Introduction: Circuit Board Protection
Materials: Liquid Potting Materials

Hilde Goossens
Agenda

1. Embedding process of electronic devices
2. Industry trends
3. Potting Material options
4. Overview potting systems
5. Application Techniques
6. Selecting the right product
7. Henkel Potting Materials Product line
Introduction
Embedding processes of electronic devices

To isolate devices from generally degrading environmental and operational effects such as oxygen, moisture, heat and cold, dust, current leakage, corrosion, mechanical shock and vibration.
Methods Of Embedding

• Casting
• Potting
• Encapsulation
• Sealing
• Impregnation
**Definition: Casting**

“Method which consists of pouring a catalysed or hardenable liquid into a mould. The hardened cast part takes the shape of the mould, and the mould is removed for re-use.”
**Definition: Potting**

“Method which consists of pouring a catalysed or hardenable liquid into a shell or housing which remains as an integral part of the unit.”
Definition: Encapsulation

“Method of providing a protective coating or a thin shell around a component or assembly. A mould is used rather than a permanent container. When the mould is removed, the cured resin is the outside surface of part.”
“Sealing describes a method of providing a barrier on a surface or around the joint of the container which houses some devices.”

Sealant may also be used to fill cracks, voids, vents holes in casts or potted parts. Sealant does not surround the device, the sealant may form the entire upper surface of the embedment, or it may be used to gasket a lid or caulk a joint.
**Definition: Impregnation**

“Method consisting of completely immersing a part in a liquid so that the interstices are thoroughly soaked and wetted; usually accomplished by vacuum and/or pressure.”

![Diagram of Impregnated Coil, Resin, and Wire Windings]
Industry Trends

• Historically potting materials were used for impregnation of coils and consumer electronics

• Automotive electronics has rapidly transferred into this category with life critical applications
  • Air bag sensors
  • ABS modules
  • Oil sensors
  • Clutch sensors
  • Transmission control units

• Request for higher temperature resistant materials (up to 175-200°C)

• Request for higher chemical resistant materials:
  • Automotive fluids (ATF, oils and different fuels)

• Better heat dissipation = improved thermal conductivity
Potting Material Options
Liquid Potting Materials:

4 major constituents:

- **Resin**: different chemistries like epoxy, polyurethane, silicone
- **Hardener (catalyst)**: Amine, Amide, Dicy, Imidazole, Anhydride, …
- **Fillers**
- **Diluent / solvents**
“A resin is a natural or synthetic compound that begins in a highly viscous state and hardens with treatment. Typically, it is soluble in alcohol, but not in water. The compound is classified in a number of different ways, depending on its exact chemical composition and potential uses.”
“A hardener (catalyst) is a substance or mixture of substances that undergoes a reaction with a resin and is consumed in that reaction, becoming a part of the polymer backbone.”
Epoxies

- >50 Epoxy Formulations
- Mix ratios: 1:1 to 20:1
- Mixed viscosity: 200 cP to >1M cP
- Hardness: 23 (A) to 95 (D)
- Gel time: 2 minutes to months
- Dk from: 3 to 7
- Df from: 0.01 to 0.09
- Dielectric Strength: up to 2000 volts/mil (20mil thickness)
## Epoxy resins

<table>
<thead>
<tr>
<th>RESINS</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diglycidyl Ether of Bisphenol A</td>
<td>- Most common</td>
</tr>
<tr>
<td></td>
<td>- Long chain</td>
</tr>
<tr>
<td></td>
<td>- Low cost</td>
</tr>
<tr>
<td>Diglycidyl Ether of Bisphenol F</td>
<td>- More expensive</td>
</tr>
<tr>
<td>Cycloaliphatic</td>
<td>- More expensive</td>
</tr>
<tr>
<td></td>
<td>- High performance</td>
</tr>
<tr>
<td></td>
<td>- Low viscosity</td>
</tr>
</tbody>
</table>
# Epoxy Hardeners/Catalysts

<table>
<thead>
<tr>
<th></th>
<th>Amines Aliphatic</th>
<th>Amines Aromatic</th>
<th>Polyamides</th>
<th>Anhydrides</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantage</strong></td>
<td>RT cure</td>
<td>Excellent chemical resistance</td>
<td>Good mixing ratio</td>
<td>Excellent high temperature performance</td>
</tr>
<tr>
<td></td>
<td>Good overall properties</td>
<td>High Tg</td>
<td>Good adhesion</td>
<td>Low exothermal</td>
</tr>
<tr>
<td><strong>Disadvantage</strong></td>
<td>High exothermal</td>
<td>Elevated temperature cure</td>
<td>Poor chemical resistance</td>
<td>Long cure schedule</td>
</tr>
<tr>
<td></td>
<td>Poor mix ratio</td>
<td>High exothermal</td>
<td>Poor thermal resistance</td>
<td>Dianhydrides are solid</td>
</tr>
<tr>
<td><strong>Typical Max. Operating Temperatures, °C</strong></td>
<td>105°C – 150°C (221 °F)</td>
<td>155 – 180°C (302-356 °F)</td>
<td>105°C (221 °F)</td>
<td>To 200°C (392 °F)</td>
</tr>
<tr>
<td><strong>Typical Pot life, hrs.</strong></td>
<td>0.5 – 0.75</td>
<td>8</td>
<td>2 – 3</td>
<td>20 hrs +</td>
</tr>
<tr>
<td><strong>General Uses</strong></td>
<td>Modules, small castings, adhesives</td>
<td>Solvent resistant apps, thermal cycling</td>
<td>Thermal cycling, low stress adhesive</td>
<td>Excellent electrical, module potting, coil potting</td>
</tr>
</tbody>
</table>
Urethanes

• >40 Urethane Formulations
• Mix ratios from: 1:1 to 1:7.7
• Mix viscosity from: 400 cP to 25,000 cP
• Hardness from: 60 (OOO) to 85 (D)
• Gel time from: 2 to 360 minutes @ 25°C
• Dk from: 3 to 7
• Df from: 0.01 to 0.2
• Dielectric Strength: up to 1200 volts/mil (20mil thickness)
# Urethane resins

<table>
<thead>
<tr>
<th>POLYOL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyether's</td>
<td>Most common type of polyol</td>
</tr>
<tr>
<td>Polypropylene glycol (PPG)</td>
<td>High cross-linking, thermoset urethanes</td>
</tr>
<tr>
<td>Polytetramethylene ether glycol (PTMEG)</td>
<td>Used when high strength is required</td>
</tr>
<tr>
<td>Polybutadiene (PolyBD)</td>
<td>Very low moisture absorption</td>
</tr>
<tr>
<td></td>
<td>Excellent low temperature flexibility</td>
</tr>
<tr>
<td></td>
<td>Restricted for export</td>
</tr>
<tr>
<td>Polyesters</td>
<td>Excellent abrasion resistance and outdoor weatherability</td>
</tr>
<tr>
<td>Adipates</td>
<td>Used for shoe soles, under hood automotive applications and coatings</td>
</tr>
<tr>
<td>Polycaprolactones</td>
<td>Low viscosity, good retention with age</td>
</tr>
<tr>
<td>Castor Oil</td>
<td></td>
</tr>
</tbody>
</table>
## Polyurethane Hardeners

<table>
<thead>
<tr>
<th></th>
<th>TDI</th>
<th>MDI</th>
<th>HDI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appearance</strong></td>
<td>toxic</td>
<td>Pure MDI: Solid (flake, fused solid)</td>
<td>Very expensive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MDI Adduct:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liquid at RT, crystallizes below 60°F</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polymeric MDI: Dark Brown color, non-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>crystallizing</td>
<td></td>
</tr>
<tr>
<td><strong>Typical Max. Operating Temperatures, °C</strong></td>
<td>125</td>
<td>125 - 150</td>
<td>150</td>
</tr>
<tr>
<td><strong>Typical Pot life, hrs.</strong></td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>General Uses</strong></td>
<td>Foams</td>
<td>General purpose electronics casting</td>
<td>Optically clear (non-yellowing)</td>
</tr>
</tbody>
</table>

TDI = toluene diisocyanate  
MDI = methylenediphenyl diisocyanate  
HDI = hexamethylene diisocyanate
Silicones

- Approximately 30 products
- Predominantly 1K but some 2K available
- Hardness 30 (OO) to 80 (A)
- Gel time from 1 hour to months
- $D_k$ from 2 to 5
- $D_f$ from 0.002 to 0.2
- Dielectric strength up to 700 volts/mil
Silicones

- Cure mechanism either condensation cure or catalyst (addition cure)
- Some condensation cures systems are also known as RTVs (room temperature vulcanisation)
## Silicones – comparison by cure

<table>
<thead>
<tr>
<th>Cure Mechanism</th>
<th>By-product</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetoxy</td>
<td>Acetic acid</td>
<td>High adhesion, High temperature, Fast cure</td>
<td>Corrosive, Strong smell</td>
</tr>
<tr>
<td>Acetone</td>
<td>Acetone</td>
<td>Non-corrosive, High adhesion, High temperature, Fast cure</td>
<td>Damaging to some plastics</td>
</tr>
<tr>
<td>Alkoxy/ Methoxy</td>
<td>Ethanol or Methanol</td>
<td>Non-corrosive, High adhesion</td>
<td>Lower temperature, Longer cure</td>
</tr>
<tr>
<td>Oxime</td>
<td>Methylethylketoxime</td>
<td>Non-corrosive, High adhesion</td>
<td>Some H&amp;S concerns</td>
</tr>
<tr>
<td>Addition</td>
<td>None</td>
<td>Non-corrosive, High adhesion, Fast cure</td>
<td>Catalyst can be poisoned</td>
</tr>
</tbody>
</table>
# Resin Chemistry: Comparison

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Epoxy</th>
<th>Polyurethane</th>
<th>Silicone</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service temperature</td>
<td>High (*) (up to 160-180°C)</td>
<td>Moderate (up to 135°C)</td>
<td>Very high (up to 230-260°C)</td>
<td>(*) depending on the selection of hardener</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>0.2 (*)</td>
<td>0.2 (*)</td>
<td>0.2 (*)</td>
<td>(*) depending on the addition of filler</td>
</tr>
<tr>
<td>Tg (°C)</td>
<td>High</td>
<td>Medium / Low</td>
<td>Very low</td>
<td></td>
</tr>
<tr>
<td>Hardness (shore)</td>
<td>High shore D</td>
<td>Shore A to shore D</td>
<td>Low shore A</td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>Brittle</td>
<td>Flexible (also low temp)</td>
<td>Very flexible (-50 / 200°C)</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>High</td>
<td>Low</td>
<td>Very low</td>
<td></td>
</tr>
<tr>
<td>Chemical resistance</td>
<td>Excellent</td>
<td>Good</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Adhesion</td>
<td>Very good</td>
<td>Good</td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Medium</td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

**Introduction: Circuit Board Protection Materials: Potting**

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Fillers

A filler is a substance often inert, added to a plastic material to improve properties and/or decrease cost.

**Filler effects:**

- Reduce cost
- Reduce exotherm
- Reduce thermal expansion coefficient
- Improve mechanical shock resistance
- Improve thermal or electrical conductivity
- Improve fire resistance
## Fillers

<table>
<thead>
<tr>
<th>Property</th>
<th>Improved Machining</th>
<th>Improved Thermal Conductivity</th>
<th>Improved Abrasion Resistance</th>
<th>Improved Impact Strength</th>
<th>Improved Electrical Conductivity</th>
<th>Improved Thixotropy</th>
<th>Flame retardant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler options</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td></td>
<td>Alumina</td>
<td>Glass</td>
<td>Mica</td>
<td>Noble Metals</td>
<td>Silica (colloidal)</td>
<td>Antimony trioxide</td>
</tr>
<tr>
<td>Calcium silicate</td>
<td></td>
<td>Flint powder</td>
<td>Alumina</td>
<td>Silica</td>
<td>Aluminium</td>
<td>Clays</td>
<td>Borates</td>
</tr>
<tr>
<td>Powdered aluminium</td>
<td></td>
<td>Carborundum</td>
<td>Glass</td>
<td>Carbon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdered copper</td>
<td></td>
<td>Silica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro balloons (microspheres)</td>
<td></td>
<td>Boron Nitride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Introduction: Circuit Board Protection Materials: Potting
Trade-off: Abrasiveness / Hardness of Fillers

MOH Hardness

Most

Diamond
Alumina
Silicon Dioxide

Abrasiveness

Least

Talc
CaCO$_3$
ATH

1

10

MOH Hardness

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Introduction: Circuit Board Protection Materials: Potting
One/Two component systems

One Components

- Ready for use
- Limited shelf life
- Often requires cool storage
- Activation energy required to start reaction

Two Components

- Needs weighing and mixing
- Long shelf life
- Room temperature storage
- Room temperature cure or heat cure
Overview Potting systems
Overview encapsulant systems: Unfilled systems

**Strengths**
- Low viscosity
- Clear transparent

**Weaknesses**
- High shrinkage/brittle
- High CTE
- Higher exotherm than filled systems
- More expensive
### Overview encapsulant systems: Mica filled systems

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improved thermal shock resistance</td>
<td>• Higher viscosity</td>
</tr>
<tr>
<td>• Less shrinkage</td>
<td>• Slightly abrasive</td>
</tr>
<tr>
<td>• Good crack resistance</td>
<td></td>
</tr>
<tr>
<td>• Good chemical resistance</td>
<td></td>
</tr>
<tr>
<td>• Good mechanical/electrical properties</td>
<td></td>
</tr>
</tbody>
</table>
Overview encapsulant systems: Calcium carbonate filled systems

**Strengths**
- Easy dispensable
- Highly machine-able
- Low shrinkage
- Non-abrasive
- Low cost

**Weaknesses**
- Lower crack resistance
- Lower thermal shock resistance
- Poor acid resistance
Overview encapsulant systems: Silica filled systems

**Strengths**
- Excellent chemical resistance
- Good mechanical/electrical properties
- Low exotherm
- Low shrinkage/CTE

**Weaknesses**
- Abrasive
- Poor machine-ability
- High viscosity

- Excellent chemical resistance
- Good mechanical/electrical properties
- Low exotherm
- Low shrinkage/CTE
Overview encapsulant systems: Aluminium oxide filled systems

**Strengths**
- Highest heat dissipation
- High voltage applications
- Excellent chemical resistance
- Low exotherm
- Good thermal cycle/shock
- Low shrinkage/CTE

**Weaknesses**
- Highly abrasive
- Poor machine-ability
- High viscosity
- Severe filler settlement
Overview encapsulant systems: Aluminium Hydroxide filled systems

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low exotherm</td>
<td>• Low temperature resistance</td>
</tr>
<tr>
<td>• Good thermal shock/cycle</td>
<td>• Poor acid resistance</td>
</tr>
<tr>
<td>• Flame retardant</td>
<td></td>
</tr>
<tr>
<td>• Medium heat dissipation</td>
<td></td>
</tr>
<tr>
<td>• Low shrinkage</td>
<td></td>
</tr>
</tbody>
</table>

Introduction: Circuit Board Protection Materials: Potting
Overview encapsulant systems: Lightweight systems

**Strengths**

- Low density
- Low dielectric constant
- Low shrinkage
- Good thermal cycle resistance
- High compressive strength
- Good mechanical properties

**Weaknesses**

- High viscosity
- Filler “floating”
- Fragile filler
Potting Application techniques
Mix ratio:
The amount of hardener that is needed to stoichiometric cure 100 parts of resin

Cure time/temperature:
Time and temperature that a polymer system need to reach the solid state and its required end-properties
Principal Application Methods

- Manual
- Twin pack systems
- Mixing and dosing equipment
Manual potting

- Small quantities
- Low investment
- Time depending on amount of material
- Pot life is crucial
- Exotherm
- De-gassing required
MixPacs

• Easy to use
• Simple volumetric mix ratios
• Designed for both small and large users
• Sales tools and help available
Mixing and Dosing Equipment

- Capital investment
- Mixing head: static or dynamic
- High throughput
- Material saving
- Maintenance required
- Abrasive fillers are critical
Selecting the right product
Selecting the Right Product

• Some pointers to help select the correct material for the application
  • Maximum and minimum operating temperature
  • Chemical resistance
  • Physical properties
  • Electrical properties
  • Flame resistant
  • Processing requirements
Selecting the Right Product

- Maximum and minimum operating conditions
  - Not only do you need to know the temperature extremes it is also important to ask:
  - How long will the part be exposed to the extreme conditions?
    - Continuous
    - Intermittent
  - Thermal shock (speed of change from one temperature to another)?
  - What are the CTEs of other materials in the assembly?
Selecting the Right Product

• Chemical resistance
  • What materials will the potting compound be exposed to during operating life?
    • Solvents
    • Inorganic acids/bases
    • Automotive fluids (gasoline, brake fluid, salt water, ATF, etc.)
    • Water
  • Will the fluids be under pressure?
• Temperature and Duration
Selecting the Right Product

• Physical properties
  • Does the material need to provide inherent strength to the final assembly?
  • Does the material need to be impact resistant?
  • Does the material need to be re-workable?
  • Is colour important?
Selecting the Right Product

• Electrical properties
  • Is dielectric constant and dissipation factor important (and at what frequencies)?
  • Is dielectric strength important (and at what thickness)?
  • Is UL relative thermal index (RTI) important?
Selecting the Right Product

• Flame resistance
  • Is the final assembly UL approved or does the potting material need to be UL approved or both?
  • What level of flame retardancy is required?
  • UL capable or actually listed?
Selecting the Right Product

• Processing requirements
  • How many parts per hour are going to be produced?
  • How is the material going to be dispensed?
  • How fast does the cure process need to be?
  • What is the maximum allowable cure temperature?
  • Does the material need to flow through small gaps?
  • Does the material need to have controlled flow/thixotropy?
  • What is the volume of material per part (potential exotherm issues)?
Selecting the Right Product

• Summary
  • Finding a material that exactly meets all of the previous requirements is going to be very difficult if not impossible
  • It is therefore important to understand which parameters are critical to the success of the application and which are “would be nice” parameters – agree their priorities
  • For example:
    • Does the customer want an optically clear material because they are using LEDs or optical sensors
    • Or
    • Does the customer just want to know the potting application is giving good results
      • If the latter is the case it may be beneficial to work on proving the consistency of the potting application rather than pick something transparent
Selection guide by operating temperature
Service temperature
-40°C / +105°C

Polyurethane

- General
  - LOCTITE STYCAST U2500
  - LOCTITE STYCAST U2535
  - LOCTITE STYCAST US2651
  - LOCTITE STYCAST US2050

- Flame retardant
  - LOCTITE STYCAST U2500FR
  - LOCTITE STYCAST US1150
  - LOCTITE STYCAST US2650
  - LOCTITE STYCAST US5532

Epoxy

- General
  - LOCTITE STYCAST 2651W1/cat 23LV
  - LOCTITE STYCAST 2651-40W1/cat 23LV
  - LOCTITE STYCAST 2651MM/cat 23LV
  - LOCTITE STYCAST ES1000
  - LOCTITE STYCAST ES1900
  - LOCTITE STYCAST ES2204
  - LOCTITE STYCAST A316 series

- Thermal conductive
  - LOCTITE STYCAST 2850FT/cat 23LV
  - LOCTITE STYCAST 2850MT/cat 23LV

- Flame retardant
  - LOCTITE STYCAST E2534FR/cat 9
  - LOCTITE STYCAST G508-1
  - LOCTITE STYCAST ES1002
  - LOCTITE STYCAST ES2505

- Light weight
  - LOCTITE STYCAST 1090/cat 23LV
  - LOCTITE STYCAST 1090SI/cat 23LV

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Introduction: Circuit Board Protection Materials: Potting
Service temperature
-40°C / +125°C

Polyurethane
- General
  - LOCTITE STYCAST U2500
  - LOCTITE STYCAST U2535
  - LOCTITE STYCAST US2651
  - LOCTITE STYCAST US2050
- Flame retardant
  - LOCTITE STYCAST U2500FR
  - LOCTITE STYCAST US1150
  - LOCTITE STYCAST US2650
  - LOCTITE STYCAST US5532
  - LOCTITE STYCAST US5544

Epoxy
- General
  - LOCTITE STYCAST 2651W1/cat 9
  - LOCTITE STYCAST 2651-40W1/cat 9
  - LOCTITE STYCAST 2651MM/cat 9
  - LOCTITE STYCAST ES1900
  - LOCTITE STYCAST ES2204
  - LOCTITE STYCAST A316 series
- Thermal conductive
  - LOCTITE STYCAST 2850FT/cat 9
  - LOCTITE STYCAST 2850MT/cat 9
- Flame retardant
  - LOCTITE STYCAST E2534FR/cat 9
  - LOCTITE STYCAST G508-1
  - LOCTITE STYCAST ES2505
- Light weight
  - LOCTITE STYCAST 1090/cat 9
  - LOCTITE STYCAST 1090SI/cat 9
Introduction: Circuit Board Protection Materials: Potting

Service temperature
-40°C / +150°C

Polyurethane
- General
  - LOCTITE STYCAST U2500 HTR

Epoxy
- General
  - LOCTITE STYCAST 2651W1*
  - LOCTITE STYCAST 2651-40W1*
  - LOCTITE STYCAST 2651MM*
  - LOCTITE STYCAST EO1058
  - LOCTITE STYCAST EO7038
  - LOCTITE STYCAST A316-48
  - XE70202
- Thermal conductive
  - LOCTITE STYCAST 2850FT*
  - LOCTITE STYCAST 2850MT*
  - LOCTITE STYCAST 2850KT*
- Flame retardant
  - LOCTITE STYCAST E 2534FR/cat 9
  - LOCTITE STYCAST G 508-1
  - LOCTITE STYCAST ES1004
  - LOCTITE STYCAST ES2505
- Light weight
  - LOCTITE STYCAST 1090*
  - LOCTITE STYCAST 1090SI*

* Cat 9 or cat 27-1
Service temperature
-40°C / +175°C

**Epoxy**

- **General**
  - LOCTITE STYCAST 2651W1/cat 27-1
  - LOCTITE STYCAST 2651-40W1/cat 27-1
  - LOCTITE STYCAST 2651MM/cat 27-1
  - LOCTITE STYCAST ES2205
  - LOCTITE STYCAST ES4322
  - LOCTITE STYCAST EO1058
  - LOCTITE STYCAST EO7038
  - LOCTITE STYCAST A316-48

- **Thermal conductive**
  - LOCTITE STYCAST 2850FT/cat 27-1
  - LOCTITE STYCAST 2850MT/cat 27-1
  - LOCTITE STYCAST 2851FT

- **Flame retardant**
  - LOCTITE STYCAST G 508-1
  - LOCTITE STYCAST ES1004

- **Light weight**
  - LOCTITE STYCAST 1090/cat 27-1
  - LOCTITE STYCAST 1090SI/cat 27-1

**Silicone**

- **General**
  - Loctite 5140
  - Loctite 5145
  - Loctite 5092/5091
  - Loctite 5088

- **Thermal conductive**
  - Loctite 5952-1
  - Loctite 5954
**Introduction: Circuit Board Protection Materials: Potting**

**Service temperature**
-40°C / +200°C

**Epoxy**
- General
  - LOCTITE STYCAST 2662/cat 17
  - LOCTITE STYCAST E2517
  - Eccobond 104
- Thermal conductive
  - LOCTITE STYCAST 2762FT/cat 17

**Silicone**
- General
  - Loctite 5140
  - Loctite 5145
  - Loctite 5092/5091
  - Loctite 5088
- Thermal conductive
  - Loctite 5952-1
  - Loctite 5954
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<td>Sample quantity</td>
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## Process information

- **Application description (housing and inner parts)**
  - small gap filling
  - required flow behaviour of product
- **Potting volume in cc**
- **Product Environment**
  - Operating temperature Range
    - continuous
    - intermittent
- **Desired Cure Method**
  - Heat, RTV, UV, RT-2part
  - Max. cure time
  - Max. cure temp.
  - 1 or Two-component acceptable
- **Product properties**
  - Viscosity (mixed viscosity when 2K)
  - Flame retardancy, UL class
  - Hardness
  - Tg
  - CTE coefficient of thermal expansion
- **High voltage requirements**
- **Product Environment - Fluid Exposure**
- **Product Environment - Thermal shock**
- **Available dispensing equipment (brand, type)**
- **Required electrical properties**:
  - Dielectric strength
  - Dielectric constant
  - Dissipation factor
  - Volume/surface resistivity
  - SIR (Surface Insulation Resistance)
- **Other**
- **Current Supplier and product description**

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October 2, 2014    Introduction: Circuit Board Protection Materials: Potting
Thank you for your attention.