

Industrial Summit Technology Corporation  
Material Safety Data Sheet

SKYBOND® 1028 POLYIMIDE RESIN

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## 1. PRODUCT IDENTIFICATION

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Synonym:	Solution of aromatic polyimide precursor in ethanol, xylene and n-methyl pyrrolidone (NMP)
Chemical Name:	1,2-Benzenedicarboxylic acid, 4,4'-carbonylbis-,ar,ar'-diethyl ester, compd. With 4,4-methylenebis[benzenamine] (1:1)
CAS No.:	65701-06-6
Contains:	Methanol, CAS No. 67-56-1, <0.7%, Methylisobutyl ketone, CAS No. 108-10-1, <0.4%
TSCA Inventory:	All components of this product appear on the Inventory of Chemical Substances published by the U.S. Environmental Protection Agency (EPA) under the authority of the Toxic Substances Control Act (TSCA).
DOT Proper Shipping Name:	Resin Solution
DOT Hazard Class/I.D. No./Packaging Group:	3 Flammable Liquid / UN 1866 / PGII
DOT Label:	Flammable Liquid
U.S. Surface Freight Classification:	Plastics, synthetic, N.O.I. liquid
SARA Hazard Notification Hazard Categories under criteria of SARA Title III rules (40 CFR Part 370):	Immediate, Delayed, Fire.
Section 313 Toxic Chemical(s):	This product contains the following substances which are defined as toxic chemicals under and subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization
Act of 1986 and 40 CFR Part 372:	<ul style="list-style-type: none"><li>• Xylene (dimethylbenzene), CAS No. 1330-20-7</li><li>• 4,4'-Methylenedianiline (MDA), CAS No. 101-77-9</li><li>• Ethylbenzene, CAS No. 100-41-4</li><li>• n-Methylpyrrolidinone (n-methylpyrrolidinone, NMP), CAS No. 872-50-4</li></ul>

In addition to the SARA 313 chemicals listed above, this product contains the following substances which is identified as a hazardous chemical under the criteria of the OSHA Hazard Communication Standard (29 CFR 1910.1200):

- Ethyl alcohol (ethanol), CAS No. 64-17-5
- Silicon dioxide (amorphous), CAS No. 7631-86-9

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## 2. WARNING STATEMENTS;

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DANGER!  
FLAMMABLE LIQUID AND VAPOR CAUSES EYE, SKIN AND RESPIRATORY TRACT IRRITATION  
MAY CAUSE ALLERGIC SKIN REACTION CONTAINS MDA: CONTAINS MATERIALS, WHICH MAY CAUSE  
CANCER, LIVER TOXIN

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### 3. PRECAUTIONARY MEASURES

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Keep away from heat, sparks and flame.  
Use with adequate ventilation.  
Avoid contact with eyes, skin and clothing.  
Avoid breathing vapors.  
Keep container closed.  
Wash thoroughly after handling.

#### CONTAINER HAZARDOUS WHEN EMPTY:

Emptied containers resin vapor and product residue. FOLLOW LABELED WARNINGS EVEN AFTER CONTAINER IS EMPTIED. RESIDUAL VAPORS MAY EXPLODE ON IGNITION. DO NO CUT, DRILL, GRIND OR WELD ON OR NEAR THIS CONTAINER. Improper disposal or reuse of this container may be dangerous and/or illegal.

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### 4. EMERGENCY AND FIRST AID PROCEDURES

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#### FIRST AID:

IF IN EYES, immediately flush with plenty of water for at least 15 minutes.  
Get medical attention. Remove material from skin and clothing.

IF ON SKIN, immediately wash with soap and plenty of water.  
Remove contaminated clothing. Get medical attention. Wash clothing before reuse.

IF INHALED, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention. Remove material from eyes, skin and clothing.

#### IN CASE OF:

FIRE, use water spray, dry chemical, foam or carbon dioxide.

SPILL OR LEAK, flush area with water spray (see "Spill, Leak & Disposal Information" section).

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### 5. OCCUPATIONAL CONTROL PROCEDURES

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Eye Protection: Where there is significant potential for eye contact, wear chemical goggles and have eye flushing equipment available.

Skin Protection: Wear appropriate protective clothing and chemical resistant gloves to prevent skin contact. Consult glove manufacturer to determine type of glove for given application. Wear chemical safety glasses, a face shield and a chemical apron when splashing is likely. Wash immediately if skin is contaminated. Remove contaminated clothing promptly and launder before reuse. Clean protective equipment before reuse. Provide a safety shower at any location where skin contact can occur. Wash thoroughly after handling.

Attention! Repeated or prolonged contact may cause allergic skin reaction in some people.

Respiratory Protection: Avoid breathing vapor and/or mist. Use NIOSH/MSHA approved respiratory protection equipment (full facepiece recommended) when airborne exposure limits (see below) are exceeded. If used, full facepiece replaces need for face shield and Chemical goggles. Consult respirator manufacturer to determine appropriate type equipment for given application. Observe

respirator use limitations specified by NIOSH/MSHA or the manufacturer. Respiratory protection programs must comply with 29 CFR 1910.134.

Ventilation: Provide natural or mechanical ventilation to control exposure levels below airborne exposure limits (see below). If practical, use local mechanical exhaust ventilation at sources of air contamination such as open process equipment. Consult NFPA Standard 91 for design of exhaust system.

Airborne Exposure Limits:

Product: SKYBOND® 1028 polyimide resin  
OSHA PEL: None established  
ACGIH TLV: None established

Component: Ethanol wt. % ~17  
OSHA PEL: 1000ppm 8-hour time-weighted average  
ACGIH TLV: 1000ppm 8-hour time-weighted average

Component: Xylene wt. % ~16  
OSHA PEL: 100ppm 8-hour Time-weighted average, 150ppm short-term exposure limit  
ACGIH TLV: 100ppm 8-hour Time-weighted average, 150ppm short-term exposure limit

Component: n-Methylpyrrolidone wt. % ~5  
OSHA PEL: None established  
ACGIH TLV: None established

IST Corp. has adopted, for its own internal use, an exposure limit 2ppm (8 mg/m<sup>3</sup>) (Skin)\*, 8-hour time-weighted average for this material.

Component: Silicon dioxide (amorphous) wt. % ~4  
OSHA PEL: 10mg/m<sup>3</sup> 8-hour Time-weighted average  
ACGIH TLV: Total dust 10mg/m<sup>3</sup> 8-hour Time-weighted Average

Component: Ethylbenzene (contained in xylene) wt. % ~3  
OSHA PEL: 100ppm 8-hour Time-weighted average, 125ppm short-term exposure limit  
ACGIH TLV: 100ppm 8-hour Time-weighted average, 125ppm short-term exposure limit

Component: 4,4'-Methylenedianiline wt. % ~18  
OSHA PEL: 10ppb 8-hour time-weighted average  
ACGIH TLV: 0.1ppm 8-hour time-weighted average – Skin\*

The ACGIH has designated 4,4'-Methylenedianiline an "A2" substance, thereby including 4,4'-Methylenedianiline among industrial substances suspect of carcinogenic potential for man. Worker exposure by all routes should be carefully controlled.

\*Skin notation means that skin absorption of this material may add to the overall exposure. Avoid skin contact.

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## 6. FIRE PROTECTION INFORMATION

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Flash Point 42°F

Method: Pensky-Martens, Closed Cup

Extinguishing Media: Water spray, dry chemical, foam, carbon dioxide or any Class B extinguishing agent.

Special Firefighting Procedures: Firefighters and others who may be exposed to products of combustion (see "Hazardous Decomposition Products", below) should wear full

protective clothing and self-contained breathing apparatus. Thoroughly decontaminate equipment after use.

Unusual Fire and Explosion Hazards: Closed containers exposed to heat may build up pressure. Use water spray to keep exposed containers and equipment cool.

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## 7. REACTIVITY DATA

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Materials To Avoid: Strong oxidizing, strong alkali.

Conditions To Avoid: Do not expose to heat or ignition sources. Volatiles given off during cure include ethanol, n-methylpyrrolidone, xylene.

Hazardous Decomposition Products: Carbon monoxide, nitrogenous products.

Hazardous Polymerization: Does not occur.

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## 8. HEALTH EFFECTS SUMMARY

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The following information summarizes human experience and the results of scientific investigations reviewed by health professionals for hazard evaluation of Skybond® 1028 polyimide resin solution and development of Precautionary Measures and Occupational Control Procedures recommended in this document.

### Effects of Exposure

Inhalation and skin contact are expected to be the primary routes of occupational exposure to SKYBOND® 1028 polyimide resin. Occupational exposure to this material has not been reported to cause significant adverse human health effects. However, the organic solvents described below have been reported to cause eye, skin and respiratory tract irritation. These solvents possess narcotic-like properties; excessive exposure may result in headache, dizziness, incoordination, nausea, loss of appetite and loss of consciousness. 4,4'-Methylenedianiline (MDA) may be present in free or partially reacted form (salts) in this SKYBOND resin. MDA has been reported to cause eye, skin and respiratory tract irritation. Reversible liver damage (hepatitis) has occurred in humans occupationally exposed to MDA. Symptoms include severe pain in the upper abdomen, high fever and chills and subsequent jaundice (yellowing of the eyes and skin). These symptoms may be delayed several days following exposure. Although infrequent, allergic skin reaction has been reported in humans animals following repeated or prolonged contact with MDA. Laboratory animals have also demonstrated allergic skin reaction following MDA exposures.

### Toxicological Data

Data from I.S.T Corp. studies are given below: Single-dose (acute) animal studies indicate:

Eye Irritation: Severely Irritating (Rabbit, 4-hr. exposure)

Skin Irritation: Severely Irritating (Rabbit, 4-hr. exposure)

Single-dose animal studies on similar SKYBOND polyimide resins indicate that these materials range from slightly toxic to practically nontoxic orally (rats) and practically nontoxic after skin application (rabbits). SKYBOND 1028 polyimide resin has not been tested for the potential to produce allergic skin reaction. However, no allergic skin reaction was observed in guinea pigs following repeated skin exposure to related SKYBOND polyimide resins. Studies with rats exposed to a similar SKYBOND polyimide resin by repeated skin application (4 weeks) reported decreased body weights, enlarged thyroid glands, serum chemistry changes, kidney effects and thyroid changes. A similar SKYBOND produced genetic changes in standard tests with bacterial cells; however, no adverse genetic changes were observed in standard tests with animals and animal cells.

### Components

Data from the available scientific literature on the components of SKYBOND 1028 polyimide resin which have been identified under the criteria of the OSHA Hazard Communication Standard (29 CFR 1910.1200) are discussed below:

#### 4,4'-Methylenedianiline (MDA)

Single-dose (acute) animal studies indicate that MDA is slightly toxic orally (rats). Rabbits, cats and dogs displayed liver and kidney damage following single oral doses of MDA at low to moderate levels. Numerous studies report liver damage in laboratory animal from repeated exposure to MDA by various routes including skin implantation (rats), dietary feeding (rats, dogs), skin application (rabbits) and short and long-term oral administration (rats, mice, dogs).

Kidney changes were also reported in rats and mice given MDA in their drinking water for 2 years. MDA has produced tumors (liver, kidney, thyroid) in rats and mice following long-term oral administration; however, no increase in bladder or liver tumors were observed in dogs given MDA in their feed for 7 years. Genetic changes were reported in standard tests using animal and bacterial cells, yeast and animals. No adverse genetic changes were reported in standard tests using insects and human cell cultures.

4,4'-Methylenedianiline is listed as a substance that "may reasonably be anticipated to be carcinogenic" by the National Toxicology Program (NTP) in their Fifth Annual Report on Carcinogens, and is classified as "possibly carcinogenic to humans" by the International Agency for Research on Cancer (IARC Monographs, Vol. 39), and is regulated as a carcinogen by OSHA (29 CFR 1910.1050). The NTP listing is based, in part, on their determination that "there is sufficient evidence for the carcinogenicity of 4,4'-methylenedianiline in experimental animals". The IARC listing is based on their determination that "there is sufficient evidence for the carcinogenicity of MDA in humans and limited evidence for the carcinogenicity of MDA in experimental animals". The OSHA listing is also based on the animal data and a NIOSH report which associated elevated bladder cancer risk with workers exposed to MDA, although OSHA concluded that the evidence in humans "was not conclusive".

#### Ethanol

In addition to the irritating effects noted above, swallowing of ethanol also causes nervous system effects and gastrointestinal tract effects; substantial amounts may cause respiratory failure leading to death. Other effects of ethanol related to repeated intake of alcoholic beverages include nutritional deficiencies, pancreas and liver damage and blood cell changes. Repeated consumption of ethanol (alcoholic beverages) by pregnant women is reported to produce adverse effects on the development of their offspring ("fetal alcohol syndrome")

Single-dose studies indicate that ethanol is practically nontoxic orally (rats) and after skin application (rabbits) or after inhalation (rats). It is mildly to severely irritating to rabbit eyes and practically nonirritating to moderately irritating to rabbit skin. It is practically nontoxic by inhalation (rat, LC50 - 20,000 ppm, 10 hour exposure). Various morphological functions and biochemical changes in heart muscle, liver, CNS and blood cells have been reported for experimental animals given ethanol orally. Repeated inhalation exposures produced liver damage in rabbits, while other treatment-related effects were reported in pigs, dogs and monkeys. Rats exposed by skin application to a 50% solution of ethanol showed only temporary skin irritation.

Several species of laboratory animals have been exposed to ethanol by various routes to determine effects on offspring. While susceptibility varies with each species, birth defects have been consistently reported in many of the species tested (mouse, rat, pig, guinea pig, monkey). Ethanol produced genetic changes in standard tests using human volunteers and animals and yeast cells. No genetic changes were reported in standard tests using bacterial or animal cells, and negative responses were reported in assays using human cells.

Ethanol is listed as a substance which is "carcinogenic to humans" by the International Agency for Research on Cancer (IARC Monographs Vol. 44). This IARC listing is based on their determination that although inadequate evidence exists for the carcinogenicity of ethanol and alcohol beverages in animals, sufficient evidence exists for the carcinogenicity of alcoholic beverages following long-term consumption of alcoholic beverages. Epidemiological studies report increased incidence of mouth and throat cancer in humans after long-term consumption of alcoholic beverages. Higher risk is associated with the drinking of dark liquors and for smokers who consume alcoholic beverages.

## Xylene

In addition to the adverse effects noted above, swallowing of xylene may cause digestive tract irritation. Although xylene exists in different structural forms (isomers), single-dose studies using a mixture of these forms indicate that xylene is slightly toxic orally (rats) and after skin application (rabbits). It is slightly irritating to the eyes of rabbits and severely irritating to the skin of rabbits. No mortality occurred in rats exposed to mixed xylene at a concentration of 21.2 mg/l for 6 hours. Repeated application of xylene to the skin of rabbits produced irritation and skin damage. Various laboratory animals exposed to xylene by repeat inhalation at high atmospheric concentrations showed slight blood changes. Guinea pigs exposed to xylene at lower concentrations showed liver damage and lung inflammation. Rats and dogs exposed to xylene by inhalation at similar levels showed no adverse effects. Rats and mice repeatedly administered xylene orally showed no evidence of toxicity or tumor development.

No birth defects were reported in two studies with rats exposed by inhalation to mixed xylene (containing ethylbenzene); toxic effects were noted in the offspring from only one study. Birth defects occurred in mice exposed orally to mixed xylene (containing ethylbenzene) at levels that produced adverse effects and mortality in the mothers. No adverse effects on the ability of rats to reproduce was reported following repeated inhalation and oral exposures.

Limited studies indicated that no adverse genetic changes occurred in humans exposed to xylene by inhalation. No adverse genetic changes were reported in standard tests using bacterial and yeast cells, insects, animals and animal cells.

## n-Methylpyrrolidone (NMP)

Human experience indicates that continued or gross skin contact with NMP produces irritation, redness and defatting of the skin. Inhalation of very high concentrations of NMP may result in headache, giddiness, nausea and mental confusion. Repeated dosing of laboratory animals with NMP has been reported to cause changes in organ weights and blood composition, reduced response to sound, and breathing difficulty at a dosage which produced death. No skin allergy was observed in guinea pigs following repeated skin exposure. Long-term inhalation (2 years) of NMP produced no increase in tumors in rats and NMP did not show tumor initiating activity in a mouse skin painting study. Birth defects were reported following dermal application of NMP to rats at amounts which produced adverse effects on the mother and following intraperitoneal injection in two strains of mice. No birth defects were reported in rats exposed to NMP by inhalation. No effects were seen on the ability of rats to reproduce when exposed to NMP for two successive generations, although toxic effects were reported in offspring at levels which produced adverse effects on the mother. NMP has produced no genetic changes in standard tests using animal and bacterial cells.

## Ethylbenzene

Ethylbenzene has been reported to cause severe eye, skin and respiratory tract irritation. Prolonged skin contact with Ethylbenzene may cause blistering, and repeated contact may remove oils from the skin surface causing dryness and cracking of the skin. This component possesses narcotic-like properties; excessive exposure may result in headache, dizziness, incoordination, fatigue, nausea, loss of appetite and loss of consciousness. Coughing, choking and shortness of breath may occur if this material is accidentally drawn into the lungs during swallowing or vomiting.

No allergic skin reaction was observed in controlled skin contact studies with human volunteers. Single-dose (acute) animal studies indicate that Ethylbenzene is slightly toxic orally (rat) and practically nontoxic after skin application (rabbit). It is slightly irritating to rabbit eyes and severely irritating to rabbit skin. One out of six rats died during a single-hour exposure to Ethylbenzene vapor (30.2 mg/L) with another dying during the 14-day observation period. Rats given Ethylbenzene orally for 6 months showed liver and kidney changes.

Numerous short-term repeat inhalation studies have been conducted and report various effects in laboratory animals including increased liver or kidney weights, body weight changes, liver kidney and tests changed. The results from animal studies (rats, rabbits and monkeys) suggest that these studies are not conclusive as to the reproductive effects of Ethylbenzene. No adverse genetic changes were reported in standard tests using bacterial or yeast cells; however, genetic changes were reported in standard tests with human cell cultures.

## Precipitated amorphous silica

Inhalation of amorphous silica can cause drying of mucous membranes of the eyes, nose and throat (due to absorption of moisture and oils), which may result in irritation and occasional nose bleeds. Repeated exposure to amorphous silica has not been reported to have significant adverse health effects in works; however, persons with breathing problems or lung disease may be at an increased risk. Laboratory studies in animals exposed by inhalation to amorphous silica report reversible lung effects.

### Additional Information

Threshold Limit Value (TLVs) has been established by the American Conference of Governmental Industrial Hygienists for ethanol, xylene, and ethylbenzene, the organic solvents used in SKYBOND 1028 polyimide resin, and for methylenedianiline, which may be present as residual monomer in this resin solution. SKYBOND 1028 polyimide resin also contain silica, which, although bound up in the polymer formed from this product, could be released as an airborne particulate following grinding or abrasive polishing of the formed resin. For further information on these materials, please refer to the current edition on the Documentation of Threshold Limit Values and Biological Exposure Indices.

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## **9. PHYSICAL DATA**

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Appearance:	Brown viscous liquid
Odor:	Amine-like
Solubility in Water:	Slight
Specific Gravity(H <sub>2</sub> O = 1):	1.08 – 1.11
Vapor Density:	2.7
Brookfield Viscosity:	2,000 - 6,000 cps at 25°C
Vapor Pressure (mm Hg):	33
Solid after Cure (1.0±0.1g, 288°C at 1hr):	47 – 51%

### Note:

These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specifications for the product.

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## **10. SPILL, LEAK & DISPOSAL INFORMATION**

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### Waste Disposal:

SKYBOND® 1028 polyimide resin is a "hazardous waste" as that term is defined in the Resource Conservation and Recovery Act (RCRA), 40 CFR 261, "Identification and Listing of Hazardous Waste", due to its characteristics of ignitability. Disposal via incineration is required by regulation, Disposal should be in accordance with all applicable local, state and federal laws and regulations. Consult your attorney or appropriate regulatory officials for information on such disposal.

### Spill or Leakage Procedures:

Remove any source of sparks, flame or hot surfaces. Insure adequate ventilation.  
Absorb spill with commercial absorbing materials. Dispose of via authorized landfill procedures consistent with local, state and federal regulations. Flush area with water. Keep out of sewers, water sheds, and water system.

This product contains an ingredient which meets the definition of "polycyclic organic matter" in Section 112 of the Clean Air Act of 1990. The Comprehensive Environmental Response and Liability Act (CERCLA) requires any chemical so listed to be identified as a "hazardous substance" and that an RQ of one pound be established until superseded by EPA regulations. Because 18% of this product's ingredients meet the "polycyclic organic matter" definition, release of more than 5.5 pounds of this product to the environment in a 24 hour period requires notification of the National Response Center (1-800-424-8802). Notification of state authorities may also be required.

For further information refer to DOT Emergency Response Guidebook, Guide #26.

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## 11. ENVIRONMENTAL EFFECTS

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### Environmental Toxicity Information:

I.S.T Corp. has not developed environmental toxicity information on SKYBOND 1028 polyimide resin. However, data are available on SKYBOND 700 polyimide resin, a similar material:

96-hr LC50 Bluegill Sunfish:	380 mg/l, Practically Nontoxic
96-hr LC50 Rainbow Trout:	340 mg/l, Practically Nontoxic
48-hr LC50 Daphnia magna:	16 mg/l, Slightly Toxic

Date: 7/9/96

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**End of MSDS**