# 세계최고의방열소재기업

MOST \* COMPETITIVE THERMAL SOLUTION PROVIDER



About NanoTIM co.,Ltd

Thermal Interface Material(TIM) 전문기업 나노팀 주식회사

Nano Thermal Interface Material Catalog ver. 15



| Develo    | opmer      | nt Ro                      | admap                   |                        |                       |   |                       | "A lor                               | ig-term goal' | , |
|-----------|------------|----------------------------|-------------------------|------------------------|-----------------------|---|-----------------------|--------------------------------------|---------------|---|
|           |            | S.G : Speci                | fic gravity             | "A short-tern          | n goal"<br>30<br>2021 | "A middle-<br>Co-<br>Co-<br>Co-<br>Co-<br>Co-<br>Co-<br>Co-<br>Co-<br>Co-<br>Co | term goal"            | 2024                                 | 2025          |   |
|           | Gap filler |                            | Low S.G                 | 3 W/mk<br>S.G : 2.0    | 3 W/mk<br>S.G : 1.8   | 3 W/mk<br>S.G : 1.5 ↓   | 5                     | 5 W/mk, S.G : 1.5                    | <u> </u>      |   |
|           |            | Usability improvement      |                         | UV hardening type      |                       | <br> <br> <br>  |                       |                                      |               |   |
| Silicone  | Pad        |                            | Electrical insulation   | 7 W/mk                 | ~ 15                  | W/mk  |                       |                                      |               |   |
|           |            |                            | Electrical conductivity | 1<br>1<br>1            | ~ 35 W/mk             |   | <br> <br> <br>        |                                      |               |   |
|           | Potting    | L                          | ow viscosity            | 3 W/mk                 | 3 W//                 | 5 W/i   | mk ↑                  |                                      | <br> <br>     |   |
|           | Autresive  |                            | Acrylic                 | 2 W/mk<br>UV hardening |                       |   | 1<br>1<br>1<br>1<br>1 | -<br>-<br>-<br>-<br>-<br>-<br>-<br>- |               |   |
| Organic   | Gap filler | Р                          | oly urethane            | 1<br>1<br>1            | 2 W/I                 | mk ↑  |                       |                                      | <b>KON</b>    |   |
| materials |            |                            | Ероху                   | ,<br>,<br>,            | 2 W/ı                 | mk ↑  | <br> <br>             | <br> <br>                            |               |   |
|           | Detting    | MS Polymer (Silicone free) |                         | 2 W/mk                 | 2 W/mk *              |   | <br> <br> <br>        |                                      |               |   |
|           | Potting    |                            | Ероху                   | i                      | 2 00/1                |   | 1                     |                                      | B             |   |







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### Overview

# Two-part Liquid

| TGF - Thermal Gap Filler (MS945-02 TYPE C) 6                       |
|--|
| TAF - Thermal Adhesive Filler (MS945-02 TYPE C)                    |
| TSG - Thermal Silicone Gel (MS945-02 TYPE C)                       |
| STS - Silicone Tack Series (MS945-02 TYPE C)                       |
| One-part Liquid  |
| TGS - Thermal Grease Series (MS945-02 TYPE D) 40                   |
| TMF - Thermal Modified Silane Filler (MS945-02 TYPE C)             |
| PCM - Phase Change Material (MS945-02 TYPE D)                      |
| Pad  |
| PCM - Phase Change Material (MS945-02 TYPE D)                      |
| SPS - Silicone Pad Series (MS945-02 TYPE B)                        |
| • THS - Thermal High Consistency Rubber Silicone (MS945-02 TYPE A) |
| APS - Acrylic Pad Series (MS945-02 TYPE A)                         |

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### Two-part Liquid

#### Information on TGF

**Selection Guides** 

**Products Introduction** 

**Durability Property** 

Safety & Packaging

### TGF - Thermal Gap Filler

#### Information

TGF stands for Thermal Gap Filler.

It is a thermally conductive gap filling material that is offered as two-part component. The purpose of this material is to improve the heat delivery from the heat source to the heat sink. Depending on the customer's request, the material is available in different viscosity and hardness.

Typical properties of the gap filling material consist of the following characteristics: Thermal conductivity, viscosity, hardness, working time, volume resistivity, etc. It is generally offered in either cartridges or containers, whereas the cartridges are used with a static mixing nozzle and a dispensing gun.

By mixing the two-part component into a single mixed material, the liquid form cures into a solid form depending on the curing time and temperature. Before the liquid form cures completely into the solid form, the material placed in the interface may be conformed or pressurized by the surrounding surfaces to remove as much air layers or gaps as possible.

#### **Features and Benefits**

- Conformable
- low hardness
- Easy dispense
- Isolated electrically
- · Minimized interfacial resistance
- Superior Thermal Performance
- · Superior peel-adhesion

#### Applications

- Display (LED, LCD, PDP TV etc.)
- Memory Devices
- Custom ASICS Chips
- LED Applications
- Digital Mobile Convergence
- Automobile(motors)

#### Characteristics

- Thermal conductivity
- Viscosity
- Hardness
- Working time

#### How to use

Depending on the stored time of the material from the date of manufacture, premix prior to the actual use. For the two-part component, mix the part A and B material by a ratio of 1:1 and apply the mixed material on the desired surfaces. Once the surface is applied by a pressure with a surface the air gaps could be removed as much as possible for better heat dissipation from the heat source.

#### Processing

After the material is exposed to air the material will begin to cure. At room temperature the cure time is generally set to a certain time which can be shorten by applying additional heat or other accelerating factors. Overall the material applied at the desired surface will eventually cure throughout the material after being dispensed. Upon customer's request the curing time can be adjusted by changing the amount of catalysts.

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TGF-500-Series

| Two-part<br>Liquid    | TGF -   | Thermal Ga                | p <b>F</b> iller             |                      |                                     | all |
|-----------------------|---------|---------------------------|------------------------------|----------------------|-------------------------------------|---|
|                       | Sele    | ction Guides              |                              |                      |                                     |   |
|                       | Buildin | g a Product Numbe         | r                            |                      | 11.                                 |   |
| Information on TGF    |         | TGF                       | NT000[                       | 1                    | 00[ ]00                             | A RANGE                                 |
| Selection Guides      | The     | rmal Gap Filler NT<br>000 | - NanoTIM<br>- Thermal Condu | ctivity              | 00 - Max particle size [] – Polymer | 1111                                    |
|                       |         | []                        | Product characte             | eristics             | 00 - Viscosity                      |   |
| Products Introduction |         |                           |                              |                      |                                     |   |
| Durability Property   | NO      | Product Name              | Thermal<br>Conductivity      | Viscosity<br>[ cps ] | Hardness<br>[Shore 00]              | Product Characteristics                 |
| Safety & Packaging    |         |                           | [ •••/                       |                      | 20 30 40 50 60 70 80 90             |   |
|                       | 1       | TGF-100-Series            | 1.0 ~ 1.9                    | ~ 200,000            | • • • • • • • •                     | N - Normal<br>S - Glass Bead add.       |
|                       | 2       | TGF-200-Series            | 2.0 ~ 2.9                    | ~ 300,000            | • • • • • • • •                     | L - Light(Density)                      |
|                       | 3       | TGF-300-Series            | 3.0 ~ 3.9                    | ~ 350,000            | • • • • • • • •                     |   |
|                       | 4       | TGF-400-Series            | 4.0 ~ 4.9                    | ~450,000             | • • • • • • • •                     |   |

5.0 ~ 5.9

~550,000

4 2 2 4 4 8 4

Information on TGF

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

### TGF - Thermal Gap Filler

#### Products Introduction

#### **TGF-100 Series**

The TGF-100 Series are Thermal Conductivity  $1.0 \sim 2.0$  W/m·K  $\times$  It does not include 2.0 W/m·K The products that apply are NT150NL, NT150SL.

Thermal Product Feature Product Name Max particle size Polymer Viscosity Conductivity Normal Light NT150NL 70 DM 05 1.5 W/m·K Glass bead add. 70 Light NT150SL DM 04 ITEM **Test Conditions NT150NL NT150SL** Units A: Gray A : Gray Visual (A : B) Color B : White B: White Continuous Use temp °C -50 ~ 150 -50 ~ 150 25°C, 1rpm, No.52 Spindle 60,000 50,000 Viscosity(A) cps General 25℃, 1rpm, No.52 Spindle 50,000 30,000 Viscosity(B) cps Viscosity(Mixes) 25°C, 1rpm, No.52 Spindle 55.000 40,000 cps 1.81 1.75 Density 25°C, Gravimeter g/cc 60 50 Hardness Shore 00 Mechanical % 80 80 Elongation Flame Rating Vertical Burning Test V-0 V-0 -Electrical Withstand Voltage AC, 3000V mΑ < 0.2 < 0.2 Volume Resistivity > 1\*10<sup>12</sup> > 1\*10<sup>12</sup> Ω·cm **Thermal Conductivity** Thermal W/m·K 1.7 1.5 120 120 Cure Pot life @ 25°C Time for viscosity to double min.

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**Selection Guides** 

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Safety & Packaging

#### Products Introduction

#### **TGF-200 Series**

| Thermal<br>Conductivity | Product Feature    | Product Name      | Max particle size | Polymer | Viscosity |
|-------------------------|--------------------|-------------------|-------------------|---------|-----------|
| 2.0<br>W/m∙K            | Normal Ultra Light | NT200N<br>NT200UL |                   | DM —    | 42<br>12  |
| 2.8<br>W/m·K            | Glass bead add.    | NT200S<br>NT280S  |                   | DM      | 42<br>25  |

|              | ITEM                 | Test Conditions              | Units | NT200N               | NT200UL              | NT200S               | NT280S               |
|--------------|----------------------|------------------------------|-------|----------------------|----------------------|----------------------|----------------------|
|              | Color                | Visual (A : B)               | -     | A:Yellow<br>B:White  | A:Yellow<br>B:White  | A:Yellow<br>B:White  | A:Yellow<br>B:White  |
| General      | Continuous Use temp  | -                            | °C    | -60 ~ 200            | -50 ~ 150            | -60 ~ 200            | -60 ~ 200            |
|              | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 430,000              | 120,000              | 430,000              | 230,000              |
|              | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 420,000              | 120,000              | 420,000              | 250,000              |
|              | Viscosity(Mixes)     | 25℃, 1rpm, No.52 Spindle     | cps   | 420,000              | 120,000              | 420,000              | 250,000              |
|              | Density              | 25℃, Gravimeter              | g/cc  | 2.4                  | 1.78                 | 2.4                  | 2.5                  |
| Mochanical   | Hardness             | Shore                        | 00    | 60                   | 50                   | 60                   | 60                   |
| INIECHALIICA | Elongation           | -                            | %     | 90                   | 90                   | 90                   | 90                   |
|              | Flame Rating         | Vertical Burning Test        | -     | V-0                  | V-0                  | V-0                  | V-0                  |
| Electrical   | Withstand Voltage    | AC, 3000V                    | mA    | < 0.2                | < 0.2                | < 0.2                | < 0.2                |
|              | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
| Thermal      | Thermal Conductivity | -                            | W/m∙K | 2.0                  | 2.4                  | 2.0                  | 2.8                  |
| Cure         | Pot life @ 25°C      | Time for viscosity to double | min.  | 60                   | 120                  | 60                   | 120                  |

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Selection Guides

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Durability Property

Safety & Packaging

|  | TGF - | Thermal | Gap | Filler |
|--|-------|---------|-----|--------|
|--|-------|---------|-----|--------|

#### Products Introduction

#### **TGF-300 Series**

| Thermal<br>Conductivity | Product Feature    | Product Name      | Max particle size | Polymer | Viscosity |
|-------------------------|--------------------|-------------------|-------------------|---------|-----------|
| 3.0                     | Normal Light       | NT300N<br>NT300NL | 80       90       | DM —    | 11<br>12  |
| W/m·K                   | Glass bead<br>add. |                   |                   |         |           |

|             | ITEM                                | Test Conditions              | Units | NT300N                 | NT300NL                    |
|-------------|-------------------------------------|------------------------------|-------|------------------------|----------------------------|
|             | Color                               | Visual (A : B)               | -     | A : Brown<br>B : White | A : Navy blue<br>B : White |
| General     | Continuous Use temp                 | -                            | °C    | -50 ~ 150              | -50 ~ 150                  |
|             | Viscosity(A)                        | 25℃, 1rpm, No.52 Spindle     | cps   | 120,000                | 135,000                    |
|             | Viscosity(B)                        | 25℃, 1rpm, No.52 Spindle     | cps   | 110,000                | 120,000                    |
|             | Viscosity(Mixes)                    | 25℃, 1rpm, No.52 Spindle     | cps   | 110,000                | 135,000                    |
|             | Density                             | 25°C, Gravimeter             | g/cc  | 2.47                   | 2.05                       |
| Acchanical  | Hardness                            | Shore                        | 00    | 50                     | 46                         |
| viecnanicai | Elongation                          | -                            | %     | 80                     | 90                         |
|             | Flame Rating                        | Vertical Burning Test        | -     | V-0                    | V-0                        |
| Electrical  | Withstand Voltage                   | AC, 3000V                    | mA    | < 0.2                  | < 0.2                      |
|             | Volume Resistivity                  | -                            | Ω·cm  | > 1*1012               | > 1*1012                   |
|             | Thermal Conductivity                | -                            | W/m∙K | 3.5                    | 3.2                        |
|             | Specific heat                       | <b>25</b> ℃                  | J/g∙K | 0.99                   | 1.18                       |
| Thermal     | Thermal Resistivity                 | T = 1.0 mm                   | K/W   | -                      | 1.033                      |
|             | Thermal Resistivity                 | T= 2.0 mm                    | K/W   | -                      | 2.509                      |
|             | Coefficient of<br>Thermal Expansion | -                            | ppm   | -                      | 95                         |
| Cure        | Pot life @ 25°C                     | Time for viscosity to double | min.  | 120                    | 120                        |
|             |                                     |                              |       |                        |                            |

**Selection Guides** 

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Safety & Packaging

### TGF - Thermal Gap Filler

#### Products Introduction

#### **TGF-400 Series**

-

Thermal

Cure

Coefficient of

**Thermal Expansion** 

Pot life @ 25°C

The TGF-400 Series are Thermal Conductivity  $4.0 \sim 5.0$  W/m·K  $\times$  It does not include 5.0 W/m·K The products that apply are NT400N, NT400S.

Time for viscosity to double

| I herma<br>Conductiv               | Conductivity Product Feature |                          | t Name | Max particle size Po  | olymer Viscosity      |
|------------------------------------|------------------------------|--------------------------|--------|-----------------------|-----------------------|
| 4.0<br>W/m·K<br>Glass bead<br>add. |                              | NT4                      | 00N    | - 80 - 1              | DM 22                 |
|                                    |                              | NT4                      | 00\$   | 80                    | DM 30                 |
|                                    | ITEM                         | Test Conditions          | Units  | NT400N                | NT400S                |
|                                    | Color                        | Visual (A : B)           | -      | A : Blue<br>B : White | A : Blue<br>B : White |
|                                    | Continuous Use temp          | -                        | °C     | -60 ~ 200             | -60 ~ 200             |
| General                            | Viscosity(A)                 | 25℃, 1rpm, No.52 Spindle | cps    | 240,000               | 300,000               |
|                                    | Viscosity(B)                 | 25℃, 1rpm, No.52 Spindle | cps    | 180,000               | 300,000               |
|                                    | Viscosity(Mixes)             | 25℃, 1rpm, No.52 Spindle | cps    | 220,000               | 300,000               |
|                                    | Density                      | 25℃, Gravimeter          | g/cc   | 3.0                   | 3.0                   |
| Machanical                         | Hardness                     | Shore                    | 00     | 80                    | 80                    |
| Mechanical                         | Elongation                   | -                        | %      | 50                    | 50                    |
|                                    | Flame Rating                 | Vertical Burning Test    | -      | V-0                   | V-0                   |
| Electrical                         | Withstand Voltage            | AC, 3000V                | mA     | < 0.3                 | < 0.3                 |
|                                    | Volume Resistivity           | -                        | Ω·cm   | > 1*10 <sup>12</sup>  | > 1*10 <sup>12</sup>  |
|                                    | Thermal Conductivity         | -                        | W/m·K  | 4.0                   | 4.0                   |

ppm

min.

80

120

NanoTIM

-

120

Information on TGF

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**Products Introduction** 

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Safety & Packaging

### TGF - Thermal Gap Filler

#### Products Introduction

#### **TGF-500 Series**

The TGF-500 Series are Thermal Conductivity  $5.0 \sim 6.0$  W/m·K  $\times$  It does not include 6.0 W/m·K The products that apply are NT500N.

| Thermal<br>Conductivity | Produc          | ct Feature | Product Name | Max particle size | Polymer | Viscosity |
|-------------------------|-----------------|------------|--------------|-------------------|---------|-----------|
| 5.0                     | Normal          |            | NT500N -     | 90                | DM      | 15        |
| W/m∙K                   | Glass bead add. |            |              |                   |         |           |

| ITEM       |                      | Test Conditions              | Units | NT500N                |
|------------|----------------------|------------------------------|-------|-----------------------|
|            | Color                | Visual (A : B)               | -     | A : Pink<br>B : White |
| General    | Continuous Use temp  | -                            | °C    | -60 ~ 200             |
|            | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 145,000               |
|            | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 155,000               |
|            | Viscosity(Mixes)     | 25℃, 1rpm, No.52 Spindle     | cps   | 150,000               |
|            | Density              | 25℃, Gravimeter              | g/cc  | 3.1                   |
| Mechanical | Hardness             | Shore                        | 00    | 80                    |
| Mechanica  | Elongation           | -                            | %     | 50                    |
|            | Flame Rating         | Vertical Burning Test        | -     | V-0                   |
| Electrical | Withstand Voltage    | AC, 3000V                    | mA    | < 0.3                 |
|            | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup>  |
| Thermal    | Thermal Conductivity | -                            | W/m∙K | 5.0                   |
| Cure       | Pot life @ 25°C      | Time for viscosity to double | min.  | 60                    |

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**Durability Property** 

Safety & Packaging

### TGF - Thermal Gap Filler

#### Durability Property

TGF of NanoTIM has the same conditions for durability property.

| ITEM  | Test Conditions            | Units | Demand Date                                      |
|---|----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr               | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr               | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 ℃, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle    | %     |  |
| Withstand Voltage   | AC, 3000V                  | mA    | No insulation destruction                        |
| Low molecular siloxane  | D3~D6                      | ppm   | < 100  |
| Heat loss   | 100°C, 5Hour               | %     | Within 0.3%                                      |
| Heat shrinkage  | 100°C, 1Hour               | %     | Within 0.2%                                      |

### **Thermal Conductivity Change Rate**



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Safety & Packaging

### TGF - Thermal Gap Filler

#### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

#### Packaging

| Package type                             | Volume | Weight        | Photograph       |
|--|--------|---------------|------------------|
| Cartridge<br>(Integral<br>two-part type) | 25ml   | 40g ~ 75g     | A CARACTER STATE |
|  | 200ml  | 300g ~ 500g   |                  |
| Syringe<br>(separation<br>two-part type) | 590ml  | 1kg ~ 1.6kg   |                  |
| Pail<br>(separation<br>two-part type)    | 20L    | 30kg ~ 40kg   |                  |
| Drum<br>(separation<br>two-part type)    | 200L   | 300kg ~ 400kg |                  |

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Upon customer's request the gap fillers may be packed into the desired size of containers.

However, for small sizes NanoTIM offers cartridges for easy dispensing and large sizes the gap fillers are packed into a container.

% The volume/weight are indicated separately for each A/B.

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### TGF - Thermal Gap Filler

#### Useable life and storage

Information on TGF

**Selection Guides** 

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Safety & Packaging

The gap filler products are best to maintain the product characteristics when it is stored in a cool and non-humid environment, especially where it is not exposed by any sunlight. Containers that passed 2 months from the date of manufacture should be remixed with a clean mixer and vacuumed to prevent any air gaps forming prior to the mixing procedure. Whereas the cartridge contained products, the package should be flipped upside down every two weeks in order to prevent the particle fillers settling near the bottom side. The shelf life can go up to 6 months above when properly stored. Storage temperatures range from 15 to 25 degrees.

X Once an open product is stored for a long time, there is a possibility of product contamination, so the quality of the product is not guaranteed.

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### Two-part Liquid

#### Information on TAF

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Safety & Packaging

### TAF - Thermal Adhesive Filler

#### Information

TAF stands for Thermal Adhesive Filler.

TAF series are two-part silicone-based thermal filler that has low viscosity prior to curing. TAF series are an ideal thermal interface material specially designed for filling between to heat source like Chip set and other plastic encapsulated components with excellent thermal conductivity cushioning and filling properties. The purpose of this material is to improve the heat delivery from the heat source to the heat sink. Depending on the customer's request, the material is available in different viscosity and hardness.

Typical properties of the filling material consist of the following characteristics: Thermal conductivity, adhesion, viscosity, hardness, working time, volume resistivity, etc. It is generally offered in either cartridges or containers, whereas the cartridges are used with a static mixing nozzle and a dispensing gun.

By mixing the two-part component into a single mixed material, the liquid form cures into a solid form depending on the curing time and temperature.

#### Features and Benefits

- Conformable
- Isolated electrically
- · Minimized interfacial resistance
- Superior Thermal Performance
- Superior self-adhesion
- Tends to maintain formability

#### Applications

- Display (LED, LCD, PDP TV etc.)
- Memory Devices
- Custom ASICS Chips
- LED Applications
- Digital Mobile Convergence
- Automobile(motors)

#### Characteristics

Thermal conductivity

NanoTIA

TAF

- Adhesion
- Viscosity
  - Hardness
- Working time

#### How to use

Depending on the stored time of the material from the date of manufacture, premix prior to the actual use. For the two-part component, mix the part A and B material by a ratio of 1:1 and apply the mixed material on the desired surfaces. Once the surface is applied by a pressure with a surface the air gaps could be removed as much as possible for better heat dissipation from the heat source.

#### Processing

After the material is exposed to air the material will begin to cure. At room temperature the cure time is generally set to a certain time which can be shorten by applying additional heat or other accelerating factors. Overall the material applied at the desired surface will eventually cure throughout the material after being dispensed. Upon customer's request the curing time can be adjusted by changing the amount of catalysts.





Durability Property

Safety & Packaging

- CF(Cohesive Failure)
   The term refers to either partial or complete destruction within the adhesive layer.
- AF(Adhesive Failure) The term refers to either partial or complete separation of interfacial deposition agent surface and adhesive layer.

TAF

### Information on TAF

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### TAF - Thermal Adhesive Filler

### Selection Guides

Building a Product Number

| TAF                     | NT000[ ]                     | 00[ ]00                |
|-------------------------|------------------------------|------------------------|
| Thermal Adhesive Filler | NT - NanoTIM                 | 00 - Max particle size |
|                         | 000 - Thermal Conductivity   | [] – Polymer           |
|                         | [] - Product characteristics | 00 - Viscosity         |

| NO | Product Name   | Thermal<br>Conductivity<br>[ W/m⋅K ] | Viscosity<br>[ cps ] | Hardness<br>[ Shore A ]<br>20 30 40 50 60 70 80 90 | Product Characteristics          |
|----|----------------|--------------------------------------|----------------------|--|----------------------------------|
| 1  | TAF-100-Series | 1.0 ~ 1.9                            | ~ 200,000            | • • • • • •  | N - Normal<br>S - Glass Bead add |
| 2  | TAF-200-Series | 2.0 ~ 2.9                            | ~ 300,000            | • • • • • •  | L - Light(Density)               |
| 3  | TAF-300-Series | 3.0 ~ 3.9                            | ~ 350,000            | • • • • • •  |                                  |
| 4  | TAF-400-Series | 4.0 ~ 4.9                            | ~450,000             | • • • • • •  |                                  |
| 5  | TAF-500-Series | 5.0 ~ 5.9                            | ~550,000             | • • • • • •  |                                  |

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Information on TAF

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### TAF - Thermal Adhesive Filler

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#### **TAF-100 Series**

The TAF-100 Series are Thermal Conductivity  $1.0 \sim 2.0$  W/m·K  $\times$  It does not include 2.0 W/m·K The products that apply are NT150NL, NT150SL.

| Therma<br>Conducti              | al Prod<br>vity      | uct Feature Produc           | t Name | Max particle size Po  | lymer Viscosity       |
|---------------------------------|----------------------|------------------------------|--------|-----------------------|-----------------------|
| 1.5<br>W/m·K Glass bead<br>add. |                      | Light NT1                    | 50NL - | — 70 C                | DM 05                 |
|                                 |                      | Light NT150SL                |        | — 70 C                | DM 04                 |
|                                 | ITEM                 | Test Conditions              | Units  | NT150NL               | NT150SL               |
|                                 | Color                | Visual (A : B)               | -      | A : Gray<br>B : White | A : Gray<br>B : White |
|                                 | Continuous Use temp  | -                            | °C     | -50 ~ 150             | -50 ~ 150             |
| General                         | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps    | 60,000                | 50,000                |
|                                 | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps    | 50,000                | 30,000                |
|                                 | Viscosity(Mixes)     | 25℃, 1rpm, No.52 Spindle     | cps    | 55,000                | 40,000                |
|                                 | Density              | 25°C, Gravimeter             | g/cc   | 1.81                  | 1.75                  |
|                                 | Hardness             | Shore                        | 00     | 85                    | 85                    |
| Mechanical                      | Hardness             | Shore                        | А      | 40                    | 40                    |
| Mechanica                       | Adhesion PCB         | 150℃, 1Hour                  | -      | CF 100%               | CF 100%               |
|                                 | Adhesion AL          | 150℃, 1Hour                  | -      | CF 100%               | CF 100%               |
|                                 | Flame Rating         | Vertical Burning Test        | -      | V-0                   | V-0                   |
| Electrical                      | Withstand Voltage    | AC, 3000V                    | mA     | < 0.2                 | < 0.2                 |
|                                 | Volume Resistivity   | -                            | Ω·cm   | > 1*10 <sup>12</sup>  | > 1*10 <sup>12</sup>  |
| Thermal                         | Thermal Conductivity | -                            | W/m∙K  | 1.7                   | 1.5                   |
| Cure                            | Pot life @ 25°C      | Time for viscosity to double | Hour   | 9                     | 9                     |

<u>Nano TIM</u>

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### TAF - Thermal Adhesive Filler

#### Products Introduction

#### **TAF-200 Series**

| Thermal<br>Conductivity | Produ           | uct Feature | Product Name | Max particle size | Polymer  | Viscosity |
|-------------------------|-----------------|-------------|--------------|-------------------|----------|-----------|
| 2.0                     | Normal          |             |              | 40<br>70          | DM<br>DM | 07<br>06  |
| W/m·K                   | Glass bead add. |             | NT200S       | 40<br>70          | DM<br>DM | 12<br>10  |

|            | ITEM                 | Test Conditions              | Units | NT200N-40DM07        | NT200N-70DM06        |
|------------|----------------------|------------------------------|-------|----------------------|----------------------|
|            | Color                | Visual (A : B)               | -     | A:Yellow<br>B:White  | A:Yellow<br>B:White  |
|            | Continuous Use temp  | -                            | °C    | -50 ~ 200            | -50 ~ 150            |
| General    | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 70,000               | 68,000               |
|            | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 70,000               | 60,000               |
|            | Viscosity(Mixes)     | 25℃, 1rpm, No.52 Spindle     | cps   | 70,000               | 60,000               |
|            | Density              | 25℃, Gravimeter              | g/cc  | 2.55                 | 2.05                 |
|            | Hardness             | Shore                        | 00    | 90                   | 85                   |
| Acchanical | Hardness             | Shore                        | А     | 60                   | 40                   |
| lechanica  | Adhesion PCB         | 150℃, 1Hour                  | -     | CF 100%              | CF 100%              |
|            | Adhesion AL          | 150℃, 1Hour                  | -     | CF 100%              | CF 100%              |
|            | Flame Rating         | Vertical Burning Test        | -     | V-0                  | V-0                  |
| Electrical | Withstand Voltage    | AC, 3000V                    | mA    | < 0.2                | < 0.2                |
|            | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
| Thermal    | Thermal Conductivity | -                            | W/m∙K | 2.0                  | 2.3                  |
| Cure       | Pot life @ 25°C      | Time for viscosity to double | Hour  | 9                    | 9                    |
|            |                      |                              |       |                      |                      |

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#### Products Introduction

#### **TAF-200 Series**

| Thermal<br>Conductivity | Prod            | uct Feature | Product Name | Max particle size | Polymer  | Viscosity       |
|-------------------------|-----------------|-------------|--------------|-------------------|----------|-----------------|
| 2.0                     | Normal          | ]           | NT200N       | 40<br>70          | DM<br>DM | 07<br>06        |
| 2.0<br>W/m·K            | Glass bead add. | ]           | NT200S       | 40<br>70          | DM<br>DM | <u>12</u><br>10 |

| ITEM       |                      | Test Conditions              | Units | NT200S-40DM12        | NT200S-70DM10        |
|------------|----------------------|------------------------------|-------|----------------------|----------------------|
|            | Color                | Visual (A : B)               | -     | A:Yellow<br>B:White  | A:Yellow<br>B:White  |
|            | Continuous Use temp  | -                            | °C    | -50 ~ 200            | -50 ~ 150            |
| General    | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 112,000              | 90,000               |
|            | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 105,000              | 105,000              |
|            | Viscosity(Mixes)     | 25°C, 1rpm, No.52 Spindle    | cps   | 120,000              | 100,000              |
|            | Density              | 25°C, Gravimeter             | g/cc  | 2.11                 | 2.36                 |
|            | Hardness             | Shore                        | 00    | 87                   | 85                   |
| Maghaniagl | Hardness             | Shore                        | А     | 45                   | 47                   |
| WECHANICA  | Adhesion PCB         | 150℃, 1Hour                  | -     | CF 100%              | CF 100%              |
|            | Adhesion AL          | 150℃, 1Hour                  | -     | CF 100%              | CF 100%              |
|            | Flame Rating         | Vertical Burning Test        | -     | V-0                  | V-0                  |
| Electrical | Withstand Voltage    | AC, 3000V                    | mA    | < 0.2                | < 0.2                |
|            | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
| Thermal    | Thermal Conductivity | -                            | W/m∙K | 2.1                  | 2.1                  |
| Cure       | Pot life @ 25°C      | Time for viscosity to double | Hour  | 9                    | 9                    |

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### TAF - Thermal Adhesive Filler

#### Products Introduction

#### **TAF-300 Series**

| Thermal<br>Conductivity | Product Feature    | Product Name      | Max particle size | Polymer | Viscosity |
|-------------------------|--------------------|-------------------|-------------------|---------|-----------|
| 3.0                     | Normal Light       | NT300N<br>NT300NL | )                 | DM      | 11<br>12  |
| W/m·K                   | Glass bead<br>add. |                   |                   |         |           |

|            | ITEM                 | Test Conditions              | Units | NT300N                 | NT300NL                    |
|------------|----------------------|------------------------------|-------|------------------------|----------------------------|
|            | Color                | Visual (A : B)               | -     | A : Brown<br>B : White | A : Navy blue<br>B : White |
|            | Continuous Use temp  | -                            | °C    | -50 ~ 150              | -50 ~ 150                  |
| General    | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 120,000                | 130,000                    |
|            | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 110,000                | 120,000                    |
|            | Viscosity(Mixes)     | 25℃, 1rpm, No.52 Spindle     | cps   | 110,000                | 120,000                    |
|            | Density              | 25℃, Gravimeter              | g/cc  | 2.47                   | 2.05                       |
|            | Hardness             | Shore                        | 00    | 85                     | 85                         |
| Acchanical | Hardness             | Shore                        | А     | 30                     | 30                         |
| nechanicai | Adhesion PCB         | 150℃, 1Hour                  | -     | CF 100%                | CF 100%                    |
|            | Adhesion AL          | 150℃, 1Hour                  | -     | CF 100%                | CF 100%                    |
|            | Flame Rating         | Vertical Burning Test        | -     | V-0                    | V-0                        |
| Electrical | Withstand Voltage    | AC, 3000V                    | mA    | < 0.2                  | < 0.2                      |
|            | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup>   | > 1*10 <sup>12</sup>       |
| Thermal    | Thermal Conductivity | -                            | W/m∙K | 3.5                    | 3.2                        |
| Cure       | Pot life @ 25°C      | Time for viscosity to double | Hour  | 9                      | 10                         |

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### TAF - Thermal Adhesive Filler

#### Products Introduction

#### **TAF-400 Series**

| Thermal<br>Conductivity | Produ              | ict Feature | Product Name | Max particle size | Polymer | Viscosity |
|-------------------------|--------------------|-------------|--------------|-------------------|---------|-----------|
| 4.0                     | Normal             |             | NT400N       | 80                | DM      | - 22      |
| W/m·K                   | Glass bead<br>add. |             |              |                   |         |           |

| ITEM       |                      | Test Conditions              | Units | NT400N                |
|------------|----------------------|------------------------------|-------|-----------------------|
|            | Color                | Visual (A : B)               | -     | A : Blue<br>B : White |
|            | Continuous Use temp  | -                            | °C    | -60 ~ 200             |
| General    | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 220,000               |
|            | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 220,000               |
|            | Viscosity(Mixes)     | 25℃, 1rpm, No.52 Spindle     | cps   | 220,000               |
|            | Density              | 25℃, Gravimeter              | g/cc  | 3.0                   |
|            | Hardness             | Shore                        | 00    | 95                    |
| Mochanical | Hardness             | Shore                        | А     | 60                    |
| Mechanica  | Adhesion PCB         | 150℃, 1Hour                  | -     | CF 100%               |
|            | Adhesion AL          | 150℃, 1Hour                  | -     | CF 100%               |
|            | Flame Rating         | Vertical Burning Test        | -     | V-0                   |
| Electrical | Withstand Voltage    | AC, 3000V                    | mA    | < 0.3                 |
|            | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup>  |
| Thermal    | Thermal Conductivity | -                            | W/m∙K | 4.0                   |
| Cure       | Pot life @ 25°C      | Time for viscosity to double | Hour  | 6                     |

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### TAF - Thermal Adhesive Filler

#### Products Introduction

#### **TAF-500 Series**

The TAF-500 Series are Thermal Conductivity  $5.0 \sim 6.0$  W/m·K  $\times$  It does not include 6.0 W/m·K The products that apply are NT500N.

| Thermal<br>Conductivity | Produ              | uct Feature | Product Name | Max particle size | Polymer | Viscosity |
|-------------------------|--------------------|-------------|--------------|-------------------|---------|-----------|
| 5.0                     | Normal             |             | NT500N       | 90                | DM      | 15        |
| W/m·K                   | Glass bead<br>add. |             | NT500S       | 90                | DM      | 13        |

|             | ITEM                 | Test Conditions              | Units | NT500N                | NT500S                |
|-------------|----------------------|------------------------------|-------|-----------------------|-----------------------|
|             | Color                | Visual (A : B)               | -     | A : Pink<br>B : White | A : Pink<br>B : White |
|             | Continuous Use temp  | -                            | °C    | -60 ~ 200             | -60 ~ 200             |
| General     | Viscosity(A)         | 25℃, 1rpm, No.52 Spindle     | cps   | 145,000               | 135,000               |
|             | Viscosity(B)         | 25℃, 1rpm, No.52 Spindle     | cps   | 155,000               | 114,000               |
|             | Viscosity(Mixes)     | 25°C, 1rpm, No.52 Spindle    | cps   | 150,000               | 132,000               |
|             | Density              | 25℃, Gravimeter              | g/cc  | 3.1                   | 3.1                   |
|             | Hardness             | Shore                        | 00    | 85                    | 85                    |
| Acchanical  | Hardness             | Shore                        | А     | 40                    | 40                    |
| viecnanicai | Adhesion PCB         | 150℃, 1Hour                  | -     | CF 100%               | CF 100%               |
|             | Adhesion AL          | 150℃, 1Hour                  | -     | CF 100%               | CF 100%               |
|             | Flame Rating         | Vertical Burning Test        | -     | V-0                   | V-0                   |
| Electrical  | Withstand Voltage    | AC, 3000V                    | mA    | < 0.3                 | < 0.3                 |
|             | Volume Resistivity   | -                            | Ω·cm  | > 1*10 <sup>12</sup>  | > 1*10 <sup>12</sup>  |
| Thermal     | Thermal Conductivity | -                            | W/m∙K | 5.0                   | 5.0                   |
| Cure        | Pot life @ 25°C      | Time for viscosity to double | Hour  | 8                     | 8                     |

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### TAF - Thermal Adhesive Filler

#### Durability Property

TAF of NanoTIM has the same conditions for durability property.

| ITEM  | Test Conditions            | Units | Demand Date                                      |
|---|----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr               | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr               | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 ℃, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle    | %     |  |
| Withstand Voltage   | AC, 3000V                  | mA    | No insulation destruction                        |
| Low molecular siloxane  | D3~D6                      | ppm   | < 100  |
| Heat loss   | 100°C, 5Hour               | %     | Within 0.3%                                      |
| Heat shrinkage  | 100°C, 1Hour               | %     | Within 0.2%                                      |

### **Thermal Conductivity Change Rate**



NanoTIM

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#### Information on TAF

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### TAF - Thermal Adhesive Filler

#### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

#### Packaging

| Package type                             | Volume | Weight        | Photograph  |
|--|--------|---------------|---|
| Cartridge                                | 25ml   | 40g ~ 75g     | A CONTRACT OF A |
| (Integral<br>two-part type)              | 200ml  | 300g ~ 500g   |   |
| Syringe<br>(separation<br>two-part type) | 590ml  | 1kg ~ 1.6kg   |   |
| Pail<br>(separation<br>two-part type)    | 20L    | 30kg ~ 40kg   |   |
| Drum<br>(separation<br>two-part type)    | 200L   | 300kg ~ 400kg |   |

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 The constraint of the constra

Upon customer's request the adensive fillers may be packed into the desired size of containers. However, for small sizes NanoTIM offers cartridges for easy dispensing and large sizes the adhesive fillers are packed into a container.

 $\ensuremath{\overset{\scriptstyle \ensuremath{\times}}{\times}}$  The package weight may vary depending on the density of the product.

% The volume/weight are indicated separately for each A/B.

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## TAF - Thermal Adhesive Filler

#### Useable life and storage

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The adhesive filler products are best to maintain the product characteristics when it is stored in a cool and non-humid environment, especially where it is not exposed by any sunlight. Containers that passed 2 months from the date of manufacture should be remixed with a clean mixer and vacuumed to prevent any air gaps forming prior to the mixing procedure. Whereas the cartridge contained products, the package should be flipped upside down every two weeks in order to prevent the particle fillers settling near the bottom side. The shelf life can go up to 6 months above when properly stored. Storage temperatures range from 15 to 25 degrees.

X Once an open product is stored for a long time, there is a possibility of product contamination, so the quality of the product is not guaranteed.

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THE ULTIMATE THERMAL SOLUTION PROVIDER

### Two-part Liquid

### TSG - Thermal Silicone Gel

#### Information

Low viscosity

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#### Information on TSG

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#### Safety & Packaging

### mormation

TSG stands for Thermal Silicone Gel.

It is a thermally conductive silicone gel material that is offered as two-part component. This product is low in viscosity and works well, and It cures at room temperature or with heat to form elastic, thermally conductive and flame-retardant rubber.

#### Features and Benefits

Thermal management

Excellent adhesion

### Applications

- OBC(on-board charger)
- Inverter
- Converter
- Automotive electronics



#### How to use

Depending on the stored time of the material from the date of manufacture, premix prior to the actual use. For the two-part component, mix the part A and B material by a ratio of offered and apply the mixed material on the desired surfaces.

Information on TSG

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### Building a Product Number

Selection Guides

TSG - Thermal Silicone Gel

| TSG                  | NT000[ ]                     | 00[ ]00                |
|----------------------|------------------------------|------------------------|
| Thermal Silicone Gel | NT - NanoTIM                 | 00 - Max particle size |
|                      | 000 - Thermal Conductivity   | [] – Polymer           |
|                      | [] - Product characteristics | 00 - Viscosity         |

| NO | Product Name   | Thermal<br>Conductivity | Viscosity |    |    | H<br>[ | l <b>ard</b><br>Sho | l <b>nes</b><br>re A | 5 <b>5</b><br>\] |    |    | Product Characteristics    |
|----|----------------|-------------------------|-----------|----|----|--------|---------------------|----------------------|------------------|----|----|----------------------------|
|    |                | [ W/m∙K ]               |           | 20 | 30 | 40     | 50                  | 60                   | 70               | 80 | 90 |                            |
| 1  | TSG-100-Series | 1.0 ~ 1.9               | ~ 5,000   |    | •  | •      | •                   | •                    | •                | •  | •  | N - Normal<br>A - Adhesive |
| 2  | TSG-200-Series | 2.0 ~ 2.9               | ~ 10,000  |    | •  | •      | •                   | •                    | •                | •  | •  |                            |
| 2  | TSG-300-Series | 3.0 ~ 3.9               | ~ 20,000  |    | •  | •      | •                   | •                    | •                | •  | •  |                            |

Information on TSG

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**Durability Property** 

Safety & Packaging

### TSG - Thermal Silicone Gel

#### Products Introduction

#### **TSG-100 Series**

Thermal

The TSG-100 Series are Thermal Conductivity 1.0~2.0W/m·K X It does not include 2.0W/m·K The products that apply are NT100N.

| Therma<br>Conducti | al Prod              | uct Feature Produc           | t Name | Max particle size Polymer Viscosity |   |
|--------------------|----------------------|------------------------------|--------|-------------------------------------|---|
| 1.0                | Normal               | ]                            |        |                                     |   |
| W/m·K              | Adhesive             | <u>NT</u>                    | 100A – | DM 03                               | ] |
|                    | ITEM                 | Test Conditions              | Units  | NT100N                              |   |
|                    | Color                | Visual (A : B)               | -      | A : White<br>B : Gary               |   |
|                    | Continuous Use temp  | -                            | °C     | -50 ~ 150                           |   |
| General            | Viscosity(A)         | 25°C, 3rpm, No.40 Spindle    | cps    | 2,900                               |   |
|                    | Viscosity(B)         | 25℃, 3rpm, No.40 Spindle     | cps    | 3,100                               |   |
|                    | Viscosity(Mixes)     | 25°C, 3rpm, No.40 Spindle    | cps    | 3,000                               |   |
|                    | Density              | 25°⊂, Gravimeter             | g/cc   | 1.75                                |   |
|                    | Hardness             | Shore                        | А      | 40                                  |   |
| Acchanical         | Elongation           | -                            | %      | 100                                 |   |
| Nechanica          | Tensile strength     | -                            | Мра    | > 0.5                               |   |
|                    | Adhesion Al          | 150℃, 1H, Oven               | Мра    | > 1                                 |   |
|                    | Flame Rating         | Vertical Burning Test        | -      | V-0                                 |   |
| Electrical         | Withstand Voltage    | AC, 3000V                    | mA     | < 0.15                              |   |
|                    | Volume Resistivity   | -                            | Ω·cm   | > 1*10 <sup>12</sup>                |   |
| Thermal            | Thermal Conductivity | -                            | W/m∙K  | 1.0                                 |   |
| Cure               | Pot life @ 25°C      | Time for viscosity to double | min.   | 120                                 |   |

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#### **TSG-300 Series**

The TSG-300 Series are Thermal Conductivity  $3.0 \sim 4.0$  W/m·K  $\times$  It does not include 4.0 W/m·K The products that apply are NT300N.

| Thermal<br>Conductivity | Product Feature | Product Name         | Max particle size | Polymer | Viscosity |
|-------------------------|-----------------|----------------------|-------------------|---------|-----------|
| 3.0                     | Normal          | - NT300N             | 70                | DM      |           |
| W/m·K                   | Adhesive        | - NT300A<br>- NT300A |                   | DM -    | 05<br>15  |

|            | ITEM                 | Test Conditions              | Units   | NT300N-70DM08         | NT300A-70DM05         | NT300A-70DM15         |
|------------|----------------------|------------------------------|---------|-----------------------|-----------------------|-----------------------|
|            | Color                | Visual (A : B)               | -       | A : White<br>B : Gary | A : White<br>B : Gary | A : White<br>B : Gary |
|            | Continuous Use temp  | -                            | °C      | -50 ~ 150             | -50 ~ 150             | -50 ~ 150             |
| General    | Viscosity(A)         | 25℃, 1rpm, No.40 Spindle     | cps     | 9,500                 | 7,000                 | 15,000                |
|            | Viscosity(B)         | 25℃, 1rpm, No.40 Spindle     | cps     | 8,700                 | 5,700                 | 13,000                |
|            | Viscosity(Mixes)     | 25℃, 1rpm, No.40 Spindle     | cps     | 8,300                 | 5,500                 | 15,000                |
|            | Density              | 25°C, Gravimeter             | g/cc    | 2.9                   | 2.9                   | 2.9                   |
|            | Hardness             | Shore                        | А       | -                     | 70                    | -                     |
|            | Hardness             | Shore                        | 00      | 50                    | -                     | 75                    |
| Mechanical | Elongation           | -                            | %       | 50                    | 50                    | 50                    |
|            | Tensile strength     | -                            | Мра     | -                     | > 0.5                 | > 0.5                 |
|            | Adhesion Al          | 150℃, 1H, Oven               | Мра     | -                     | > 1                   | > 1                   |
|            | Flame Rating         | Vertical Burning Test        | -       | V-0                   | V-0                   | V-0                   |
| Electrical | Withstand Voltage    | AC, 3000V                    | mA      | < 0.2                 | < 0.2                 | < 0.2                 |
|            | Volume Resistivity   | -                            | Ω·cm    | > 1*10 <sup>12</sup>  | > 1*10 <sup>12</sup>  | > 1*10 <sup>12</sup>  |
| Thermal    | Thermal Conductivity | -                            | W/m∙K   | 3.0                   | 3.0                   | 3.0                   |
| mermai     | CTE                  | TMA                          | ppm/°C  | 250                   | 250                   | 250                   |
| Cure       | Pot life @ 25°C      | Time for viscosity to double | min.    | 40                    | 48                    | 48                    |
| Ouro       | Cure @ 120°C         | Oven                         | minutes | 60                    | 90                    | 90                    |

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**Durability Property** 

Safety & Packaging

### TSG - Thermal Silicone Gel

#### Durability Property

TSG of NanoTIM has the same conditions for durability property.

| ITEM  | Test Conditions            | Units | Demand Date                                      |
|---|----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr               | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr               | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 ℃, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle    | %     |  |
| Withstand Voltage   | AC, 3000V                  | mA    | No insulation destruction                        |
| Low molecular siloxane  | D3~D6                      | ppm   | < 100  |
| Heat loss   | 100°C, 5Hour               | %     | Within 0.3%                                      |
| Heat shrinkage  | 100°C, 1Hour               | %     | Within 0.2%                                      |

### **Thermal Conductivity Change Rate**



Information on TSG

**Selection Guides** 

**Products Introduction** 

**Durability Property** 

Safety & Packaging

### TSG - Thermal Silicone Gel

#### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS) • Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl, Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl, Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether, Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether, Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether, Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

#### Packaging

Upon customer's request the TSG may be packed into the desired size of containers. % Please contact NanoTIM representative for information on packaging size and availability.

#### Useable life and storage

Special precautions must be taken to prevent moisture from contacting these materials. Containers should be kept tightly closed and head or air space minimized.

Some filler may settle to the bottom of the liquid after several weeks. To ensure a uniform product mix, the material in each container should be thoroughly free-mixing prior to use.

| SGS  |  |   | end Dates   2018  | n m  | Page 2 of 6  |   |   |
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### Nano TIM I

### STS - Silicone Tack Series

#### Information

Information on STS

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

STS series are two-part silicone-based Tackiness that has low viscosity prior to curing. STS series are mixing two-part 1:1 weight ratio will heat up and harden to form a soft silicone gel.

Features and Benefits

- Transparency
- Good workability
- Low viscosity

How to use

- Soft and tacky gel
- Excellent tackiness after curing
- Excellent resistance to temperature extremes
- Excellent electrical properties
- Environment friendly product

STS blend A and B to 1:1.

Rapid heat cure(Room-temperature curable)

For appropriate gel property A and B are blended homogeneously.

Curing takes place without any heat release but can be accelerated by heating.

#### Applications

- Display (LED, LCD, PDP TV etc...)
- Memory Devices
- IC insulation potting
- Power module potting
- Delicate assemblies

### STS - Silicone Tack Series

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**Products Introduction** 

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| 515                 |                            |
|---------------------|----------------------------|
| Silicon Tack Series | NT - NanoTIM               |
|                     | 000 - Thermal Conductivity |

[] - Product characteristics

| NO | Product Name   | Thermal<br>Conductivity<br>[ W/m⋅K ] | Viscosity<br>[ cps ] | Product Characteristics |
|----|----------------|--------------------------------------|----------------------|-------------------------|
| 1  | STS-000-Series | 0.0 ~ 0.9                            | ~ 2,000              | N - Normal              |

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### STS - Silicone Tack Series

#### Products Introduction

#### **STS-000 Series**

The STS-000 Series are simple silicone. The products that apply are NT020.

| ITEM    |                       | Test Conditions          | Units   | NT020     |
|---------|-----------------------|--------------------------|---------|-----------|
| General | Color                 | -                        | -       | clear     |
|         | Viscosity(A)          | 25℃, 5rpm, No.40 Spindle | cps     | 1,200     |
|         | Viscosity(B)          | 25℃, 5rpm, No.40 Spindle | cps     | 1,100     |
|         | Viscosity(Mixes)      | 25℃, 5rpm, No.40 Spindle | cps     | 1,100     |
|         | Density               | 25℃, Gravimeter          | g/cc    | < 1       |
|         | Operating temperature | -                        | °C      | -40 ~ 150 |
| Thermal | Thermal Conductivity  | -                        | W/m∙K   | 0.1 ~ 0.2 |
| Cure    | Cure                  | Pot Life @ 25°C          | minutes | 150       |
|         |                       | Cure @ 25°C              | hour    | 24        |
|         |                       | Cure @ 60°C              | minutes | 30        |
|         |                       | Cure @ 100°C             | minutes | 10        |
|         |                       | Cure @ 120°C             | minutes | < 10      |

NanoTIM L
# Two-part Liquid

Information on STS

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

# STS - Silicone Tack Series

### Durability Property

STS of NanoTIM has the same conditions for durability property.

| ITEM  | Test Conditions            | Units | Demand Date                                      |
|---|----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr               | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr               | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 ℃, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle    | %     |  |
| Withstand Voltage   | AC, 3000V                  | mA    | No insulation destruction                        |
| Low molecular siloxane  | D3~D6                      | ppm   | < 100  |
| Heat loss   | 100°C, 5Hour               | %     | Within 0.3%                                      |
| Heat shrinkage  | 100°C, 1Hour               | %     | Within 0.2%                                      |

### **Thermal Conductivity Change Rate**



NanoTIM

37

### Two-part Liquid

Information on STS

#### **Selection Guides**

**Products Introduction** 

**Durability Property** 

#### Safety & Packaging

# STS - Silicone Tack Series

### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

#### Packaging

Upon customer's request the STS may be packed into the desired size of containers. % Please contact NanoTIM representative for information on packaging size and availability

#### Useable life and storage

Special precautions must be taken to prevent moisture from contacting these materials. Containers should be kept tightly closed and head or air space minimized.

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NanoTIN

# TGS - Thermal Grease Series

#### Information

#### Information on TGS

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

TGS series are the superior thermal interface material with Nano-dispersion technology to mix the silicon fluid and high-performance nano powder, which can help the thermal dissipating of electric components.

TGS thermal compound is a silicone-based thermal grease made from a silicone fluid with thermally conductive material and metal oxide fillers. Also, this is able to achieve less than thickness of 1 mils to minimize the thermal pathway and maximize heat-flow.

This material can be divided into two main categories: Automobile and Computer.

#### **Features and Benefits**

Isolated electrically

Minimized interfacial resistance Superior Thermal Performance

Depending on the stored time of the material from the date of manufacture, premix prior to the actual use. Apply the mixed material on the desired surfaces. Once the surface is applied by a pressure with a surface the air gaps could be removed as much as possible for better heat dissipation from the heat

Tends to maintain formability

Conformable

How to use

source.

•

### Applications

- CPU, GPU (Notebooks, Desktops, Servers)
- Custom ASICS Chips
- LED Applications
- Digital Mobile Convergence
- Telecommunication Equipment







Nanotin

Information on TGS

**Selection Guides** 

# TGS - Thermal Grease Series

### Selection Guides

Building a Product Number : Computer

| TGS                   |            | A000 |
|-----------------------|------------|------|
| Thermal Grease Series | A - Attach |      |

000 - Thermal Conductivity

#### **Products Introduction**

Durability Property

Safety & Packaging

#### Building a Product Number : Automobile

| TGS                   | NT000[ ]                      | 00[ ]00                |
|-----------------------|-------------------------------|------------------------|
| Thermal Grease Series | NT - NanoTIM                  | 00 - Max particle size |
|                       | 000 - Thermal Conductivity    | [] – Polymer           |
|                       | [ ] - Product characteristics | 00 - Viscosity         |
|                       | G - Gray(Normal)              |                        |
|                       |                               |                        |

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Selection Guides

**Products Introduction** 

Durability Property

Safety & Packaging

### TGS - Thermal Grease Series

#### Products Introduction

#### **TGS-A Series**

The TGS-A Series are for computers. The products that apply are A300, A700.

| Categories | Product Name |  |
|------------|--------------|--|
| Chip       | <br>A300     |  |
|            |              |  |
| CPU<br>GPU | <br>A700     |  |

|                  | ITEM                  | Test Conditions           | Units      | A300           | A700      |
|------------------|-----------------------|---------------------------|------------|----------------|-----------|
|                  | Color                 | -                         | -          | Gray           | Gray      |
| General          | Viscosity             | 25°C, 5rpm, No.52 Spindle | cps        | 300,000        | 400,000   |
| General          | Density               | 25℃, Gravimeter           | g/cc       | 2.6            | 2.6       |
|                  | Operating temperature |                           | °C         | -40 ~ 150      | -40 ~ 150 |
|                  | Thermal Conductivity  | -                         | W/m∙K      | 3.0< A300 <4.0 | 7.0       |
|                  |                       | 10 psi                    |            | 0.14           | 0.12      |
| Thermal          | Thermal Resistance    | 20 psi                    | °C.cm2/M   | 0.11           | 0.10      |
|                  |                       | 40 psi                    | C-ciii / W | 0.09           | 0.07      |
|                  |                       | 90 psi                    |            | 0.07           | 0.05      |
| Evaporation rate |                       | 150°C, 24hr               | Wt%        | < 1            | < 1       |

Information on TGS

# TGS - Thermal Grease Series

#### Products Introduction

#### **TGS-100 Series**

The TGS-100 Series are Thermal Conductivity  $1.0 \sim 2.0$  W/m·K  $\times$  It does not include 2.0 W/m·K The products that apply are NT150G.



|            | ITEM                  | Test Conditions          | Units     | NT150G               |
|------------|-----------------------|--------------------------|-----------|----------------------|
|            | Color                 | -                        | -         | Gray                 |
| Conorol    | Viscosity             | 25℃, 1rpm, No.40 Spindle | cps       | 440,000              |
| General    | Density               | 25°C, Gravimeter         | g/cc      | 2.8                  |
|            | Operating temperature | -                        | °C        | -40 ~ 150            |
|            | Flame Rating          | Vertical Burning Test    | -         | V-0                  |
| Electrical | Breakdown Voltage     | DC                       | KV/mm     | 3                    |
|            | Volume Resistivity    |                          | Ω·cm      | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity  | -                        | W/m∙K     | 1.5                  |
|            |                       | 10 psi                   |           | 0.36                 |
| Thermal    | Thermal Resistance    | 20 psi                   | °C.cm2/M  | 0.28                 |
|            | merman resistance     | 40 psi                   | C CIII /W | 0.23                 |
|            |                       | 90 psi                   |           | 0.16                 |

Selection Guides

Products Introduction

**Durability Property** 

Safety & Packaging

# TGS - Thermal Grease Series

#### Products Introduction

#### **TGS-200 Series**

The TGS-200 Series are Thermal Conductivity  $2.0 \sim 3.0$  W/m·K  $\times$  It does not include 3.0 W/m·K The products that apply are NT250G.



|            | ITEM                  | Test Conditions          | Units      | NT250G               |
|------------|-----------------------|--------------------------|------------|----------------------|
|            | Color                 | -                        | -          | Gray                 |
| Conoral    | Viscosity             | 25℃, 1rpm, No.40 Spindle | cps        | 650,000              |
| General    | Density               | 25°C, Gravimeter         | g/cc       | 2.5                  |
|            | Operating temperature | -                        | °C         | -40 ~ 150            |
|            | Flame Rating          | Vertical Burning Test    | -          | V-0                  |
| Electrical | Breakdown Voltage     | DC                       | KV/mm      | 3                    |
|            | Volume Resistivity    |                          | Ω·cm       | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity  | -                        | W/m·K      | 2.43                 |
|            |                       | 10 psi                   |            | 0.28                 |
| Thermal    | Thermal Resistance    | 20 psi                   | °C.cm2/M   | 0.22                 |
|            | memaricesistance      | 40 psi                   | C CIII / W | 0.19                 |
|            |                       | 90 psi                   |            | 0.15                 |

Selection Guides

Information on TGS

**Products Introduction** 

**Durability Property** 

Safety & Packaging

# TGS - Thermal Grease Series

#### Products Introduction

#### **TGS-400 Series**

The TGS-400 Series are Thermal Conductivity  $4.0 \sim 5.0$  W/m·K  $\times$  It does not include 5.0 W/m·K The products that apply are NT400G, NT400GL.



|            | ITEM                  | Test Conditions          | Units    | NT400G               | NT400GL              |
|------------|-----------------------|--------------------------|----------|----------------------|----------------------|
|            | Color                 | -                        | -        | Gray                 | Gray                 |
| Conoral    | Viscosity             | 25℃, 1rpm, No.40 Spindle | cps      | 2,000,000            | 440,000              |
| General    | Density               | 25°C, Gravimeter         | g/cc     | 2.8                  | 2.8                  |
|            | Operating temperature | -                        | °C       | -40 ~ 150            | -40 ~ 150            |
|            | Flame Rating          | Vertical Burning Test    | -        | V-0                  | V-0                  |
| Electrical | Breakdown Voltage     | DC                       | KV/mm    | 3                    | 3                    |
|            | Volume Resistivity    |                          | Ω·cm     | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity  | -                        | W/m∙K    | 4.0                  | 4.0                  |
|            |                       | 10 psi                   |          | 0.25                 | 0.3                  |
| Thermal    | Thermal Resistance    | 20 psi                   | °C.cm2/M | 0.21                 | 0.13                 |
|            | mermantesistance      | 40 psi                   | C CHI /W | 0.17                 | 0.071                |
|            |                       | 90 psi                   |          | 0.13                 | 0.056                |

#### Selection Guides

Information on TGS

**Products Introduction** 

**Durability Property** 

Safety & Packaging

Information on TGS

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

# TGS - Thermal Grease Series

### Durability Property

TGS of NanoTIM has the same conditions for durability property.

| ITEM  | Test Conditions            | Units | Demand Date                                    |
|---|----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr               | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr               | %     | Thermal conductivity change rate , Within 100/ |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 ℃, humidity 85%) 500hr | %     | mermai conductivity change rate . Within 10%   |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle    | %     |  |
| Low molecular siloxane  | D3~D6                      | ppm   | < 100  |
| Oil Bleeding  | 150°C, 200hr               | %     | < 10   |
| Evaporation volume  |                            | %     | <1   |

### **Thermal Conductivity Change Rate**



Information on TGS

#### **Selection Guides**

**Products Introduction** 

**Durability Property** 

#### Safety & Packaging

# TGS - Thermal Grease Series

### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

### Packaging

| Package type | Volume | Photograph |
|--------------|--------|------------|
| Cartridge    | 333ml  |            |
| Pail         | 20L    |            |

### Useable life and storage

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SGS

SGS

Test Report

Upon customer's request the TGS may be packed into the desired size of containers.

However, for small sizes(333ml Syringe) NanoTIM offers syringe for easy dispensing. and large sizes(20L Pail) the grease are packed into a container.

% Please contact NanoTIM representative for information on packaging size and availability.

Nanotin

# TMF - Thermal Modified Silane Filler

#### Information

Information on TMF

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

# TMF is a one-liquid type heat dissipation product with MS Polymer and is a flexible product with excellent thermal conductivity, adhesion, and elasticity.

#### Features and Benefits

- Adhesive
- Conformable
- low hardness

How to use

- Easy dispense
- Isolated electrically
- Minimized interfacial resistanceSuperior Thermal Performance

- Applications
- Display (LED, LCD, PDP TV etc.)
- Memory Devices
- Custom ASICS Chips
- LED Applications
- Digital Mobile Convergence
- Automobile(motors)

### Characteristics

- Thermal conductivity
- Viscosity
- Hardness
- Working time

Apply this product to the desired surface with minimal air contact after opening.

Nanotim



TMF-200-Series

1

 $2.0 \sim 2.9$ 

**Product Characteristics** 

N - Normal

**Selection Guides** 

#### **Products Introduction**

Durability Property

Safety & Packaging

# TMF - Thermal Modified Silane Filler

#### Products Introduction

#### TMF-200 Series

The TMF-200 Series are Thermal Conductivity  $2.0 \sim 3.0$  W/m·K  $\times$  It does not include 3.0 W/m·K The products that apply are NT200N.

|            | ITEM                    | Test Conditions          | Units | NT200N               |
|------------|-------------------------|--------------------------|-------|----------------------|
|            | Color                   |                          | -     | White                |
| General    | Viscosity               | 25℃, 1rpm, No.52 Spindle | cps   | 200,000              |
|            | Density                 | 25℃, Gravimeter          | g/cc  | 2.27                 |
| Mechanical | Hardness                | Shore                    | А     | 55                   |
|            | Flame Rating            | Vertical Burning Test    | -     | V-0                  |
| Electrical | Withstand Voltage       | AC, 3000V                | mA    | < 0.15               |
|            | Volume Resistivity      |                          | Ω·cm  | > 1*10 <sup>12</sup> |
| Thermal    | Thermal Conductivity    | -                        | W/m∙K | 2.09                 |
| Durability | l ow molecular silovane | D4~D10                   | ppm   | < 20                 |
| Property   |                         | D4~D20                   | ppm   | < 30                 |
| Cure       | Working time @ 25°C     |                          | min.  | 30                   |
| Oure       | Cure                    | 2T                       | Hour  | 24                   |
|            |                         |                          |       |                      |

NanoTIM L

Information on TMF

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

# TMF - Thermal Modified Silane Filler

### Durability Property

TMF of NanoTIM has the same conditions for durability property.

| ITEM  | Test Conditions             | Units | Demand Date                                      |
|---|-----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr                | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr                | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 °C, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40℃~150℃) 500 Cycle %     |       |  |
| Withstand Voltage   | AC, 3000V                   | mA    | No insulation destruction                        |

### **Thermal Conductivity Change Rate**



#### Information on TMF

#### **Selection Guides**

**Products Introduction** 

**Durability Property** 

#### Safety & Packaging

**TMF - Thermal Modified Silane Filler** 

#### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS) - Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl, Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl, Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether, Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether, Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether, Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

### | Packaging

| Package type | Volume | Photograph |
|--------------|--------|------------|
| Cartridge    | 333ml  |            |
| Pail         | 20L    |            |

Upon customer's request the TMF may be packed into the desired size of containers.

SGS

SGS

However, for small sizes(333ml Syringe) NanoTIM offers syringe for easy dispensing. and large sizes(20L Pail) the grease are packed into a container.

※ Please contact NanoTIM representative for information on packaging size and availability.

### Useable life and storage

Special precautions must be taken to prevent moisture from contacting these materials. because It could curing. So containers should be kept tightly closed and head or air space minimized.

NanoTIN

THE ULTIMATE THERMAL SOLUTION PROVIDER

# One-part Liquid & Pad

#### Information on PCM

**Selection Guides** 

**Products Introduction** 

#### **Durability Property**

#### Safety & Packaging



#### Information

PCM is a thermal interface material to meet the requirement of heat in electronic component through high thermal performance. PCM is a wax based organic composed of thermal filler, metal oxide and other additive. At typical application operating temperature, PCM softens and flows to produce high thermal performance by achieving minimum bond-line and maximum surface wetting.

PCM is also easy to use and re-workable. PCM can be also easily used on the component to need high thermal resistance and reliability.

PCM meets all environmental requirement Including RoHS and flame rating. This Application Note contains Recommendations on how to specify, handle and install PCM thermal interface pad and liquid.

#### Features and Benefits Ap

- High thermal conductivity
- Stable at elevated temperature
- Easy handling(Flexible) at room temperature
- Sticky at room temperature

### Applications

- CPU (Notebooks, Desktops, Servers)
- Custom ASICS Chips
- GPUs (Graphics Chips)
- North & Southbridge Chipsets
- FBDIMM, UDIMM, RDIMM
- High-power Module

#### Characteristics

- Organic phase change sheet
- Highly wetting interface material
- Re-workability





Nanotin

Information on PCM

**Selection Guides** 

**Products Introduction** 

Durability Property

Safety & Packaging

# PCM - Phase Change Material

### Selection Guides

Building a Product Number

| РСМ                   | NT000[ ]                      | 00[ ]00                       |
|-----------------------|-------------------------------|-------------------------------|
| Phase Change Material | NT - NanoTIM                  | 00 - Max particle size        |
|                       | 000 - Thermal Conductivity    | [ ] – Polymer                 |
|                       | [ ] - Product characteristics | 00 - Phase Change temperature |
|                       | N - Normal Pad                |                               |
|                       | HV - High Viscosity Liquid    |                               |
|                       | LV - Low Viscosity Liquid     |                               |

|              | NO Product Name |                | Thermal<br>Conductivity | Change Temperature<br>[ ℃ ] |    |    |    |    |     |                     | Product Characteristics |
|--------------|-----------------|----------------|-------------------------|-----------------------------|----|----|----|----|-----|---------------------|-------------------------|
|              |                 | [ W/m·K ]      | 40                      | 50                          | 60 | 70 | 80 | 90 | 100 |                     |                         |
|              | 1 Liquid DCM    | 2.5            |                         |                             |    |    | •  | •  |     | HV - High Viscosity |                         |
| 1 Liquid PCM |                 | 4.0            |                         | •                           |    |    |    |    |     | LV - Low viscosity  |                         |
|              | 2               | PCM-400-Series | 4.0 ~ 4.9               |                             | •  |    |    |    |     |                     | N - Normal Pad          |

# PCM - Phase Change Material

### One-part Liquid & Pad

### Selection Guides

#### Information on PCM

#### **Selection Guides**

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**Durability Property** 

#### Safety & Packaging

### Pressure vs Thickness



PCM softens and flows at the phase change temperature and pressure conditions encountered in a typical application between a hot component and its cooling component. During the initial power cycle, as the PCM pad softens and flows to displace air in the interface gap, the average thickness of the pad will decrease and the total area covered by the pad will increase.

PCM will be increased on the order of 30% in length and width. This 30% length/width increase was determined using a "generic" heat sink, its associated metal spring clip and a microprocessor device with integrated heat spreader. It is very important that thermal interface material is to fully cover the footprint of the heat generating device. Each application will vary in terms of flatness, co-planarity, applied clamping pressure, operating temperature, PCM to spreader placement tolerance, spreader-to component placement tolerance, etc., so it is recommended that the PCM size is verified through actual testing to be sure that thermal requirements are met.

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# PCM - Phase Change Material

#### Products Introduction

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|           | ITEM                     | Test Conditions          | Units | NT400N               | NT250HV              | NT400LV              |
|-----------|--------------------------|--------------------------|-------|----------------------|----------------------|----------------------|
|           | Form                     | Visual                   | -     | Pad                  | High Viscosity       | Low Viscosity        |
|           | Color                    | Visual                   | -     | Gray                 | White                | Gray                 |
|           | Viccosity                | 10 shear rate, 60℃       | Pa∙s  | 75                   | -                    | -                    |
|           | VISCOSITY                | 25℃, 1rpm, No.52 Spindle | cps   | -                    | 370,000              | 57,000               |
| General   | Density                  | 25℃, Gravimeter          | g/cc  | 2.8                  | 1.9                  | 2.7                  |
|           | Thickness                | 25℃                      | mm    | 0.15~1.0             | -                    | -                    |
|           | Operating temperature    |                          | °C    | -40 ~ 125            | -40 ~ 150            | -40 ~ 125            |
|           | Phase Change temperature |                          | °C    | 45                   | 73 ~ 87              | 45                   |
|           | Change peak temperature  |                          | °C    | -                    | 84                   | -                    |
|           | Flame Rating             | Vertical Burning Test    | -     | V-2                  | V-1                  | V-2                  |
| lectrical | Withstand Voltage        | AC, 3000V                | mA    | < 0.2                | < 0.2                | < 0.2                |
|           | Volume Resistivity       |                          | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
| bermal    | Thermal Conductivity     | -                        | W/m∙K | 4.0                  | 2.5                  | 4.0                  |
| neimai    | Latent heat              |                          | J/g   | -                    | 5.04                 | -                    |



#### Latent heat of PCM-NT250HV

The DSC has been utilized to measure the latent heat.

PCM-NT250HV phase changes within the temperature range from 73C to 87C. Also, the peak that is found around 84C shows that this change is maximized.

When the material phase changes, about 5J/g of energy is used for the endothermic reaction.

As the portion of the phase changing material increases the phase change occurring temperature decreases.

\* However, latent heat is assumed to increase proportionally.

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# PCM - Phase Change Material

### Durability Property

| Information on | РСМ |
|----------------|-----|
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**Selection Guides** 

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Safety & Packaging



Thermal Performance Curve

Thickness vs Thermal Resistance



### **Pressure vs Thermal Resistance**



Information on PCM

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#### Safety & Packaging

#### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS) - Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl, Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl, Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether, Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether, Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether, Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

#### Packaging

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As with any (PCM) phase change material, PCM material requires an initial phase change to achieve optimum thermal performance. Initial thermal performance will behave as a dry joint thermal interface, because the material has not yet driven out the air gaps between the heat spreader and the component. Re-flow and wetting of the surfaces typically takes only a few minutes once the 45°C phase change temperature is achieved. Also, allowing the monitored electronic component to reach 60°C, the PCM sheet would fully change phase for maximum wetting. Pressure enhances and accelerates the effect. After this initial re-flow, the interface resistance will behave as high performance thermal grease, even after powering down of the microprocessor. Unless the heat spreader is removed from the component the initial high interface resistance will not be seen during subsequent power cycles.

#### Useable life and storage

PCM is a temperature sensitive material, and should be stored below 25°C.

Short term exposure to higher temperatures, up to 45°C during product shipment will not affect product performance. It is recommended there is no weight pressing down onto the PCM on preventing wrinkling of the sheet.

Nanotin

# SPS – Silicone Pad Series

#### Information

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SPS series are an ideal thermal interface material specially designed for heatsink attachment to heat source like Chip set, and other plastic encapsulated components with excellent thermal conductivity cushioning and gap-filling properties.

It is also suitable for mounting heat spreader onto power converter and motor control PCB. SPS series also meet all environmental requirement including RoHS.

#### **Features and Benefits**

- Conformable
- Isolated electrically
- Minimized interfacial resistance
- Superior Thermal Performance
- Superior peel-adhesion



- Display (LED, LCD, PDP TV etc...)
- Memory Devices
- Custom ASICS Chips
- LED Applications
- Digital Mobile Convergence



NanoTIM



#### Structure







#### Structure - Natural + add.



### SPS – Silicone Pad Series

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| SPS                 | NT000[ ]                     | 00[ ]00                |
|---------------------|------------------------------|------------------------|
| Silicone Pad Series | NT - NanoTIM                 | 00 - Max particle size |
|                     | 000 - Thermal Conductivity   | [] – Polymer           |
|                     | [] - Product characteristics | 00 - Hardness          |

| NO | Product Name   | Thermal<br>Conductivity | Hardness<br>[ Shore 00 / A ] |    |    |    |    |    |    | Product Characteristics |   |
|----|----------------|-------------------------|------------------------------|----|----|----|----|----|----|-------------------------|---|
|    |                | [ W/m·K ]               | 0~20                         | 30 | 40 | 50 | 60 | 70 | 80 | 90                      |   |
| 1  | SPS-100-Series | 1.0 ~ 1.9               | •                            | •  | •  | •  | •  | •  | •  | •                       | N - Natural<br>L - Light(Density)                   |
| 2  | SPS-200-Series | 2.0 ~ 2.9               | •                            | •  | •  | •  | •  | •  | •  | •                       | U - Ultra Soft                                      |
| 3  | SPS-300-Series | 3.0 ~ 3.9               | •                            | •  | •  | •  | •  | •  | •  | •                       | S - Glass Fiber mesh add.<br>F - Transfer Film add. |
| 4  | SPS-400-Series | 4.0 ~ 4.9               | •                            | •  | •  | •  | •  | •  | •  | •                       | A - Adhesive Fiim add.                              |
| 5  | SPS-500-Series | 5.0 ~ 5.9               |                              |    | •  | •  | •  | •  | •  | •                       |   |

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### SPS – Silicone Pad Series

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#### **SPS-100 Series**



|            | ITEM                      | Test Conditions       | Units | NT100N               |
|------------|---------------------------|-----------------------|-------|----------------------|
|            | Color                     | -                     | -     | Pink                 |
| Conorol    | Density                   | 25℃, Gravimeter       | g/cc  | 2.0                  |
| General    | Operating temperature     | -                     | °C    | -40 ~ 150            |
|            | Thickness                 | Mitsutoyo             | mm    | 0.5 ~ 3              |
|            | Hardness                  | Shore                 | 00    | 15                   |
| Machanical | Elongation                |                       | %     | 120                  |
| Mechanica  | Tensile strength          |                       | Ν     | 1.2                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 12                 |
| Electrical | Withstand Voltage         | AC, 3000V             | mA    | < 0.29               |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m∙K | 1.0                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.14               |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.08               |

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### SPS – Silicone Pad Series

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#### **SPS-100 Series**

| Thermal<br>Conductivity | Product<br>Feature | Product Name   | Max | particle size | Polymer | Hardness |
|-------------------------|--------------------|----------------|-----|---------------|---------|----------|
|                         |                    | NT150N         |     | 70            | DM      | - 50     |
| 1.5<br>W/m·K            | Normal Glas        | Fiber NT150NS  |     | 20            | DM      | 70       |
|                         | Ultra              | soft &NT150NUF |     | 90            | DM      | 25       |

|            | ITEM                      | Test Conditions       | Units | NT150N               | NT150NS              | NT150NUF             |
|------------|---------------------------|-----------------------|-------|----------------------|----------------------|----------------------|
|            | Color                     | -                     | -     | Gray                 | Gray                 | White                |
| Conorol    | Density                   | 25℃, Gravimeter       | g/cc  | 2.6                  | 2.4                  | 1.72                 |
| General    | Operating temperature     | -                     | °C    | -40 ~ 150            | -40 ~ 150            | -40 ~ 150            |
|            | Thickness                 | Mitsutoyo             | mm    | 1 ~ 10               | 0.2 ~ 1              | 0.5 ~ 9              |
|            | Hardness                  | Shore                 | 00    | 50                   | 70                   | 5 ~ 25               |
| Machanical | Elongation                |                       | %     | 100                  | 20                   | 150                  |
| Mechanica  | Tensile strength          |                       | Ν     | 1.4                  | 1.5                  | 1.5                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  | 0.1                  | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 12                 | > 12                 | > 12                 |
| LIECTICA   | Withstand Voltage         | AC, 3000V             | mA    | < 0.29               | < 0.29               | < 0.29               |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m∙K | 1.8                  | 1.5                  | 1.5                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.14               | < 0.14               | < 0.14               |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.08               | < 0.08               | < 0.08               |

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### SPS – Silicone Pad Series

#### Products Introduction

#### **SPS-200 Series**

Thermal Product Conductivity Feature Product Name Max particle size Polymer Hardness Light 70 25 Normal NT200NL DM 2.0 W/m·K Ultra soft Light NT200UL 90 DM 20

|            | ITEM                      | Test Conditions       | Units | NT200NL              | NT200UL              |
|------------|---------------------------|-----------------------|-------|----------------------|----------------------|
|            | Color                     | -                     | -     | Yellow               | Yellow               |
| Conoral    | Density                   | 25℃, Gravimeter       | g/cc  | 1.8                  | 1.62                 |
| General    | Operating temperature     | -                     | °C    | -40 ~ 150            | -40 ~ 150            |
|            | Thickness                 | Mitsutoyo             | mm    | 1.5 ~ 3              | 0.3 ~ 2.0            |
|            | Hardness                  | Shore                 | 00    | 25                   | 5 ~ 25               |
| Machanical | Elongation                |                       | %     | 120                  | 120                  |
| Mechanica  | Tensile strength          |                       | Ν     | 1.2                  | 1.2                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 12                 | > 12                 |
| LIECTICA   | Withstand Voltage         | AC, 3000V             | mA    | < 0.20               | < 0.20               |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m∙K | 2.0                  | 1.95                 |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.14               | < 0.14               |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.08               | < 0.08               |

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### SPS – Silicone Pad Series

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#### **SPS-200 Series**

| Thermal<br>Conductivity |        | Product<br>Feature               | Product Name | Max particle size | Polymer | Hardness |
|-------------------------|--------|----------------------------------|--------------|-------------------|---------|----------|
| 2.5<br>W/m·K            | Normal | Ultra soft & Glass<br>Fiber Mesh | NT250NUS     | 90                | DM      | 15 ~ 25  |
|                         |        | Ultra soft &<br>Transfer Film    | NT250NUF     | 90                | DM      | 15 ~ 25  |

|              | ITEM                      | Test Conditions       | Units | NT250NUS             | NT250NUF             |
|--------------|---------------------------|-----------------------|-------|----------------------|----------------------|
|              | Color                     | -                     | -     | Brown                | Brown                |
| Conorol      | Density                   | 25℃, Gravimeter       | g/cc  | 1.98                 | 1.95                 |
| General      | Operating temperature     | -                     | °C    | -40 ~ 150            | -40 ~ 150            |
|              | Thickness                 | Mitsutoyo             | mm    | 0.5 ~ 9              | 0.5 ~ 9              |
|              | Hardness                  | Shore                 | 00    | 5 ~ 25               | 5 ~ 25               |
| Machanical   | Elongation                |                       | %     | 20                   | 120                  |
| IVIECHANICAI | Tensile strength          |                       | Ν     | 1.5                  | 1.2                  |
|              | Internal tearing strength |                       | Ν     | 0.1                  | 0.1                  |
|              | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  |
| Electrical   | Breakdown Voltage         | -                     | KV    | > 12                 | > 12                 |
| Electrical   | Withstand Voltage         | AC, 3000V             | mA    | < 0.29               | < 0.29               |
|              | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|              | Thermal Conductivity      | -                     | W/m∙K | 2.5                  | 2.5                  |
| Thermal      | Heat loss                 | 100℃, 5Hour           | %     | < 0.14               | < 0.14               |
|              | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.08               | < 0.08               |

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### SPS – Silicone Pad Series

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#### **SPS-300 Series**

| Thermal<br>Conductivity | Produ<br>Featu | uct<br>ire               | Product Name      | N | lax particle size | Polymer |   | Hardness      |
|-------------------------|----------------|--------------------------|-------------------|---|-------------------|---------|---|---------------|
| 3.0                     | Normal         |                          | NT300N<br>NT300NU |   | 70<br>90          | DM DM   |   | 40 ~ 70<br>20 |
| vv/m (X                 | _              | Glass Fiber<br>mesh add. | NT300NS           |   | 70 -              | - DM -  | _ | 30 ~ 70       |

|              | ITEM                      | Test Conditions       | Units | NT300N               | NT300NU              | NT300NS              |
|--------------|---------------------------|-----------------------|-------|----------------------|----------------------|----------------------|
|              | Color                     | -                     | -     | Gray                 | Light Blue           | White                |
| Conorol      | Density                   | 25℃, Gravimeter       | g/cc  | 2.8                  | 2.8                  | 2.8                  |
| General      | Operating temperature     | -                     | °C    | -40 ~ 150            | -60 ~ 200            | -40 ~ 150            |
|              | Thickness                 | Mitsutoyo             | mm    | 1.5 ~ 5              | 0.5 ~ 9              | 0.3 ~ 0.7            |
|              | Hardness                  | Shore                 | 00    | 50                   | 20                   | 70                   |
| Machanical   | Elongation                |                       | %     | 120                  | 100                  | 20                   |
| IVIECHALIICA | Tensile strength          |                       | Ν     | 1.2                  | 1.5                  | 1.2                  |
|              | Internal tearing strength |                       | Ν     | 0.1                  | 0.1                  | 0.1                  |
|              | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  | V-0                  |
| Flootrical   | Breakdown Voltage         | -                     | KV    | > 6                  | ≻ 12                 | > 7                  |
| Electrical   | Withstand Voltage         | AC, 3000V             | mA    | < 0.29               | < 0.30               | < 0.29               |
|              | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|              | Thermal Conductivity      | -                     | W/m∙K | 3.0                  | 3.0                  | 3.0                  |
| Thermal      | Heat loss                 | 100°C, 5Hour          | %     | < 0.14               | < 0.14               | < 0.2                |
|              | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.08               | < 0.08               | < 0.15               |

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### SPS – Silicone Pad Series

#### Products Introduction

#### **SPS-300 Series**

Thermal Product Conductivity Feature Product Name Max particle size Polymer Hardness 90 DM 70 NT300NL 3.0 Normal W/m·K Glass Fiber 90 50 NT300NLS DM mesh add.

|            | ITEM                      | Test Conditions       | Units | NT300NL              | NT300NLS             |
|------------|---------------------------|-----------------------|-------|----------------------|----------------------|
|            | Color                     | -                     | -     | Light Blue           | Light Blue           |
| Conoral    | Density                   | 25℃, Gravimeter       | g/cc  | 2.05                 | 2.05                 |
| General    | Operating temperature     | -                     | °C    | -40 ~ 150            | -40 ~ 150            |
|            | Thickness                 | Mitsutoyo             | mm    | 1.5 ~ 5              | 1.5 ~ 3              |
|            | Hardness                  | Shore                 | 00    | 70                   | 50                   |
| Maghaniagl | Elongation                |                       | %     | 120                  | 20                   |
| Mechanical | Tensile strength          |                       | Ν     | 1.5                  | 1.2                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 6                  | > 6                  |
| Electrical | Withstand Voltage         | AC, 3000V             | mA    | < 0.2                | < 0.2                |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m·K | 3.2                  | 3.2                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.3                | < 0.3                |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.2                | < 0.2                |

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### SPS – Silicone Pad Series

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#### **SPS-300 Series**

Thermal Product Conductivity Feature Product Name Max particle size Polymer Hardness Glass Fiber 90 35 NT360NS DM mesh add. 3.0 Normal W/m·K 30 NT380N 70 DM

|            | ITEM                      | Test Conditions       | Units | NT360NS              | NT380N               |
|------------|---------------------------|-----------------------|-------|----------------------|----------------------|
|            | Color                     | -                     | -     | Light Blue           | Light Blue           |
| Conoral    | Density                   | 25℃, Gravimeter       | g/cc  | 2.7                  | 2.85                 |
| General    | Operating temperature     | -                     | °C    | -40 ~ 180            | -40 ~ 180            |
|            | Thickness                 | Mitsutoyo             | mm    | 0.5 ~ 9              | 0.5 ~ 20             |
|            | Hardness                  | Shore                 | 00    | 35                   | 30                   |
| Maghaniagl | Elongation                |                       | %     | 20                   | 120                  |
| Mechanica  | Tensile strength          |                       | Ν     | 1.5                  | 1.2                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 6                  | > 6                  |
| Electrical | Withstand Voltage         | AC, 3000V             | mA    | < 0.3                | < 0.3                |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m·K | 3.6                  | 3.8                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.3                | < 0.3                |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.2                | < 0.2                |

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### SPS – Silicone Pad Series

#### Products Introduction

#### **SPS-400 Series**

The SPS-400 Series are Thermal Conductivity  $4.0 \sim 5.0$  W/m·K  $\times$  It does not include 5.0 W/m·K The products that apply are NT400N.



|            | ITEM                      | Test Conditions       | Units | NT400N               |
|------------|---------------------------|-----------------------|-------|----------------------|
|            | Color                     | -                     | -     | Blue                 |
| Conorol    | Density                   | 25℃, Gravimeter       | g/cc  | 2.8                  |
| General    | Operating temperature     | -                     | °C    | -40 ~ 180            |
|            | Thickness                 | Mitsutoyo             | mm    | 0.5 ~ 9              |
|            | Hardness                  | Shore                 | 00    | 35                   |
| Machanical | Elongation                |                       | %     | 60                   |
| Mechanica  | Tensile strength          |                       | Ν     | 1.2                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 12                 |
| Liectrical | Withstand Voltage         | AC, 3000V             | mA    | < 0.3                |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m∙K | 4.0                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.3                |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.2                |

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### SPS – Silicone Pad Series

#### Products Introduction

#### **SPS-500 Series**

The SPS-500 Series are Thermal Conductivity  $5.0 \sim 6.0$  W/m·K  $\times$  It does not include 6.0 W/m·K The products that apply are NT500N.



|            | ITEM                      | Test Conditions       | Units | NT500N               |
|------------|---------------------------|-----------------------|-------|----------------------|
|            | Color                     | -                     | -     | Pink                 |
| Conorol    | Density                   | 25℃, Gravimeter       | g/cc  | 3.1                  |
| General    | Operating temperature     | -                     | °C    | -40 ~ 200            |
|            | Thickness                 | Mitsutoyo             | mm    | 1.5 ~ 3              |
|            | Hardness                  | Shore                 | 00    | 40 ~ 65              |
| Machanical | Elongation                |                       | %     | 60                   |
| Mechanica  | Tensile strength          |                       | Ν     | 1.2                  |
|            | Internal tearing strength |                       | Ν     | 0.1                  |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  |
| Electrical | Breakdown Voltage         | -                     | KV    | > 6                  |
| Liectrical | Withstand Voltage         | AC, 3000V             | mA    | < 0.3                |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m∙K | 5.0                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.3                |
|            | Heat shrinkage            | 100℃, 1Hour           | %     | < 0.2                |

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### SPS – Silicone Pad Series

SPS of NanoTIM has the same conditions for durability property.

#### Durability Property

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| ITEM  | Test Conditions             | Units | Demand Date                                      |
|---|-----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr                | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr                | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 °C, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle     | %     |  |
| Withstand Voltage   | AC, 3000V                   | mA    | No insulation destruction                        |
| Low molecular siloxane  | D3~D6                       | ppm   | < 100  |
| Heat loss   | 100°C, 5Hour                | %     | Within 0.3%                                      |
| Heat shrinkage  | 100℃, 1Hour                 | %     | Within 0.2%                                      |

#### **Thermal Conductivity Change Rate**



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### SPS - Silicone Pad Series

### Safety Date

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#### Safety & Packaging

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

#### Packaging

It can be sold by adjusting various thickness and area. Contact NanoTIM Incorporated. Thank you very much.

ex) sample



### Useable life and storage

Products are best to maintain the product characteristics when it is stored in a cool and non-humid environment, especially where it is not exposed by any sunlight.

| SGS  |  |  | ad Date : 2019   |   | Page 2 ut 6  |   |  |
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| Information on THS    | Buildin                                      | g a Product Nu<br>THS | umber<br>[ ]000TM   |                       |  | 00[ ]00 |     |              |     |    |    |  |
| Selection Guides      | Thermal High<br>Consistency Rubber<br>Series |                       | NT - NanoTIM<br>000 - Thermal Conductivity<br>[ ] - Product characteristic: |                       | 00 - Max particle size<br>ity [] – Polymer<br>tics 00 - Hardness |         |     |              |     | ze |    |  |
| Products Introduction |  |                       |   |                       |  |         |     |              |     |    |    |  |
| Durability Property   | NO   | Product Nam           | Thermal<br>conductivity   | Hardness<br>[Shore A] |  |         |     |              |     |    |    | Product Characteristics  |
| Safety & Packaging    |  |                       | [ W/m·K ]   | 20                    | 30   | 40      | 50  | 60           | 70  | 80 | 90 |  |
|                       | 1  | THS-100-Serie         | es 1.0 ~ 1.9  |                       |  |         | •   | •            | •   | •  | •  | <ul><li>N - Normal</li><li>S - Glass fiber mesh add.</li><li>A - Adhesive Layer add.</li></ul> |
|                       | 2  | THS-200-Serie         | es 2.0 ~ 2.9  |                       |  |         | •   | •            | •   | •  | •  | P - Polyimide Film add.<br>E - High Elongation   |
# 

THS

#### Products Introduction

#### **THS-100 Series**

THS – Thermal High Consistency Rubber Series

|            | ITEM                      | Test Conditions       | Units | NT160N               | NT160NS              | NT160NSA             | NT160NSAP            |
|------------|---------------------------|-----------------------|-------|----------------------|----------------------|----------------------|----------------------|
|            | Color                     | -                     | -     | Pink                 | Gray                 | Pink                 | Pink                 |
|            | Density                   | 25℃, Gravimeter       | g/cc  | 2.12                 | 2.12                 | 2.12                 | 2.12                 |
| General    | Operating temperature     | -                     | °C    | -60 ~ 200            | -60 ~ 200            | -60 ~ 200            | -60 ~ 200            |
|            | Thickness                 | Mitsutoyo             | mm    | 0.2 ~ 0.3            | 0.2 ~ 0.3            | 0.2 ~ 0.5            | 0.12 ~ 0.5           |
| Mechanical | Hardness                  | Shore                 | А     | 90                   | 90                   | 90                   | 90                   |
|            | Elongation                |                       | %     | 50                   | 20                   | 20                   | < 10                 |
|            | Tensile strength          |                       | MPa   | 36.7                 | 64.4                 | 64.4                 | 28.23                |
|            | Internal tearing strength |                       | kN/m  | 43.1                 | 58.8                 | 58.8                 | 31.15                |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  | V-0                  | V-0                  |
| Electrical | Withstand Voltage         | DC                    | V     | 6000                 | 6000                 | 6000                 | 6000                 |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m·K | 1.7                  | 1.7                  | 1.7                  | 1.0                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.3                | < 0.3                | < 0.3                | < 0.3                |
|            | Heat shrinkage            | 100°C, 1Hour          | %     | < 0.2                | < 0.2                | < 0.2                | < 0.2                |

Information on THS

Pad

**Selection Guides** 

#### **Products Introduction**

**Durability Property** 

Safety & Packaging

# NanoTIM HanoTIM

THS – Thermal High Consistency Rubber Series

## Pad

### Products Introduction

#### **THS-200 Series**

The THS-200 Series are Thermal Conductivity 2.0~3.0W/m·K  $\times$  It does not include 3.0W/m·K The products that apply are NT200NA, NT250NS, NT250NSA, NT250NSAP,

|            | ITEM                      | Test Conditions       | Units | NT200NA              | NT250NS              | NT250NSA             | NT250NSAP            |
|------------|---------------------------|-----------------------|-------|----------------------|----------------------|----------------------|----------------------|
|            | Color                     | -                     | -     | Pink                 | Pink                 | Pink                 | Pink                 |
|            | Density                   | 25℃, Gravimeter       | g/cc  | 2.12                 | 2.12                 | 2.43                 | 2.43                 |
| General    | Operating temperature     | -                     | °C    | -60 ~ 200            | -60 ~ 200            | -60 ~ 200            | -60 ~ 200            |
|            | Thickness                 | Mitsutoyo             | mm    | 0.2 ~ 0.5            | 0.2 ~ 0.5            | 0.2 ~ 0.5            | 0.2 ~ 0.5            |
| Mechanical | Hardness                  | Shore                 | А     | 60                   | 80                   | 80                   | 80                   |
|            | Elongation                |                       | %     | < 10                 | 20                   | < 10                 | < 10                 |
|            | Tensile strength          |                       | MPa   | 36.7                 | 64.4                 | 64.4                 | 28.23                |
|            | Internal tearing strength |                       | kN/m  | 43.1                 | 58.8                 | 58.8                 | 31.15                |
|            | Flame Rating              | Vertical Burning Test | -     | V-0                  | V-0                  | V-0                  | V-0                  |
| Electrical | Withstand Voltage         | DC                    | V     | 6000                 | 6000                 | 6000                 | 6000                 |
|            | Volume Resistivity        |                       | Ω·cm  | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> | > 1*10 <sup>12</sup> |
|            | Thermal Conductivity      | -                     | W/m∙K | 2.0                  | 2.5                  | 2.5                  | 1.9                  |
| Thermal    | Heat loss                 | 100℃, 5Hour           | %     | < 0.3                | < 0.3                | < 0.3                | < 0.3                |
|            | Heat shrinkage            | 100°C, 1Hour          | %     | < 0.2                | < 0.2                | < 0.2                | < 0.2                |

Selection Guides

Information on THS

#### **Products Introduction**

**Durability Property** 

Safety & Packaging

## THS – Thermal High Consistency Rubber Series

THS of NanoTIM has the same conditions for durability property.

#### Durability Property

Information on THS

**Selection Guides** 

**Products Introduction** 

**Durability Property** 

Safety & Packaging

| ITEM  | Test Conditions             | Units | Demand Date                                      |
|---|-----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr                | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr                | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 °C, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle     | %     |  |
| Withstand Voltage   | AC, 3000V                   | mA    | No insulation destruction                        |
| Low molecular siloxane  | D3~D6                       | ppm   | < 100  |
| Heat loss   | 100°C, 5Hour                | %     | Within 0.3%                                      |
| Heat shrinkage  | 100°C, 1Hour                | %     | Within 0.2%                                      |

### **Thermal Conductivity Change Rate**



NanoTIM

# Nano TIM<sup>®</sup>

Pad

Information on THS

**Selection Guides** 

**Products Introduction** 

**Durability Property** 

Safety & Packaging

## THS – Thermal High Consistency Rubber Series

### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

### Packaging

It can be sold by adjusting various thickness and area. X Please contact NanoTIM representative for information on packaging size and availability.

### Useable life and storage

Products are best to maintain the product characteristics when it is stored in a cool and non-humid environment, especially where it is not exposed by any sunlight.

| SGS  |                      |  |                                    |  |   |      |                |
|--|----------------------|--|------------------------------------|--|---|------|----------------|
| Test Report no monte   | T5007A18-4934        |  | and Date   2018                    | 99.05                                  | Page 2 std  |      |                |
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| Their Barna  | Unit                 |  | Pad .                              | -                                      | facults   |      |                |
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| Flame Relationity-FEEn FEDEr   | Annual No.           | AUNATE-48  | 343.001                            |  |   |      |                |
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| the former of the local states when the ter-   | Test Same            |  |                                    |  | Tool Method   | -    | Annula         |
| interest is been a to make a larger, the second  | 21-2-49ytes          | Carolable (bane)   | 1984                               | WE WEAK                                | 0410-001423214.2817.0CMB  | 83   | 4.0            |
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| d'i tenent   | Benzy-budy p         | (447)  |                                    | 7010 release                           | 14 16 18 C 43321 4 . 3817 . BC/MID  | 88   | H.O.           |
|  | The second second    | Contraction of the local distance of the loc |                                    | 1000 1000                              |   | 1 11 | 24.00          |

# **APS – A**crylic **P**ad **S**eries

#### Information

Information on APS

Selection Guides

**Products Introduction** 

**Durability Property** 

Safety & Packaging

This product is made of acrylic base and is a pad type. Used as a heat dissipation product with shock, high tear resistance and high bonding strength. In addition, it has the advantage of being able to remove this product without residue.

#### **Features and Benefits**

- Outstanding shock resistance
- High tear resistance
- Very high bonding strength
- Excellent push out resistance
- Easy removability by stretching the adhesive
- The tape can be removed even after a long bonding time
- Residue free removability

#### Applications

- · Battery mounting
- Permanent mounting of components in electronic devices with the option to remove the parts for repairing or recycling
- Temporary fixation of components



# **APS – A**crylic **P**ad **S**eries

### Selection Guides

Information on APS

#### **Selection Guides**

**Products Introduction** 

Durability Property

Safety & Packaging

| Building a Product Number |                              |                        |  |  |  |  |  |  |
|---------------------------|------------------------------|------------------------|--|--|--|--|--|--|
| APS                       | NT000[ ]                     | 000                    |  |  |  |  |  |  |
| Acrylic Pad Series        | NT - NanoTIM                 | 00 – Product thickness |  |  |  |  |  |  |
|                           | 000 - Thermal Conductivity   |                        |  |  |  |  |  |  |
|                           | [] - Product characteristics |                        |  |  |  |  |  |  |

| NO | Product Name   | Thermal<br>Conductivity | Hardness<br>[ Shore A ] |    |    |    |    |    | Product Characteristics |    |   |
|----|----------------|-------------------------|-------------------------|----|----|----|----|----|-------------------------|----|---|
|    |                | [ W/m·K ]               | 20                      | 30 | 40 | 50 | 60 | 70 | 80                      | 90 |   |
| 1  | APS-000-Series | 0.0 ~ 0.9               |                         |    |    |    |    | •  | •                       | •  | N - Normal<br>S - Glass Fiber mesh add. |

NanoTIM

# **APS – A**crylic **P**ad **S**eries

#### Products Introduction

#### **APS-000 Series**

The APS-000 Series are Thermal Conductivity  $0.0 \sim 1.0$  W/m·K  $\times$  It does not include 1.0 W/m·K The products that apply are NT080NS. Product thickness are  $130 \mu$ m,  $200 \mu$ m,  $250 \mu$ m.



Information on APS

**Products Introduction** 

Durability Property

Safety & Packaging

| Thermal<br>Conductivity |  | Product<br>Feature |             | Product Name | Thickness   |  |
|-------------------------|--|--------------------|-------------|--------------|-------------|--|
| 0.8<br>W/m⋅K            |  | Normal             | Glass Fiber | NT080NS      | 130/200/250 |  |

|            | ITEM                  | Test Conditions       | Units   | NT080NS-130          | NT080NS-200          | NT080NS-250          |
|------------|-----------------------|-----------------------|---------|----------------------|----------------------|----------------------|
|            | Color                 |                       | -       | White                | White                | White                |
|            | Thickness             |                       | μm      | 130                  | 200                  | 250                  |
| General    | Reinforcement Carrier |                       |         | Glass Fiber          | Glass Fiber          | Glass Fiber          |
|            | Density               | 25℃, Gravimeter       | g/cc    | 1.78                 | 1.78                 | 1.78                 |
|            | CTE                   |                       | ppm     | 325                  | 325                  | 325                  |
|            | Hardness              | Shore                 | А       | 70                   | 70                   | 70                   |
| Mechanical | Elongation            |                       | %       | 20                   | 20                   | 20                   |
|            | Tensile strength      |                       | Мра     | 6                    | 6                    | 6                    |
|            |                       | R.T                   | gf/inch | 1,500                | 1,500                | 1,500                |
| Adhesion   | Lap Shear             | 10 min at 100℃        | gf/inch | 1,650                | 1,650                | 1,650                |
|            |                       | 10 min at 150℃        | gf/inch | 1,800                | 1,800                | 1,800                |
|            | Flame Rating          | Vertical Burning Test | -       | V-0                  | V-0                  | V-0                  |
| Electrical | Withstand Voltage     | AC                    | V       | 3000                 | 5800                 | 8500                 |
|            | Volume Resistivity    |                       | Ω⋅cm    | > 1*10 <sup>10</sup> | > 1*10 <sup>10</sup> | > 1*10 <sup>10</sup> |
| Thermal    | Thermal Conductivity  | -                     | W/m∙K   | 0.8                  | 0.85                 | 0.8                  |

NanoTIM

# APS – Acrylic Pad Series

APS of NanoTIM has the same conditions for durability property.

### Durability Property

Information on APS

**Selection Guides** 

**Products Introduction** 

**Durability Property** 

Safety & Packaging

| ITEM  | Test Conditions            | Units | Demand Date                                      |
|---|----------------------------|-------|--|
| Heating stability<br>(Thermal conductivity, Breakdown voltage)  | 150°C, 500hr               | %     |  |
| Cooling stability<br>(Thermal conductivity, Breakdown voltage)  | -40°C, 500hr               | %     | 1. Thermal conductivity change rate : Within 10% |
| Thermos hygrostat<br>(Thermal conductivity, Breakdown voltage)  | (85 ℃, humidity 85%) 500hr | %     | 2. Withstand Voltage : No insulation destruction |
| Thermal Shock Test<br>(Thermal conductivity, Breakdown voltage) | (-40°C~150°C) 500 Cycle    | %     |  |
| Withstand Voltage   | AC, 3000V                  | mA    | No insulation destruction                        |
|   |                            |       |  |

D3~D6

#### **Thermal Conductivity Change Rate**

Low molecular siloxane



ppm

NanoTIM

< 100

Information on APS

**Selection Guides** 

**Products Introduction** 

**Durability Property** 

Safety & Packaging

## **APS – A**crylic **P**ad **S**eries

### Safety Date

The stability test is being carried out on the following items and the test results have been determined to be suitable.

- Heavy Metals (Test Method by ICP-OES)
- Cadmium(Cd), Lead(Pb), Mercury(Hg), Hexavalent Chromium(Cr VI)
- Flame Retardants-PBBs/PBDEs (Test Method by GC-MS)
   Monobromobiphenyl, Dibromobiphenyl, Tribromobiphenyl, Tetrabromobiphenyl,
  Pentabromobiphenyl, Hexabromobiphenyl, Octabromobiphenyl, Nonabromobiphenyl,
  Decabromobiphenyl, Monobromobiphenyl ether, Dibromobiphenyl ether,
  Tribromobiphenyl ether, Tetrabromobiphenyl ether, Pentabromobiphenyl ether,
  Hexabromobiphenyl ether, Octabromobiphenyl ether, Nonabromobiphenyl ether,
  Decabromobiphenyl ether
- RoHS Phthalates (Test Method by GC-MS)
- Di-(2-ethylhexyl) phthalate (DEHP), Di-butyl phthalate (DBP), Benzyl butyl phthalate (BBP), Di-isobutyl phthalate (DIBP)

### Packaging

It can be sold by adjusting various thickness and area. X Please contact NanoTIM representative for information on packaging size and availability.

### Useable life and storage

Products are best to maintain the product characteristics when it is stored in a cool and non-humid environment, especially where it is not exposed by any sunlight.

| SGS  |                        |                      |                  |  |  |        |              |
|--|------------------------|----------------------|------------------|--|--|--------|--------------|
| Test Report No. 100415-05<br>Sample No. 200415-05<br>Sample Description 1444754<br>InterNet No. 1504<br>Marcino 1504 | 75479A184804<br>0.921  |                      | and Date : 2019. | 59. 55   | Page 2 st6   |        |              |
| Magoy Malan  |                        |                      |                  |  |  |        |              |
| and down   |                        |                      |                  | 1.00   |  |        |              |
| Eastern (Sil)  | inging                 | with reference to EC | 82521-0-2810     | 6.4  | 4.0  |        |              |
| Least (Pb)   | right                  | With reference to EC | 142321-8:3810    | 1  | 82   |        |              |
| Menuty (Ng)  |                        | DESCRIPTION          | a ty (D+ORT)     | -  |  |        |              |
| Farms Relaminants - FIEIn TOCEs  | Test Re                | port as research     | CTERINA 15-005   |  | Invent Date - 2018, 08   |        | Page 1       |
| Waterstand   | Rom No. Part 1         | No. No.              |                  |  |  |        |              |
| Deconcogniery  | Materials              | NA                   |                  |  |  | _      |              |
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| that it has been and in such that it has not   | trank been             | ## (18h)             |                  | 1010 refere  | 104 10 (\$1 \$155) 4 (\$15) 4 (\$10 \$10 \$10 \$10 \$10 \$10 \$10 \$10 \$10 \$10 | 85     | H.D.         |
| ( Instant  | Bendy-budy p           | (148) (187)          |                  | 7010 141914  | Gen. IRC 43321-8: 3817 ; BC/MID  | 80     | H.O.         |
|  | The manufacture of the | National (2009)      |                  | With referen   | 108 10 100 \$23214 UK17, SICHES  | 80     | 16.0         |

APS

Nanotin