

### Flammability ratings for selecting cable ties

Note: Flammability ratings of cable tie materials per UL as follows. These tests for flammability of plastic material are intended to serve as a preliminary indication of acceptability with respect to flammability for particular applications.

### UL 94 vertical burn test procedures

Test specimens of the material, with dimensions 127 x 12.7 mm (5" x 1/2"), with the thickness intended for use in the end product, are tested in both the manufactured condition and in the aged state. The test requires that the specimen be supported in a vertical fixture and a precisely controlled flame applied for a 10 second period. The flame is removed and the duration of flaming is noted. If the flame extinguishes, a second exposure to flame for 10 seconds is applied and duration of flaming is again noted. It is observed and recorded whether or not test specimens drip flaming particles that ignite a cotton swab.

#### Materials classed 94 V-0:

A material classed 94 V-0 shall:

- A Not have any specimens that burn with flaming combustion for more than 10 seconds after either application of the test flame
- B Not have a total flaming combustion time exceeding 50 seconds for the 10 flame applications for each set of five specimens
- C Not have any specimens that burn with flaming or glowing combustion up to the holding fixture
- D Not have any specimens that drip flaming particles that ignite the dry absorbent surgical cotton located 304.8 mm (12") below the test specimen
- E Not have any specimens with glowing combustion that persists for more than 30 seconds after the second removal of the test flame

#### Materials classed 94 V-1:

A material classed 94 V-1 shall:

- A Not have any specimens that burn with flaming combustion for more than 30 seconds after either application of the test flame
- B Not have a total flaming combustion time exceeding 250 seconds for the 10 flame applications for each set of five specimens
- C Not have any specimens that burn with flaming or glowing combustion up to the holding fixture

D Not have any specimens that drip flaming particles that ignite the dry absorbent surgical cotton located 304.8 mm (12") below the test specimen

E Not have any specimens with glowing combustion that persists for more than 60 seconds after the second removal of the test flame.

#### Materials classed 94 V-2:

A material classed 94 V-2 shall:

- A Not have any specimens that burn with flaming combustion for more than 30 seconds after either application of the test flame
- B Not have a total flaming combustion time exceeding 250 seconds for the 10 flame applications for each set of five specimens
- C Not have any specimens that burn with flaming or glowing combustion up to the holding fixture
- D Be permitted to have specimens that drip flaming particles that burn only briefly, some of which ignite the dry absorbent surgical cotton placed 304.8 mm (12") below the test specimen
- E Not have any specimens with glowing combustion that persists for more than 60 seconds after the second removal of the test flame

### UL 94 horizontal burn (HB) test procedures

The test uses a 1/2 inch x 5 inches (12.7 mm x 127 mm) specimen held at one end in a horizontal position with marks at 1 inch (25.4 mm) and 5 inches (127 mm) from the free end. A flame is applied to the free end for 30 seconds or until the flame front reaches the 1 inch (25.4 mm) mark. If combustion continues the duration is timed between the 1 inch (25.4 mm) mark and the 5 inch (127 mm) mark. If combustion stops before the 5 inch (127 mm) mark, the time of combustion and the damaged length between the two marks are recorded. A set of three specimens are tested.

#### Materials classed 94 HB

A material that is less than 0.118 inch (3 mm) in thickness will be classified 94HB if it has a burning rate of less than 3 inches (76.2 mm) per minute or stops burning before the 5 inches (127 mm) mark. If one specimen from the set of three fails to comply, then a second set of three are tested. All three of this second set must comply.

HB rated materials are considered "self-extinguishing". This is the lowest (least flame retardant) UL94 rating.

**\*Nylon 6.6 = Polyamide 6.6 is Halogen-free and Silicone-free.**

### Technical Information

PROPERTY	METHOD	UNIT OF MEASURE	RUBBER BASED (SELF-ADHESIVE)	ACRYLIC BASED (2 COMPONENT GLUE)
COATED SIDES	-	each	2	2
FOAM DENSITY	-	Kg/m <sup>3</sup>	96.9	96.9
PEEL ADHESION	PSTC 1	N/cm width	10.9	
	ASTM D 1000	Average		8.8
<b>SHEAR ADHESION</b>				
22°C 50% R4	PSTC 7	Hours	100 +	8 +
22°C OCCASIONAL WETTING		N/m <sup>2</sup>	68971	15174
TENSILE STRENGTH	ASTM D 412	PSI	100	100 +
TEAR RESISTANCE	ASTM D 624	N/cm	52.6	52.6 +
ELONGATION AT BREAK	-	%	400	200
SERVICE TEMPERATURE	-	°C Min	-18	-29
	-	°C Max	+66	+79
FLAMMABILITY	ASTM D 624		Slow Burn	Slow Burn

### Installation instructions for self-adhesive mounting bases

- Mounting surfaces should be cleaned with alcohol based (IPA) cleaner before application
- The self-adhesive mounting bases have a double-sided adhesive tape made of synthetic foam, covered by a protecting foil.
- To install the self-adhesive mounting base, remove the protecting foil and press the mounting base onto the cleaned surface
- The thickness of the self-adhesive foam (0.8 mm) compensates the irregularities of the application surfaces and allows installations on structured surfaces of cabinet doors, on sheet metal, on machines, etc
- The adhesion is achieved immediately during the installation, which means that later repositioning is not possible

### Product Ref.: TC2PA

- 2 component glue
- Consists of one tube each of adhesive and activator
- Easy application
- Stable and durable adhesion
- Applicable on all Polyamide and Aluminium mounting bases and cable clamps
- Also applicable on concrete and other porous surfaces
- UV resistant

### Installation instructions for Product Ref. :

#### TC2PA (2 component glue)

- Mounting surfaces should be cleaned before application
- The liquid adhesive in the tube is to be spread onto the mounting surface. It can be used on most rough surfaces (like concrete)
- The activator liquid is then spread onto the surface of the mounting base
- Place the surface of the mounting base in contact with the surface where it has to be mounted, position the mounting base correctly and then press firmly
- Repositioning the mounting base remains possible only for a few seconds
- Do not use the mounting base immediately after installation. The Acrylic-based adhesive requires a set-up time that can be influenced by factors such as temperature (allow 24 - 72 hours for maximum performance)
- Temperature of installation needs to be above +20°C

### Ordering Information

PRODUCT REF.	DESCRIPTION	WEIGHT
TC2PA	2 component glue	0.21 kg



UV-resistant



Flame retardant



Heat resistant



Weatherproof



Low temperature flexibility



Radiation resistant



Low smoke



Chemically resistant

### Selecting the right material for your applications

Thomas & Betts offers cable ties and accessories in a wide variety of materials, each suited for specific environments. The purpose of this document, therefore, is to assist in choosing the best material for a particular application.

The effects of weathering, flame, chemicals, extreme temperatures and radiation on the different materials is clearly presented in tabular form. This will facilitate the choice of the best material for the application.

Having determined the most suitable material, one can choose from the wide variety of cable ties, identification ties, mounting bases, lashing ties, etc., offered by Thomas & Betts.

### Material specifications

#### Polyamide 6.6

- Thermoplastic material used in cable ties for universal applications in the industry
- Excellent resistance to shocks, chemicals, oils and temperature fluctuations
- High surface hardness and a small coefficient of friction
- Flammability rating: UL 94 V-2
- Halogen free and Silicone free
- Available in natural version or in a wide range of colours
- Indoor applications

#### Polyamide 6.6, weather resistant



- Similar to Polyamide 6.6, but recommended for outdoor applications
- UV-resistant
- Halogen free and Silicone free
- Colour: black
- Flammability rating: UL 94 V-2

#### Polyamide 6.6, heat stabilised



- Similar to Polyamide 6.6, but increased operating temperatures, up to 105°C
- Excellent tensile strength
- High temperature resistance
- Colour: natural (may have a greenish tint)
- Flammability rating: UL 94 V-2

#### Polyamide 6.6, flame retardant



- Excellent flammability rating: UL 94 V-0
- Ideal in areas where human life is at risk
- Colour: white

#### Polyamide 12, weather resistant



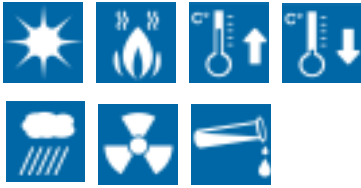
- Extremely flexible, also at low temperatures
- Ages better than Polyamide 6.6
- UV-resistant and weatherproof
- Better chemical resistance than Polyamide 6.6
- Colour: black
- Flammability rating: UL 94 V-2

#### Polypropylene, weather resistant



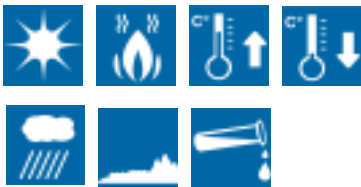
- Resistant against inorganic acids, polyhydric alcohols, neutral and basic salts
- Resists a number of other chemicals
- UV resistant
- Lower tensile strength than Polyamide 6.6
- Colour: black
- Flammability rating: UL 94 HB

### Tefzel® 280 (trademark of DuPont de Nemours)



- Tensile strength slightly lower than Polyamide 6.6
- Tefzel® 280 is inert to most solvents and chemicals, hydrolytically stable, UV and weather resistant
- Radiation resistant (meets IEEE383) and approved for nuclear plant use
- Non-outgassing properties for zero gravity applications
- Very high temperature resistance
- Flammability rating: UL 94 V-0
- The best all around plastic material for cable ties
- Colour: aquamarine

### Halar® (trademark of Solvay Solexis)



- Similar to Tefzel® in performance
- Outstanding characteristic: lower smoke density when burnt
- Recommended for applications where smoke generation is a concern, such as plenum areas
- Colour: maroon
- Flammability rating: UL 94 V-0

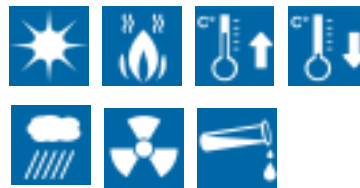
### Delrin® (trademark of DuPont de Nemours)



- Excellent resistance to a wide variety of solvents, esters, oils, greases, gasoline and other petroleum hydrocarbons
- Resistant to weak acids and bases
- Excellent resistance to UV (weatherable acetal)
- Limited self-extinguishing properties
- Colour: black
- Flammability rating: UL 94 HB

### 302/304 Stainless Steel

### 316 Stainless Steel



- Superior corrosion resistance
- Excellent tensile strengths at extreme temperatures
- High resistance to chemicals, acids and radiation
- 316 grade has a better resistance to saltwater corrosion and can be supplied with a halogen free coating
- Extensively used in offshore, rail and petrochemical industries

### General

There is a number of factors to be considered when choosing the proper materials for a specific environment. It is extremely difficult to provide data on all the possible combinations or conditions that can occur and therefore, it is recommended that this information be used as a guideline and that cable tie samples be tested in the intended application, by the user, to determine suitability.

### How to use Table 1:

If your application is in an extremely cold environment, three materials will answer your need: Tefzel<sup>®</sup>\*, Polyamide 12 and stainless steel. If you also require high tensile strength, then stainless steel is your best choice. Where high strength is not required, Polyamide 12 might be your choice as it is the less costly.

This information is based on data provided by the manufacturers of the specific materials listed and is provided only as a general guide. No specific recommendation is intended. As each application may vary, testing should be conducted by the user in the intended environment.

Table 1 gives relative performance ratings of the different materials we offer. Chemical resistance is shown in Table 2

\* Trademark of E.I. Du Pont

### Material codes used in tables

MATERIAL	CODE
STANDARD POLYAMIDE 6.6	PA6.6
WEATHER RESISTANT POLYAMIDE 6.6	UV PA6.6
HEAT-STABILISED POLYAMIDE 6.6	HS PA6.6
FLAME RETARDANT POLYAMIDE 6.6	FR PA6.6
WEATHER RESISTANT POLYAMIDE 12	UV PA12
POLYPROPYLENE	PP
WEATHER RESISTANT POLYPROPYLENE	UV PP
TEFZEL <sup>®</sup> *	TZ
HALAR <sup>®</sup> **	HAL
DELRIN <sup>®</sup> *	DEL
STAINLESS STEEL	SS

\* Trademark of E.I. DuPont de Nemours and Company

\*\* Trademark of Solvay Solexis

Table 1 - Information on cable tie materials

	POLYAMIDE 6.6 PA6.6	POLYAMIDE 6.6 WEATHER RESISTANT* UV PA6.6	POLYAMIDE 6.6 HEAT STABILISED HS PA6.6	POLYAMIDE 6.6 FLAME RETARDANT FR PA6.6	POLYAMIDE 12 WEATHER RESISTANT UV PA12	POLYPROPYLENE WEATHER RESISTANT UV PP	HALAR <sup>®</sup> HAL	DELRIN <sup>®</sup> DEL	STAINLESS STEEL SS	ETFE (TEFZEL) TZ
MATERIAL CODE	TY...M L-... -9-...	TY...MX L-... -0-...	TYH...M L-... HS-...-...	TY...MFR TS...HF	TYC...MX	TYP...MX	TYV...M	TYD... CSS	RL.. or LD... or YLS...	TYZ...M
MAX. OPERATING TEMPERATURE	+85°C	+85°C	+105°C	+85°C	+85°C	+85°C	+140°C	+85°C	+540°C +105°C for coated	+150°C
MIN. OPERATING TEMP.	-40°C	-40°C	-40°C	-40°C	-55°C	-40°C	-46°C	-40°C	-80°C	-46°C
UL FLAMMABILITY RATING	V-2	V-2	V-2	V-0	V-2	HB	V-0	HB	Excellent	V0
SPECIFIC DENSITY	1.14	1.14	1.14	1.16	1.02	0.90 - 0.91	-	-	7.95	1.67 - 1.75
WATER ABSORPTION (24h/ASTM)	2.5 - 3.1%	2.5 - 3.1%	2.5 - 3.1%	3.0 - 3.5%	0.7 - 1.1%	0.01 - 0.03%	-	-	0%	0.02%
COLOURS	Natural**	Black	Natural***	White	Black	Black	Maroon	Black	Metallic/ Black	Aquamarine
E-MODULE (N/mm <sup>2</sup> )	2000	2000	2000	1400	1600	1100-1300	-	-	193000	1000
NOTCH IMPACT	2-20	2-20	2-20	3-25	3.5-13	3-17	-	-	122J(IZOD)	o.B.
STRENGTH CONFORM DIN 53453 (KJ/m <sup>2</sup> )										
UV RESISTANT		■			■	■	■	■	■	■
FLAME RETARDANT				■			■		■	■
HEAT RESISTANT			■				■		■	■
ENHANCED WEATHERABILITY					■	■	■	■	■	■
FLEXIBLE AT LOW TEMPERATURES					■	■				
RADIATION RESISTANT								■	■	
CHEMICALLY RESISTANT	See table 2 (pages 107 - 109)									
HALOGEN FREE	■	■	■	■	■	■	■	■	■	■

\* 2% Carbon for military specifications

\*\* Can be supplied in a wide range of colours

\*\*\* May have a greenish tint

Table 2 - Resistance of available materials to various chemicals at 21°C

REAGENTS	CONCENTRATION	HS PA6.6	HAL	DEL	PA6.6	UV PA6.6	FR PA6.6	UV PA12	PP	UVPP	TZ*	SS
Arsenic Acid	40%	-	-	-	-	-	-	-	E	E	-	E
Acetaldehyde	50%	S	-	-	S	S	S	-	-	-	-	-
Acetone	100%	E	E	F	E	E	E	E	E	E	E	E
Aluminum Hydroxide	AQ	-	E	-	-	-	-	-	E	E	E	E
Ammonia	All	-	E	-	-	-	-	E	E	E	E	E
Ammonium Carbonate	5%	S	E	-	S	S	S	E	E	E	E	E
Ammonium Hydroxide	10%	E	E	F	E	E	E	-	E	E	E	E
Ammonium Nitrate	-	-	E	-	-	-	-	E	E	E	E	E
Ammonium Sulfate	10%	-	E	-	-	-	-	S	S	S	S	S
Barium Carbonate	All	-	E	-	-	-	-	E	E	E	E	E
Barium Chloride	5%	NR	-	-	NR	NR	NR	E	E	E	E	E
Barium Sulfate	10%	E	-	-	E	E	E	E	E	E	E	E
Barium Sulfide	10%	S	-	-	S	S	S	E	E	E	E	E
Benzene	100%	E	E	F	E	E	E	E	S	S	E	E
Benzoic Acid	100%	NR	E	-	NR	NR	NR	E	E	E	E	E
Butyric Acid	50%	NR	E	-	NR	NR	NR	-	E	E	E	E
Calcium Carbonate	AQ	-	E	-	-	-	-	-	E	E	E	E
Calcium Hydroxide	20%	-	F	E	-	-	-	-	E	E	E	E
Calcium Hydrochlorite	2	NR	-	-	NR	NR	NR	-	F	F	F	F
Calcium Sulfate	2%	-	E	-	-	-	-	-	E	E	E	E
Carbon Tetrachloride	100%	E	E	E	E	E	E	E	F	F	E	E
Chlorine (WET)	-	NR	-	-	NR	NR	NR	-	F	F	F	F
Chlorine (DRY)	-	NR	-	-	NR	NR	NR	-	NR	NR	F	F
Chloroacetic Acid	30%	NR	-	-	NR	NR	NR	-	-	-	F	F
Chloroform	100%	-	E	-	-	-	-	F	F	F	E	E
Chromic Acid	50%	NR	S	-	NR	NR	NR	-	F	F	F	F
Citric Acid	50%	S	E	E	S	S	S	E	E	E	E	E
Copper Cyanide	10%	-	E	-	-	-	-	-	E	E	E	E
Copper Nitrate	50%	-	E	-	-	-	-	-	E	E	E	E
Cider	-	-	E	-	-	-	-	-	E	E	E	E
Dichloroethane	100%	-	E	-	-	-	-	-	-	-	E	E
Diethyl Ether	100%	-	E	S	-	-	-	E	E	E	E	E
Ethyl Alcohol	100%	S	E	-	S	S	S	E	E	E	E	E
Ethyl Chloride	100%	-	S	E	-	-	-	F	F	F	E	E
Ethylene Glycol	100%	E	E	S	E	E	E	-	E	E	E	E
Ferric Hydroxide	All	-	E	-	-	-	-	-	E	E	E	E
Ferric Nitrate	10%	-	E	-	-	-	-	-	E	E	E	E
Ferrous Sulfate	10%	-	E	-	-	-	-	-	E	E	E	E
Fuel Oil	100%	-	E	-	-	-	-	E	-	-	E	E
Furfural	100%	-	E	-	-	-	-	-	F	F	E	E
Gallic Acid	AQ	-	E	-	-	-	-	-	-	-	E	E
Gasoline	100%	E	E	-	E	E	E	-	S	S	E	E
Glycerine	100%	-	E	-	-	-	-	E	E	E	-	E
Hydrocyanic Acid	All	-	E	-	-	-	-	-	E	E	E	E
Hydrogen Peroxide	30%	NR	E	F	NR	NR	NR	S	E	E	E	E
Hydrogen Sulfide	Dry	NR	E	-	NR	NR	NR	E	E	E	E	E

Ratings

E = Excellent

S = Satisfactory

F = Fair

NR = Not Recommended

(AQ = Aqueous)

Table 2 - Resistance of available materials to various chemicals at 21°C

REAGENTS	CONCENTRATION	HS PA6.6	HAL	DEL	PA6.6	UV PA6.6	FR PA6.6	UV PA12	PP	UVPP	TZ*	SS
Iodoform	100%	-	E	-	-	-	-	-	-	-	E	E
Isopropyl Alcohol	100%	S	E	-	S	S	S	E	E	E	E	E
Jet Fuel	100%	E	E	-	E	E	E	-	S	S	E	E
Lactic Acid	10%	E	E	-	E	E	E	S	E	E	E	E
Lanolin	10%	E	E	-	E	E	E	E	E	E	E	E
Lead Acetate	5%	-	E	-	-	-	-	-	E	E	E	E
Linseed Oil	10%	E	E	E	E	E	E	E	E	E	E	E
Magnesium Carbonate	All	-	E	-	-	-	-	E	E	E	E	E
Magnesium Chloride	10%	F	-	-	F	F	F	F	F	F	F	F
Magnesium Nitrate	All	-	E	-	-	-	-	E	E	E	E	E
Malic Acid	AQ	-	E	-	-	-	-	-	E	E	E	E
Mercury	100%	-	E	-	-	-	-	E	E	E	E	E
Methyl Alcohol	100%	S	E	-	S	S	S	E	E	E	E	E
Methyl Chloride	100%	-	S	-	-	-	-	-	S	S	E	E
MethylEthyl Ketone	100%	-	E	F	-	-	-	E	E	E	E	E
Naptha	100%	-	E	-	-	-	-	-	E	E	E	E
Nitric Acid	30%	NR	E	NR	NR	NR	NR	-	E	E	E	E
Nitric Acid	30-70%	NR	S	NR	NR	NR	NR	-	F	F	S	E
Nitrous Acid	5%	-	E	-	-	-	-	-	F	F	E	E
Oieic Acid	100%	-	E	S	-	-	-	-	E	E	E	E
Oxalic Acid	10%	-	E	-	-	-	-	S	E	E	E	E
Paraffin	100%	E	E	-	E	E	E	E	E	E	E	E
PetroleumEther	100%	-	E	-	-	-	-	E	F	F	E	E
Phenol	90%	NR	E	NR	NR	NR	NR	-	E	E	E	E
Phosphoric Acid	10%	NR	E	-	NR	NR	NR	-	E	E	E	E
Picric Acid	1%	-	E	-	-	-	-	-	E	E	E	E
Potassium Bromide	AQ	-	-	-	-	-	-	-	S	S	S	S
Potassium Carbonate	1%	-	E	-	-	-	-	E	E	E	E	E
Potassium Chlorate	AQ	-	E	-	-	-	-	S	E	E	E	E
Potassium Dichromate	40%	NR	E	-	NR	NR	NR	F	E	E	E	E
Potassium Ferrocyanide	25%	-	E	-	-	-	-	-	E	E	E	E
Potassium Hydroxide	5%	S	E	-	S	S	S	-	E	E	E	E
Potassium Iodide	All	-	E	-	-	-	-	E	E	E	E	E
Potassium Nitrate	50%	F	E	-	F	F	F	E	E	E	E	E
Potassium Permanganate	5%	NR	E	S	NR	NR	NR	NR	E	E	E	E
PotassiumSulfate	5%	-	E	-	-	-	-	E	E	E	E	E
PotassiumSulfide	AQ	-	E	-	-	-	-	-	E	E	E	E
Propyl Alcohol	100%	E	E	-	E	E	E	-	E	E	E	E
Silver Nitrate	10%	-	E	-	-	-	-	E	E	E	E	E
Sodium Acetate	60%	E	E	-	E	E	E	-	E	E	E	E
Sodium Bicarbonate	All	E	E	-	E	E	E	E	E	E	E	E
Sodium Bisulfate	10%	-	E	E	-	-	-	E	E	E	E	E
Sodium Borate	All	-	E	-	-	-	-	-	E	E	E	E
Sodium Carbonate	5%	E	E	S	E	E	E	E	E	E	E	E
Sodium Chlorate	25%	-	E	E	-	-	-	S	E	E	E	E
Sodium Chloride	2%	E	E	S	E	E	E	E	E	E	E	E
Sodium Fluoride	5%	-	-	-	-	-	-	-	F	F	F	F

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Sodium Hydroxide	10%	E	E	S	E	E	E	E	E	E	E	E
Sodium Hyposulfite	AQ	-	E	-	-	-	-	-	-	-	E	E
Sodium Nitrate	5%	E	E	-	E	E	E	E	E	E	E	E
Sodium Nitrite	AQ	-	E	-	-	-	-	S	E	E	E	E
Sodium Perchlorate	10%	-	E	-	-	-	-	-	-	-	E	E
Sodium Phosphate	5%	-	E	-	-	-	-	E	E	E	E	E
Sodium Sulfate	5%	S	E	-	S	E	E	E	E	E	E	E
Sodium Thiosulfate	5%	-	-	S	-	-	-	S	S	S	S	S
Stearic Acid	100%	-	E	-	-	-	-	F	E	E	E	E
Sulfur	100%	-	E	-	-	-	-	E	E	E	E	E
Sulfur Dioxide	All	NR	E	-	NR	NR	NR	E	E	E	E	E
Sulfuric Acid	Conc.	NR	E	NR	NR	NR	NR	-	S	S	E	E
Sulfuric Acid	5%	NR	F	F	NR	NR	NR	F	F	F	F	F
Tannic Acid	10%	-	E	-	-	-	-	-	E	E	E	E
Tartaric Acid	50%	-	E	E	-	-	-	E	E	E	E	E
Tetrahydrofuran	100%	-	F	E	-	-	-	S	F	F	E	E
Toluene	100%	E	E	F	E	E	E	E	F	F	E	F
Xylene	100%	E	-	E	E	E	E	F	F	E	E	
Zinc Chloride	70%	F	E	NR	F	F	F	E	E	E	E	E
Zinc Nitrate	AQ	-	E	-	-	-	-	E	E	E	E	E
Zinc Sulfate	AQ	-	E	-	-	-	-	E	E	E	E	E

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S = Satisfactory

F = Fair

NR = Not Recommended

(AQ = Aqueous)

### Technical information

UNIT	x	CONSTANT	=	UNIT
BTU		778.0		foot-pound (ft x lb)
BTU		1054.8		Joules
BTU		0.293		Watt-hours (W x h)
centimetres (cm)		0.032808		feet (ft)
centimetres (cm)		0.3937		inches (in)
centimetres (cm)		0.00001		kilometres (km)
centimetres (cm)		0.010		metres (m)
centimetres (cm)		10.0		millimetres (mm)
circular mils		0.00064516		circular millimetres
circular mils		0.0000007854		inches <sup>2</sup> (in <sup>2</sup> )
circular mils		0.000506671		square millimetres (mm <sup>2</sup> )
circular mils		0.7854		mils <sup>2</sup>
cubic centimetre (cm <sup>3</sup> )		0.000035314		cubic foot (ft <sup>3</sup> )
cubic centimetre (cm <sup>3</sup> )		0.061023		cubic inch (in <sup>3</sup> )
cubic centimetre (cm <sup>3</sup> )		0.000001		cubic metre (m <sup>3</sup> )
cubic centimetre (cm <sup>3</sup> )		0.0026417		gallons
cubic foot (ft <sup>3</sup> )		17280.		cubic inch (in <sup>3</sup> )
cubic foot (ft <sup>3</sup> )		28317.016		cubic centimetre (cm <sup>3</sup> )
cubic inch (in <sup>3</sup> )		0.00057870		cubic feet (ft <sup>3</sup> )
cubic inch (in <sup>3</sup> )		0.000016387		cubic metre (m <sup>3</sup> )
cubic inch (in <sup>3</sup> )		16.387162		cubic centimetre (cm <sup>3</sup> )
cubic metre (m <sup>3</sup> )		1000000.0		centimetre (cm)
cubic metre (m <sup>3</sup> )		35.314456		cubic foot (ft <sup>3</sup> )
cubic metre (m <sup>3</sup> )		264.17		gallons
foot (ft)		0.00018939		miles
foot (ft)		0.33333		yards (yd)
foot (ft)		12		inches (in)
foot (ft)		0.00030480		kilometres (km)
foot (ft)		0.30480		metres (m)
foot (ft)		30.480		centimetres (cm)
foot (ft)		304.80		millimetres (mm)
foot/pound (ft/lb)		0.00067197		metres/grams (m/g)
foot-pound (ft x lb)		0.001285		BTU
foot-pound (ft x lb)		1.356		Joules (J)
foot/pound (ft/lb)		0.1383		kilogram/metre (kg/m)
gallons (US)		3.785332		litres (l)

UNIT	x	CONSTANT	=	UNIT
gallons		0.13368		cubic foot (ft <sup>3</sup> )
gallons		231.0		cubic inch (in <sup>3</sup> )
gallons		3785.332		cubic centimetres (cm <sup>3</sup> )
grams (g)		15.432		grains
gram/centimetre <sup>3</sup> (gm/cm <sup>3</sup> )		0.0361275		pounds/in <sup>3</sup> (lb/in <sup>3</sup> )
horsepower (hp)		33000.0		ft x lb/min
horsepower (hp)		550.0		ft x lb/sec
horsepower (hp)		745.7		Watts (W)
inch (in)		0.027178		yards (yd)
inch (in)		0.083333		feet (ft)
inch (in)		0.00002540		kilometre (km)
inch (in)		0.025400		metre (m)
inch (in)		2.54000514		centimetre (cm)
inch (in)		25.4000514		millimetre (mm)
inch (in)		1000.0		mils
Joules		0.000948		BTU
Joules		107		ergs
liters (l)		61.0250		cubic inch (in <sup>3</sup> )
metres (m)		1.093611		yard (yd)
metres (m)		3.2808333		feet (ft)
metres (m)		39.37		inch (in)
metres (m)		100.0		centimetre (cm)
miles		1760.0		yards (yd)
miles		5280.0		feet (ft)
miles		1.6093		kilometre (km)
millimetres (mm)		0.0032808		feet (ft)
millimetres (mm)		0.03937		inch (in)
millimetres (mm)		0.001		metres (m)
millimetres (mm)		0.01		centimetres (cm)
millimetres (mm)		39.3701		mils
millimetres (mm)		1000.0		microns (µm)
Watts (W)		44.25		ft x lb/minute
Watts (W)		0.737562		ft x lb/sec
Watts (W)		0.001341		horsepower (hp)
Watt-hours (W x h)		3.41266		BTU