Product information

ANCAMIDE® 910

Curing Agent

DESCRIPTION

Ancamide 910 curing agent is a versatile, flexible hardener designed for use with liquid epoxy resin. The engineered chemistry of Ancamide 910 curing agent provides a unique combination of properties not found in other epoxy hardeners. The product delivers outstanding flexibility/peel strength, and it also imparts excellent thermal shock resistance and good electrical properties to epoxy based formulations. Additional features include lower viscosity than conventional polyamides and non corrosive status. Ancamide 910 curing agent can be used either as a sole curing agent or as a modifier, and it is an ideal choice for electronic potting and encapsulation compounds, two-component adhesive formulations, coatings, civil engineering and composites applications.

TYPICAL PROPERTIES

Property	Value	Unit	Method
Appearance	Amber Liquid		
Colour	<6	Gardner	ASTM D 1544-80
Viscosity @ 25°C	6,000	mPa.s	Brookfield RVTD, Spindle 3
Amine Value	118	mg KOH/g	Perchloric Acid Titration
Specific Gravity @ 21°C	0.99	g/ml	
Equivalent	230	Wt/{H}	
Recommended Use Level	110-125	PHR	With Bisphenol A diglycidyl ether (EEW=190)
Flash Point (closed cup)	>93	°C	

ADVANTAGES

- Outstanding flexibility and peel strength
- Excellent thermal shock resistance
- Lower viscosity than standard polyamides
- Non-corrosive

APPLICATIONS

- Electronic potting and encapsulation
- General-purpose, two-component adhesives
- Coatings, civil engineering and composites

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SHELF LIFE

At least 24 months from the date of manufacture in the original sealed container at ambient temperature.

PACKAGING AND HANDLING

Refer to the Safety Data Sheet for Ancamide 910 curing agent.

TYPICAL HANDLING PROPERTIES*

Property	Value	Unit	Method
Mixed Viscosity at 25°C	6,650	mPa.s	Brookfield RVTD, Spindle 3
Gel Time (150g mix at 25°C)	120	mins	Techne GT-3 Gelation Timer
Thin Film Set Time 25°C	8	h	BK Drying Recorder Phase III

TYPICAL PERFORMANCE PROPERTIES*

Property	Value	Unit	Method
Tensile Strength	6.9	MPa	ISO 527
Tensile Modulus	0.8	GPa	ISO 527
Tensile Elongation @ Break	100	%	ISO 527
Hardness	57	Shore D	DIN 53505
Glass Transition Temperature	25	°C	DSC

SUPPLEMENTARY DATA

Unless otherwise noted, all adhesion tests were run on the model adhesive formulation found in Appendix A.

* With Bisphenol A diglycidyl ether (EEW=190)

ADHESION TO COLD ROLLED STEEL

Room Temperature Cure: Ancamide 910 curing agent imparts good flexibility to ambient cured two component epoxy resin formulations when used as a sole curing agent (as shown in Figure 1). Additionally, Ancamide 910 curing agent also reveals a unique synergy with conventional polyamides such as Ancamide 350A curing agent, in that adding as little as 25% of Ancamide 350A to Ancamide 910 dramatically enhances the shear strength value beyond what either curing agent would achieve alone (also shown in Figure 1). The results from the strength retention test done at elevated temperature mirror the same synergistic trend, although to a lesser degree.

Elevated Temperature Cure: As depicted in Figure 2, Ancamide 350A curing agent outperforms Ancamide 910 curing agent in terms of strength developed after heat cure, as well as in elevated temperature strength retention after heat cure. This comes as no surprise given the distinctive chemistry differences between the two products and the resulting cross-link density variations. Yet once again, a positive synergy is observed when the two curing agents are blended — providing comparable strength after elevated temperature cure while still taking advantage of the properties Ancamide 910 curing agent provides, such as low viscosity and improved flexibility.

Peel Strength: One of the best measures of flexibility and adhesion is peel strength. Figure 3 demonstrates the striking improvement Ancamide 910 curing agent offers in peel strength performance relative to Ancamide 350A curing agent and Ancamide 910/Ancamide 350A blends: more than double the peel strength at ambient temperature, and at least 70% greater strength after heat cure versus Ancamide 350A curing agent.

FIGURE 1: ADHESION TO COLD ROLLED STEEL SHEAR STRENGTH AFTER 7-DAY CURE @ 25°C

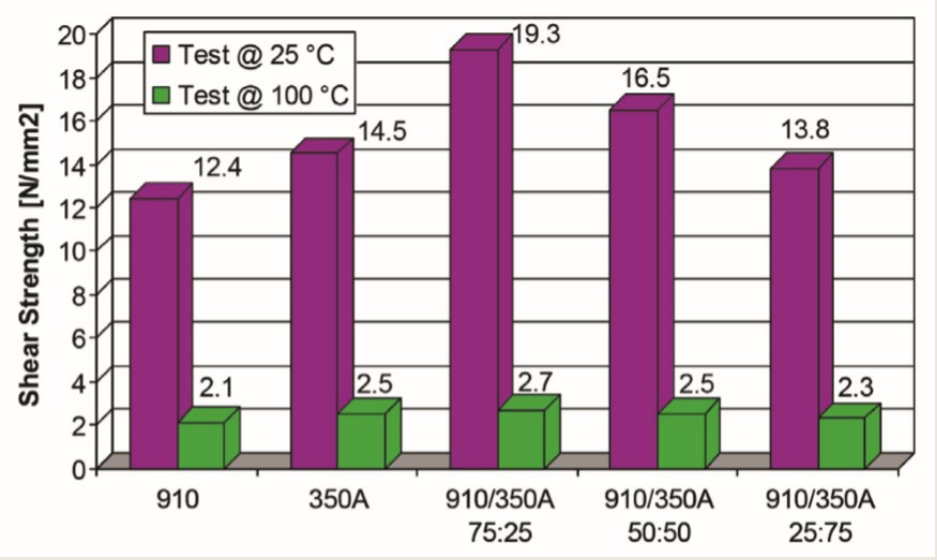


FIGURE 2: ADHESION TO COLD ROLLED STEEL SHEAR STRENGTH AFTER 30-MINUTE CURE @ 150°C

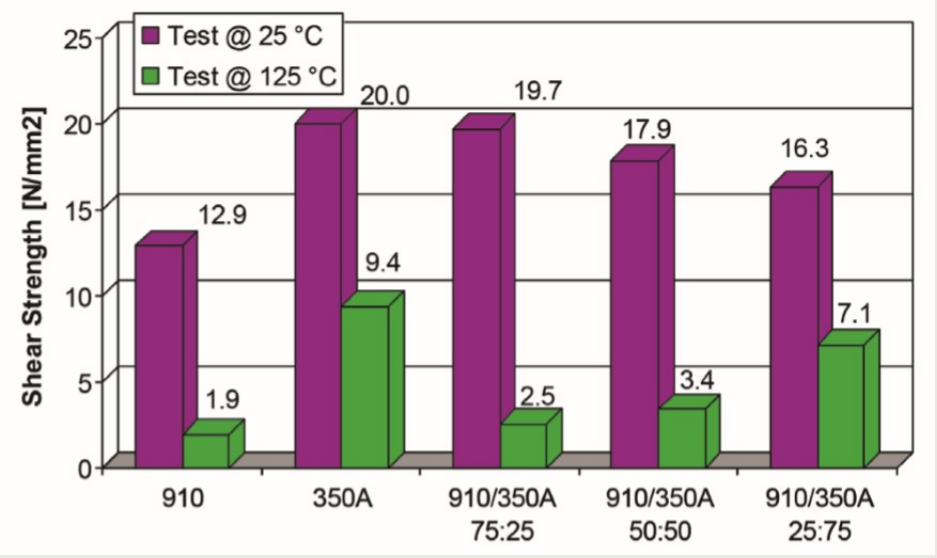


FIGURE 3: ADHESION TO COLD ROLLED STEEL PEEL STRENGTH AT 25°C

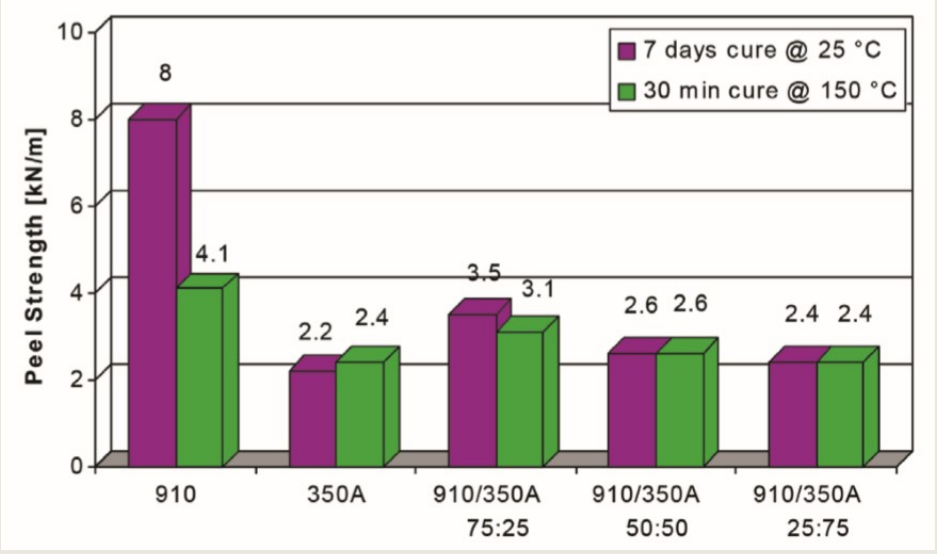
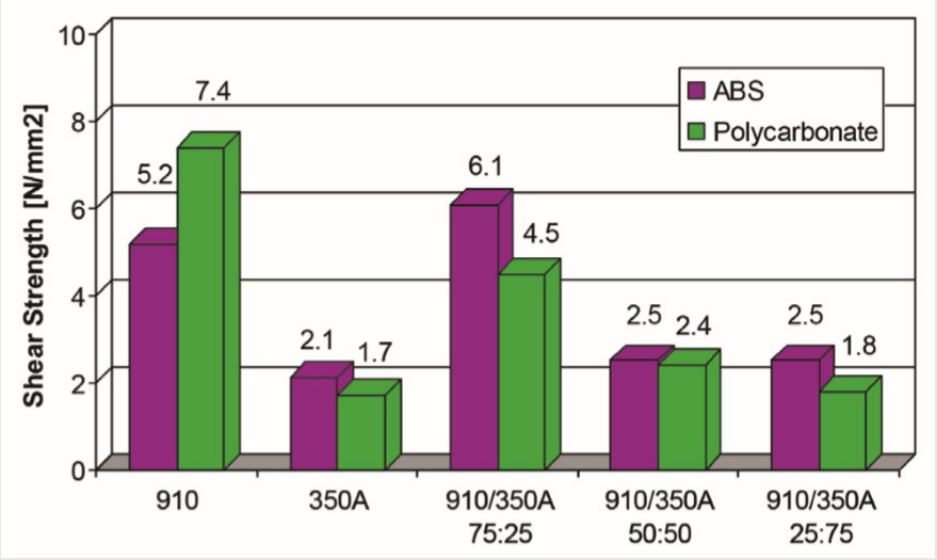


FIGURE 4: ADHESION TO ABS AND POLYCARBONATE SHEAR STRENGTH AFTER 7-DAY CURE @ 25°C



Adhesion to Plastics: The adhesion of Ancamide 910 curing agent and Ancamide 910/350A blends to plastic is illustrated in Figure 4. On both ABS and polycarbonate substrates, Ancamide 910 curing agent emerges as the clear winner in terms of shear strength, due to its outstanding flexibility. The synergistic results between a 75/25 blend of Ancamide 910 and Ancamide 350A curing agents on ABS substrates are also worth noting. Better performance can be obtained with a combination of the two than either product provides individually.

Tensile Strength: When it comes to tensile strength development, Ancamide 350A curing agent exceeds the performance of that of Ancamide 910 curing agent—again, due to Ancamide 350A curing agent's tighter cross-link density and lower degree of flexibility. The synergy between both curing agents reappears — this time with the 25/75 blend of Ancamide 910 and Ancamide 350A curing agents, which provides the highest tensile strength of any of the formulations tested. And, as would be predicted, the tighter cross-link density of Ancamide 350A curing agent results in a lower elongation result, while the more flexible Ancamide 910 curing agent provides 100% elongation. A 75/25 blend (Ancamide 910/Ancamide 350A) of the two provides more moderate elongation performance (60%). Figure 5 provides supporting data.

Performance Versus a Competitive Flexible Curing Agent: To illustrate the uncommon versatility of Ancamide 910 as a problem-solving curing agent for a wide variety of applications, a comparative analysis was conducted between Ancamide 910 curing agent, blends of Ancamide 910 and Ancamide 350A curing agent, and a competitive flexible curing agent. The model formulation used is presented in Appendix A.

In Figure 6, Ancamide 910 curing agent displays the highest peel strength but the lowest shear strength. Ancamide 350A curing agent, on the other hand, displays greater shear strength but lower flexibility/peel strength. The competitive curing agent also offers improved peel strength but with moderate flexibility. The “best of both worlds” performance comes from the 75/25 blend of Ancamide 910 and Ancamide 350A curing agents. Given the wide variety of applications and performance requirements a formulator faces on a regular basis, the blend offers a distinct advantage in that the formulator has the ability to tailor the balance of flexibility and strength precisely to his formulation requirements simply by adjusting the ratios within the Ancamide 910 and Ancamide 350A blend.

In Figure 7, tensile strength data is reported in conjunction with percent elongation results. Once again, Ancamide 910 curing agent displays high flexibility/lower strength; Ancamide 350A curing agent displays high strength/lower flexibility; and the competitive curing agent and the Ancamide 910/Ancamide 350A blend display moderate strength/percent elongation combinations; with the blend allowing for precise tailoring of the formulation performance to meet the needs of the specific application.

FIGURE 5: TENSILE PROPERTIES AFTER 2 H CURE @ 70°C

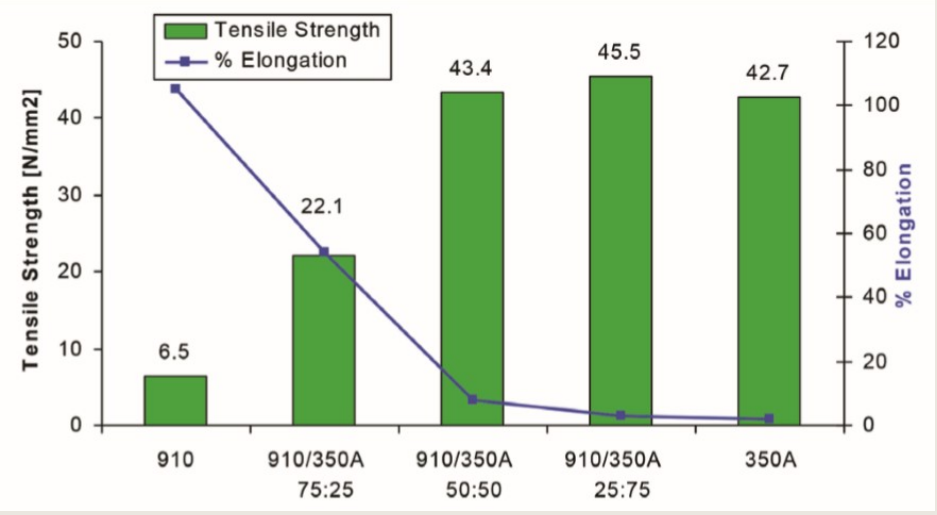


FIGURE 6: ANCAMIDE 910 VS. COMPETITIVE FLEXIBLE HARDENER SHEAR STRENGTH AND PEEL STRENGTH AFTER 7-DAY CURE @ 25°C

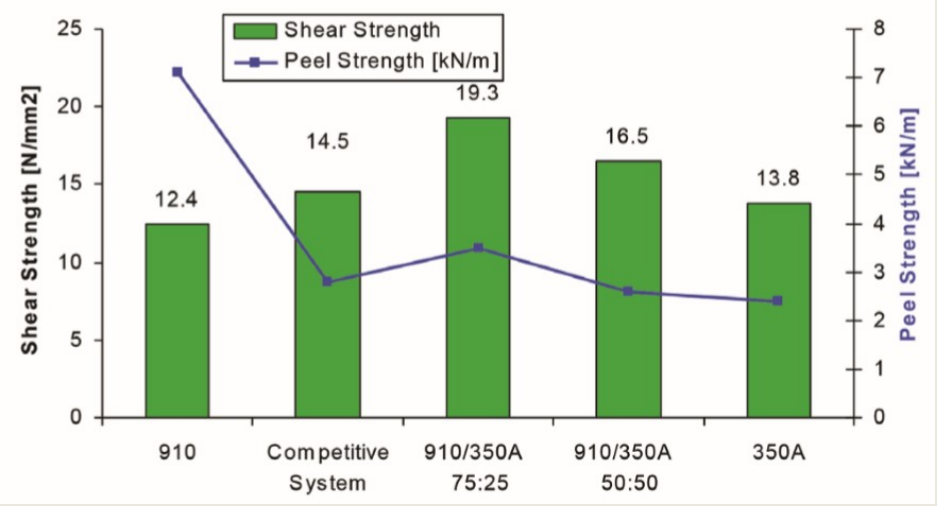


FIGURE 7: ANCAMIDE 910 VS. COMPETITIVE FLEXIBLE HARDENER TENSILE STRENGTH AFTER 2 H CURE @ 70°C

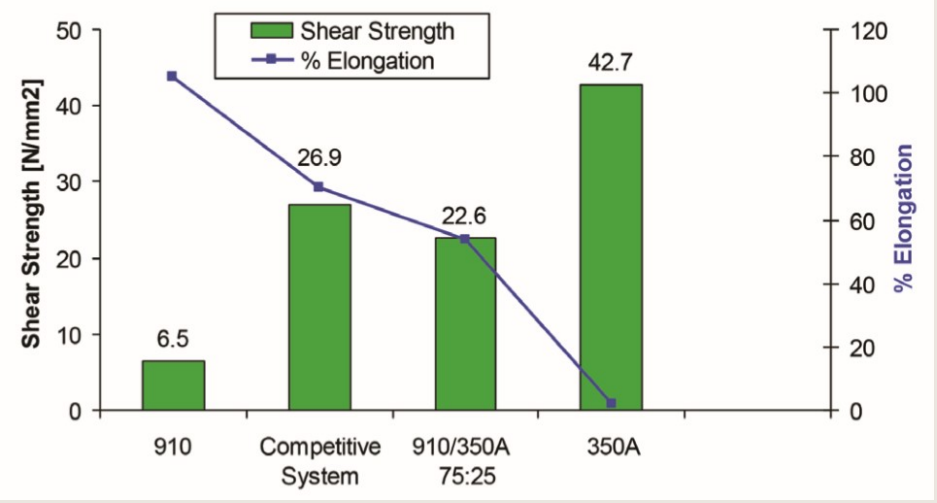


FIGURE 8: ELECTRICAL INSULATING PROPERTIES

Property	ASTM	Value
Dielectric Constant @ 100 kHz	D-150	4.12
Dissipation Factor @ 100 kHz (%)	D-150	0.07
Volume Resistivity (ohm-cm)	D-257	4.22×10^{11}
Dielectric Strength @0.08" (volts/mm)	D-149	21.6

OTHER PERFORMANCE PROPERTIES

Electrical Insulating Performance: Ancamide 910 curing agent offers good insulating performance at moderate frequencies, as demonstrated in Figure 8. Its performance begins to deteriorate at higher frequencies, and therefore it is not recommended for use in high voltage applications.

Stoichometric Latitude Relative to Peel Strength: For Ancamide 910 curing agent, going slightly over or slightly under stoichiometry with standard liquid epoxy resin has virtually no effect on the formulation's final flexibility, in terms of peel strength, as illustrated in Figure 9.

Peak Exotherm: Peak exotherm data was collected for Ancamide 910 and Ancamide 350A curing agent in a 150 g mass. In each case, the curing agent was blended with a stoichiometric amount of standard liquid epoxy resin. Ancamide 910 curing agent displays a peak exotherm temperature of 65°C versus a peak exotherm temperature of 43°C for Ancamide 350A curing agent.

Thermal Shock Resistance: Ancamide 910 curing agent was evaluated for thermal shock resistance via a "Modified Olyphant Washer Test." No cracking was observed in the Ancamide 910 curing agent-based formulation from cycles 1-10. At cycle 11, the Ancamide 910 formulation began to soften but did not crack. At cycle 12, the first cracking was observed. Test conditions are noted in Figure 10.

FIGURE 9: EFFECT OF STOICHIOMETRIC VARIATION ON PEEL STRENGTH

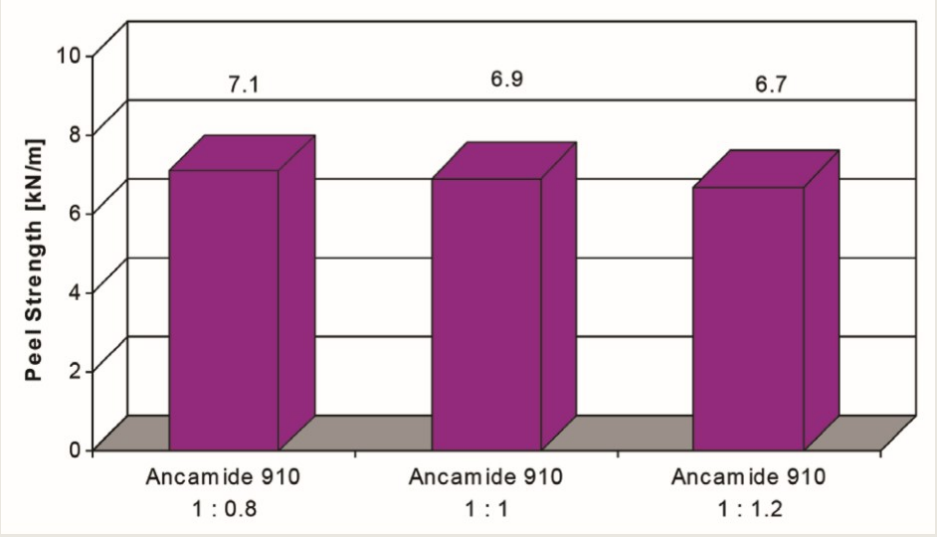


FIGURE 10: TEST CONDITIONS FOR MODIFIED OLYPHANT WASHER TEST

Cycle #	Test Condition	Test Time
1	Cool from 25°C to 5°C	10 minutes
2	Heat from 5°C to 25°C	30 minutes
3	Cool from 25°C to -15°C	10 minutes
4	Heat from -15°C to 25°	30 minutes
5	Cool from 25°C to -35°C	10 minutes
6	Heat from -35°C to 25°C	30 minutes
7	Cool from 25°C to -55°C	10 minutes
8	Heat from -55°C to 25°C	30 minutes
9	Heat from 25°C to 130°C	30 minutes
10	Cool from 130°C to -55°C	10 minutes
11	Heat from -55°C to 150°C	30 minutes
12	Cool from 150°C to -75°C	10 minutes

APPENDIX:
MODEL ADHESIVE FORMULATION

A Side	Parts by weight
DGEBA Liquid Epoxy Resin (EEW=190)	60
Talc	38
Fumed Silica	2
B Side	
Curing Agent	50
Aluminum	22
Talc	27
Fumed Silica	1

• Curing agents used: Ancamide 350A, Ancamide 910 and blends of the two, as well as a competitive curing agent (AHEW=256) for comparative purposes.

• The amount of curing agent was 50 parts in all cases. Mix ratios used were based on a 1:1 stoichiometric ratio. As the curing agents and ratios within blends changed, mix ratios changed as well.

• This formulation was used for all tests featured in this brochure unless otherwise designated.

APPENDIX B: SUBSTRATES, BONDING PARAMETERS AND TEST METHODS

SUBSTRATES	
Cold Rolled Steel	Zinc Phosphate treated cold-rolled steel, 0.8mm
ABS	Dow Pulse 830, 85 °C bake material, 3mm
Polycarbonate	General Electric Lexan LS, 120 °C bake material, 3mm
SURFACE PREPARATION	
Cold Rolled Steel	Dry rag wipe
ABS and Polycarbonate	Dry rag wipe
LAP SHEAR SAMPLE PREPARATION AND TESTING	
25 x 100mm coupons	
12.5mm overlap for metals and 25mm overlap for thermoplastic substrates	
0.25mm 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	
25 x 100mm coupons	
75mm bond overlap	
0.25mm 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.	

Ancamide® is a registered trademark of Evonik Industries AG or one of its subsidiaries.

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