New Products Guide
-Silicones to Highly Functionalize Plastics-
Silicones to Highly Functionalize Resins

With a Variety of Product Lineups, Shin-Etsu Silicone Contributes to Highly Functionalize Your Products.

- **Silicone based Resins**
- **Organic & Inorganic Hybridization Agents**
- **Silicone Resins & Oligomers**
  - **Silane Coupling Agents**
  - **Silicone Oligomers**
  - **Modified Silicone Fluids**
- **Blend-in Materials**
- **Silicone Master Pellets**
- **Silicone Powders**
- **Spherical Silica Fine particles**
- **Ionic Silicone Oligomer**

**Product Classification**
- Silanes
- Silane Coupling Agents
- Silicone Oligomers
- Silicone Fluids
- Silicone Resins
- Silicone Rubbers
- Silicone Gums

- **2D Structure**
- **3D Structure**

**Molecular Weight**
- Low
- High

- **Silicone Gums**
- **Silicone Fluids**
- **Silicone Resins**
- **Silicone Rubbers**
- **Silicone Oligomers**
- **Silane Coupling Agents**

**Properties**
- Heat Resistance
- Electrical Insulation
- Water Repellency
- Oil Repellency
- Weatherability
- Impact Resistance
- Stress Relaxation
- Lubricity
- Wear Resistance
- Releasability
- Adhesion
- Filler Dispensibility
- Flexibility
- Cold Resistance
- Antistatic Property
- Light Dispersibility
- Stress Relaxation
- Flowability
Modified Silicone Fluids

Modified Silicone Fluids which bind various reactive groups exhibit a variety of properties by reacting with organic resin.

- **Enhanced properties**
  - Heat resistant
  - Cold resistant
  - Weather resistant
  - Impact resistant
  - Flexibility

- **Dual-end reactive silicone fluids**

- **Single-end reactive silicone fluids**

**Types of resins**

<table>
<thead>
<tr>
<th>Reactive groups</th>
<th>Thermoset resin</th>
<th>Thermoplastic resin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amino groups</td>
<td>Polyurethane</td>
<td>Epoxy</td>
</tr>
<tr>
<td>Epoxy groups</td>
<td></td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Hydroxyl groups</td>
<td>Carbinol type</td>
<td>Epoxy</td>
</tr>
<tr>
<td></td>
<td>Diol type</td>
<td>Polyurethane</td>
</tr>
<tr>
<td></td>
<td>Polyether type</td>
<td>Polyurethane</td>
</tr>
<tr>
<td></td>
<td>Phenol type</td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Methacryl groups</td>
<td></td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Carboxyl groups</td>
<td></td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Mercapto groups</td>
<td></td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Acidanhydride groups</td>
<td></td>
<td>Polyurethane</td>
</tr>
</tbody>
</table>

**Enhanced properties**

Lubricating property, Release property
Anti-blocking property, Impact resistant
Stress relaxation, Coloring property

**Enhanced properties**

Lubricating property, Release property
Anti-blocking property, Impact resistant
Stress relaxation, Coloring property

**Silicone Master Pellets**

By blending few amounts of Silicone Master Pellets with resin, it is easy to obtain a compound in which the silicone is evenly dispersed.

**Contact to**
Sales and Marketing Department I Phone: +81-(0)3-3246-5132
Shin-Etsu has developed a unique line of silicone powders which fall into three categories: Hybrid Silicone Powder, Silicone Resin Powder, and Silicone Rubber Powder.

**Hybrid Silicone Powder**
- Form: Rubber powders covered with resin
- Model of hybrid silicone powder: KMP-600 by scanning with electron microscope

**Silicone Resin Powder**
- Model of silicone resin powder: KMP-706 by scanning with electron microscope

**Silicone Rubber Powder**
- Molecular structure: Straight-chain crosslinked polymer
- Model of silicone rubber powder: KMP-597 by scanning with electron microscope

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**General Properties**

<table>
<thead>
<tr>
<th>Type</th>
<th>Product name</th>
<th>Shape</th>
<th>Average particle size μm</th>
<th>Particle size distribution μm</th>
<th>True specific gravity</th>
<th>Moisture content %</th>
<th>Rubber hardness Durometer A</th>
<th>Re refractive index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid silicone powder</td>
<td>KMP-600</td>
<td>Spherical powder</td>
<td>5</td>
<td>1-15</td>
<td>0.99</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>KMP-601</td>
<td>Spherical powder</td>
<td>12</td>
<td>2-25</td>
<td>0.98</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
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<tr>
<td></td>
<td>KMP-602</td>
<td>Spherical powder</td>
<td>30</td>
<td>4-60</td>
<td>0.98</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
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<tr>
<td></td>
<td>KMP-605</td>
<td>Spherical powder</td>
<td>2</td>
<td>0.75</td>
<td>0.99</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
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<tr>
<td></td>
<td>KMP-756</td>
<td>Spherical powder</td>
<td>0.8</td>
<td>0.2</td>
<td>0.99</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>KMP-758</td>
<td>Spherical powder</td>
<td>2</td>
<td>1.4</td>
<td>1.3</td>
<td>1</td>
<td>1</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>X-52-7621</td>
<td>Spherical powder</td>
<td>3.5</td>
<td>1.6</td>
<td>1.3</td>
<td>1</td>
<td>1</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>X-52-854</td>
<td>Spherical powder</td>
<td>0.7</td>
<td>0.2</td>
<td>1.3</td>
<td>1</td>
<td>1</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>X-52-1133*</td>
<td>Emulsion</td>
<td>5</td>
<td>1-10</td>
<td>0.97</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>KMP-9729</td>
<td>Spherical powder</td>
<td>13</td>
<td>2-30</td>
<td>0.97</td>
<td>0.1</td>
<td>30</td>
<td>1.41</td>
</tr>
<tr>
<td></td>
<td>X-52-1131*</td>
<td>Emulsion</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Aqueous dispersion of silicone rubber powder. By drying spherical powders are obtained. *(Not specified values)*

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**Product Data**

- **Hybrid silicone powder**
  - KMP-600 Particle size distribution
  - KMP-600 Heat resistance (Weight changes vs. temperatures)

- **Silicone resin powder**
  - KMP-706 Particle size distribution
  - KMP-706 Heat resistance (Weight changes vs. temperatures)

- **Silicone rubber powder**
  - KMP-597 Particle size distribution
  - KMP-597 Heat resistance (Weight changes vs. temperatures)

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**Enhanced Properties**

- **Silicone Powder**
  - Lubricity • Wear resistance
  - Soft-feel property

- **Silicone Rubber Powder**
  - Lubricity • Wear resistance
  - Soft-feel property

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**Dispersibility**

- Hybrid silicone powder KMP-601
- Silicone rubber powder *

*Applying a shearing force improves dispersibility of silicone rubber powders in resin.
Long-Chain Spacer Silane Coupling Agents

With maximum freedom of functional group, Long-Chain Spacer Silane Coupling Agents improve reactivity. It improves flexibility and impact resistance in hybrid of resin and inorganic filler. And, with increased compatibility, it is possible to improve transparency of reactant in resin and inorganic filler, and high load inorganic filler into resins.

Features
- Increased hydrophobicity (Lipophilicity)
- Increased flexibility

General Properties

<table>
<thead>
<tr>
<th>Product name</th>
<th>Chemical name</th>
<th>Organic functional groups</th>
<th>Chemical structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBM-1083</td>
<td>7-Octenytrimethoxysilane</td>
<td>Olefin</td>
<td>(MeO)₃SiOC₂H₅</td>
</tr>
<tr>
<td>KBM-4803</td>
<td>8-Glycidoxyoctyltrimethoxysilane</td>
<td>Epoxy</td>
<td>(MeO)₃SiOC₂H₅</td>
</tr>
<tr>
<td>KBM-5803</td>
<td>8-Methacryloxyoctyltrimethoxysilane</td>
<td>Methacrylic</td>
<td>(MeO)₃SiOC₂H₅</td>
</tr>
<tr>
<td>KBM-6803</td>
<td>N-2-(aminoethyl)-8-aminooctyltrimethoxysilane</td>
<td>Amine</td>
<td>(MeO)₃SiOC₂H₅</td>
</tr>
</tbody>
</table>

Applications
- Organic / Inorganic adhesion improver
- Glass/Epoxy, coupling performance evaluation

Protected Functional Group Silanes

Protected functional group silanes have protected organic reactive groups. With protected functional group silanes, creating 1 component materials, which were formerly 2 component materials, or simultaneously adding a reaction system is possible, but was difficult due to the reactivity of silanes. And protected functional group silanes exhibit highly improved storage stability.

General Properties

<table>
<thead>
<tr>
<th>Product name</th>
<th>Chemical name</th>
<th>Chemical structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-12-1056ES</td>
<td>3-(Triethoxysilylthio)propyltrimethoxysilane</td>
<td>(CH₃O)₃SiSCH₂CH₂CH₃</td>
</tr>
<tr>
<td>KBE-9103P</td>
<td>3-Triethoxysilyl(N-(1,3 dimethyl-butylidene) propylamine</td>
<td>(CH₃O)₃SiCH₂CH₂N(CH₃)₂</td>
</tr>
<tr>
<td>X-12-967C</td>
<td>3-(Trimethoxysilyl)propylsuccinic anhydride</td>
<td>(CH₃O)₃SiCH₂CH₂C₂H₄OC₂H₅</td>
</tr>
</tbody>
</table>

Comparison of adhesion of X-12-1056ES and KBM-803(conventional grade)

Contact to: Sales and Marketing Department II Phone: +81-(0)3-3246-5131
Shin-Etsu Chemical developed 2 types of coupling agents (polymer type) containing a number of reactive organic groups.

1) Coupling Agents (Alkoxy Oligomer Type) which are partial hydrolysates of conventional coupling agent
2) Silane Coupling Agents (Multifunctional Group Type) with organic backbone

### Coupling Agents (Alkoxy Oligomer Type)

Owing to 100% of active ingredients, Coupling Agents (Alkoxy Oligomer Type) with siloxane back bone reduce generation quantity of alcohol. By choice of organic groups, it can achieve hydrophilic treatment on surfaces of coating as paint additives, or adapt adhesion (rework property) as additives for adhesive.

#### Features

- Partial hydrolysis condensation of silane coupling agent
- Large numbers of reactive functional groups with resins
- Film formulation property
- Low volatility

#### Structural model of alkoxy oligomers

![Structural model of alkoxy oligomers]

#### Silane Coupling Agents (Multifunctional Group Type)

Silane coupling agent with organic backbone contains a number of alkoxy groups and organic functional groups. Owing to a number of reaction points, the user can expect improved adhesion. It is useful for primer, since its primary component is low volatility and it has a film formulation property.

#### Features

- Hydrolyzable groups are trialkoxysilyl groups.
- Large numbers of reactive functional groups with resins
- Film formulation property
- Low volatility

#### Structural model of silane coupling agents (multifunctional group type)

![Structural model of silane coupling agents (multifunctional group type)]
With its cyclic siloxane structure, KR-470 exhibits almost no shrinkage during curing. Its molecular structure is specified, meaning that reactions are easy to control. Cures with light or heat with the addition of an acid generator, acid anhydride, or amine-type catalyst. Excellent compatibility owing to low molecular weight.

Silicone Oligomers

### Ionic Silicone Oligomer X-40-2450

X-40-2450 is a silicone oligomer created through the silicone modification of an ionic liquid. By introducing ionic groups into siloxane structure, X-40-2450 has silicone’s unique properties including antistatic properties.

#### Features

When added in small amounts to resins, X-40-2450 migrates easily to the coating surface.

#### General properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>X-40-9310</th>
<th>X-40-2450</th>
<th>X-40-2750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of silicone</td>
<td>Silicone</td>
<td>Silicone</td>
<td>Siloxane</td>
</tr>
<tr>
<td>Appearance</td>
<td>Transparent liquid</td>
<td>Transparent liquid</td>
<td>Colorless</td>
</tr>
<tr>
<td>Non-volatile content</td>
<td>99%</td>
<td>95%</td>
<td>99%</td>
</tr>
<tr>
<td>Viscosity</td>
<td>mPa/s</td>
<td>160</td>
<td>2.5</td>
</tr>
<tr>
<td>Viscosity</td>
<td>1.24</td>
<td>0.97</td>
<td>1.17</td>
</tr>
<tr>
<td>Solvent</td>
<td>None</td>
<td>MEK*1</td>
<td>None</td>
</tr>
<tr>
<td>Expected properties</td>
<td>Antistatic property</td>
<td>Antistatic property</td>
<td>Antistatic property</td>
</tr>
<tr>
<td>Application examples</td>
<td>Adding and dispersing into resins</td>
<td>Antistatic property, releasability</td>
<td>Antistatic property, releasability</td>
</tr>
</tbody>
</table>

### Silicone Oligomers Containing Alicyclic Epoxy Groups

Silicone oligomers contain only epoxy groups as their reactive functional groups, and can be formulated to cure by way of an acid anhydride, photo-cationic or thermal-cationic curing system.

Silicone oligomers cure by the same mechanisms as do epoxy resins, while offering excellent heat resistance and high Tg (glass-transition temperature) that are characteristic of siloxane bonds. The cyclosiloxane-based oligomers exhibit low shrinkage during curing.

#### Features

With its cyclic siloxane structure, KR-470 exhibits almost no shrinkage during curing. Its molecular structure is specified, meaning that reactions are easy to control. Cures with light or heat with the addition of an acid generator, acid anhydride, or amine-type catalyst. Excellent compatibility owing to low molecular weight.

### General Properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>KR-470</th>
<th>X-40-2678</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-point</td>
<td>Low cure shrinkage</td>
<td>Diffusional (improved crack resistance)</td>
</tr>
<tr>
<td>Numbers of Epoxy functional groups</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Viscosity</td>
<td>mPa/s</td>
<td>3,000</td>
</tr>
<tr>
<td>Viscosity</td>
<td>g/mol</td>
<td>200</td>
</tr>
</tbody>
</table>

### Comparison data of cured material

<table>
<thead>
<tr>
<th>Parameter</th>
<th>KR-470</th>
<th>Epoxy</th>
<th>Alicyclic epoxy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cure system</td>
<td>Acid anhydride curing</td>
<td>Acid anhydride curing</td>
<td></td>
</tr>
<tr>
<td>Hardness Shore D</td>
<td>87</td>
<td>85</td>
<td>98</td>
</tr>
<tr>
<td>Flexural modulus MPa</td>
<td>2,250</td>
<td>2,940</td>
<td>3,020</td>
</tr>
<tr>
<td>Curing shrinkage areometry</td>
<td>-1.7</td>
<td>-1.7</td>
<td>-1.7</td>
</tr>
<tr>
<td>Boiling water absorption ratio</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
</tr>
<tr>
<td>Tg</td>
<td>181</td>
<td>125</td>
<td>175</td>
</tr>
<tr>
<td>Coefficient of linear expansion</td>
<td>-7.7</td>
<td>7.7</td>
<td>6.6</td>
</tr>
</tbody>
</table>

### Test Result of Antistatic Properties

<table>
<thead>
<tr>
<th>Surface resistivity (Ω)</th>
<th>Initial</th>
<th>After water rinsing test*1</th>
<th>After immersion test in water*2</th>
<th>After heating test*3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 x 10^13</td>
<td>&gt; 10^13</td>
<td>&gt; 10^13</td>
<td>&gt; 10^13</td>
</tr>
</tbody>
</table>

*1 After rubbing the cured specimen 50 times with wet absorbent cotton, wiped off remaining water and took the measurements.

*2 After submerging the cured specimen into water (25℃×12h), wiped off remaining water and took the measurements.

*3 Measured after heating the cured specimen (105℃×1day).

*4 In Commerce: KSCF-50K

### Comparison Chart of Cured Materials

- Adhesion
- Durability
- Transmissivity
- Volume change
- Heat resistance
- Water absorption ratio

### Structural Model

[Diagram of X-40-2450 and X-40-2450]

### Ionic Silicone Oligomer X-40-2450

[Diagram of X-40-2450 and X-40-2450]

### Ionic Silicone Oligomer X-40-2450

[X-40-9310 X-40-2450 X-40-2750]
Silicone Resins & Oligomers

Silicone Oligomer Type Coatings

Silicone Oligomer Type Coating Agents contain alkoxyisilyl groups and cure at ambient temperatures and humidities with the use of a curing agent. They form very hard, glossy coatings that are highly resistant to heat and light, owing to their 3D siloxane structures.

Cross linking mechanism \[ 2 \text{Si-OR} + 2\text{H}_2\text{O} \rightarrow (2\text{Si-OH} + 2\text{ROH}) \rightarrow \text{Si-O-Si} + \text{H}_2\text{O} + 2\text{ROH} \]

Product & Catalyst line up

By using different types of silicone oligomers and curing agents, the user can obtain coatings that vary widely in their curing speed and hardness or flexibility.

Product line up

<table>
<thead>
<tr>
<th>Methyl Type</th>
<th>Features : Water repellency, Excellent curability</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-40-9250</td>
<td>High flexibility</td>
</tr>
<tr>
<td>X-40-9246</td>
<td>High hardness</td>
</tr>
<tr>
<td>X-40-9225</td>
<td>High polymerization degree (Viscosity)</td>
</tr>
<tr>
<td>KR-500</td>
<td>Low T/D Ratio</td>
</tr>
<tr>
<td>KR-515</td>
<td>Low cure speed</td>
</tr>
<tr>
<td>KC-898</td>
<td>Low flexibility</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Methyl / Phenyl Type</th>
<th>Features : Gloss, Excellent flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>KR-401N</td>
<td>Excellent curability, Gloss</td>
</tr>
<tr>
<td>X-40-9227</td>
<td>Imports flexibility</td>
</tr>
<tr>
<td>KR-510</td>
<td>Forms high hardness coating</td>
</tr>
<tr>
<td>KR-9218</td>
<td>Forms medium hardness coating</td>
</tr>
</tbody>
</table>

Catalyst Line Up

<table>
<thead>
<tr>
<th>Product name</th>
<th>Type</th>
<th>Addition amount with</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-20</td>
<td>Phosphonic acid</td>
<td>0-10</td>
<td>Very high activity</td>
</tr>
<tr>
<td>X-40-220BA</td>
<td>Phosphonic acid</td>
<td>10-90</td>
<td>High activity, can accelerate curing.</td>
</tr>
<tr>
<td>D-25</td>
<td>Titanium</td>
<td>0.5-3</td>
<td>Higher activity than D-20</td>
</tr>
<tr>
<td>D-20</td>
<td>Titanium</td>
<td>2-5</td>
<td>Slow reactivity</td>
</tr>
<tr>
<td>DX-175</td>
<td>Titanium</td>
<td>3-5</td>
<td>Solvent diluted type (Easy to use)</td>
</tr>
<tr>
<td>DX-9740</td>
<td>Aluminum</td>
<td>5-5</td>
<td>Solvent diluted type (Easy to use)</td>
</tr>
<tr>
<td>CAT-AC</td>
<td>Aluminum</td>
<td>0.5-10</td>
<td>Solvent diluted type (Easy to use)</td>
</tr>
</tbody>
</table>

Formulation Example and Film Properties

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Product name</th>
<th>Catalyst (Additive amount) %</th>
<th>Film thickness μm</th>
<th>Tack free 25℃ min</th>
<th>Pencil hardness</th>
<th>Fracture resistance</th>
<th>Impact resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>KR-500</td>
<td>D-20(2)</td>
<td>25</td>
<td>40</td>
<td>H</td>
<td>±</td>
<td>±</td>
<td></td>
</tr>
<tr>
<td>KR-500</td>
<td>D-20(4)</td>
<td>25</td>
<td>25</td>
<td>2H</td>
<td>± --</td>
<td>±</td>
<td></td>
</tr>
<tr>
<td>KR-500</td>
<td>D-9740(5)</td>
<td>25</td>
<td>100</td>
<td>SH</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>KR-500</td>
<td>X-40-9225</td>
<td>D-20(3)</td>
<td>30</td>
<td>60</td>
<td>H</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>KR-500</td>
<td>X-40-9250</td>
<td>D-20(2)</td>
<td>80</td>
<td>75</td>
<td>F</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Result : + = Excellent ± = Satisfactory -- = Poor

*Substrate : Polished steel sheet, Cure conditions : 25℃ / 70% RH×7days (Tack-free time varies depending on temperature and humidity)

Ultra High Molecular Weight Silicone Resin KR-251

KR-251 is a methyl silicone resin with a very high molecular weight. With KR-251, the molecular weight has been increased as much as possible without causing gelation.

Features

- Very hard film
- Easy to crack
- Heat cure is necessary

Common methyl silicone resins
- Very hard film
- Easy to crack
- Heat cure is necessary

Common grade silicone resin
- Low molecular weight
- Poor film forming properties when dried
- Easy to crack due to high crosslinking density

KR-251
- The coating film is hard to crack.
- Form the coating film by air drying
- Form the harder coating film by heating

General property

<table>
<thead>
<tr>
<th>Parameter</th>
<th>KR-251</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Colorless transparent liquid</td>
</tr>
</tbody>
</table>
| Non-volatile content | 105℃ × 3h | 20%
| Viscosity 25℃ | mm²/s | 18
| Specific gravity 25℃ | 0.92 |
| Acid value | < 2 |
| Solvent | Toluene |

Film properties

<table>
<thead>
<tr>
<th>Clear coating</th>
<th>Curing condition</th>
<th>25℃×1day</th>
<th>150℃×30min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Film thickness</td>
<td>8μm</td>
<td>8μm</td>
<td></td>
</tr>
<tr>
<td>Pencil hardness</td>
<td>HB</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

Substrate : Polished steel sheet (Not specified values)
With very small average particle size, narrow distribution and its hydrophobized surface, Spherical Silica Fine Particles have a superior flowability, dispersion, water repellency and lubricity.

**Features**
- Narrow particle size distribution, monodisperse and no aggregation.
- Fine adhesion to various powders and it improves the flowability.

**General Properties**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>QSG-170</th>
<th>QSG-100</th>
<th>QSG-90</th>
<th>QSG-80</th>
<th>QSG-30</th>
<th>QSG-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average particle size* ( \text{nm} )</td>
<td>170</td>
<td>110</td>
<td>90</td>
<td>80</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Bulk density ( \text{g/cm}^3 )</td>
<td>0.44</td>
<td>0.44</td>
<td>0.44</td>
<td>0.44</td>
<td>0.22</td>
<td>0.22</td>
</tr>
<tr>
<td>True specific gravity</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Specific surface area ( \text{m}^2/\text{g} )</td>
<td>16</td>
<td>25</td>
<td>30</td>
<td>40</td>
<td>150</td>
<td>160</td>
</tr>
<tr>
<td>Hydrophobicity, Methanol wettability ( % )</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>72</td>
</tr>
<tr>
<td>Production method</td>
<td>Sol-Gel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The average particle size by dynamic light scattering (Laser Doppler)

**Particle Size Distribution QSG-100**

![Particle Size Distribution Graph]

**Adhesion State with Various Powders QSG-100**

- Metal silicons
- Glass frits
- Surface of Nylons
- Polyester particles

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  (JCQA-0004 JCQA-E-0002)

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  (JCQA-0479 JQA-EM0298)

- Takefu Plant
  ISO 9001 ISO 14001
  (JCQA-0419 JCQA-E-0538)

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