Product information

# ANCAMIDE® 2482

## Curing Agent

## DESCRIPTION

Ancamide 2482 curing agent is a modified polyamide optimized for use with liquid epoxy resins in two-component adhesives. The product offers a number of advantages, particularly where low viscosity and cost-effectiveness are of primary interest. Ancamide 2482 curing agent combines the resiliency of traditional polyamides with state-of-the-art amine technology to produce a uniquely versatile curing agent for adhesive applications. Special features of Ancamide 2482 curing agent include low viscosity without the use of an external plasticizer, excellent wetting ability and low cost.

## TYPICAL PROPERTIES

| Property | Value | Unit | Method |
|---|---|---|---|
| **Appearance** | Amber Liquid | | |
| **Color** | 7 | Gardner | ASTM D 1544-80 |
| **Viscosity @ 25°C** | 5,500 | cP | ASTM D 455-83, Brookfield RV, Spindle 27 |
| **Amine Value** | 370 | mg KOH/g | Perchloric Acid Titration |
| **Specific Gravity @ 25°C** | 0.9672 | | ASTM D 147-85 |
| **Flash Point** | >392 | °C | Seta flash closed cup |
| **Equivalent Wt/{H}** | 125 | | |
| **Recommended Use Level** | 60-65 | phr | EEW=190 |

## ADVANTAGES

- Low viscosity
- Cost-effective
- Plasticizer-free
- Excellent adhesion to metal and plastic substrates
- Good flexibility
- Excellent environmental resistance

## APPLICATIONS

- Two-component ambient temperature or heat-cured epoxy adhesives for metal, plastic or wood bonding
- Two-component adhesives where low viscosity and good rheology are required
- Two-component adhesives where high filler loading is required

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## SHELF LIFE

At least 24 months from the date of manufacture in the original sealed container at ambient temperature. Store away from excessive heat and humidity in tightly closed containers.

## STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamide 2482 curing agent.

## TYPICAL HANDLING PROPERTIES*

| Property | Value | Unit | Method |
|---|---|---|---|
| **Mixed Viscosity @ 25°C** | 10,500 | cP | ASTM D 455-83, Brookfield RV, Spindle 52 |
| **Gel Time (150g mix @ 25°C)** | 130 | min | Techne GT-4 gelation timer |
| **Thin Film Set Time @ 25°C** | 7.0 | hr | BK drying recorder |
| **Peak Exotherm (100 g mass)** | 90 | °C | ASTM D 2471-71 |

## TYPICAL PERFORMANCE*

| Property | Value | Unit | Method |
|---|---|---|---|
| **(2 hr cure @ 70°C)** | | | |
| **Glass Transition Temperature** | 78 | °C | ASTM D 3418-82 |
| **Compressive Strength** | 10,400 | psi | ASTM D 695-85 |
| **Compressive Modulus** | 289 | thousand psi | ASTM D 695-85 |
| **Tensile Strength** | 9,400 | psi | ASTM D 638-86 |
| **Tensile Modulus** | 366 | thousand psi | ASTM D 638-86 |
| **Tensile Elongation at break** | 5.5 | % | |
| **Flexural Strength** | 15,800 | psi | ASTM D 790-86 |
| **Flexural Modulus** | 414 | thousand psi | ASTM D 790-86 |
| **Hardness** | 78 | Shore D | ASTM D 2240-86 |

* Ancamide 2482 curing agent formulated with standard Bisphenol-A based (DGEBA, EEW=190) epoxy resin.

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## SUPPLEMENTARY INFORMATION

### HANDLING PROPERTIES

To demonstrate its applicability in structural adhesives, Ancamide 2482 curing agent was compared against the industry standard polyamide, Ancamide 350A curing agent. Table 1 demonstrates the typical handling characteristics of Ancamide 2482 and Ancamide 350A curing agents.

Ancamide 2482 curing agent offers significantly lower viscosity than the industry standard polyamide, and this provides several key options to formulators. Unlike a traditional polyamide, Ancamide 2482 curing agent allows the usage of a higher amount of fillers in the adhesive formulation, which improves both the coefficient of thermal expansion property and the formulation cost. When high filler loading is not desired, Ancamide 2482 curing agent imparts improved handling and/ or rheology characteristics to adhesive formulations.

In addition, Ancamide 2482 curing agent imparts higher reactivity than the control. This higher reactivity (lower thin film set time) provides faster development of strength than the control, enabling greater productivity.

The reactivity of Ancamide 2482 curing agent was further characterized by a Differential Scanning Calorimeter (DSC).

Table 2 demonstrates that Ancamide 2482 curing agent imparts lower onset temperature and peak temperature as compared with Ancamide 350A curing agent. In addition, Ancamide 2482 curing agent offers a high degree of throughcure after one and seven days, as compared with the industry standard polyamide.

TABLE 1: COMPARATIVE HANDLING CHARACTERISTICS OF POLYAMIDES

| | Ancamide 2482 | Ancamide 350A |
|---|---|---|
| **Color, Gardner** | | |
| **Viscosity @ 77°F (cP)** | 5,500 | 11,000 |
| **AHEW** | 125 | 114 |
| **PHR** | 65 | 60 |
| **Thin Film Set Time @ 77°F, hr** | 7.0 | 10.0 |
| **Gel Time @ 77°F, min** | 130 | 200 |

TABLE 2: REACTIVITY* PROFILE BY DSC**

| | Ancamide 2482 | |
|---|---|---|
| **Onset Temperature, °F** | 162 | 171 |
| **Peak Temperature, °F** | 244 | 255 |
| **Heat of Reaction, J/gm** | 270 | 290 |
| **% Cure after 1 day at 77°F** | 83 | 62 |
| **% Cure after 7 days at 77°F** | 90 | 80 |

* With standard Bisphenol-A based liquid epoxy resin (EEW=190).
** Scan rate: 50 °F (10 °C)/min

TABLE 3: MODEL ADHESIVE FORMULATIONS (1:1 BY VOLUME)

| A Side | Ancamide 2482 by weight | Ancamide 350A by weight | Method |
|---|---|---|---|
| **DGEBA type liquid resin (EEW=190)** | 60.0 | 60.0 | |
| **Diethylene glycol** | 1.0 | 1.0 | |
| **Aluminum 101** | 37.0 | 37.0 | ASTM D 455-83, Brookfield RV, Spindle 27 |
| **Cab-O-Sil TS-720** | 2.0 | 2.0 | Perchloric acid titration |
| **B Side** | | | |
| **Ancamide 2482** | 38.0 | - | |
| **Ancamide 350A** | - | 38.0 | |
| **ATBNX16** | 12.0 | 12.0 | ASTM D 147-85 |
| **Aluminum 101** | 22.0 | 22.0 | ASTM D 455-83, Brookfield RV, Spindle 27 |
| **Microtuff 325** | 27.0 | 27.0 | Seta flash closed cup |
| **Cab-O-Sil TS-720** | 1.0 | 1.0 | Perchloric acid titration |

## ADHESION TO METAL AND PLASTIC SUBSTRATES

To demonstrate utility across a broad range of applications, Ancamide 2482 curing agent was again compared with Ancamide 350A curing agent. Toughened model formulations with1:1 volume mix ratio were developed for each curing agent and evaluated on multiple substrates under different cure schedules. Table 3 describes the composition of each model formulation, and Table 4 specifies the substrates, bonding parameters and test methods employed within this study. Single lap shear and T-Peel data were collected for the metal substrates, and single lap shear data were collected for the thermoplastic substrates.

TABLE 4: SUBSTRATES, BONDING PARAMETERS AND TEST METHODS

| | |
|---|---|
| **Substrates** | |
| **Cold Rolled Steel** | B952 P60 from ACT, 0.030” |
| **Aluminium** | 2024 T-3, 0.063” |
| **Polycarbonate** | Rigid exterior quality |
| **ABS** | Rigid exterior quality |
| **Surface Preparation** | |
| **Cold Rolled Steel** | Dry rag wipe |
| **Aluminium** | Chromic acid etching, ASTM D 2651 |
| **Polycarbonate and ABS** | Dry rag wipe |
| **LAP SHEAR SAMPLE PREPARATION AND TESTING** | |
| | 1" x 4" coupons |
| | 0.5" overlap for metals and 1.0" overlap for thermoplastic substrates |
| | 0.010" bond line thickness (including glass micro-beads; 1g/100 g of mixed adhesive formulation) |
| | Testing according to ASTM D1002 |
| **T-PEEL SAMPLE PREPARATION AND TESTING** | |
| **For Metal Substrates Only** | 1" x 4" coupons |
| | 3” bond overlap |
| | 0.010" bond line thickness (including glass micro-beads; 1g/100 g of mixed adhesive formulation) |
| | Testing according to ASTM D1876 |
| **CURE SCHEDULES** | |
| As indicated. | |
| **TEST CONDITIONS** | |
| As indicated. | |

## ADHESION TO COLD ROLLED STEEL

Figures 1 and 2 illustrate Ancamide 2482 curing agent’s versatility beyond just low viscosity. The lap shear and peel results are impressive regardless of cure schedules. Ancamide 2482 curing agent consistently matches or exceeds the performance level of the traditional system and remains robust. Mode of failure is equally important as the absolute value of shear and peel strength. Both formulations provide cohesive failure, where the adhesive pulls apart but the bond at the substrate interface remains intact.

FIGURE 1: SHEAR STRENGTH ON COLD ROLLED STEEL @ 77°F

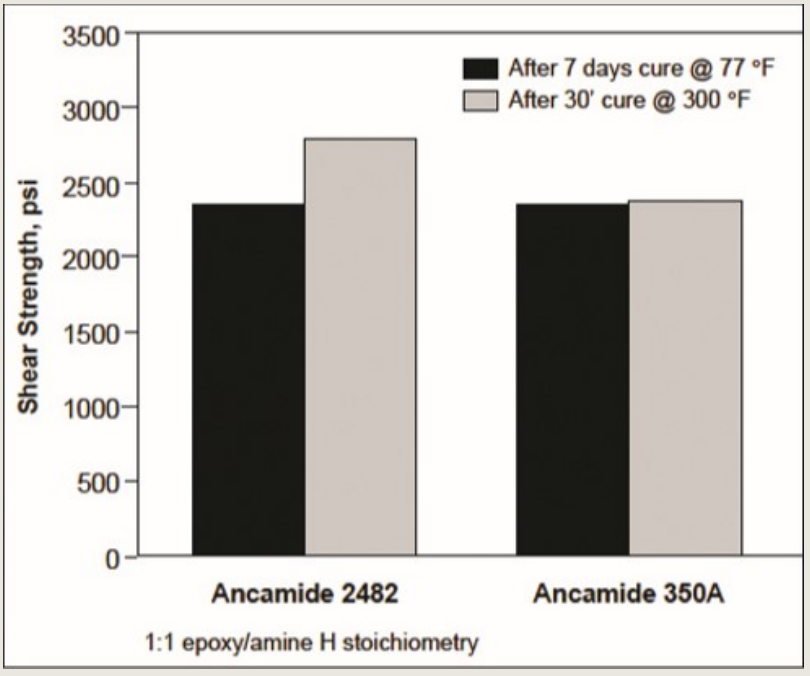
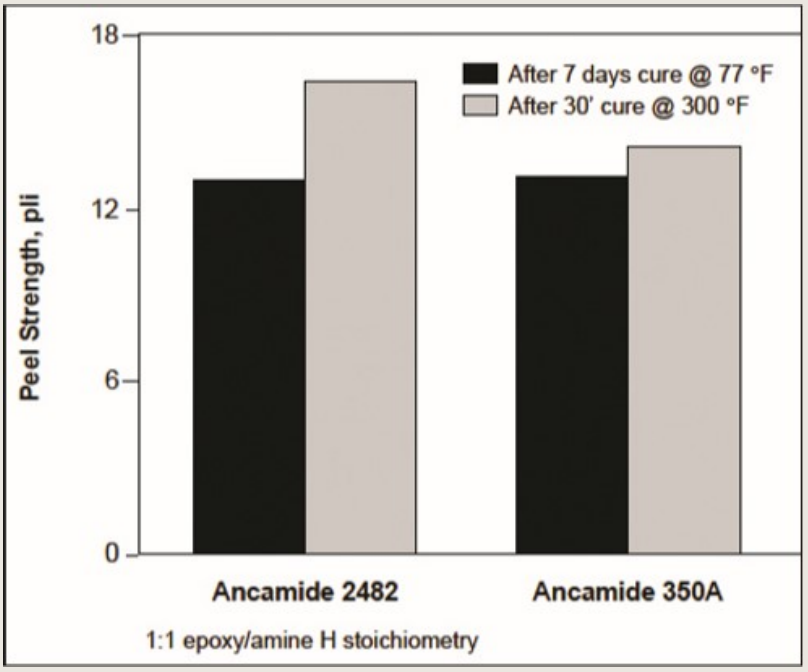


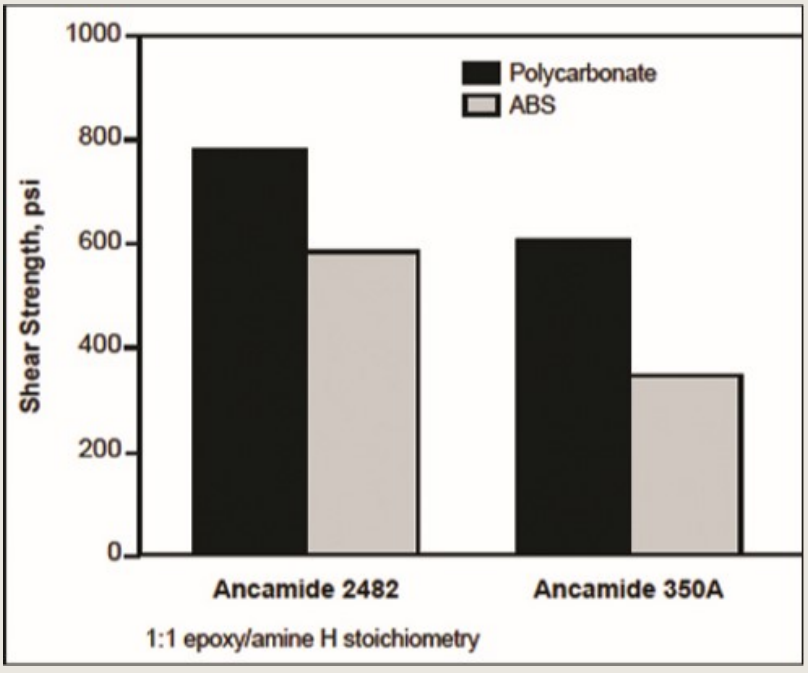

FIGURE 2: PEEL STRENGTH ON COLD ROLLED STEEL @ 77°F



## ADHESION TO COLD ROLLED STEEL

Figure 3 shows the lap shear results for polycarbonate and ABS substrates after seven days of cure at 77°F (25°C). Both formulations show good performance on polycarbonate. Adhesively bonded lap joints demonstrate substrate failure. On ABS, we observe adhesive failure, which is not surprising given that ABS resin provides a low energy surface and our model formulations are not optimized for plastic bonding. However, with the formulation based on Ancamide 2482 curing agent, we achieve significantly higher shear strength than the control.

FIGURE 3: SHEAR STRENGTH AFTER SEVEN DAYS CURE @ 77°F




## ADHESION TO ALUMINUM

Figures 4 and 5 illustrate shear strength and peel strength data on aluminum after room temperature and heat cure schedules. Once again, Ancamide 2482 curing agent consistently matches or exceeds the performance level of the traditional system. Both systems provide cohesive failure.

FIGURE 4: SHEAR STRENGTH ON ALUMINUM @ 77°F

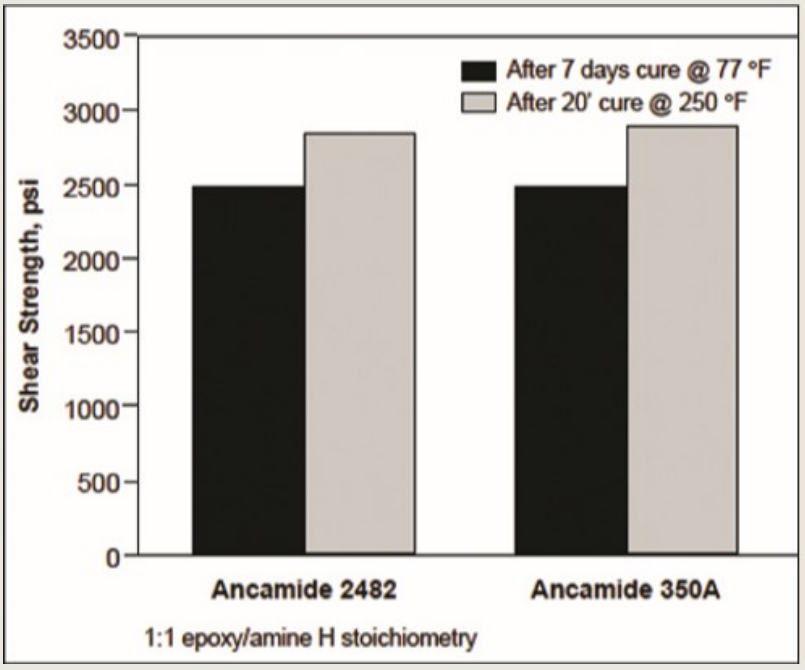
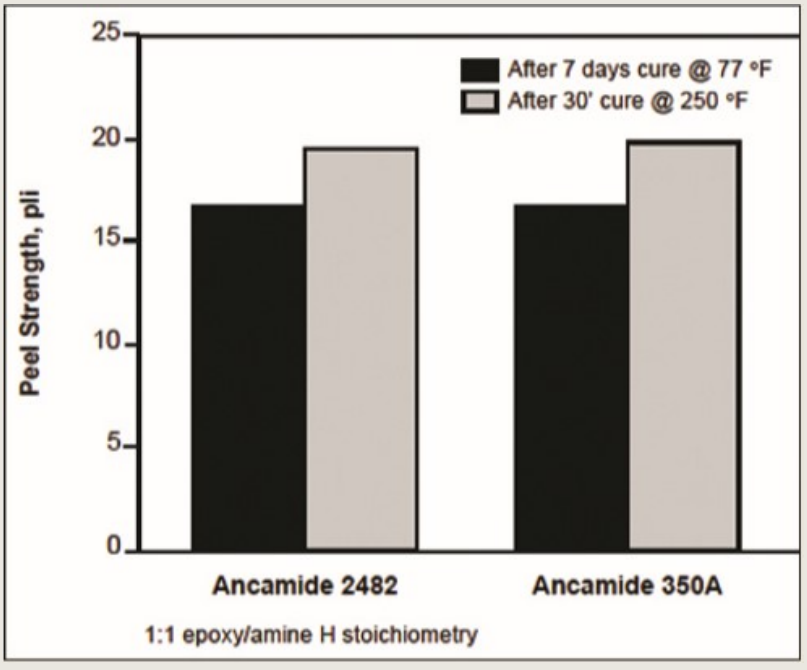



FIGURE 5: SHEAR STRENGTH ON ALUMINUM @ 77°F



## EFFECT OF DIFFERENT STOICHIOMETRIC RATIO ON ADHESION

To demonstrate the effect of different stoichiometric ratios on adhesion to aluminum, two stoichiometric ratios, 1:0.8 epoxy/ amine H and 1:1.2 epoxy/amine H, were compared with 1:1 epoxy/amine H stoichiometric ratio. Following two specific cure schedules, single lap joints and peel samples were prepared and tested at room temperature. Figures 6 and 7 illustrate lap shear strength and peel strength values after seven days of cure at 77°F(25°C), whereas Figures 8 and 9 represent the same after 20 minutes of cure at 250°F (120°C). The results show that the Ancamide 2482 curing agent-based system maintains strength.

FIGURE 6: SHEAR STRENGTH ON ALUMINUM AFTER 7 DAYS CURE @ 77°F

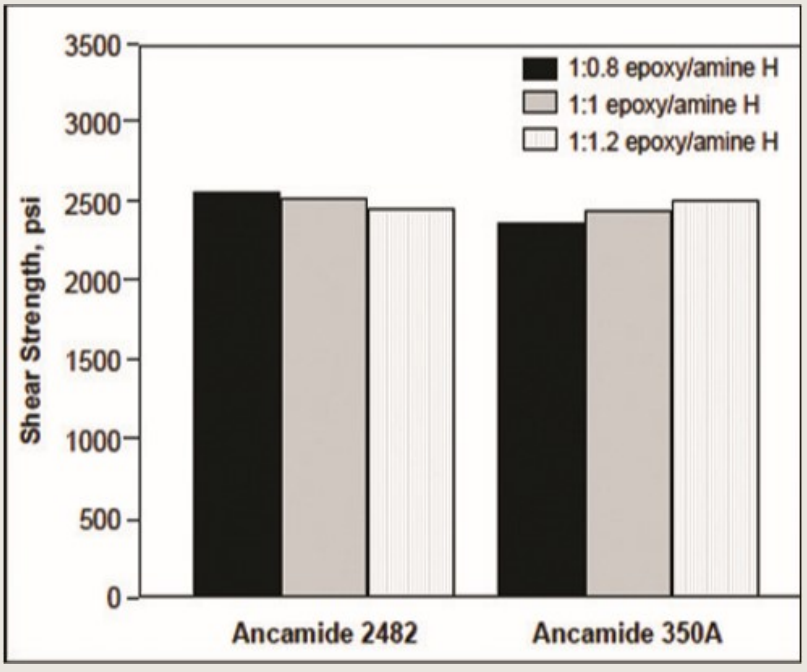


FIGURE 7: PEEL STRENGTH ON ALUMINUM AFTER 7 DAYS CURE @ 77°F

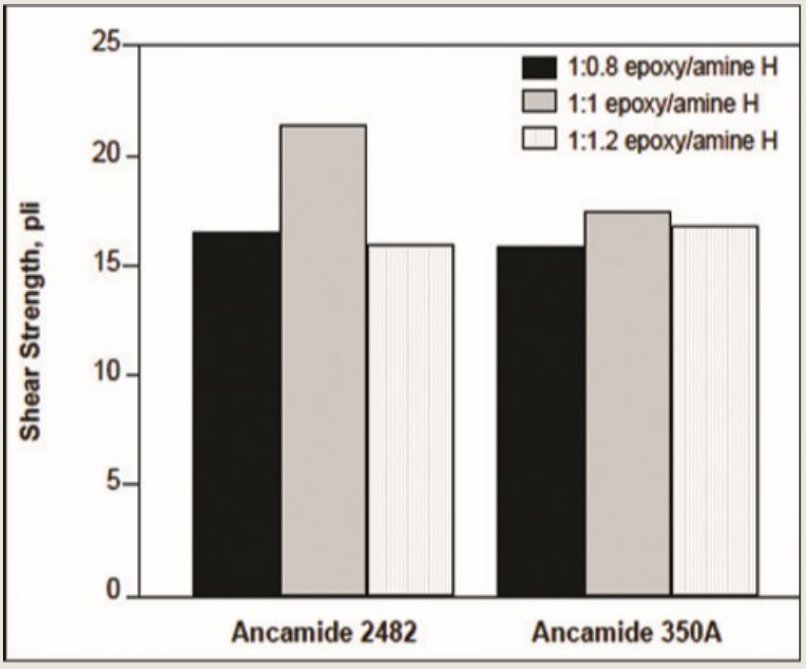
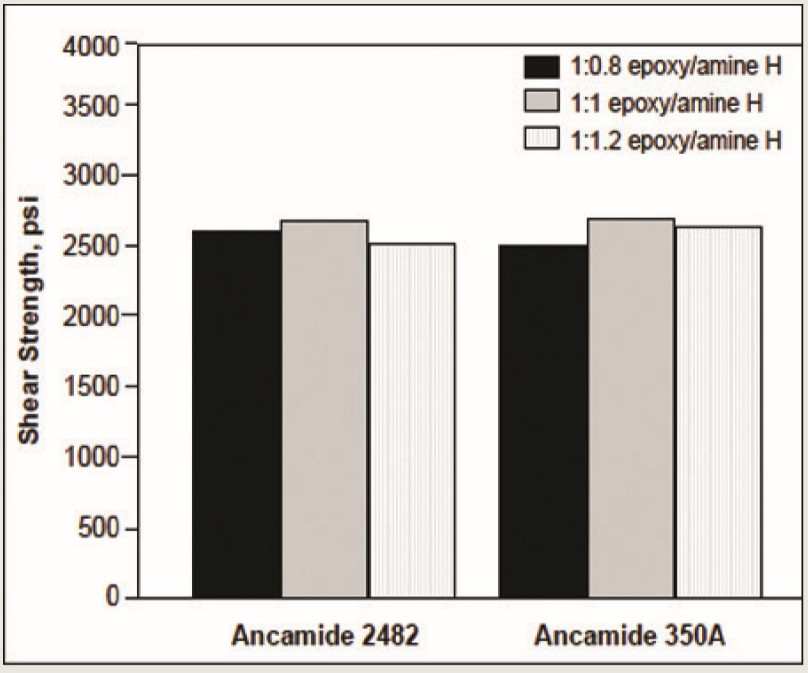



FIGURE 8: SHEAR STRENGTH ON ALUMINUM AFTER 20‘ CURE @ 250°F



## ADHESION INTEGRITY AFTER EXPOSURE TO HUMIDITY

Reliability is a primary concern of the adhesive end user. To gauge an adhesive's ability to maintain bondline integrity and adhesive strength, shear strength was measured on aluminum for both systems after one week of exposure to hot and humid conditions. In this test, bonded samples were exposed at 90°F (32°C) and 90% RH, and then they were tested at room temperature.

The results, illustrated in Figure 10, indicate that Ancamide 2482 curing agent matches the performance of the industry standard polyamide, and further demonstrates its suitability for use in structural epoxy adhesive applications.

## HIGH COST-EFFECTIVENESS

Ancamide 2482 curing agent can provide excellent cost-effectiveness in your formulation. Figure 11 shows a comparison of formulation costs between Ancamide 2482 and an industry standard polyamide such as Ancamide 350A curing agent. As can be seen, lower formulation costs can be achieved at all filler loadings, regardless of the desired target viscosity. In addition, these viscosity targets can be reached with higher filler loadings without a negative impact on strength and overall performance. For any given target viscosity, Ancamide 2482 allows for higher filler loading as compared with standard polyamides.

FIGURE 9: PEEL STRENGTH ON ALUMINUM AFTER 20‘ CURE @ 250°F

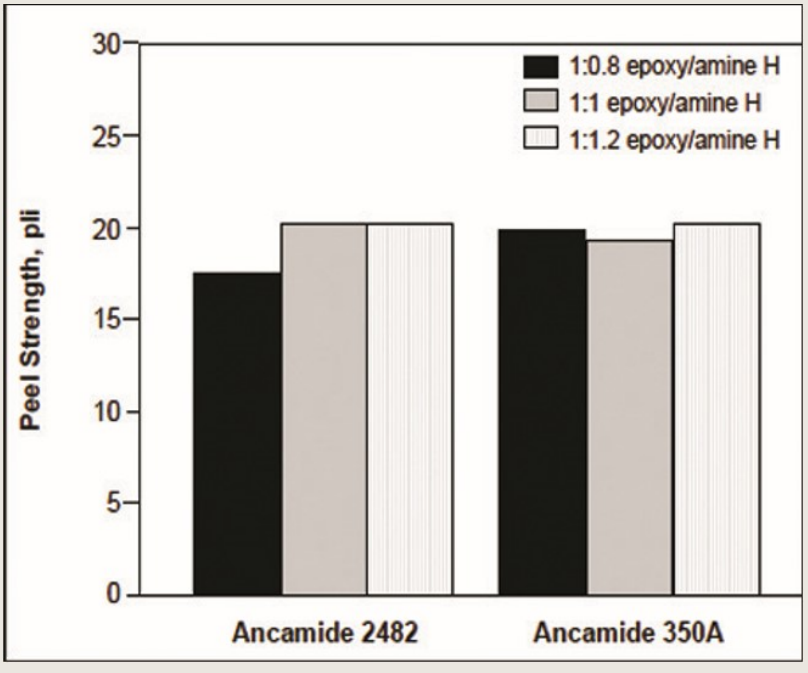


FIGURE 10: SHEAR STRENGTH ON ALUMINUM AFTER HUMIDITY EXPOSURE

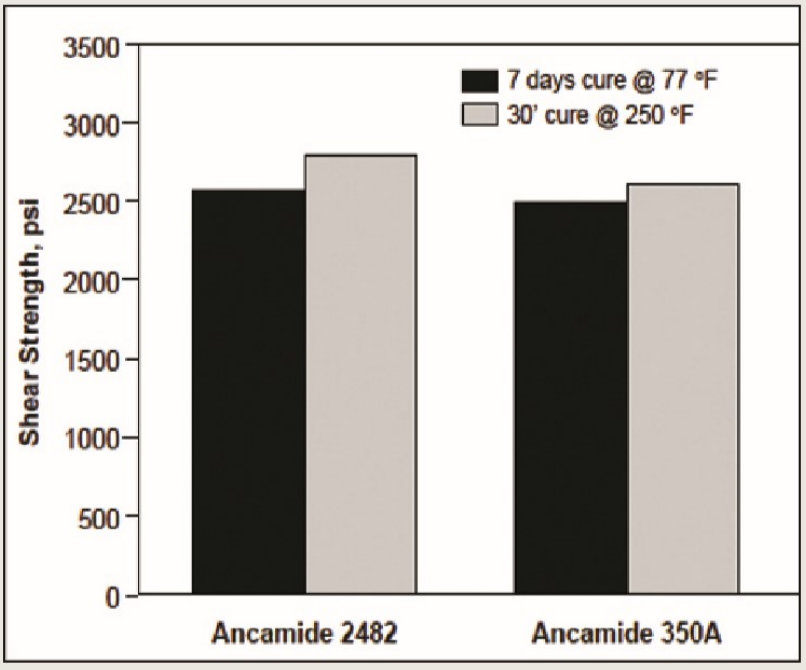
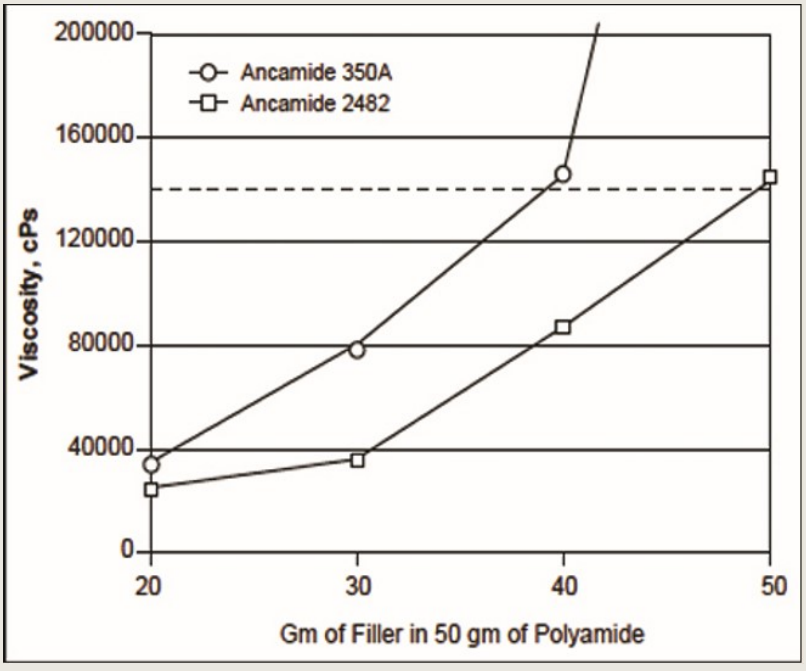



FIGURE 11: ANCAMIDE 2482 LOWERS FORMULATIONS COST



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**EVONIK OPERATIONS GMBH**
Business Line Crosslinkers
Paul-Baumann-Str. 1
45764 Marl
Germany

www.evonik.com/crosslinkers
**Product Information**: APCSE@evonik.com
**Sample Request:** APCSE@evonik.com

**EVONIK CORPORATION**
Business Line Crosslinkers
7001 Hamilton Boulevard
Trexlertown, PA 18087
USA

CrosslinkersProdinfo@evonik.com
Crosslinkers-Samples@evonik.com

**EVONIK SPECIALTY CHEMICALS (SHANGHAI) CO., LTD.**
Business Line Crosslinkers
55, Chundong Road
Xinzhuang Industry Park
Shanghai, 201108
China
CL-Asiainfo@evonik.com
CL-Asiainfo@evonik.com