

DANVERS INDUSTRIAL PARK
10 ELECTRONICS AVE., DANVERS, MA 01923
(508) 777-7860 FAX (508) 739-5640

TRANSENE COMPANY, INC.

THIS MATERIAL SAFETY DATA SHEET (MSDS) HAS BEEN PREPARED IN COMPLIANCE WITH THE FEDERAL OSHA HAZARD COMMUNICATION STANDARD, 29 CFR 1910.1200. THIS PRODUCT MAY BE CONSIDERED TO BE A HAZARDOUS CHEMICAL UNDER THAT STANDARD. (REFER TO THE OSHA CLASSIFICATION IN SEC. I.) THIS INFORMATION IS REQUIRED TO BE DISCLOSED FOR SAFETY IN THE WORKPLACE. THE EXPOSURE TO THE COMMUNITY, IF ANY, IS QUITE DIFFERENT.

I. PRODUCT IDENTIFICATION

REVISION NO : 14
REVISION DATE : 1/01/97
PRODUCT CODE : HPE880113
FILE NUMBER : HPE00018.0004

PRODUCT NAME: TITANIUM ETCHANT TFTN

SYNONYMS: Chlorohydric acid, hydrogen chloride, muriatic acid

CHEMICAL FAMILY: Inorganic acid

FORMULA: HCl

DESCRIPTION: Acid

OSHA HAZARD CLASSIFICATION: Corrosive; eye and skin hazard; lung toxin

II. COMPONENT DATA

PRODUCT COMPOSITION

CAS or CHEMICAL NAME: HYDROCHLORIC ACID MIXTURE

CAS NUMBER: 7647-01-0 (HCL)

PERCENTAGE RANGE: 15%

HAZARDOUS PER 29 CFR 1910.1200: Yes

EXPOSURE STANDARDS:

	OSHA (PEL)		ACGIH (TLV)	
	ppm	mg/cubic-meter	ppm	mg/cubic-meter
TWA:		None		None
CEILING:	5	7	5	7.5
STEL:		None		None

CAS or CHEMICAL NAME: Water

CAS NUMBER: 7732-18-5

PERCENTAGE RANGE: 62-93%

HAZARDOUS PER 29 CFR 1910.1200: No

EXPOSURE STANDARDS: None Established

III. PRECAUTIONS FOR SAFE HANDLING AND STORAGE

DO NOT TAKE INTERNALLY. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. UPON CONTACT WITH SKIN OR EYES, WASH OFF WITH WATER. AVOID BREATHING MIST OR VAPOR.

STORAGE CONDITIONS: Store in cool, clean, well-ventilated area.

DO NOT STORE AT TEMPERATURES ABOVE: 38 Deg.C (100 Deg.F)

DO NOT EXPOSE TO DIRECT LIGHT.

PRODUCT STABILITY AND COMPATIBILITY: Stable

SHELF LIFE LIMITATIONS: 1 year

INCOMPATIBLE MATERIALS FOR PACKAGING: Glass or polyethylene containers recommended.

INCOMPATIBLE MATERIALS FOR STORAGE OR TRANSPORT: When shipped with oxidizers, must be separated by 18 inches, with wood pallets and

absorbent material in between.

IV. PHYSICAL DATA

APPEARANCE: Clear, colorless liquid

FREEZING POINT: 7% (-2 Deg.C (28 Deg.F))

37% (-74 Deg.C (-101 Deg.F))

BOILING POINT: 7-20% (> 100-110 Deg.C (>212 to 230 Deg.F))

20-38% (110-74 Deg.C (230 to 167 Deg.F))

DECOMPOSITION TEMPERATURE: No Data

SPECIFIC GRAVITY: 1.035-1.188

BULK DENSITY: Not Applicable

pH @ 25 DEG.C: < 1

VAPOR PRESSURE @ 20 DEG.C: 7-32% (0-23.5 mmHg)

(Partial pressure HCl) 32-38% (23.5-210 mmHg)

SOLUBILITY IN WATER: Complete

VOLATILES, PERCENT BY VOLUME: 100%

EVAPORATION RATE: Approximately 1 (Water=1)

VAPOR DENSITY: 1.3 (active ingredient)

MOLECULAR WEIGHT: 36.46 (Active ingredient)

ODOR: Pungent, suffocating odor.

COEFFICIENT OF OIL/WATER DISTRIBUTION: No Data

V. PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

PERSONAL PROTECTION FOR ROUTINE USE OF PRODUCT

RESPIRATORY PROTECTION: Respirator protection not normally needed.

If vapors, mists, or aerosols are generated,
wear a NIOSH/MSHA approved respirator.

VENTILATION: Local exhaust ventilation is recommended if vapors, mists or aerosols are generated. Otherwise, use good general room ventilation.

SKIN PROTECTIVE EQUIPMENT: Wear gloves, boots, apron and a face shield with safety glasses. A full impermeable suit is recommended if exposure is possible to large portion of body.

OTHER: Emergency eye wash and safety showers must be provided in the immediate work area.

EQUIPMENT SPECIFICATIONS:

RESPIRATOR TYPE: Full facepiece, NIOSH/MSHA approved equipped with chemical cartridges approved for hydrogen chloride
GLOVE TYPE: Neoprene
BOOT TYPE: Neoprene
APRON TYPE: Neoprene
FACE SHIELD: Yes
PROTECTIVE SUIT: Neoprene

VI. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABILITY DATA:

FLAMMABLE: No
COMBUSTIBLE: No
PYROPHORIC: No
FLASH POINT: Not Applicable
AUTOIGNITION TEMPERATURE: Not Applicable
FLAMMABLE LIMITS AT NORMAL ATMOSPHERIC TEMPERATURE AND PRESSURE (PERCENT VOLUME IN AIR): LEL - Not Applicable UEL - Not Applicable

NFPA RATINGS:

Health: 3
Flammability: 0
Reactivity: 1

HMIS RATINGS:

Health: 3
Flammability: 0
Reactivity: 1

EXTINGUISHING MEDIA: Not Applicable

FIRE FIGHTING TECHNIQUES AND COMMENTS: Use water to cool containers exposed to fire. Contact with reactive metals, e.g., aluminum may result in the generation of flammable hydrogen gas. On small fires, use dry chemical or carbon dioxide. On large fires, use water. Not combustible but contact with common metals produces flammable hydrogen gas. May also release chlorine gas by reaction with oxidizing agents.

VII. REACTIVITY INFORMATION

CONDITIONS UNDER WHICH THIS PRODUCT MAY BE UNSTABLE:

TEMPERATURES ABOVE: No Data

MECHANICAL SHOCK OR IMPACT: No

ELECTRICAL (STATIC) DISCHARGE: No

HAZARDOUS POLYMERIZATION: Will not occur

INCOMPATIBLE MATERIALS: Alkaline materials, aluminium, amines, carbonates, iron, sulfuric acid, hydroxides, leather and other

fabrics, metallic oxides, magnesium, oleum, perchloric acid, zinc
HAZARDOUS DECOMPOSITION PRODUCTS: Flammable hydrogen gas by reaction with many metals. Also, chlorine gas is released by reaction with oxidizing agents.

OTHER CONDITIONS TO AVOID: Heat, exposure to sunlight

SUMMARY OF REACTIVITY:

OXIDIZER: No

PYROPHORIC: No

ORGANIC PEROXIDE: No

WATER REACTIVE: No

CORROSIVE: Yes

VIII. FIRST AID

EYES: Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Call a physician at once.

SKIN: Immediately flush with water for at least 15 minutes. Call a physician. If clothing comes in contact with the product, the clothing should be removed immediately and should be laundered before re-use.

INGESTION: Immediately drink large quantities of water. DO NOT induce vomiting. Call a physician at once. DO NOT give anything by mouth if the person is unconscious or if having convulsions.

INHALATION: If person experiences nausea, headache or dizziness, person should stop work immediately and move to fresh air until these symptoms disappear. If breathing is difficult, administer oxygen, keep the person warm and at rest. Call a physician. In the event that an individual inhales enough vapor to lose consciousness, person should be moved to fresh air at once and a physician should be called immediately. If breathing has stopped, artificial respiration should be given immediately. In all cases, ensure adequate ventilation and provide respiratory protection before the person returns to work.

IX. TOXICOLOGY AND HEALTH INFORMATION

ROUTES OF ABSORPTION

Oral, dermal, inhalation, eye contact

WARNING STATEMENTS AND WARNING PROPERTIES

MAY BE HARMFUL IF SWALLOWED. CAUSES EYE, SKIN, DIGESTIVE TRACT AND RESPIRATORY TRACT BURNS. CAN CAUSE LUNG DAMAGE.

HUMAN DOSE RESPONSE DATA

ODOR THRESHOLD: The odor threshold for concentrated HCl (38%) is 1-5 ppm.

IRRITATION THRESHOLD: Irritation threshold for concentrated HCl has been reported to be 5 ppm or greater.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH: The IDLH for hydrogen chloride gas is 50 ppm.

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE

INHALATION

ACUTE:

Inhalation of the mist or vapor or hydrogen chloride gas may cause irritation of the mucous membranes and respiratory tract with symptoms of burning, choking and coughing. At exposure concentrations greater than the TLV, damage may occur to the mucous membranes (ulceration of the nose and throat) and respiratory tract. At these high concentrations, severe breathing difficulties may occur which may be delayed in onset and may be due to pulmonary edema (fluid in the lung) or laryngeal edema or spasm.

CHRONIC:

Repeated or prolonged exposure to concentrations greater than accepted occupational limits may cause dental discoloration and erosion of the teeth.

SKIN

ACUTE:

Hydrochloric acid mist may rapidly cause skin inflammation and burns. Direct contact with the liquid will be corrosive to the skin and can cause severe irritation and/or burns characterized by redness, swelling and scab formation. The potential for scarring and ulceration of the contacted tissue also exists.

CHRONIC:

Repeated contact with the mist has been reported to cause a contact dermatitis (skin rash). Prolonged or repeated exposure with the liquid may cause permanent damage.

EYE

ACUTE:

Exposure to the mist may result in eye irritation and/or severe burns with permanent damage and possible loss of sight. Direct contact with the liquid will be corrosive to the eye with resulting severe burns, potential visual impairment or loss of sight.

INGESTION

ACUTE:

Irritation and/or burns can occur to the entire gastrointestinal tract, including the stomach and intestines, characterized by nausea, vomiting, diarrhea, abdominal pain, bleeding, and/or tissue ulceration. Ingestion causes severe damage to the gastrointestinal tract with the potential to cause perforation.

CHRONIC:

There are no known or reported effects from chronic exposure. Chronic ingestion of significant amounts of this product is unlikely because of its acute corrosive action.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Respiratory and cardiovascular disease

INTERACTIONS WITH OTHER CHEMICALS WHICH ENHANCE TOXICITY

None known or reported

ANIMAL TOXICOLOGY

ACUTE TOXICITY:

Inhalation LC 50: 3124 ppm/ 1 hour (rat)

Oral LD 50: 900 mg/kg (rabbit)

Dermal LD 50: No Data

Corrosive to skin and eyes; severe respiratory irritant

AQUATIC TOXICITY:

It is the resulting pH rather than the concentration of HCl that governs its lethality to aquatic life. Only when the pH value is depressed to 5.0 or lower will hydrochloric acid prove lethal to fish.

The 96 hr. LC50 at 20 degrees Celsius for bluegill sunfish occurs when HCl lowers the pH value to 3.6. The 96 hr. LC50 for mosquito fish (*Gambusia affinis*) in turbid water is a concentration of 282 mg/l of HCl.

100% mortality to trout occurred for a 24 hr. exposure at a concentration of 10 mg/l.

The toxic threshold of HCl toward *Daphnia magna* has been reported to be 56 to 62 mg/l in soft water and Lake Erie water, respectively.

ACUTE TARGET ORGAN TOXICITY:

This product is corrosive to all tissues contacted and upon inhalation, may cause irritation to mucous membranes and respiratory tract.

CHRONIC TARGET ORGAN TOXICITY:

The only known or reported health effects from repeated exposure to hydrochloric acid are described above and are related to tissue damage to dental enamel and gums leading to erosion of the teeth. These effects would occur from exposures greater than currently accepted occupational limits.

REPRODUCTIVE TOXICITY:

There are no known or reported effects on reproductive function or fetal development.

CARCINOGENICITY:

This product is not known or reported to be carcinogenic by any reference source including IARC, OSHA, NTP, or EPA. IARC has classified hydrochloric acid as having inadequate evidence for carcinogenicity to humans and animals. IARC therefore considers hydrochloric acid to be not classifiable as to its carcinogenicity to humans.

The carcinogenesis response to the combined and separate exposures to formaldehyde and hydrochloric acid was investigated in male inbred Sprague-Dawley rats. The rats were exposed to gaseous formaldehyde, 14 ppm and hydrochloric acid, 10 ppm. No carcinogenic response was observed with hydrochloric acid alone.

MUTAGENICITY:

Hydrochloric acid has been tested and was shown to be non-mutagenic in a battery of mutagenicity and genotoxicity assays including the following: Ames assay, Salmonella and Saccharomyces (yeast) microbial assays, L5178Y mouse lymphoma gene mutation assay, sister chromatid exchange assay, and the mammalian chromosomal aberrations assay.

X. TRANSPORTATION INFORMATION

THIS MATERIAL IS REGULATED AS A DOT HAZARDOUS MATERIAL.

DOT DESCRIPTION FROM THE HAZARDOUS MATERIALS TABLE 49 CFR 172.101:
LAND (U.S. DOT): HYDROCHLORIC ACID SOLUTION, 8, UN1789, PG 11

WATER (IMO): Same as above

AIR (IATA/ICAO): Same as above

HAZARD LABEL/PLACARD: CORROSIVE

REPORTABLE QUANTITY: 5000 lbs. (Per 49 CFR 172.101, Appendix)

EMERGENCY GUIDE NO: 60

SPECIAL COMMENTS: RQ does not apply to package size.

XI. SPILL AND LEAKAGE PROCEDURES

FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC AT 800-424-9300.

REPORTABLE QUANTITY: This product is subject to a Reportable Quantity with respect to hydrochloric acid. RQs are subject to change and reference should be made to 40 CFR 302.4 for the current requirements.

SPILL MITIGATION PROCEDURES:

Hazardous concentrations in air may be found in local spill area and immediately downwind.

AIR RELEASE: Vapors may be suppressed by the use of a water fog, or vapor suppressant foam. Dike and contain all run-off water for treatment as a hazardous waste.

WATER RELEASE: This material is heavier than and soluble in water. Contain contaminated water by building a dike of compatible absorbents. Vacuum or pump material to a neutralization container and treat. See SPILL RESIDUES below.

LAND SPILL: Compatible absorbents: Sand, clay soil and commercial absorbents.

SPILL RESIDUES:

Dispose of per guidelines under Section XII, WASTE DISPOSAL.

This material may be neutralized for disposal; you are requested to contact OCEAN at 800-OLIN-911 before beginning any such operation.

PERSONAL PROTECTION FOR EMERGENCY SPILL AND FIRE-FIGHTING SITUATIONS:

Response to this material MAY REQUIRE the use of a full encapsulated suit and self-contained breathing apparatus (SCBA).

Additional protective clothing must be worn to prevent personal contact with this material. Those items include but are not limited to boots, gloves, hard hat, splash-proof goggles, full face shield, impervious clothing, i.e., chemically impermeable suit, and self-contained breathing apparatus.

Compatible materials for response to this material are neoprene or butyl rubber.

XII. WASTE DISPOSAL

If this product becomes a waste, it meets the criteria of a hazardous waste as defined under 40 CFR 261 and would have the following EPA hazardous waste number: D002.

If this product becomes a waste, it will be a hazardous waste which is subject to the Land Disposal Restrictions under 40 CFR 268 and must be managed accordingly.

As a hazardous liquid waste, it must be disposed of in accordance with Local, State and Federal regulations in a permitted hazardous waste treatment, storage and disposal facility by treatment.

CARE MUST BE TAKEN TO PREVENT ENVIRONMENTAL CONTAMINATION FROM THE USE OF THIS MATERIAL. THE USER OF THIS MATERIAL HAS THE RESPONSIBILITY TO DISPOSE OF UNUSED MATERIAL, RESIDUES AND CONTAINERS IN COMPLIANCE WITH ALL RELEVANT LOCAL, STATE AND FEDERAL LAWS AND REGULATIONS REGARDING TREATMENT, STORAGE AND DISPOSAL FOR HAZARDOUS AND NONHAZARDOUS WASTES.

XIII. ADDITIONAL REGULATORY STATUS INFORMATION

TOXIC SUBSTANCES CONTROL ACT:

This substance is listed on the Toxic Substances Control Act inventory.

NSF LIMITS: NSF Maximum Drinking Water Use Concentration - 40 mg/l as hydrochloric acid

SUPERFUND AMENDMENT AND REAUTHORIZATION ACT, TITLE III:

HAZARD CATEGORIES, PER 40 CFR 370.2:

HEALTH:

Immediate (Acute),
Delayed (Chronic)

PHYSICAL:

None

EMERGENCY PLANNING AND COMMUNITY RIGHT TO KNOW, PER 40 CFR 355, APP.A:

EXTREMELY HAZARDOUS SUBSTANCE - THRESHOLD PLANNING QUANTITY:

None Established

SUPPLIER NOTIFICATION REQUIREMENTS, PER 40 CFR 372.45:

This mixture or tradename product contains a toxic chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372.

CHEMICALS LISTED ARE: Hydrochloric acid

XIV. ADDITIONAL INFORMATION

MSDS REVISION STATUS: Revisions to Sections II, III, V, VI, IX, XI and XV.

XV. MAJOR REFERENCES

1. Griffith, J.F., et al., Dose-Response Studies with Chemical Irritation in the Albino Rabbit Eye as a Basis for Selecting Optimum Testing Conditions for Predicting Hazard to the Human Eye. Toxicology and Applied Pharmacology, Vol. 55, pp. 501-513, 1980.
2. Toxicological Testing of Selected Hazardous Materials for Transportation Purposes. NTIS PB Report: (PB-270-991), National Technical Information Service, Springfield, VA, April 1976.

3. Isquith, A., et al., Genotoxicity Studies on Selected Organosilicon Compounds: In Vitro Assays. Food and Chemical Toxicology, Vol. 26, No. 3, pp. 255-261, 1988.
4. Sellakumar, Arthur R., et al., Carcinogenicity of Formaldehyde and Hydrogen Chloride in Rats. Toxicology and Applied Pharmacology, Vol. 81, pp. 401-406, 1985.

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET SHOULD BE PROVIDED TO ALL WHO WILL USE, HANDLE, STORE, TRANSPORT, OR OTHERWISE BE EXPOSED TO THIS PRODUCT. THIS INFORMATION HAS BEEN PREPARED FOR THE GUIDANCE OF PLANT ENGINEERING, OPERATIONS AND MANAGEMENT AND FOR PERSONS WORKING WITH OR HANDLING THIS PRODUCT. OLIN BELIEVES THIS INFORMATION TO BE RELIABLE AND UP TO DATE AS OF THE DATE OF PUBLICATION, BUT MAKES NO WARRANTY THAT IT IS. ADDITIONALLY, IF THIS MATERIAL SAFETY DATA SHEET IS MORE THAN THREE YEARS OLD, YOU SHOULD CONTACT OLIN AT THE PHONE NUMBER LISTED BELOW TO MAKE CERTAIN THAT THIS SHEET IS CURRENT.

TRANSENE COMPANY, INC.

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be

Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS

must include a copy of this addendum

Hazard Categories for SARA
Section 311/312 Reporting

Acute Chronic Fire Pressure Reactive
.....

Product or Components
of Product:

Hydrochloric Acid (7647-01-0)

Applicable Products:

PC Copper Etchant (CE-100, CE-200),
CRE-473, Iron Oxide Mask Etchant, TFP,
TFIN, Electroless Nickel Plating Strike,
PC Electroless Copper D, Bright Electroless
Tin Part B, SF50

SARA EHS Sec. 302 RQ (lbs.)	TPQ (lbs.)	SARA Section 313 Chemicals Name List	Chemical Category	CERCLA Sec. 103 RQ (lbs.)	RCRA Sec. 261.33
5000	500	Yes	No	5000	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.

SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.

SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Environmental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802). Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

Effective Date: 02-17-87 Supersedes 04-30-86

PALLADIUM ETCHANT TITANIUM ETCHANT

Selective and controllable etchants for application in Semiconductor fabrication and thin film microelectronics technology.

TFP, Palladium Etchant is designed for high resolution pattern delineation of sputtered, evaporated and electrolessly deposited films. These films are commonly employed barrier layers for silicon wafer metallization systems of nickel and gold.

TFT, Titanium Etchant is designed for etching evaporated films commonly employed as bonding and barrier layers in microelectronics. Excellent resolution, photo resist compatibility, and minimal undercutting are readily achieved.

TFTN, Titanium Etchant is intended for etching Ti films deposited on glass on SiO₂ substrates. TFTN does not contain hydrofluoric acid.

PROPERTIES

Appearance

pH

Flash Point

Storage

Shelf/Life

Toxicity

OPERATION

Tank

Temperature

Etch Rate

Rinse

* Compatible

Resists

Metallization

TFP

Dark Amber Aqueous Solution

<1

Non-Flammable Room-Temperature

1 year

Acid

Glass/Pyrex/PVC

40°- 60°C

110A/Sec @ 50°C

Water

Pos & Neg. Gold/Ni-gold

TFT

Clear Aqueous Solution

1

Non-Flammable Room Temperature

1 year

Strong Acid

Polyethylene/ Polypropylene

20°-50°C

25A/sec @ 20°C

50A/sec @ 30°C

Water

Pos & Neg.



TFTN

Clear Aqueous Solution

1

Non-Flammable Room-Temperature

1 year

Strong Acid

Polyethylene/ Polypropylene

70°-85°C

10A/sec @ 70°C

50A/sec @ 85°C

Water

Pos & Neg. Most Metals Except Al

*** KPR/KMER/KTFR: PKP (Transene); AZ/RISTON/ETC.**

Transene Co. Inc. 10 Electronics Ave, Danvers, MA 01923 Tel: 978-777-7860 Fax: 739-5640