

Thorndike Corporation
680 North Bedford Street, East Bridgewater, MA. 02333
Tel: 508-378-9797
Fax: 508-378-1529

www.thorndikecorp.com

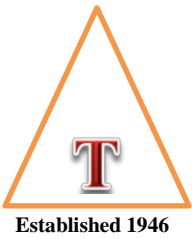
Silicon Carbide (Vitrified Bond – Wheel mix)

1. Material Identification: TC4000HT
2. Chemical Analysis:
 - Silicon carbide: 78%
 - Bond: 20%
 - Iron oxide: 0.9%
 - Other oxides: 1.1%
3. Maximum Use temperature: 1800°F, (982°C)
4. Most commonly used Grit size: 240 – 280
5. Density: 118 lbs. /ft³(31.2 grams/in³) (1.9 grams/cm³)
6. Thermal coefficient of Linear Expansion: 2.8×10^{-6} inches per °F (average)
7. Thermal Conductivity: 4.5 (BTU/hr. ft. °F) of 7.8 (Watts/m²k)
8. Total emissivity: 0.92
9. Electrical Resistivity: (ohm – cm):
 - Room temp: 280 – 500
 - 2100 °F: 2 – 3
10. Porosity: 15%
11. Relative Permeability: 1.00
12. Relative permittivity: 13±(depending on grit size and batch characteristics)
 - Measured results on batch dated 7/21/2006: $\epsilon_r = 16.5$ (9.4GHz)
 - Measured results on batch dated 9/7/2011: $\epsilon_r = 11.1$ (9.4 GHz)
13. Dielectric loss tangent: 0.15 – 0.35 (depending on grit size and batch characteristics)
 - Measured results on batch dated 7/21/2006: loss tangent: =0.17 (10GHz)
 - Measured results on batch dated 9/7/2011: loss tangent: =0.34 (10 GHz)
14. Electrical attenuation: 50 db / inch at 10.0 GHz
15. Out gassing characteristics in a vacuum NASA Criteria Limits for space acceptance: Total mass loss, TML <1.0%
Collected Volatile Condensable Materials: CVCM < 0.10%
Measured values of Silicon Carbide. (Typical values measured in the past.)
(Each batch of material is not tested unless requested in purchase order which is an additional charge)
Total mass loss, (TML): <0.30%
Collected Volatile Condensable Materials: (CVCM) <0.050%

Disclosure:

The above information is to use as reference only based on past measurements, customer interface, and typical applications. It is not intended to be used as warranty for any legal responsibility for any particular application. The materials are supplied for engineering evaluation, testing, and product design for microwave applications. For additional electrical support or engineering design for a particular application, we can supply engineering support for an additional cost. We have an in house microwave engineering lab, equipment and personnel to help with the product design.





Bulletin No.:

Material: Silicon Carbide

Various Properties of Silicon Carbide Materials

The parts used in the microwave industry are constructed from pure silicon carbide powder, mixed with porcelain bonding materials. The silicon carbide powder content is in the 85-90% range by volume with the porcelain bonding agent filling in the rest. The bonding agent reduces the thermal conductivity since its effect acts as a thermal insulator. The overall conductivity of the ceramic compound is still very good for use as microwave absorbers.

The dielectric constant of pure silicon carbide powder is roughly 40, at 1 Mhz. (slightly less in the Ghz., range) The compound silicon carbide used in the microwave industry has a dielectric constant of approximately, 14-16, depending on the batch and grain size.

In its pure form, silicon carbide is classified as a true, semi-conductor with a normal resistivity ranging from .001 to 10 ohm-cm. It has very high dielectric loss, resulting in its excellent ability to absorb microwave signals. Other impurities can be added to change its loss characteristics such as beryllium oxide. This keeps a very high thermal conductivity but insulates the silicon carbide particles from each other. This effect is used for lower loss substrate materials for microwave circuits. The beryllium oxide helps lower crosstalk effects within the compound.

The thermal expansion of silicon carbide compounds, also range, depending on the impurities. The standard ceramic parts used for microwave absorption applications have a thermal expansion value of about $4.5 \times 10^{-6}/^{\circ}\text{K}^*$
(REF: Volume 4 of Engineering Materials Handbook)

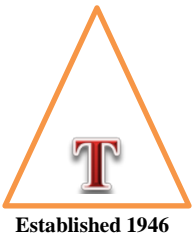
Aluminum on the other hand has a thermal expansion of $22.5 \times 10^{-6}/^{\circ}\text{K}^{**}$ Copper has a thermal expansion of $17 \times 10^{-6}/^{\circ}\text{K}^{**}$ Both of these element metals are higher than silicon carbide.

** (REF: Elements of Materials Science and Engineering, Van Vlack)

Sic.pw3

CALL THORNDIKE CORPORATION FOR ALL YOUR LOW AND HIGH POWER ABSORBER REQUIREMENTS!!!





Thorndike Corporation

680 North Bedford Street
East Bridgewater, MA 02333
(508) 378-9797 / 9798
Fax: (508) 378-1529
Toll free: 800-367-3367
www.thorndikecorp.com

Bulletin No.: 111-4XXX Series

**Material: TC4XXX Series of Materials:
TC4000HT-K 240 Grit "Grey" Silicon Carbide Absorber**

MATERIAL CHARACTERISTICS

Attenuation: >25 dB / inch at 10 GHz
Density: .066 lbs/Cubic Inch - Average
Relative Permeability: 1.45
Relative Permittivity: 18 +/- 4 depending on grit size and batch characteristics
Loss Factor dB/inch: 159
Thermal Coefficient of Linear Expansion: 5×10^{-6} in/°c. from 25 to 1500 deg. C
Outgassing Characteristics: Typical of Silicon Carbide
Total Mass Loss (TML): <.30%
Collected Volatile Condensable Materials (CVCM): <.30%
Test @ 3.0 GHz
Dielectric Constant, Permittivity: 16.3
Loss Tangent: 0.51

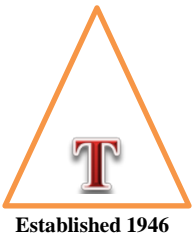
Note 1:

NASA CRITERIA FOR SPACE MATERIAL ACCEPTANCE

- TML less than or equal to 1.0%
- CVCM less than or equal to 0.10%
- Specific Heat: 750 J/Kg•°K or 0.18 (Btu/lb•°F)
- Thermal Conductivity: 4.5(BTU/hr. ft. °F) or 7.8 (Watts/m°k)

CALL THORNDIKE CORPORATION FOR ALL YOUR LOW AND HIGH-POWER ABSORBER REQUIREMENTS!!!





Thorndike Corporation

680 North Bedford Street
East Bridgewater, MA 02333
(508) 378-9797 / 9798
Fax: (508) 378-1529
Toll free: 800-367-3367
www.thorndikecorp.com

Bulletin No.: TB109

Material: TC4XXXHT series, High Power Silicon Carbide

Thorndike material **TC4000HT & TC4000HT-K** are ceramic based silicon carbide materials used exclusively throughout the microwave industry, due to its extremely high firing temperature of over 1500 degrees centigrade. As is all ceramic materials, it can withstand power levels causing the material to literally glow during operation without degrading its electrical performance. The carbide loading of the material constitutes the **HIGH** Rf absorption. The material undergoes a chemical bond during firing, giving it extremely low outgassing characteristics, thus making it ideal for space applications.

Thorndike Corporation has complete facilities to procure, grind and machine all your high power absorbers to exact mechanical specifications. We can also design the element geometry to your electrical requirements through our in house microwave engineering department.

CALL THORNDIKE CORPORATION FOR ALL YOUR LOW AND HIGH POWER ABSORBER REQUIREMENTS!!!

