

Tough-Seal 21 is a sealant for potting electrical and electronic components when premium thermal cycling performance is required. It delivers low embedment stress upon cure and during thermal cycle exposures. This inherent resilience is gentle on sensitive circuitry while it provides an exceptional shield to protect the electrical components from the environment.

Tough-Seal 21 is a two component, hybrid epoxy elastomer material that does not contain isocyanates. It has a milder health and safety profile than urethanes.

Tough-Seal 21 is provided in a convenient mix ratio that is easy to mix. It sets quickly at room temperature to form a hardened polymer with exceptional flexibility to - 40°C and elevated temperature resistance to 300°F. As an epoxy, Tough-Seal picks up where urethanes drop off, while its tough, rubbery nature delivers thermal cycling performance not typically found in epoxy materials.



Key Polymer is ISO 9001 certified and has 45 years in the business of supplying specification materials to the electronic industries.

Visit the Key Polymer website for a complete product list



Tough-Seal 21 Technicals (Typical values, not intended for specifications)

| Wet Properties           | Part A      | Part B      | MIX         |
|--------------------------|-------------|-------------|-------------|
| Color                    | Milky White | Black       | Black       |
| Viscosity at 25°C (77°F) | 7,000 cPs   | 11,000 cPs  | 10,000 cPs  |
| Brookfield RVT           | #5 @ 20 rpm | #5 @ 20 rpm | #5 @ 20 rpm |
| Specific Gravity         | 1.32        | 1.28        | 1.29        |
| Density (lbs/gal)        | 11.0        | 10.7        | 10.8        |
| Shelf Life               | 3 months    | 3 months    |             |

Shelf Life Conditions: Unopened, factory sealed containers and cartridges in factory sealed foil pouches have a shelf life of 3 months from the date of shipment at room temperature 68°F to 77°F (20°C to 25°C) OR 12 months from the date of shipment when stored at 0°F to 38°F (-18°C to 3°C). The gel time of KEY Tough-Seal 21 becomes longer as the Aside component ages beyond 3 month at room temperature. While ultimate cure and properties are unaffected by the gel time extension, the cure rate is affected beyond 3 months age. Refrigerator or freezer storage can be used to preserve gel time. Storage above 90°F (32°C) is not recommended. Contact Key Polymer to discuss the supply chain management of Tough-Seal 21 in your operation.

| Mix Ratio by Weight<br>Mix Ratio by Volume  | Combine 51 Parts A-side with 100 Parts B-side by Weight<br>Combine 1 Part A-side with 2 Parts B-side by Volume |               |                              |                       |  |
|---|--|---------------|------------------------------|-----------------------|--|
| Gel Time (100 grams)                        | 10 minute  | es            |                              |                       |  |
| Electrical Properties                       | ASTM   | Temperature   | Value                        |                       |  |
| Volume Resistivity                          | D257   | 23°C (73°F)   | 1.33 x 10 <sup>12</sup> Ω-cm | 的目的形态。                |  |
| Dielectric Strength                         | D149   | 23°C (73°F)   | 350 Volts/mil                |                       |  |
| Dielectric Constant                         | D150   | 23°C (73°F)   | 6                            |                       |  |
| Dissipation Factor                          | D150   | 23°C (73°F)   | 0.06                         | 110                   |  |
| Frequency 1kHz                              |  |               |                              |                       |  |
|   |  |               |                              | СН                    |  |
| Mechanical Properties                       | ASTM   | Temperature   | Value                        | % F                   |  |
| Lap Shear Strength                          | D1002  | 25°C (77°F)   | 640 psi Cohesive             | ЮШ                    |  |
| Aluminum 2024T3 Bare 0.5 in <sup>2</sup> ov | erlap 5 mil gap  |               |                              | R 35                  |  |
| Tensile Strength                            | D638   | 25°C (77°F)   | 350 psi                      |                       |  |
| Elongation at Break                         | D638   | 25°C (77°F)   | 350%                         | 0,                    |  |
| Type 1 0.120 men unickness                  |  |               |                              | and the second second |  |
| Linear Shrinkage                            | D2256  | 25°C (77°F)   | < 0.001 in/in                | - Actor               |  |
| Hardness, Shore A                           | D2240  | 0°C (32°F)    | 58A                          |                       |  |
|   |  | 25°C (77°F)   | 52A                          | 1000                  |  |
|   |  | 80°C (176°F)  | 50A                          | a had the same        |  |
|   |  | 100°C (212°F) | 50A                          |                       |  |
|   |  | 120°C (248°F) | 50A                          |                       |  |
|   |  | 150°C (302°F) | 48A                          |                       |  |



## Tough-Seal 21 Guards Electrical Components!

Tough-Seal 21 has the service temperature of an epoxy and the flexibility common to urethanes. It's the best of both worlds. Tough-Seal is a hybrid epoxy elastomer and as such, it possesses the resilience of an elastomeric matrix but Tough-Seal sets to form epoxy domains seeded throughout the cured polymer that boost thermal resistance. This Interpenetrating Polymer Network, IPN, remains flexible but capable of delivering superior thermal cycling and it does so without the use of



isocyanates and their associated health & safety issues because Tough-Seal is not a urethane.

Tough-Seal is superior to ordinary epoxy and urethane potting compounds.

Potting compounds & encapsulants are specified to flow over an electrical device and fill up a housing with a hardened thermoset plastic to serve as an environmental barrier. Epoxy and urethane materials are prevalent throughout industry because they suitably withstand intrusive environmental moisture, salts and chemicals that can attack sensitive electronics and cause shorts. Epoxies are typically rigid materials with high service temperatures and urethanes are more flexible with lower heat resistance. Ideally, one would specify a flexible potting compound to maintain a seal with the housing wall but elevated service temperatures degrade urethanes. Ordinary epoxy materials can handle the high service temperatures but they are vulnerable to pull back from the housing in cold conditions. Pull back creates a gap that is readily exploited by the aggressive environment. Tough-Seal won't pull back!

Chemistry aside, Tough-Seal is a Guard Dog that grips the wall in cold when others contract to expose a gap, yet it won't wilt under the heat. Tough-Seal picks up where urethanes leave off and guards up to 300°F.

## *Hit the Milestone & Get the Guard Dog Order Your Tough-Seal 21 Evaluation Kit Today!*



Order an evaluation kit and everything you need to perform a high quality engineering evaluation is expedited to you including direct access to the consultants on the technical service "Seal Team" at Key Polymer. Time and time again, specifying engineers determine that Tough-Seal comes out on top in side by side testing with your existing encapsulant. See for yourself.



## ZERO TOLERANCE FOR STRESS

**ZERO EMBEDMENT STRESS**: the stress that electrical components are subjected to when they are embedded in the potting compound. It is the principle cause of component failure even when an impermeable seal to the environment is attained. The sensitive components can be dislodged from their connections when (1) the potting compound hardens from a liquid to a solid and later when (2) the part is exposed to thermal cycling and the persistent expansion and contraction of the encapsulant.

**ZERO SHRINK - ZERO STRESS**: Tough-Seal avoids initial embedment stress upon cure because it has imperceptibly low shrinkage. Thermoset plastics have a slightly larger volume in their freshly mixed liquid state than they possess in their hardened cured state. This differential volume is manifest by shrinkage and is aggravated by the size of the pour and the extent of the resulting exotherm. The higher service temperature traditional epoxy system essentially squeezes the components that it is designed to protect right off the board. More flexible urethane systems shrink less and are more compliant than typical epoxies but they are not recommended for the service temperatures encountered in underthe-hood automotive service. Moreover, as is indicated later, flexible urethane systems become hard in the cold extremes of thermal cycles and they induce stress post-potting.



The novel, hybridized nature of Tough-Seal has zero shrinkage upon cure per ASTM D2256 and it cures with little to no reaction exotherm even in large pours.

Tough-Seal doesn't get hot but it can take the heat ... under-the-hood.



**THERMAL CYCLING - ZERO STRESS**: Why does Tough-Seal have superior thermal cycling characteristics? Uncharacteristic of standard epoxies and urethanes, the hardness of Tough-Seal is not a function of temperature. The hardness of other potting compound chemistries are strong functions of temperature and they definitely get harder as they get colder and become softer as they are heated. In the graph below, the hardness of Tough-Seal is nearly constant. Again expansion and contraction forces are eliminated and thus they do not act on embedded circuitry.



Tough-Seal forms a tough seal, but it is gentle on electrical components because it does not change as conditions do. It thermal cycles like no other and it guards electrical components. Is your project nearly complete with your launch date fast approaching but you're getting hammered on environmental testing with your existing encapsulant? You thought the hard part was over with all design reviews signed off except the potting compound selection and now the specification of the potting compound is the only thing standing between you and success. Your electronic design is high tech, why not go with the latest technology in polymer encapsulation?

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## **Tough-Seal Applications**

**Applications for Tough-Seal:** Tough-Seal 21 is an ideal material for the encapsulation of sensitive electrical and electronic components that are subject to thermal cycling stress. Tough-Seal 21 bonds exceptionally well to the walls of most plastic and metallic housings, frames and shells and stays firmly in place without pull back during environmental exposure. For connectors, Tough-Seal adheres and seals to wire insulation and metal contacts and receptacles. It is soft enough to deliver a resilient and durable potting but receptacles are not prone to push back upon plug insertion. Tough-Seal 21 also makes a useful glob-top encapsulant to protect vulnerable microelectronic components from environmental, mechanical & electrical damage.



Essentially, if you use urethane encapsulants we can extend your service temperature and rid your facility of isocyanates. If you use silicones, Tough-Seal offers a cost effective, non-silicone option with a friendly ratio and faster cure. If you use epoxy materials, Tough-Seal is an upgrade technology that can set quick, withstand the temperature yet offer imperceptibly low shrinkage upon cure, low embedment stress, and outstanding thermal cycling performance to solve your rigidity woes. Is Tough-Seal right for your application? To find out, call Key now or simply click to get a kit and see for yourself.



Send Us Your Tough-Seal Testimonials and we'll send you a Tough-Seal cap. Order an evaluation kit and everything you need to perform a high quality engineering evaluation is expedited to you. Post your comparison data and an image of your application to tough-seal@keypolymer.com and we'll forward you our snazzy bulldog ball cap in appreciation. See for yourself. Tough-Seal comes out on top in side by side testing with your existing encapsulant.



## Application of Tough-Seal

**Applying Tough-Seal**: So how do we get started? Tough-Seal 21 is available in a variety of cartridges from 50cc to 400cc in volume. Tough-Seal 21 is also made available in gallons, pails or drums. Metered mixing and dispensing is preferred over hand mix and cartridges offer a convenient method of getting started without capital outlay. Both manual and pneumatic dispensing guns are available as well as cost effective stand mounted cartridge dispensing units with dosing capability. Key Polymer has close working relationships with metermix equipment manufacturers and is content to work closely with your engineering staff and theirs to specify a new unit. Key technical service is also a useful resource on the decisions needed to switch over existing equipment to Tough-Seal. Get started with a click for an evaluation kit.





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## Take the Tough-Seal 21 Challenge

Order an evaluation kit and everything you need to perform a high quality engineering evaluation is expedited to you including direct access to the consultants on the technical service "Seal Team" at Key Polymer. Time and time again, specifying engineers determine that Tough-Seal comes out on top in side by side testing with your existing encapsulant. See for yourself. Order a kit today!

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Send Us Your Tough-Seal Testimonials and we'll send you a Tough-Seal cap. Order an evaluation kit and everything you need to perform a high quality engineering evaluation is expedited to you. Post your comparison data and an image of your application to tough-seal@keypolymer.com and we'll forward you our snazzy bulldog ball cap in appreciation. See for yourself. Tough-Seal comes out on top in side by side testing with your existing encapsulant.



### **Contact Key Polymer**

| Toll-Free number: | 1-888-KEY POLY |
|-------------------|----------------|
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Key Polymer is ISO 9001 certified and has 45 years in the business of supplying specification materials to the electronic industries.

Visit the Key Polymer website for a complete product list