors to be considered by formulators are whether the formulation or mixture containing DMAC is likely to be used by the general public or by women of childbearing age and whether spills or splashing of the product are likely to be encountered in normal use.

CAUTION: Distributors, resellers, formulators and users of DMAC and mixtures or products containing DMAC have the responsibility of providing adequate information on safety, toxicity including embryotoxicity, and safe handling procedures to their employees and customers.

Resin and Polymer Solvent—DMAC's strong solvent action makes it particularly useful in the manufacture of films and fibers and as a booster solvent in coating and adhesive formulations. Polymers containing over 50% vinylidene chloride are soluble to 20% at elevated temperatures in DMAC. In many cases DMAC solutions have higher solids content at practical working viscosities, resulting in more economical formulations than is possible with lower cost but less powerful solvents. DMAC may be particularly useful for dissolving:

Polyacrylonitrile	Cellulose derivatives
Polyvinyl chloride	Styrenes
Polyamides	Linear polyesters
Polyimides	

Reaction Catalyst and Medium—DMAC is useful as a reaction medium because it is an excellent solvent for a variety of organic and inorganic compounds. Due to its high dielectric constant and solvating ability, DMAC may participate in the reaction mechanism and frequently the effect is catalytic. This often results in higher yields under less vigorous conditions than is possible with other solvents. The products frequently may be isolated by adding water to the reaction mixture. Typical of reactions that may be benefited by the use of DMAC are:

Elimination reactions such as dehydrohalogenation and dehydrogenation

Cyclizations

Halogenations

Preparation of nitriles

Alkylations

Interesterifications

Phthaloylations

Preparation of organic acid chlorides.

Crystallization and Purification Solvent—The unusual solvent power of DMAC has been found useful in the purification by crystallization of aromatic dicarboxylic acids such as terephthalic acid and p-carboxyphenylacetic acid. DMAC and dibasic acids form crystalline complexes containing two moles of the solvent for each mole of acid.

Electrolytic Solvent—The use of DMAC as a nonaqueous electrolytic solvent is promising because salts are moderately soluble in DMAC and appear to be completely dissociated in dilute solutions.

STORAGE AND HANDLING

Persons handling DMAC in drums or in bulk quantities should be thoroughly familiar with DMAC hazards and safe handling practices. Refer to the Du Pont bulletin "Dimethylformamide (DMF)—Properties, Uses, Storage and Handling" for more detailed information on a product whose storage and handling requirements are similar to those of DMAC. This publication is available from any Du Pont Sales Office listed on the back page.

Storage—DMAC is stored and handled in steel equipment and is usually handled at ambient temperatures. DMAC freezes at −20 C (−4 F). It is combustible and is thermally stable below 350 C (662 F) if uncontaminated.

Aluminum or stainless steel equipment is recommended for handling DMAC where stringent color or iron contamination requirements are present. Mild steel is *not* recommended for high temperature service or for handling water solutions containing less than 83 percent DMAC. Many plastics are dissolved or softened by DMAC. White asbestos or TEFLON® TFE or FEP fluorocarbon resins are the preferred materials for gaskets and packing.

DMAC is hygroscopic and should be stored and handled in equipment designed to minimize moisture pickup.

Fire Hazard—DMAC is a Class II combustible liquid as defined by OSHA regulations. Its flash point, 63 C (145 F), is above the temperature at which it is normally stored and handled. However, DMAC should be stored and used in areas protected from flame, sparks, or excessive heat. Storage tanks and equipment should be electrically grounded.

In the event of fire, fire-fighting personnel should wear respiratory protection with breathing air supply and fight fires from upwind. Use water spray, foam, dry chemical, or carbon dioxide to extinguish fires.

Use caution in approaching an advanced or massive fire where confined DMAC is exposed to high heat or flame because in these circumstances this material may decompose rapidly and exothermically, and rupture the containing vessel.

Smoke and fumes from burning DMAC may be harmful upon inhalation or skin contact and, therefore, must be avoided.

When contact with smoke is not avoidable, wear full protective equipment with breathing air supply.

Engineering Control of Hazards—DMAC storage and handling facilities and operating areas should include the following key elements:

- Store and handle DMAC in totally enclosed equipment where possible, or in systems designed to avoid human contact. If contact cannot be avoided, personnel must wear proper personal protective equipment because DMAC is readily absorbed through the skin.
- Unloading and process facilities must isolate DMAC from chemicals with which it reacts violently. See Hazardous Chemical Reactions on page 2.
- DMAC is a combustible liquid and should be stored and used in areas protected from flames, sparks and excessive heat.
- Storage tanks and equipment should be electrically grounded.
- Electrical equipment, wiring and fixtures must meet the requirements of the National Electrical Code, Article 500.[d]
- Vents and pressure relief devices must be designed to handle pressure limitations and volumes of vapor that could be expected in emergency conditions.
- The process and storage tank vents should be located so that toxic, flammable vapors given off during fires or emergency conditions will not harm personnel or increase the fire hazard.
- Dikes, waste drains and collection facilities must be provided to contain possible spills or leaks during unloading and other transfers. DMAC spills, leaks and rinsings must be safely collected for later disposal or recovery.
- The storage and process layout must include provisions for more than one escape route in the event of fire, explosion or release of toxic vapors or liquid.
- The following safety facilities should be provided: readily accessible safety showers, fire extinguishers and other fire fighting equipment, water hydrants or hoses with spray nozzles for flushing and other emergency equipment such as chemical-proof suits and respiratory apparatus.
- In addition to engineering controls, thorough operator training, written operating instructions, safety rules, check lists, work permit and flame permit procedures are required to assure safe operation.

Spills—Spills or leaks of DMAC should be taken care of promptly. They should be contained where possible in a suitable collection system (tank or sump) designed to minimize personnel exposure and pollution. Spills or

[d] Available from National Fire Protection Association, 470 Atlantic Ave., Boston, MA 02210.

DU PONT

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

Name
Dimethylacetamide (DMAC), Technical

Synonyms
DMAC

Chemical Family
Amide

CAS Name
Acetamide,N,N-dimethyl

CAS Registry No.
127-19-5

I.D. Nos./Codes NIOSH Access #AB77000
Wiswesser Line Notation 1VN1&1

Formula:
$CH_3CON(CH_3)_2$

Manufacturer/Distributor
E. I. Du Pont De Nemours & Co., (Inc.)

Product Information and Emergency Phone
(302) 774-2421

Address
Wilmington, DE 19898

Transportation Emergency Phone
(800) 424-9300

HAZARDOUS COMPONENTS

Material(s)	*Approximate %*
Dimethylacetamide	100%

PHYSICAL DATA

Boiling Point, 760 mm Hg
166°C (331°F)

Melting Point
-20°C (-4°F)

Specific Gravity
0.95 (water = 1)

Vapor Pressure 2 mm Hg @ 25°C (77°F)
4 mm Hg @ 37.7°C (100°F)

Vapor Density
3.0 (air = 1)

Solubility in H_2O
100%

% Volatiles by Vol.
100% at B.P.

Evaporation Rate (Butyl Acetate = 1)
0.17

Form Liquid ***Appearance*** Clear ***Color*** Colorless ***Odor*** Faint ammonia-like. Odor threshold = 22 ppm

pH Information
Acid, in aqueous solution.

Octanol/Water Partition Coefficient
Log P = -0.77

FIRE AND EXPLOSION DATA

Flash Point 63°C (145°F) ***Method*** TCC

Autoignition Temperature
490°C (914°F)

Flammable Limits in Air, % by Vol. ***Lower*** 1.8 @ 100°C (212°F) ***Upper*** 8.6 @ 120°C (248°F)

Fire and Explosion Hazards
Combustible

Extinguishing Media "Alocohol-resistant" foam, dry chemical, CO_2. (Water spray may be ineffective.)

Special Fire Fighting Instructions Evacuate enclosed areas. Stay upwind. If contact with smoke and fumes cannot be avoided, wear chemical-proof suit with hood and breathing air supplied. Use water spray to cool containers, flush spills from source of ignition, and to disperse vapors.

HAZARDOUS REACTIVITY

Instability
Stable
Incompatibility Highly exothermic reactions may occur in presence of iron with highly halogenated compounds, such as carbon tetrachloride or benzene hexachloride; or with strong oxidizing agents.
Decomposition: May release ammonia, carbon monoxide gases.
Polymerization
Will not occur

HEALTH HAZARD INFORMATION

Exposure Limits
OSHA 8-hour Time Weighted Average (TWA) & ACGIH TLV®-TWA are 10 ppm, 35 mg/m^3 (skin).

Routes of Exposure and Effects

(See attached page)

First Aid

(See attached page)

PROTECTION INFORMATION

Ventilation
Use with ventilation adequate to maintain permissible exposure limit.
Personal Protective Equipment Wear appropriate equipment to prevent any possibility of skin contact with liquid or reasonable probability of eye contact, such as safety spectacles or chemical splash goggles, DMAC-resistant gloves (such as "Buta-Sol" or equivalent). If permissible exposure limits are exceeded, use OSHA-permissible respiratory protection, such as supplied air or self contained breathing apparatus for concentrations to 100 ppm; and with full face-piece and operated in positive pressure mode for concentration to 400 ppm.
DISPOSAL PROCEDURES
Spill, Leak or Release: (See attached page)
Waste Disposal Comply with Federal, State and local regulations. If approved, may be disposed of by incineration, bio-oxidation, or by removal to licensed hazardous material landfill.

SHIPPING PRECAUTIONS

Transportation
(See attached page)
Shipping Containers
Railroad tank cars, tank trucks, drums.
Storage Conditions Keep in well ventilated area, away from heat, sparks and flame. Keep container tightly closed. Avoid prolonged exposure to sun. Keep plug up to prevent leakage. Do not use pressure to empty drums.
REFERENCES AND ADDITIONAL INFORMATION

Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Before using, read Du Pont Dimethylacetamide Data Sheet.
For more information, refer to NIOSH "Guide to Industrial Respiratory Protection", Publication #76-189; NIOSH/OSHA "Pocket Guide to Chemical Hazards", Publication #78-210. Both NIOSH publications are available from the U.S. Dept. of HEW, NIOSH, 4676 Columbia Parkway, Cincinnati OH 45226; Phone (513-684-4287).

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DIMETHYLACETAMIDE (DMAC), TECH. MSDS ATTACHMENT

HEALTH HAZARD INFORMATION

Routes of Exposure and Effects:

Harmful if inhaled or absorbed through skin. Long term overexposures may cause cumulative, systemic injury, particularly to the liver.

Based on tests with laboratory animals, DMAC is embryotoxic. See Du Pont DMAC Product Data Sheet for further discussion and advice on employment of women where DMAC is present. Causes irritation.

First Aid:

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.

In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse. Discard contaminated shoes.

If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Call a physician. Never give anything by mouth to an unconscious person.

DISPOSAL PROCEDURES

Spill, Leak or Release:

Dike spill with sand or earth. Absorb with sand or non-flammable absorbent material and transfer to steel drums for recovery or disposal. Flush away remaining traces with water.

SHIPPING PRECAUTIONS

Transportation:

DMAC is regulated as a Hazardous Material by the Department of Transportation (DOT). The DOT proper shipping name is Combustible Liquid, N.O.S. The DOT Hazard Class is Combustible Liquid (49 CFR 172.101). Combustible liquids are not regulated by DOT in containers less than 110 gallons (49 CFR 173.118a). 49 STC Code = 4915185.

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