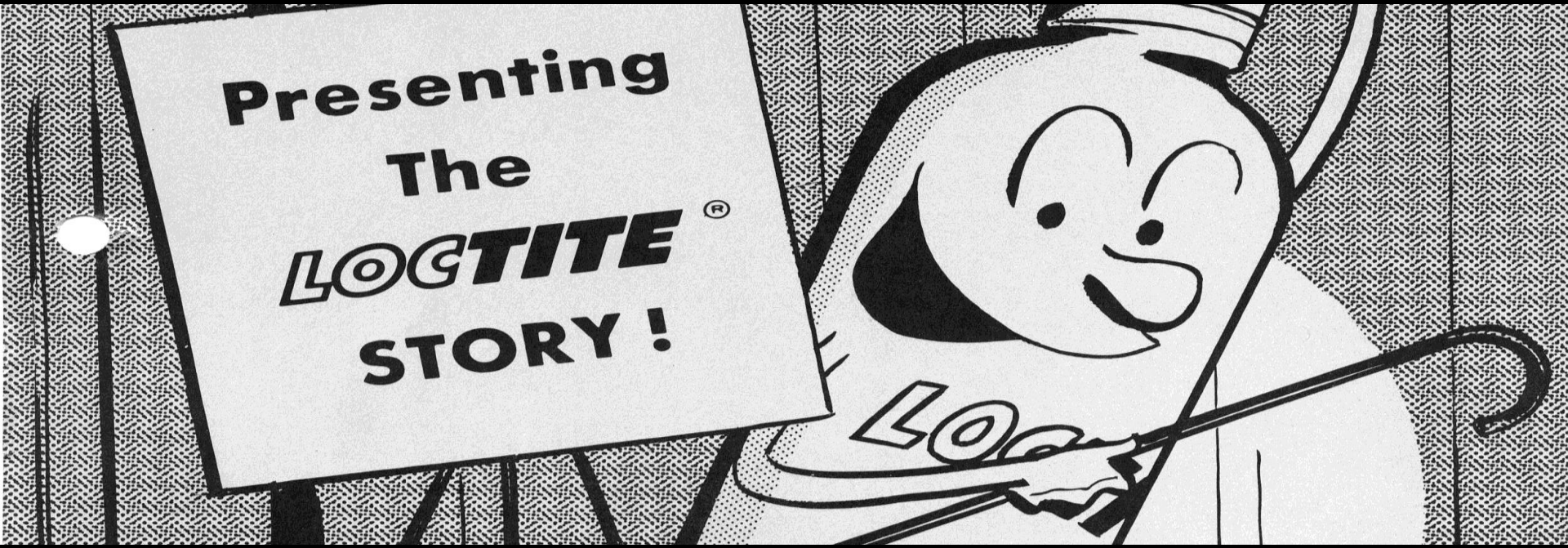
LOCTITE®
IN INDUSTRY

LOCTITE® IN INDUSTRY



Industry born, industry built

LOCTITE® IN INDUSTRY

Henkel

Industry proven under extreme conditions

LOCTITE® IN INDUSTRY

Henkel

A vital component in the most demanding fields

LOCTITE® IN INDUSTRY

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Automotive

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Mining & Manufacturing

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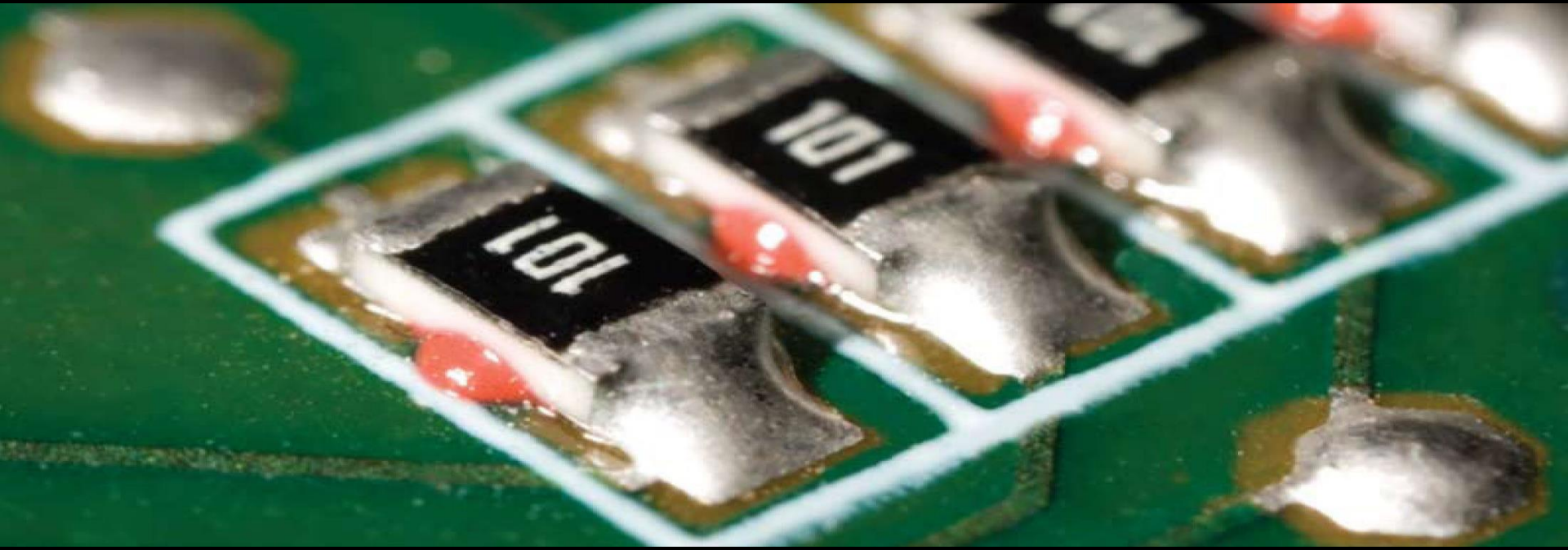
Electronics

LOCTITE® IN INDUSTRY



Henkel

Aerospace

LOCTITE® IN INDUSTRY

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LOCTITE®
IN INDUSTRY

Innovation

Education

Social Media

Henkel

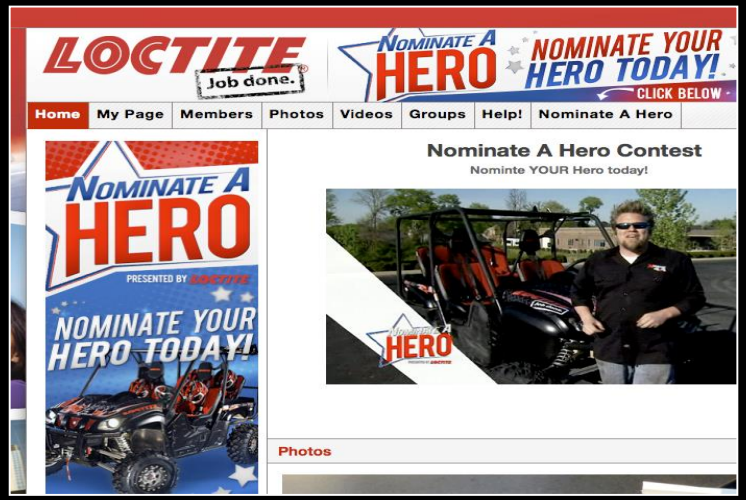
LOCTITE® IN INDUSTRY

More than the professional's choice, the professional's passion.

Henkel

Passion kept red-hot in…

LOCTITE® IN INDUSTRY



Promotion

Sponsorship

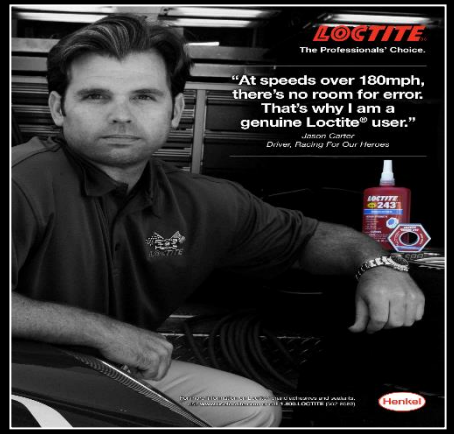
Advertising

Henkel

Passion driving customer confidence and commitment

LOCTITE® IN INDUSTRY

Instant Recognition



Loyalty

2010 Plant Engineering PRODUCT of the YEAR WINNER

PM EDITOR'S CHOICE AWARDS 10

Top-Rankings

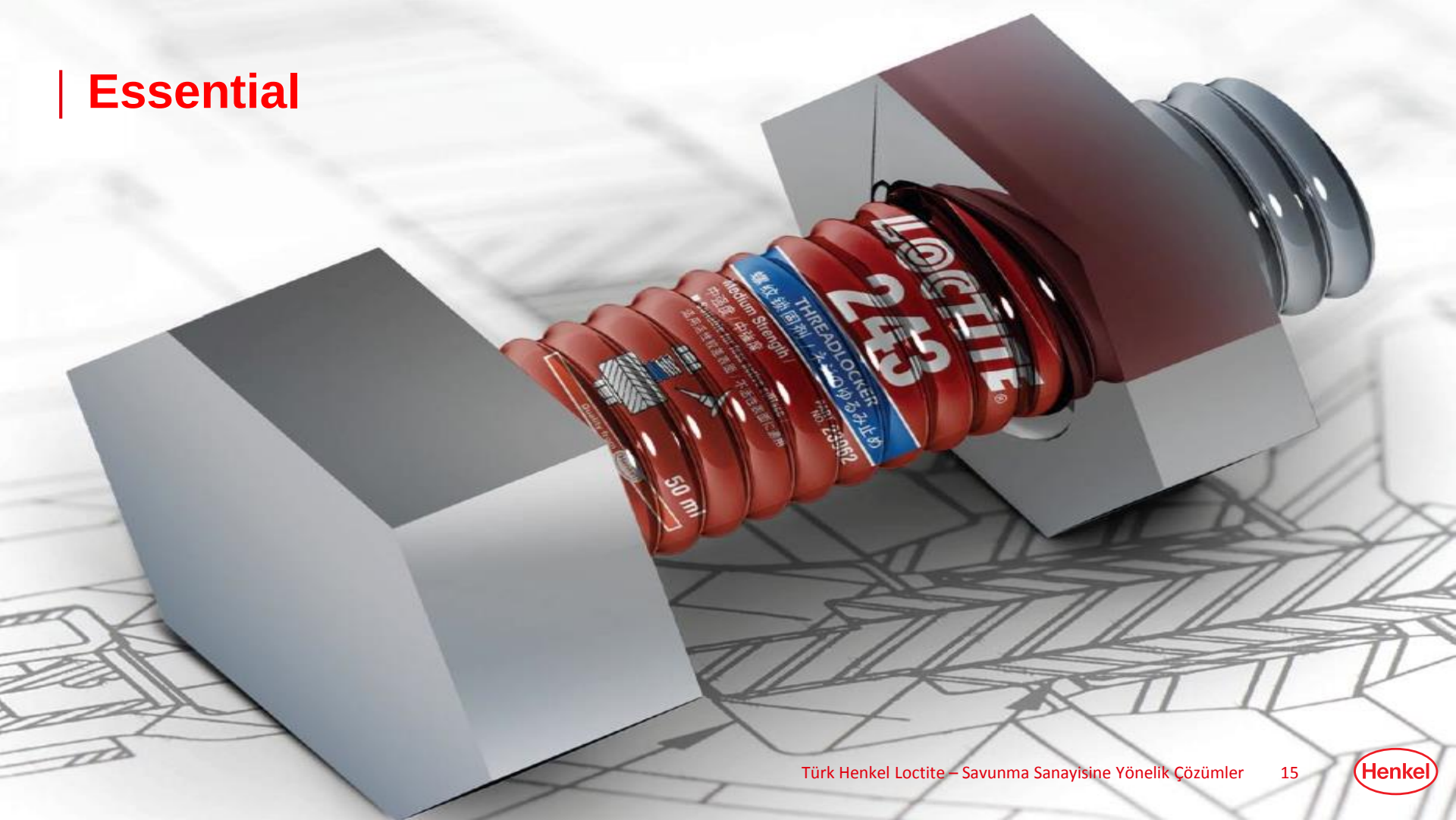
Henkel

From the beginning

To the future

Loctite in industry is

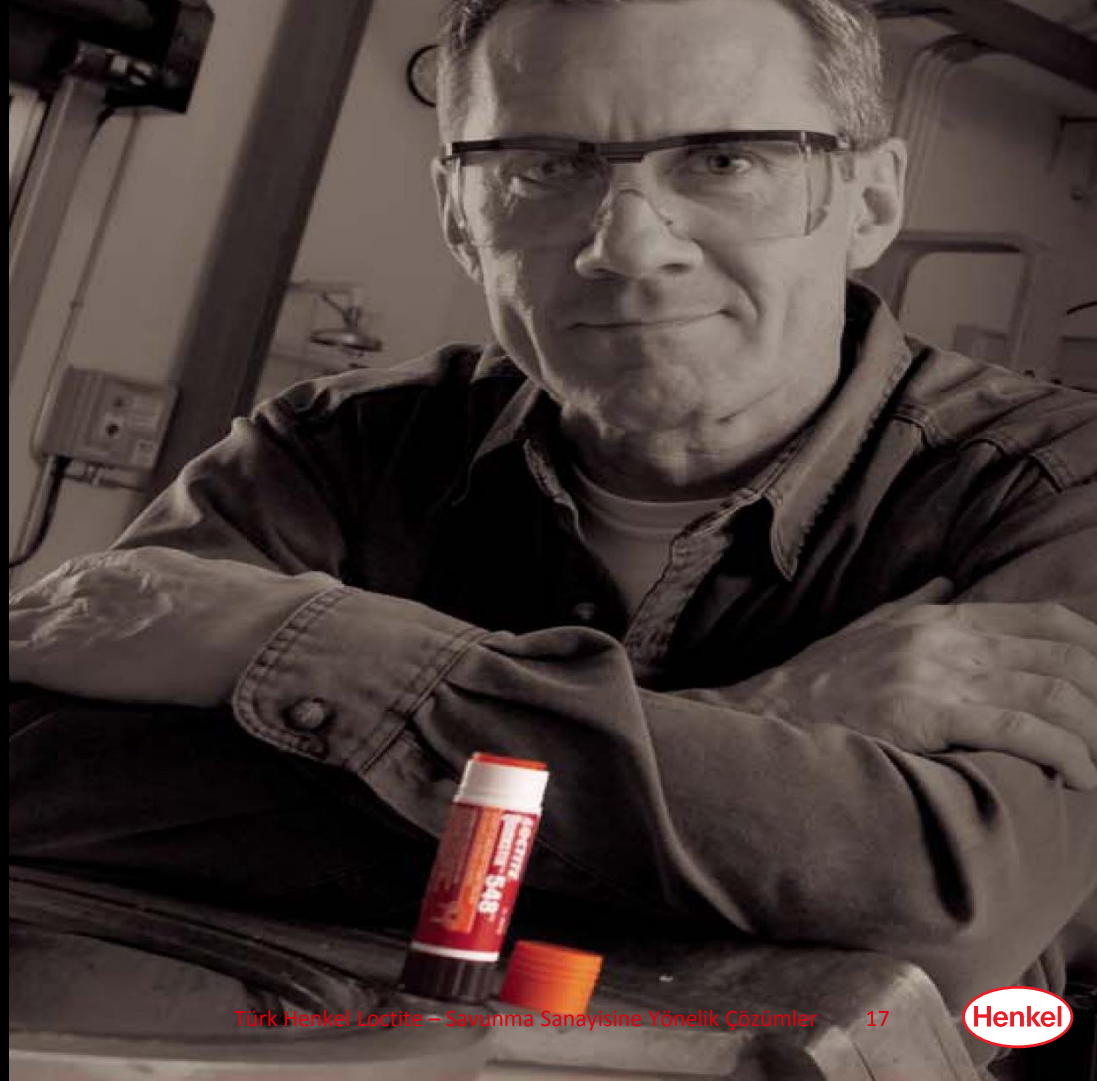
Essential



Irreplaceable

or

A customer favorite



LOCTITE® IN INDUSTRY

Let’s keep it that way.

Henkel

Henkel Overview

Who we are
Global leading positions in consumer and industrial businesses

Consumer Businesses

Laundry & Home Care

Persil Purex Pril

Beauty Care

Schwarzkopf SYOSS Dial

Industrial Business

Adhesive Technologies

LOCTITE

TECHNOMELT

Who we are
Henkel at a glance 2016

Around
50,000
employees all over the world

18.7 billion euros
sales, 3.8% organic sales growth

42%
of our sales generated in emerging markets

100
most sustainable corporations in the world[1]

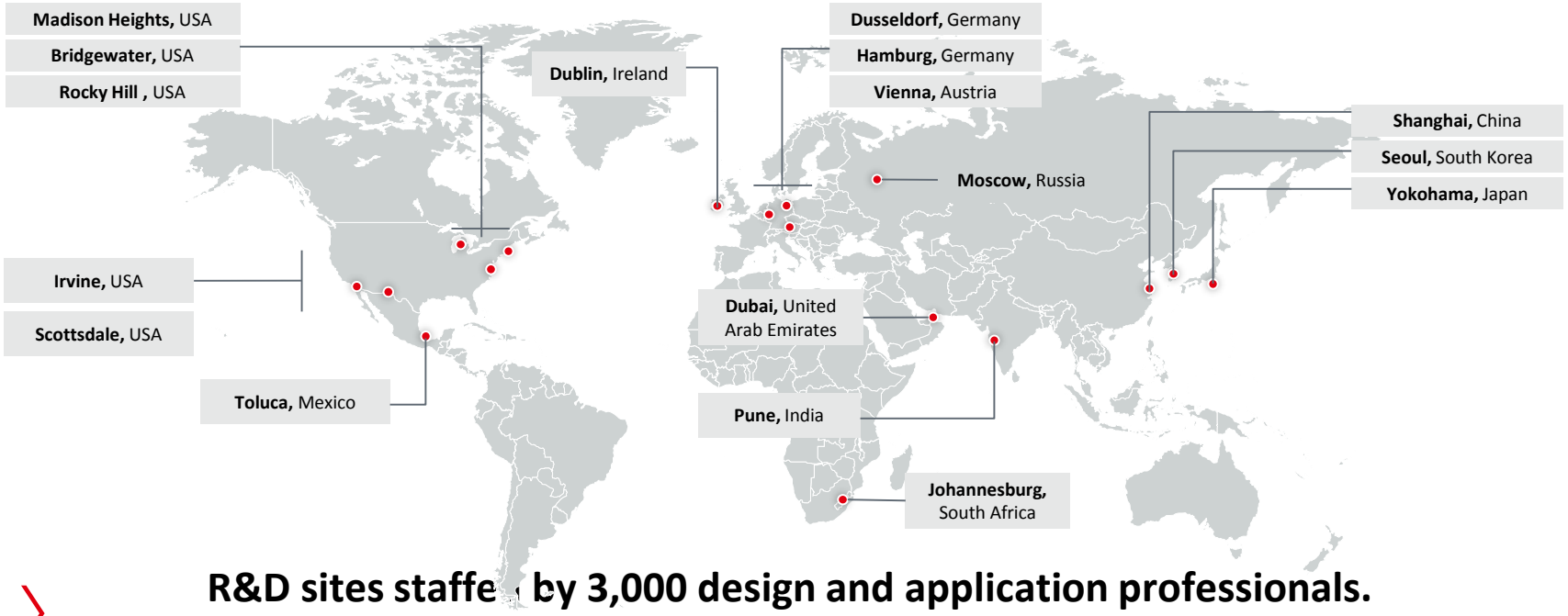
44%
of our sales generated by our top 10 brands

140 years
of brand success

More than **2,000** social projects supported

[1]Recognized for 5 years in a row as one of the “Top 100” by the World Economic Forum.

Major Henkel R&D and manufacturing sites around the world



R&D sites staffed by 3,000 design and application professionals.
Close to 150 manufacturing sites globally.

Who we are
Global footprint

- Henkel products and technologies available **worldwide**
- Employees from **123 nations**
- Strong presence in emerging markets: **42% of sales, 53% of employees**
- Over **171 manufacturing** and **22 major R&D sites** around the world

Adhesive Technologies
Who we are

8,256
million euros sales

32%
innovation rate[1]

+3.6%
organic sales growth

57%
of our sales generated by our top 10 brands

[1] Percentage share of sales generated with new products launched onto the market within the last five years.

Adhesive Technologies
Top brands and product groups

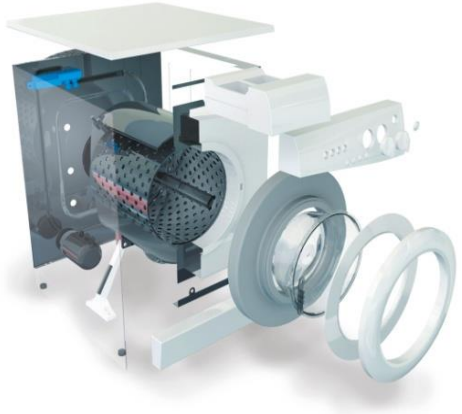
The Adhesive Technologies business sector comprises five market- and customer-focused strategic business units:

- General Industry
- Transport and Metal
- Packaging, Consumer Goods and Construction Adhesives
- Electronics
- Adhesives for Consumers, Craftsmen and Building

LOCTITE.
BONDERITE.
TECHNOMELT.
TEROSON.
AQUENCE.

Adhesive Technologies
General Industry

General Industry
Who we are



Our Customer Commitment

- We create competitive advantage for Industry – through our broad range of specialized products
- We partner with our customers – to understand and anticipate their needs and make them more effective and efficient.
- Through our extensive global resources, our customers are assured of the most innovative, consistent and reliable solutions.
- We strive to develop products that align with the goal of innovative, sustainable solutions

Technology Leadership

Brand Strength

#1 preferred supplier among plant supervisors

#1 preferred supplier among design engineers

Highest rated brand

Product Solutions and Services

- Henkel provides a full range of services and Loctite product solutions
  - **Adhesives and Sealants**
    - ~3,000 standard SKUs
    - 5,000 individual products
    - >20,000 tons per year
    - Small 0.5 ml tubes to large 275 gallon totes
  - **Design Engineering**
  - **Production Process Development**
  - **Dispensing and Curing Systems**
  - **Plant Maintenance and Manufacturing Reliability Training**

Leader in Brands and Technologies
Analytical & TDS Testing

- Degree of Cure
- Surface Analysis
- Bulk Properties Testing
- Environmental Exposure

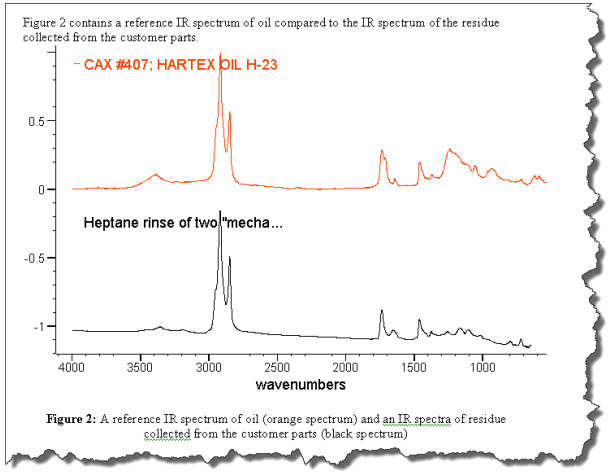


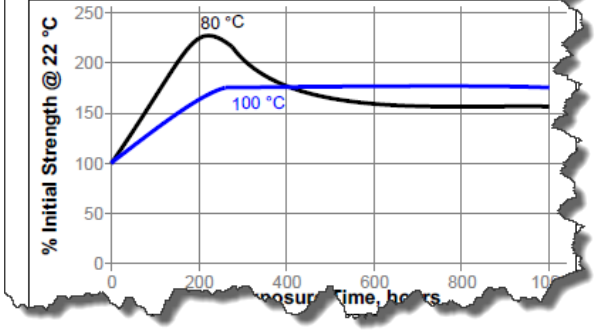
Figure 2: A reference IR spectrum of oil (orange spectrum) and an IR spectra of residue collected from the customer parts (black spectrum)

TYPICAL ENVIRONMENTAL RESISTANCE

Cured @ 100 mW/cm² , measured @ 365 nm, for 30 seconds
Block Shear Strength, ISO 13445:
Polycarbonate

Heat Aging

Aged at temperature indicated and tested @ 22 °C



Chemical/Solvent Resistance

Aged under conditions indicated and tested @ 22 °C.

		% of initial strength			
Environment	**°C**	**24 h**	**100 h**	**500 h**	**1000 h**
95% RH	40	-----	140	100	110
Water immersion	22		90	90	140
Isopropanol	22	75	-----	-----	-----
Heptane	22	90	-----	-----	-----

Leader in Brands and Technologies
Technical Customer Service Capabilities

- **Support Activities**
  - Customer Training
  - Plant Surveys & Process Review
  - Process Teardowns
  - Engineering Proposals
  - Process Cost Analysis
  - Equipment Integration
  - Industry White Papers
  - Competitive Studies
  - Voice of The Customer
  - Contract Lab Services

- **Testing Capabilities**
  - Hot Strength
  - Autoclave
  - Fluorescence detection
  - Heat Aging/Humidity
  - Solvent Exposure
  - Salt Fog
  - Thermal Cycling/Shock
  - UV Aging
  - Extractables
  - Flame Resistance

Industry Know-How

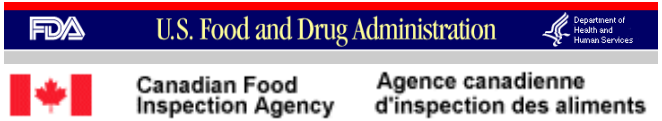
Industry Experience

Engineering Solutions for Build, Assemble, Maintain and Repair

Industry Approvals

Many Loctite® products hold industry approval(s) with the following international organizations:

- NSF International (NSF)
- American Bureau of Shipping (ABS)
- ASTM (Mil Spec)
- ISO 10993 Medical
- CSA International
- Underwriters Laboratories Inc. (UL/ULC Listed)
- Canadian Food Inspection Agency (CFIA)
- Food & Drug Administration (FDA)
- Lloyd's Register



Industry Focused Programs

PROGRAM	OEM	MRO
AG/Construction	●	
Animal Slaughtering and Processing (Beef)		●
Appliances	●	
Beverage		●
Electric Motors	●	
Elevator/Escalator		★
Food		★
General Transportation – Fleet (Rail, Truck, Bus, Taxi, Limo)		★
Medical	●	
Mining		●
Power Generation (Coal, Solar)	●	●
Power Generation (Wind, Nuclear)	★	★
Power Transmission (Gearboxes, Shafts)	●	●
Pumps	●	●
Steel		●
Wastewater Treatment		●
Weld, Rivet and Fastener Reduction	●	
Work, Truck and Trailer	●	

● = Industry focused program available
★ = Industry support tools available

We can help you in many ways

- Our sales, engineering and marketing teams are dedicated to helping industrial manufacturers:
- Increase production speed using our innovative adhesive and sealant technologies
- Increase reliability of manufactured assemblies
- Reduce labor cost
- Reduce inventory and scrap costs
- Reduce overall cost of assembly process

Questions?

DRIVING…
together

When we work together…
we grow together

Loctite® Products for Military Applications

History

- First major applications in the early 1960's
  - Still manufacture letter grade products
- Work with all specification centers
  - **PICATINNY-** Ammo, Large Cal, Mines, Mortars, Missiles, Rockets, Bombs, Artillery, Tank Ammo, Tanks, Armored Vehicles., Trucks, Humvees
  - **ABERDEEN**- Electronic Warfare, Land Warrior, Chem. & Bio Warfare, Specialized Armor
  - **CHINA LAKE-** Naval Air Weapons Development
  - **ROCK ISLAND**- Keeper of Specs, ECP's, NOR's
  - **MICOM-** Missile Development
  - **EXAMPLE:** Currently working with ARDEC on 24 precision munitions programs
- Work with all arsenals and contractors

Major Applications

- Ordnance
  - All ammunition from 5.56 to 40mm
- Munitions
  - Bombs, mortars, mines, grenades, artillery, anti-tank, etc
- Vehicles
  - Tanks, APC's, Bradley, Stryker, Palladin, Humvee, trucks
  - Example: 240 Loctite® applications on the M-1 tank
- Navy
  - Ship manufacturing / repair

Resources

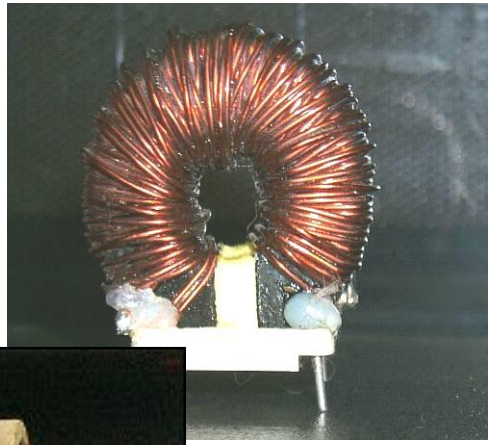
- Dedicated Application Engineer
  - Engineering center projects
- Military specific product development
  - Example: Light cured case mouth sealant
- Explosive compatibility
  - Loctite® products compatible with over 100 explosives and propellants
  - Can assist with appropriate product recommendations
- Milspecs
  - All listed on Loctite® website
- National Stock Numbers

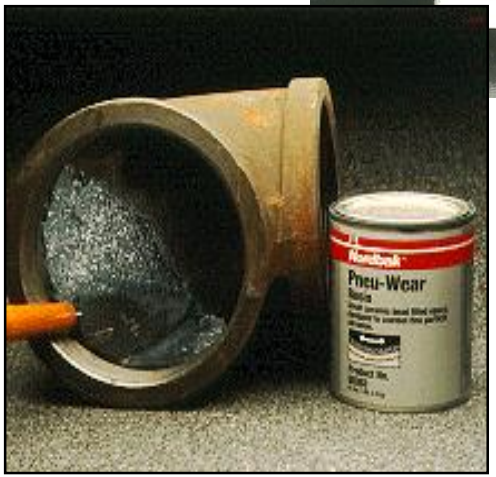
Summary

- Long history with military applications and are dedicated to our military customers
- Consistent, compliant products
- Innovative products and product development
- Local sales representative is primary contact
- Many dedicated resources available

Why Use Adhesives?

Why Use Adhesives





Why Use Adhesives

- Benefits
  - Join Dissimilar Substrates

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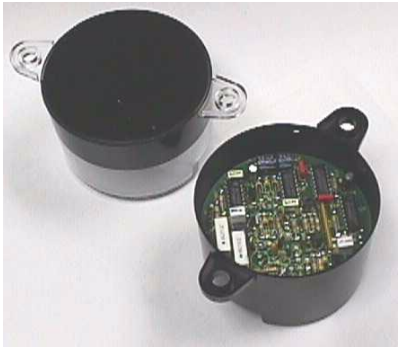
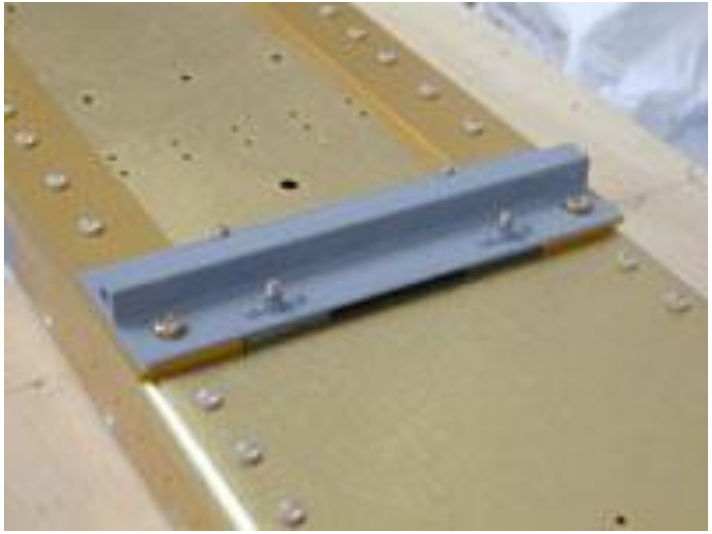
  - Fill Large Gaps



Why Use Adhesives

- Benefit
  - Join Dissimilar Substrates
  - Distribute Stresses Evenly
  - Fill Large Gaps
  - Seal, Bond & Protect
  - Neat Appearance



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- Limitations
  - Must be Cured

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  - Fixture Time

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  - Can be Messy
  - Another Chemical in the Plant

Why Use Adhesives

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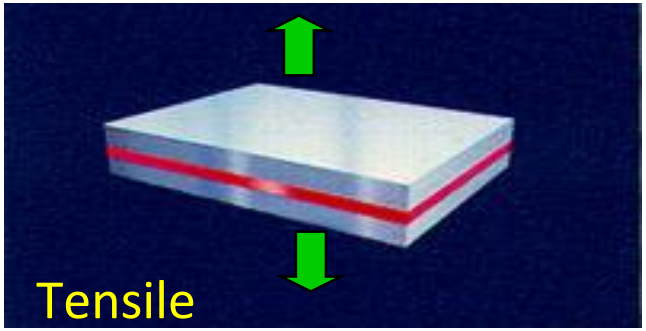
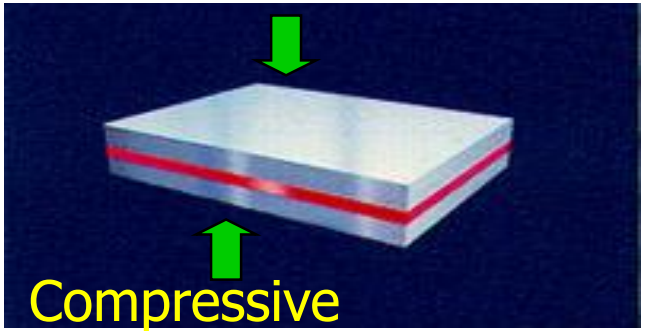
  - Fill Large Gaps
  - Seal and Bond
  - Neat Appearance
  - Easily Automated
- Limitations
  - Must be Cured
  - Fixture Time
  - Can be Messy
  - Another Chemical in the Plant
  - Potentially difficult to Disassemble

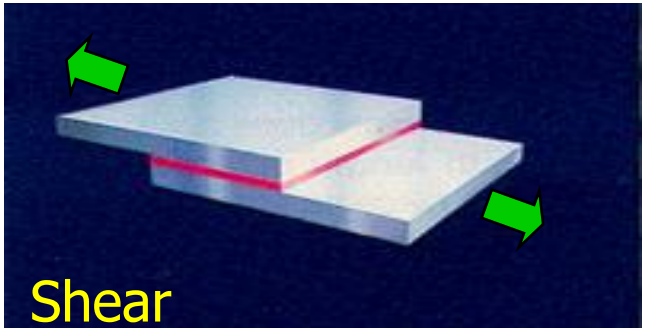
Joint Design

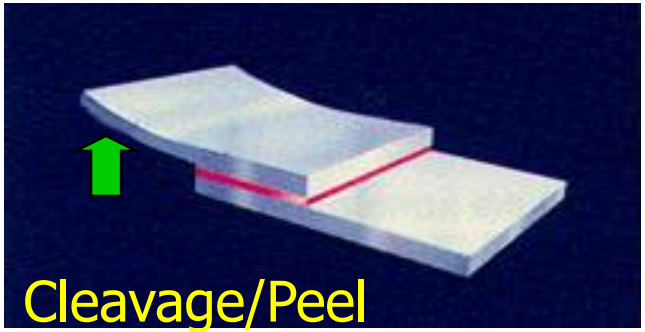
Joint Design

Type of Forces

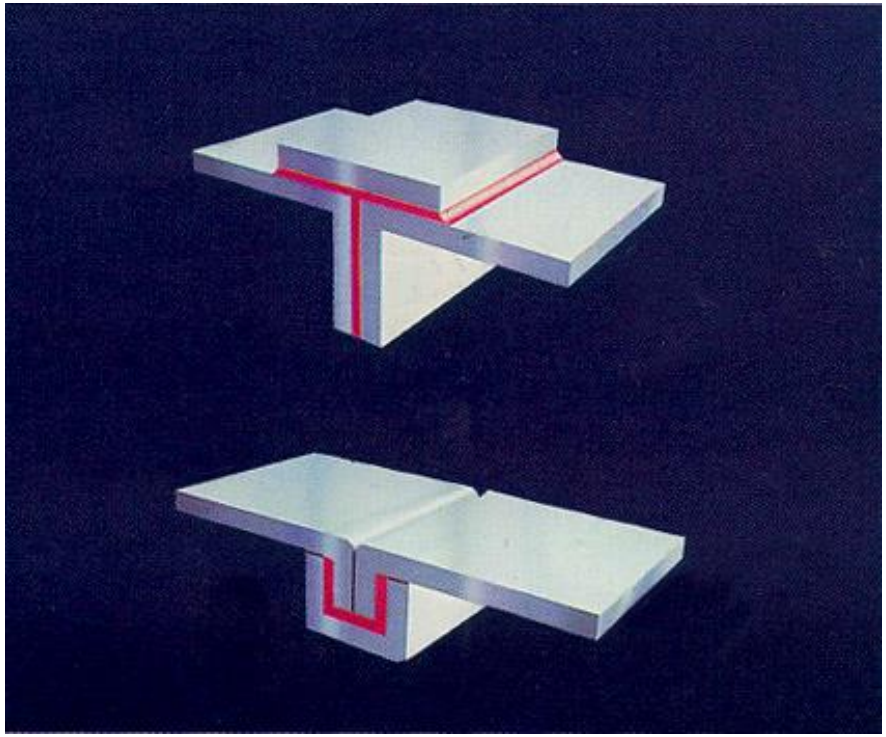






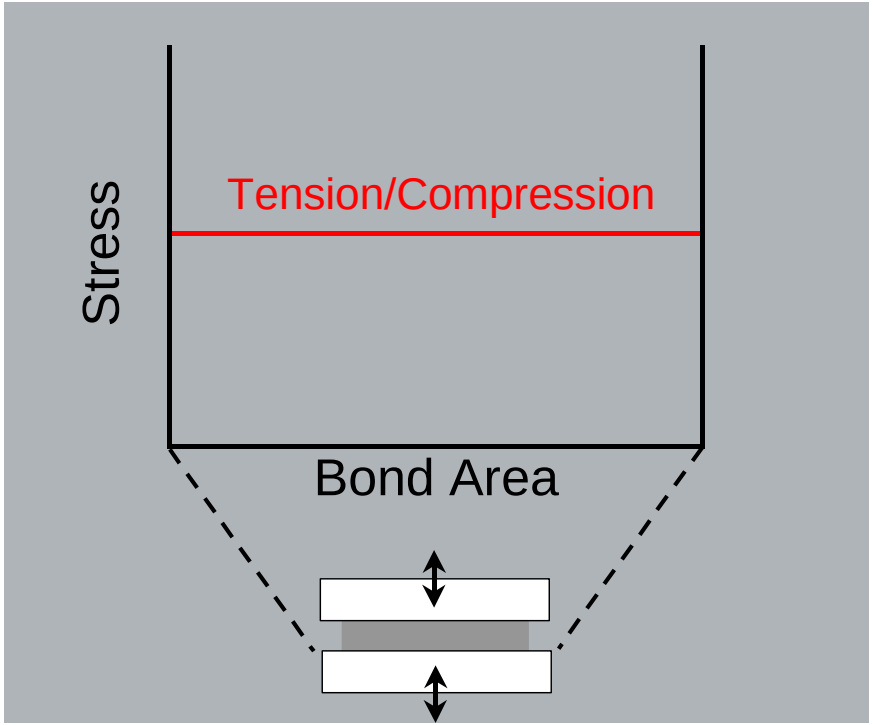


Adhesive Joint Design



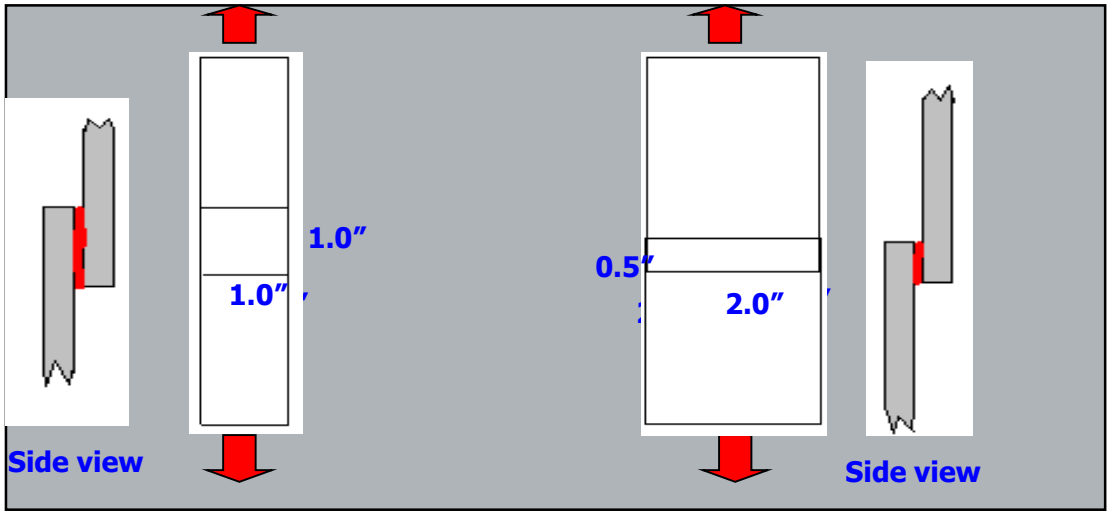
Joint Design

Stress Distribution for Tension/Compressive



Joint Design

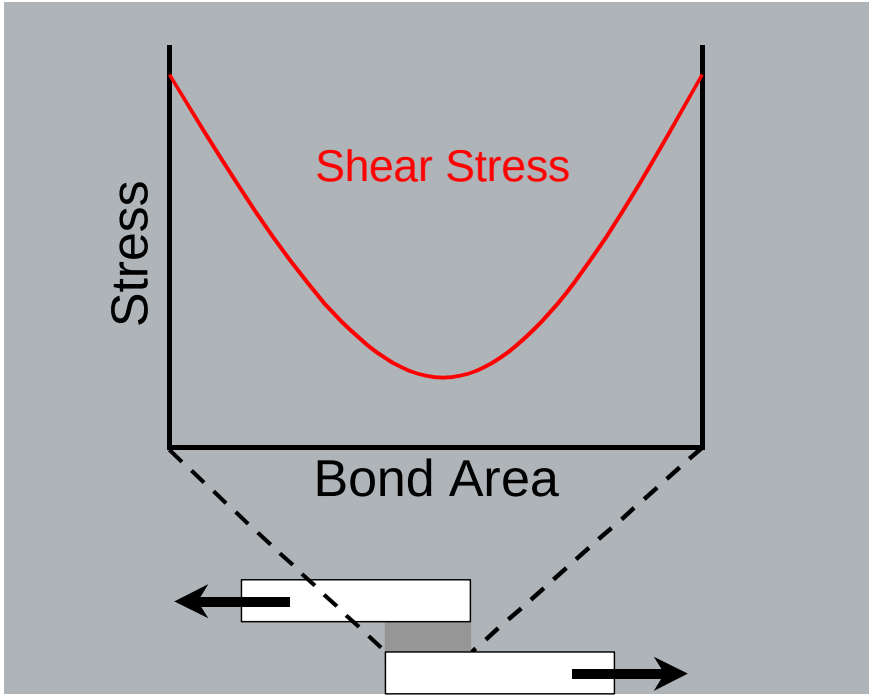
Joint Overlap vs. Width



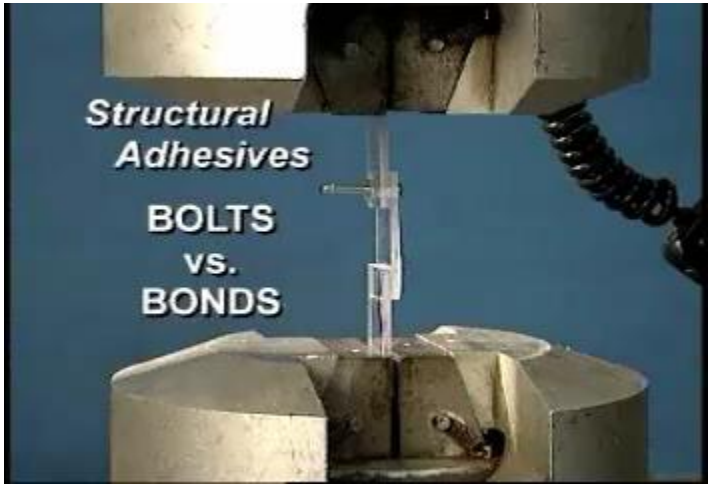
Bond Area = 1 sq in
FORCE = Shear

Joint Design

Stress Distribution for Shear Forces

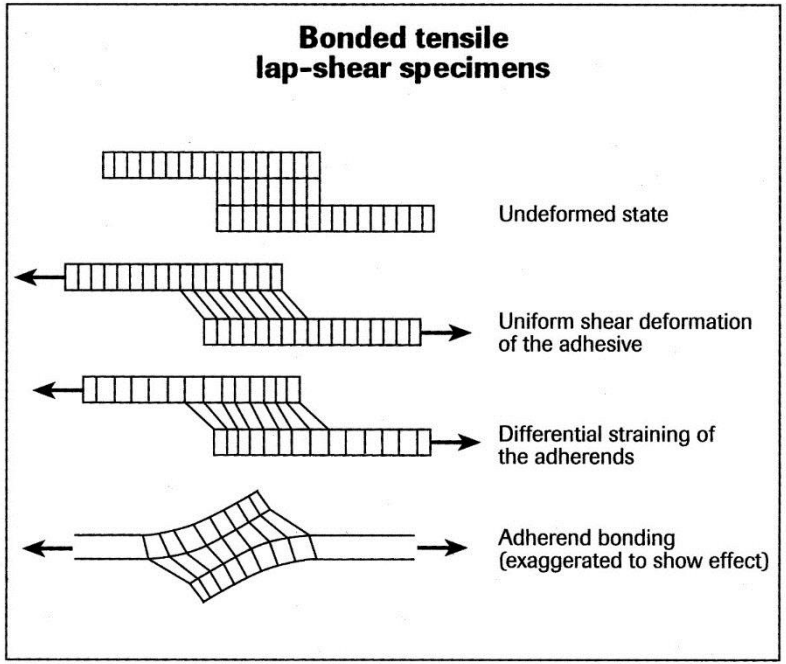


Joint Design
Stress Distribution for Shear Forces



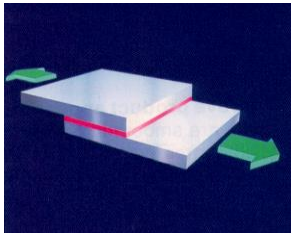
Joint Design

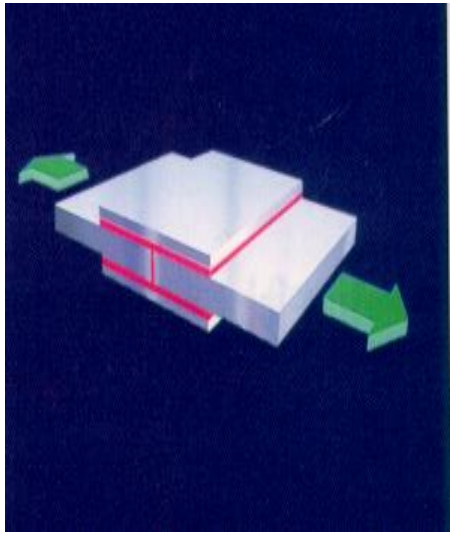
Stress Distribution for Shear Forces

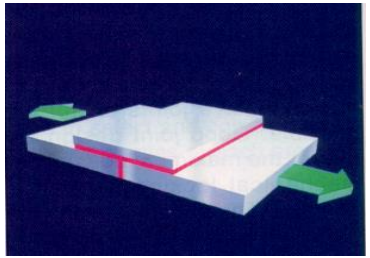


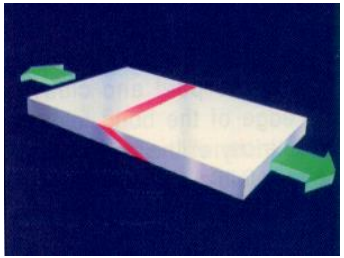
Joint Design

Lap Shear Bond



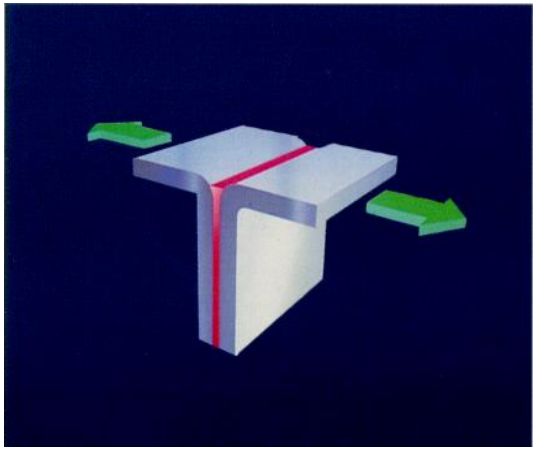


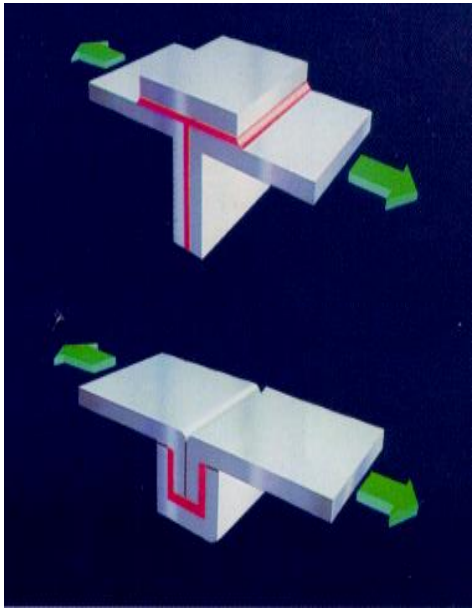




Joint Design

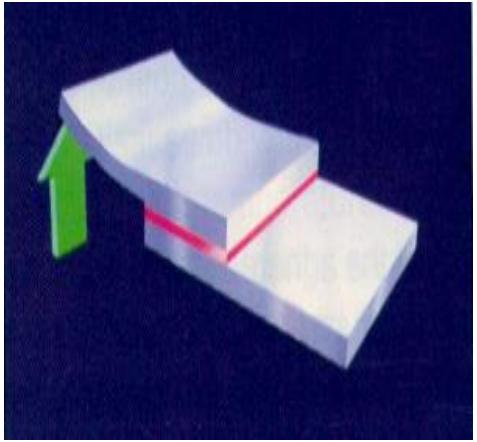
T- Cleavage

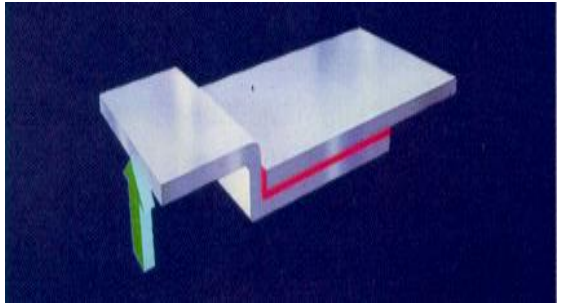


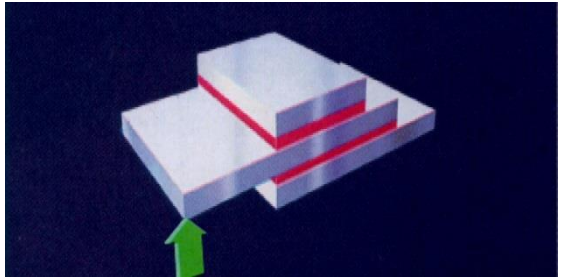


Joint Design

Peel







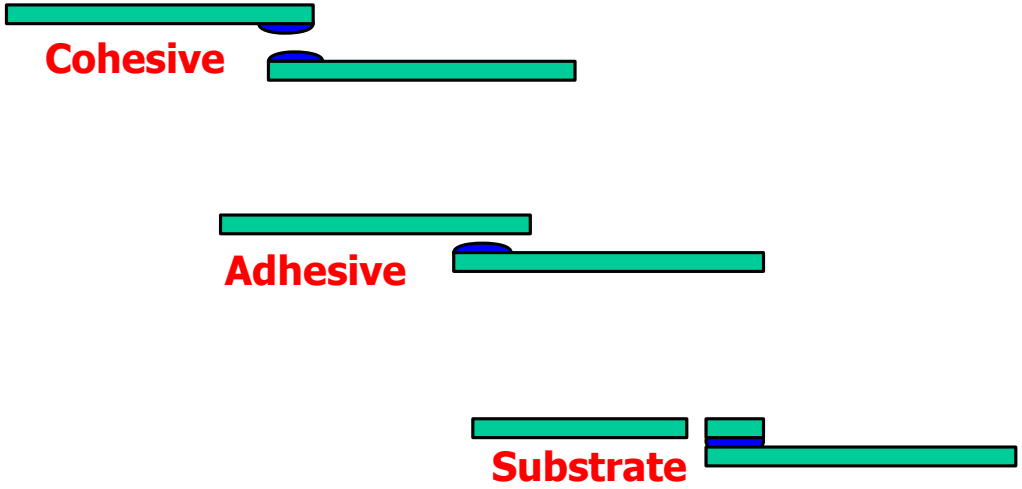
Joint Design

General Design Guidelines

- Maximize?
  - Shear, Tensile, Compressive Forces
- Minimize?
  - Peel, Cleavage Forces

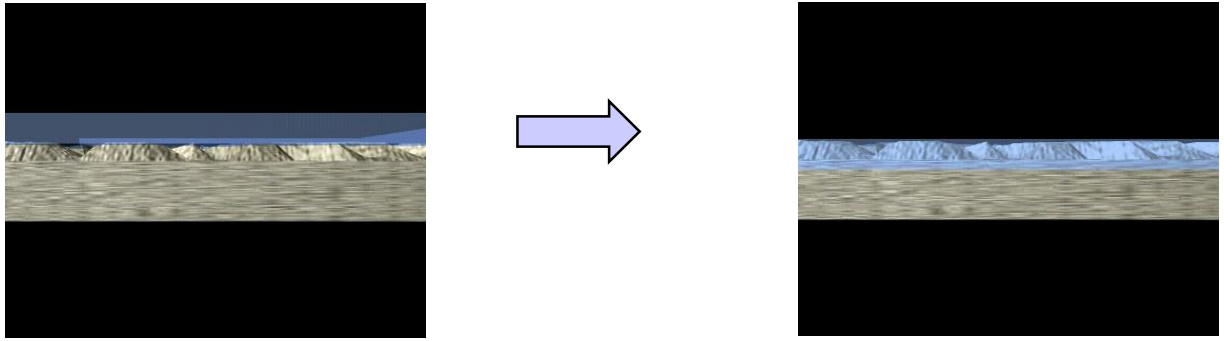
Joint Design

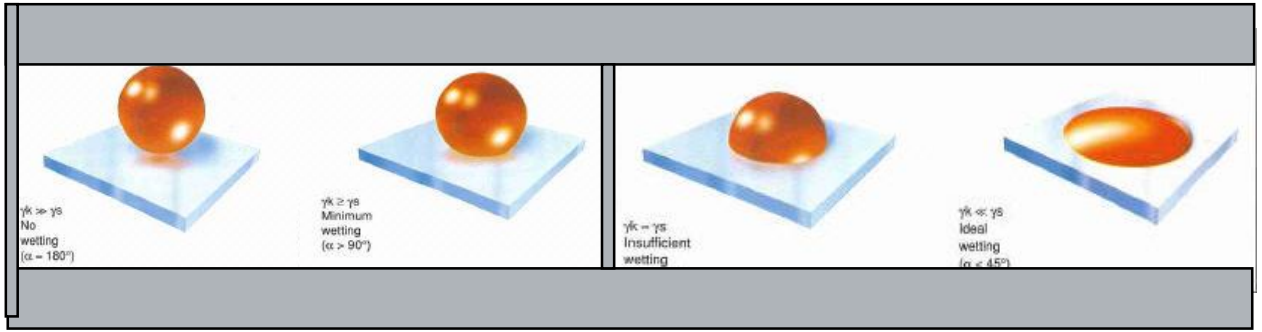
Failure Mode



Joint Design

Surface Wetting





Joint Design

Methods to > Surface Wetting

Clean/Contaminant Free

Primer

Solvent Cleaning

Plasma

Corona Electrical Discharge

Abrasion

Surface Wetting

Effects on Surface Energy

Surface Energy (dynes/cm)		
Substrate	**Initial Surface Energy**	**Surface Energy Following Plasma**
Polyproylene	29	> 73
Polyethylene	31	> 73
PTFE, FEP	22 – 37	72 - 73
Polycarbonate	46	> 73
Polysulfone	41	> 73
Silicone	24	> 73
Polyurethane	38	> 73

Source: GaSonics International Plasma Corp.

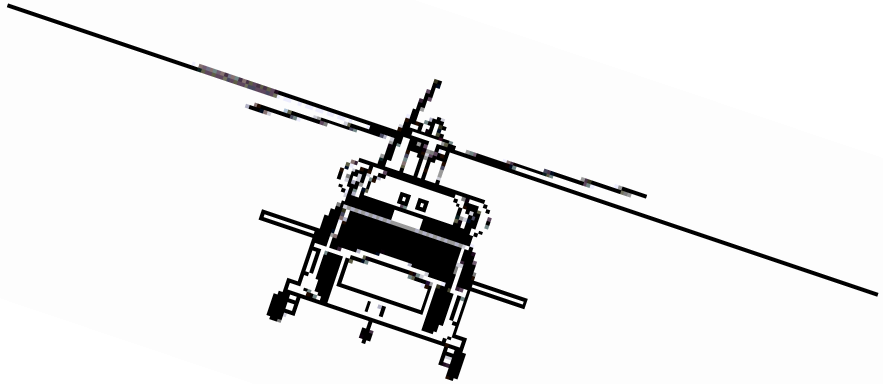
Key Selection Criteria

Key Selection Criteria

- Uncured
- Curing
- Cured
- End Use Performance

Uncured Properties

- Viscosity
- Appearance
- Odor
- Extrusion Properties
- Shelf Life



Uncured Properties

Viscosity

Measure of _____?

Examples:

- 1 cP = Water
- 1,000 cP = Oil
- 10,000 cP = Thick Honey
- 100,000 cP = Non-Sag Paste
- 1,000,000 cP = Paste

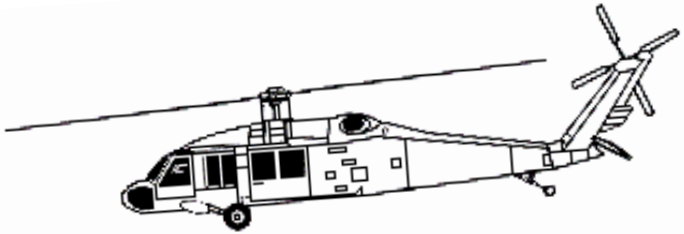
Uncured Properties

Shelf Life

Cyanoacrylates	Moisture, Contaminants
Light Cure (UV, Vis)	Ambient Light
Epoxies	Excessive Heat
Silicones	Moisture

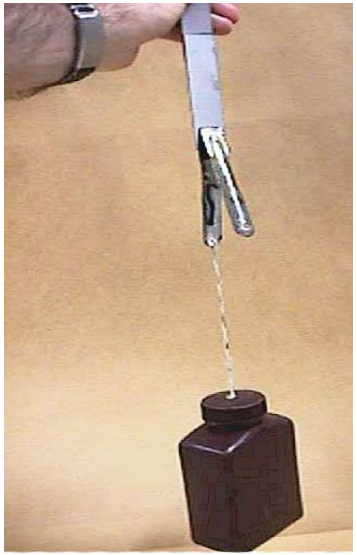
Curing Properties

- Fixture Time
- Tack Free Time
- Working Life
- Gel Time/Pot Life
- Exotherm
- Cure Through Depth



Curing Properties
Fixture Time

- Measure of how quickly an adhesive develops enough strength to bear a load.



- Key Factors
  - Substrates
  - Bond area
  - Bond gap
  - Cure mechanism

Curing Properties

Pot Life

No Gellation

Gellation Occurs

Curing Properties

Cure Through Depth (CTD)

Adhesive	CTD
Acrylics, Light Cure	0.250+”
Cyanoacrylates, Standard	0.010”
Cyanoacrylates, Light Cure	0.125+”
Epoxies, Two-Part	Unlimited
Epoxies, One-Part	Unlimited
Polyurethanes	Unlimited
Silicones, Light Cure	0.125

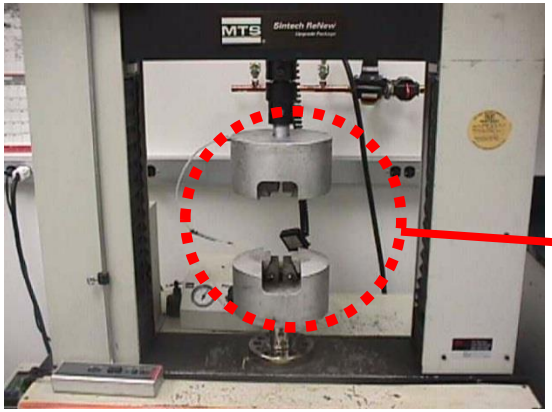
Cured Properties

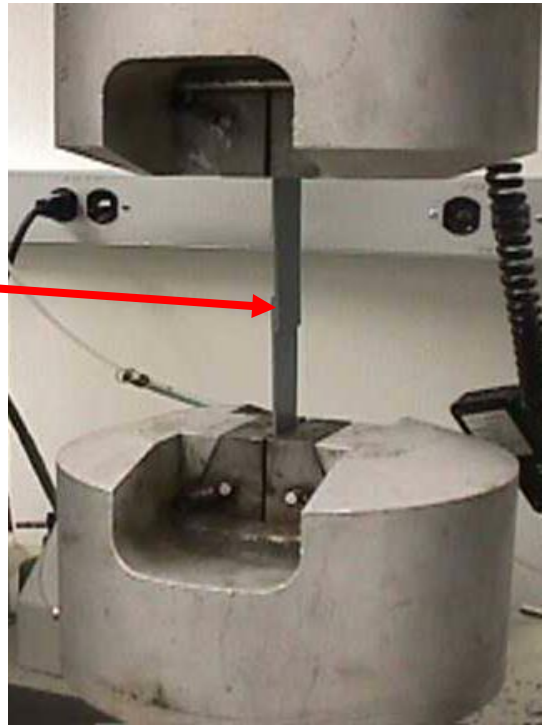
- Hardness (Durometer)
- Mechanical Properties
  - Tensile Strength
  - Elongation
  - Modulus

- Glass Transition Temperature (Tg)
- Chemical Resistance

Cured Properties

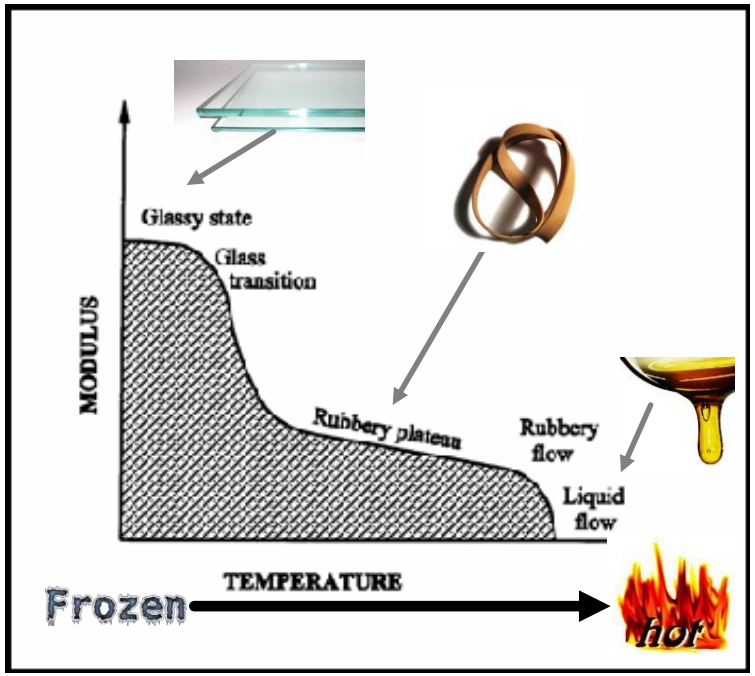
Mechanical Properties





Cured Properties

Glass Transition Temperature



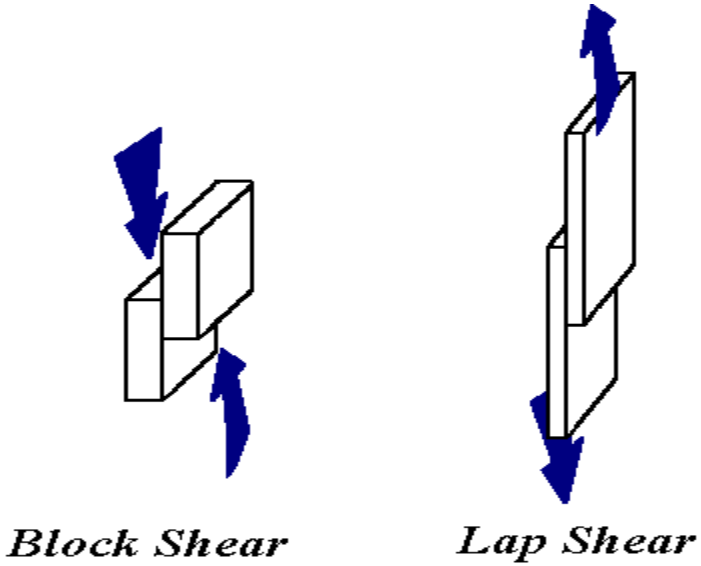
Technical Data Sheet

Performance Properties

- Bond Strength
- Environmental Resistance
  - Thermal Resistance
  - Chemical Resistance
  - Moisture Resistance

Performance Properties
Bond Strength

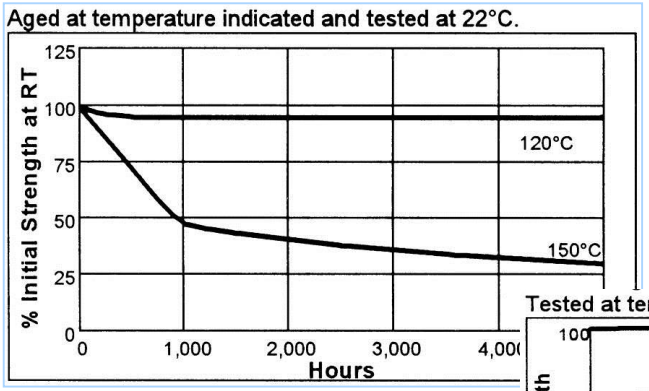
- Block Shear vs. Lap Shear



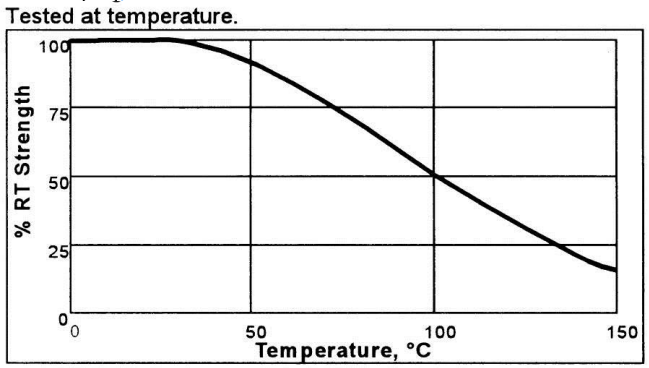
Performance Properties

Thermal Resistance

Heat Aging



Hot Strength



Performance Properties
Environmental Resistance

- Moisture and Chemical Resistance
  - Submersion
  - High Humidity
  - Plastics vs. Metals

Design Guides

Program Akışı

- 10:00 – 11:00 Savunma Sanayisine Yönelik Henkel - Loctite Çözümleri
- 11:00 – 11:15 Ara
- 11:15 – 12:30 Yapıştırıcı Kullanımı ve Seçim Kriterleri
- 12:30 – 14:00 Öğle Arası
- 14:00 – 15:00 Yapıştırıcı Teknolojisi
- 15:00 – 15:15 Ara
- 15:15 – 16:30 Yardımcı Teknolojiler
- 16:30 – 17:30 Soru – Cevap

Loctite Resources

- Design Guides
  - Metals
  - Elastomers
  - Plastics
- Sourcebooks
  - Adhesive
  - Equipment
- www.loctite.com
- Current mil specs
  - http://www.henkelna.com/cps/rde/xchg/henkel_us/hs.xsl/6125_USE_HTML.htm

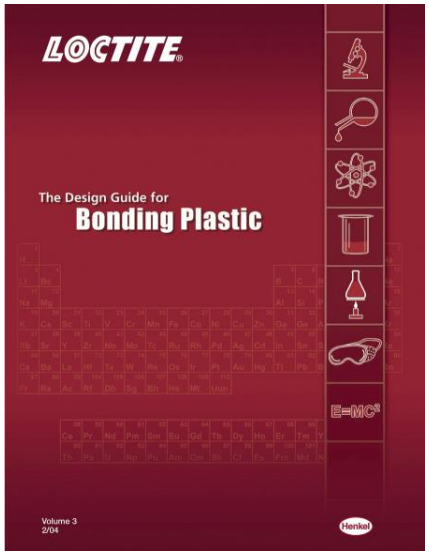
- Explosive Compatibility
  - Contact Henkel Representative for more information

Design Guides

Bonding Plastics Guide

How Do I Use It?

- Table of Contents – pg 1
- How to Use the Charts – pg 3
- Generic Plastics – pg 14
- Stress Cracking Resistance – 74
- Surface Treatments – pg 75
- Adhesive Joint Design – pg 77
- Processor Rules – pg 80
- Test Methodology – pg 84
- Trade Names – pg 91



Bonding Plastics Guide

Polycarbonate

ADHESIVE SHEAR STRENGTH (psi) (MPa)

Polycarbonate

LOCTITE	UNFILLED RESIN 4 mils	ROUGHENED 18 mil	ANTIOXIDANT 0.1% Irganox 168, 0.1% Irganox 1076	UV STABILIZER 0.4% Tinuvin 234	FLAME RETARDANT 2% BT-93, 1% Antimony Oxide	IMPACT MODIFIER 5% Paraloid EXL3607	LUBRICANT 0.3% Mold Wiz INT-33UDK	GLASS FILLER 23% Type 3090 Glass Fiber	COLORANT 4% CPC07227
Loctite® 380™ Black Max® Instant Adhesive, Rubber Toughened	250 5.2	1600 11.0	750 5.2	750 5.2	1300 9.0	1000 6.9	1300 9.0	1150 7.9	1650 11.4
Loctite® 401™ Prism® Instant Adhesive, Surface Insensitive *MEDICAL: Loctite® 4011™ Prism® Instant Adhesive, Surface Insensitive*	3850 26.6	4500 31.0	3850 26.6	3850 26.6	>4100* >28.3*	3850 26.6	3850 26.6	3850 26.6	3850 26.6
Loctite® 401™ Prism® Loctite® 770™ Prism® Primer *MEDICAL: Loctite® 4011™ Prism® / Loctite® 7701™ Prism® Primer*	2000 13.8	3400 23.5	2000 13.8	2000 13.8	>3800* >26.2*	2000 13.8	2000 13.8	600 4.1	500 3.5
Loctite® 414™ Super Bonder® Instant Adhesive, General Purpose	1600 11.0	3950 27.2	3950 27.2	1600 11.0	>3400* >23.5*	>4500* >31.0*	3850 26.6	2700 18.6	3950 27.2
Loctite® 330™ Depend® Adhesive, Two-Part No-Mix Acrylic	1100 7.6	1100 7.6	550 3.8	450 3.1	300 2.1	500 3.5	1100 7.6	1100 7.6	1100 7.6
Loctite® 3105™ Light Cure Adhesive, *MEDICAL: Loctite® 3311™ Light Cure Adhesive*	3700 25.5	4550 31.4	3700 25.5	3700 25.5	3700 25.5	3700 25.5	3700 25.5	4850 33.5	3700 25.5
Loctite® 3340™ Light Cure Adhesive, UV Cationic Epoxy	800 5.5								
Loctite® 4305™ Flashcure® Light Cure Adhesive *FLOOR SCENE: Loctite® 4307™ Flashcure® Light Cure Adhesive*	>4250* >29.3*								
Loctite® H3000™ Speedbonder™ Structural Adhesive, General Purpose	1250 8.6								
Loctite® H4500™ Speedbonder™ Structural Adhesive, Metal Bonder	1100 7.6								
Loctite® 3030™ Adhesive, Polyolefin Bonder	850 5.9								
Loctite® E-00CL™ Hysol® Epoxy Adhesive, Low Odor	900 6.2								
Loctite® E-90FL™ Hysol® Epoxy Adhesive, Flexible	1150 7.9								
Loctite® E-30CL™ Hysol® Epoxy Adhesive, Glass Bonder *MEDICAL: Loctite® M-31CL™ Hysol® Epoxy Adhesive, Glass Bonder*	2650 18.3								
Loctite® E-20HP™ Hysol® Epoxy Adhesive, Fast Setting *MEDICAL: Loctite® M-21HP™ Hysol® Epoxy Adhesive, Fast Setting*	1200 8.3								
Loctite® E-214HP™ Hysol® Epoxy Adhesive, High Strength	1200 8.3								
Loctite® Fixmaster® High Performance Epoxy	2450 16.9								
Loctite® 1942™ Hysol® Hot Melt Adhesive, EVA Based	350 2.4								
Loctite® 3651™ Hysol® Hot Melt Adhesive, Polyolefin	100 0.7								
Loctite® 7804™ Hysol® Hot Melt Adhesive	100 0.7								
Loctite® 3631™ Hysol® Hot Melt Adhesive, Urethane	3200 22.1								
Loctite® U-05FL™ Hysol® Urethane Adhesive, High Strength	850 5.9								
Loctite® Fixmaster® Rapid Rubber Repair *OEM: Loctite® U-04FL™ Hysol® Urethane Adhesive, Fast Setting*	600 4.1								
Loctite® 5900® Flange Sealant, Heavy Body RTV Silicone	200 1.4								

Adhesive Performance

Loctite® 4305™ Flashcure® Light Cure Adhesive achieved bond strengths which were higher than the grade of unfilled polycarbonate tested. Loctite® 401™ Prism® and 414™ Super Bonder® Instant Adhesives, Loctite® 3105™ Light Cure Adhesive, and Loctite® E-30CL™ Hysol® Epoxy Adhesive, Loctite® 3631™ Hysol® Hot Melt Adhesive, and Loctite® Fixmaster® High Performance Epoxy all achieved the very high bond strengths on PC. Loctite® 3651™ and 7804™ Hysol® Hot Melt Adhesives achieved the lowest bond strengths.

Surface Treatments

Surface roughening either caused no effect or a statistically significant increase in the bondability of PC. The use of Loctite® 770™ Prism® Primer in conjunction with Loctite® 401™ Prism® Instant Adhesive, or Loctite® 4011™ Prism® Medical Device Instant Adhesive with Loctite® 7701™ Prism® Primer, caused a statistically significant decrease in the bond strengths achieved on PC for most of the formulations evaluated.

Other Important Information

- Polycarbonate is generally compatible with acrylic and cyanoacrylate adhesives, but there is a potential for stress cracking. In addition, polycarbonate can be attacked by the activators for two-part, no-mix acrylic adhesives before the adhesive has cured. Any excess activator should be removed from the surface of the polycarbonate immediately.
- Polycarbonate is incompatible with anaerobic adhesives.
- Surface cleaners: isopropyl alcohol, Loctite® ODC Free Cleaner & Degreaser.

NOTES:

◆ The force applied to the test specimens exceeded the strength of the material resulting in substrate failure before the actual bond strength achieved by the adhesive could be determined.

☐ The addition of the indicated additive (or surface roughening) caused a statistically significant decrease in the bond strength within 95% confidence limits.

☐ The addition of the indicated additive (or surface roughening) caused a statistically significant increase in the bond strength within 95% confidence limits.

Bonding Plastics Guide

Plasticized PVC

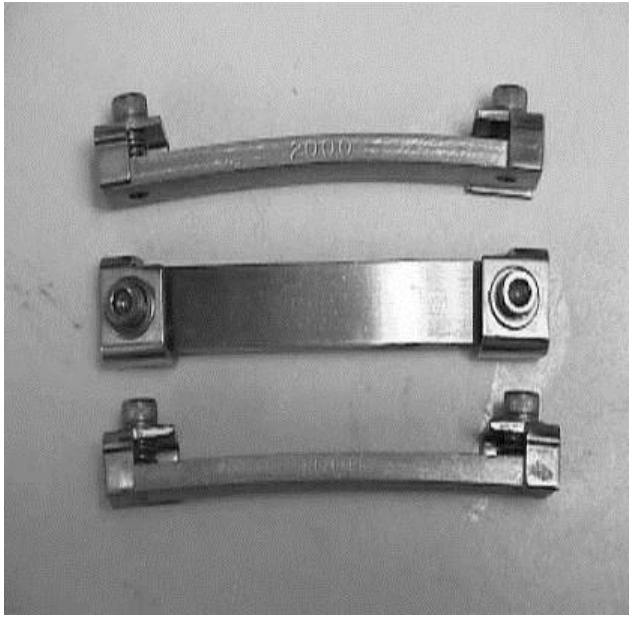
Bonding Plastics Guide
Stress Cracking

- Thermoplastics most susceptible to crazing and cracking
  - ABS
  - Acrylic
  - Polycarbonate
  - Polystyrene
  - Polysulfone
  - PVC
  - SAN

Bonding Plastics Guide

Testing for Stress Cracking Potential of Plastics

- induce a known stress (500 - 2,400 psi)
- place liquid adhesive at bend point
- monitor over time for visual appearance



Structural Bonding Introduction

2015

LOCTITE®
TEROSON®

Henkel

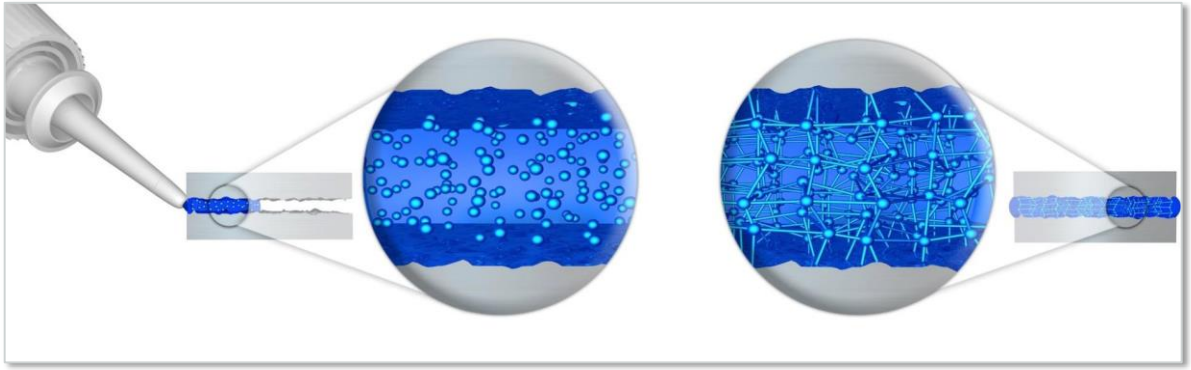
Structural Bonding

Bonding
Joining Methods

Gap filling Material	• Welding • Soldering • **Bonding**
Part Design	• Pins, keyways, • Spline Shafts • Snap Joints
Permanent Force	• Elastic Force Threaded Joint, Rivet etc. • Field Force Magnetism • Friction Force Press Fit etc.
Combinations	• **Bonded** Spot Welding • **Bonded** Press Fit • **Bonded** Flange Coupling

Bonding

Perfectly designed for material fit

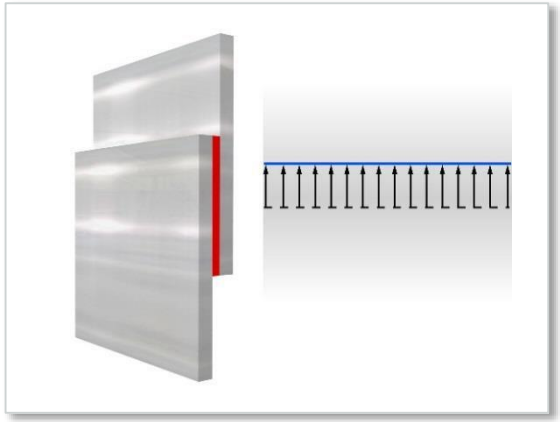
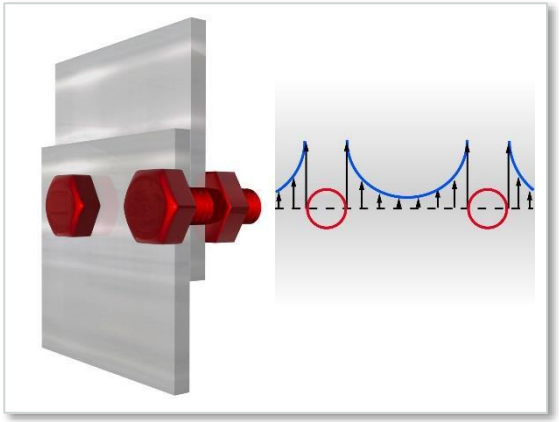
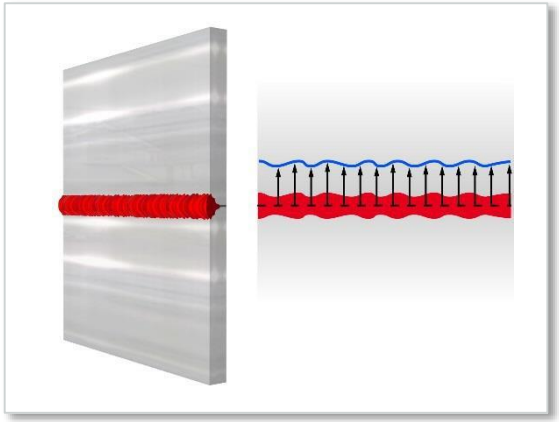


Liquid adhesive

- Adapts to gap and gap tolerances
- Adapts to surface roughness and voids
- Fills gap by 100%
- Bonds the joined parts, after change from liquid to solid
- Uses 100% of surfaces for adhesion

Bonding

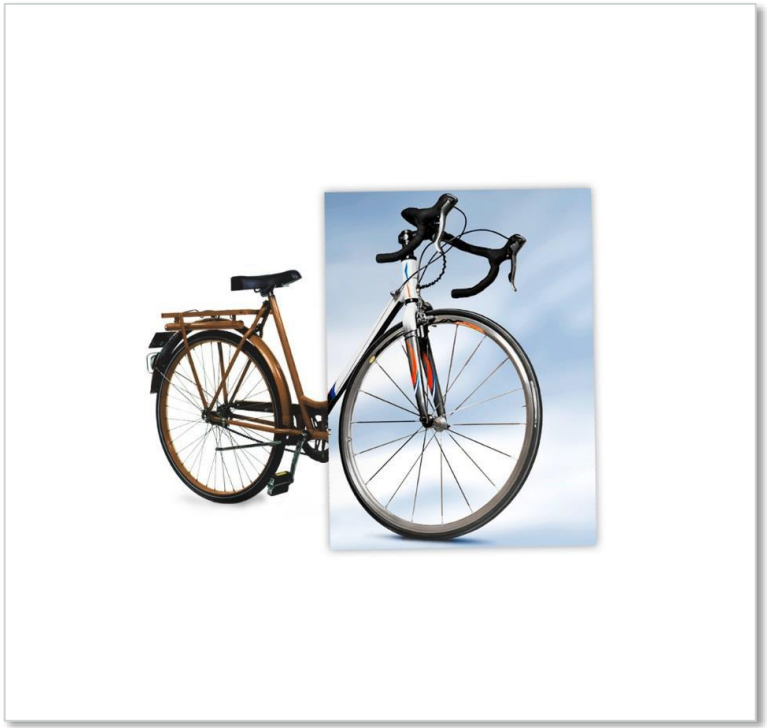
Uniform load distribution

Bonding	Bolting	Welding
		

Bonding

- Keeps the integrity of the structure
- Transmits loads most evenly
- Spreads loads over the entire bond area
- No bonded material property changes form melting

Bonding
Advantages of Bonding



Bonding
Advantages of Bonding

Optio	Benefit
• Joining dissimilar materials	• Weight reduction
• Joining fragile materials or thinner substrates	• Improved asthetical aspect
• Achieving invisible joints	• New design options
• Increasing joint strength	• Use of new materials incl. advanced materials
• Joining pre painted material	• Cost reduction, faster production
• Compensation for inaccuracies	• Higher quality
	• Increase reliability and durability

Bonding
Advantages of Bonding

Optio	Benefit
• Bonding	• Less parts
• Sealing	• Less production steps
• Vibration / noise absorption	• Cost reduction
• Electrical insolation (or conductivity)	
• Prevention of galvanic corrosion	
• Thermal conductivity	

Adhesive

Adhesive: Definition EN 923

- **Non-metallic substance** capable of **joining materials by surface bonding (adhesion)** and the bond possessing adequate internal strength **(cohesion)**

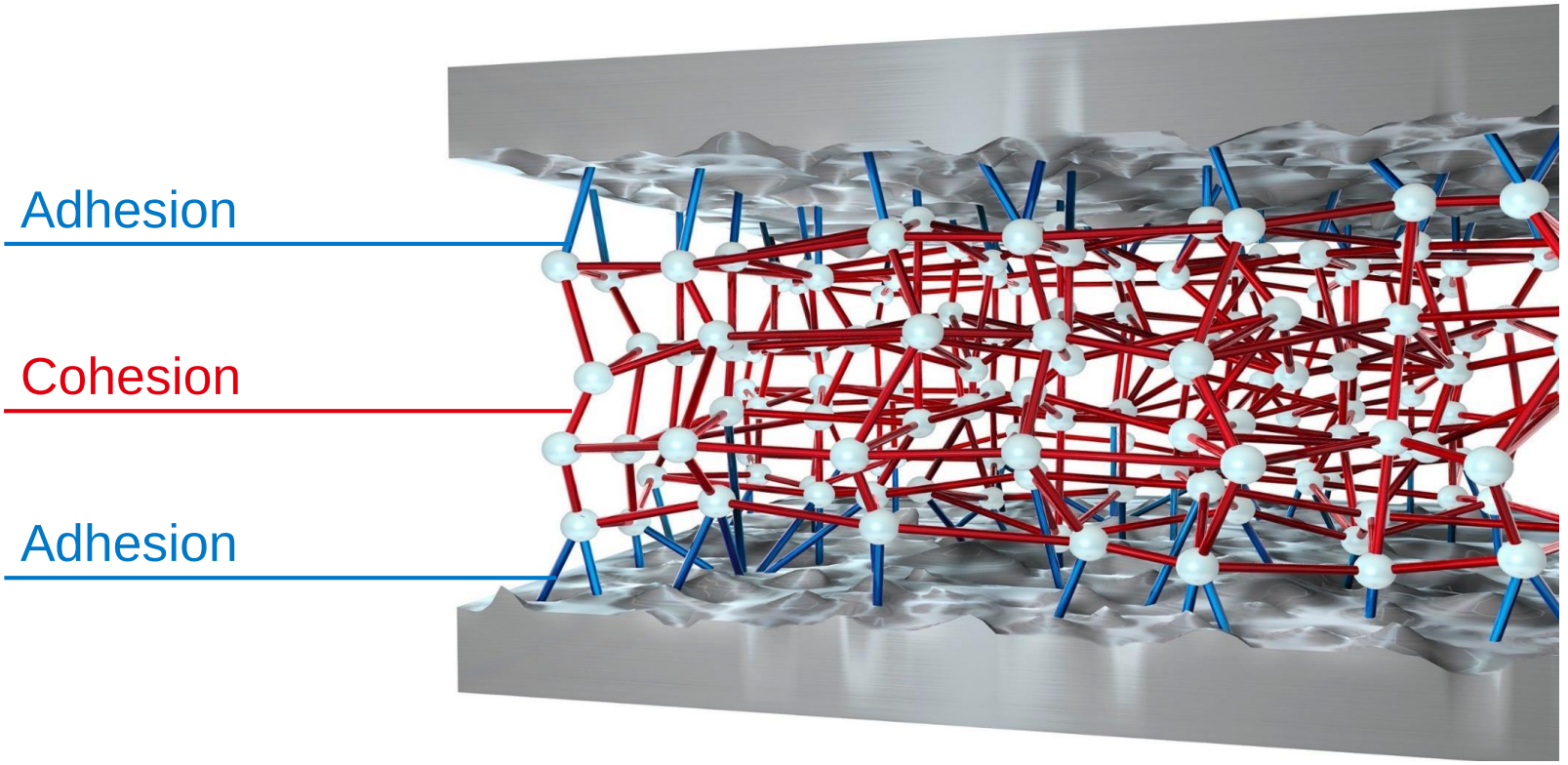
non-metallic substance

joining materials by

adhesion & cohesion

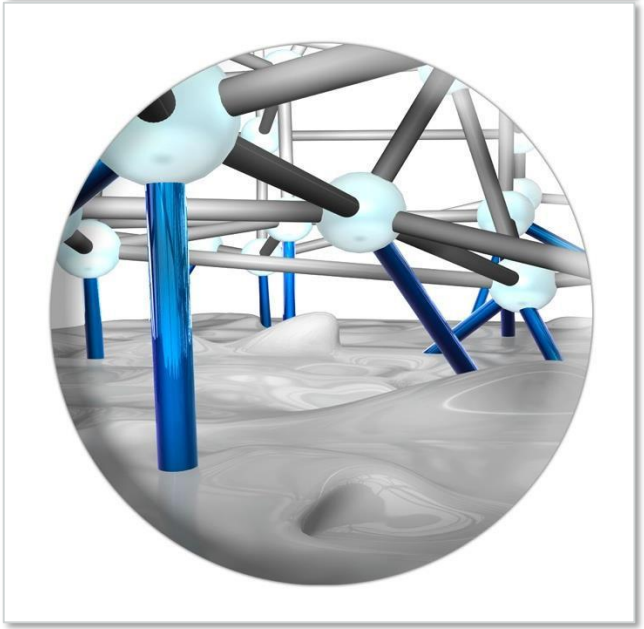
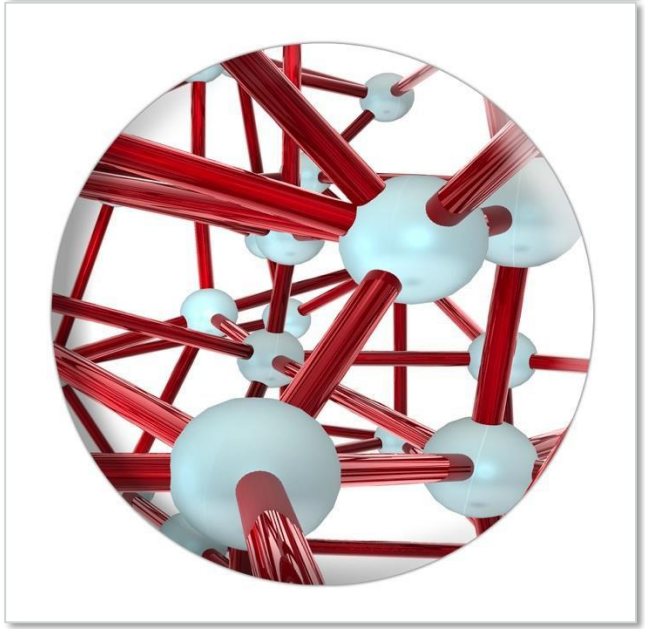
Adhesive

Adhesion and Cohesion



Adhesive

Adhesion and Cohesion

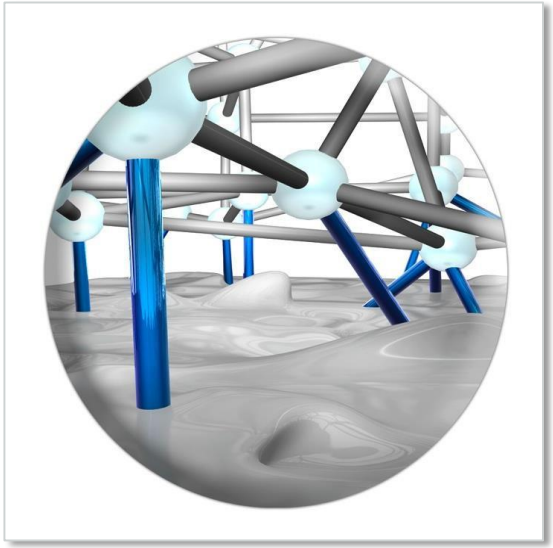
Adhesi	Cohesi
	

Adhesive

Adhesion

Ability to bond to the surface

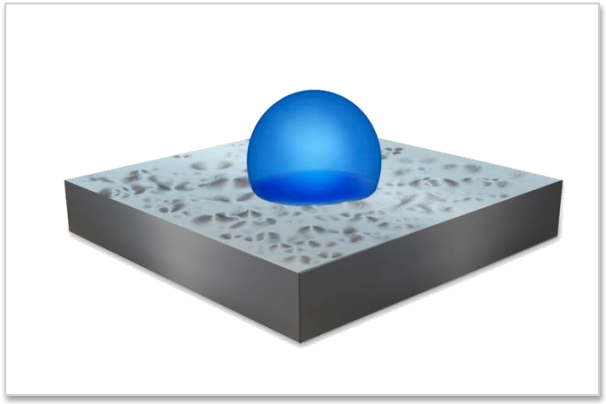
- Depends on:
  - Surface polarity
  - Surface roughness
  - Surface contamination
  - Surface wetability



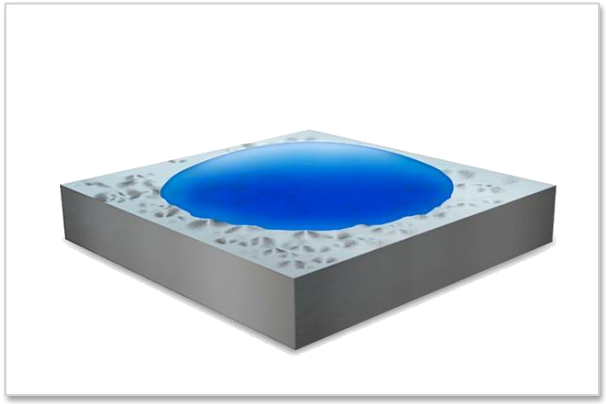
Reliable adhesion needs reliable surface conditions and a liquid adhesive.

Adhesive

Surface wetting necessary for good adhesion



- Limited contact
- Liquid stays off the surface



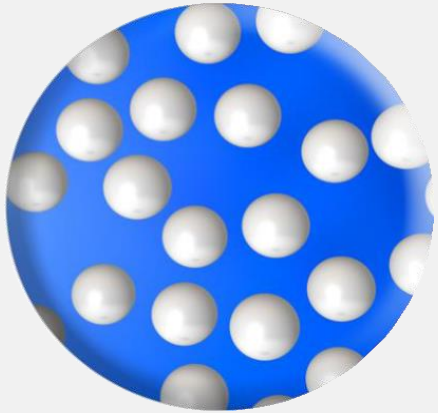
- Optimum contact
- Liquid smoothes onto the surface

The liquid adhesive has to be in optimum contact to the surface through surface preparation, e.g. cleaning, pre-treatment

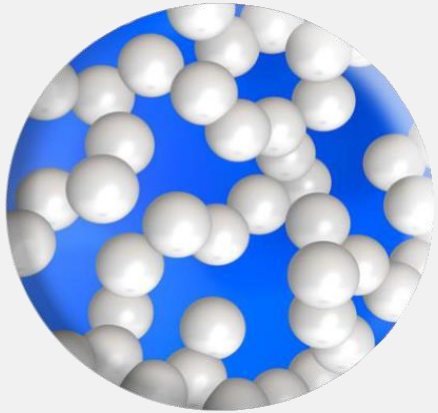
Adhesive

Cohesion achieved by polymer building

Liquid



Solid

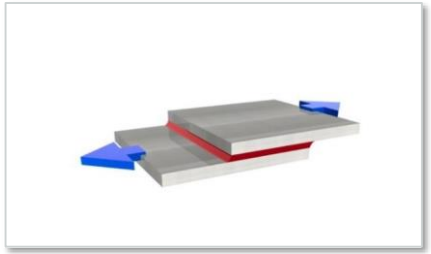


Cohesion needs proper cure of the adhesive

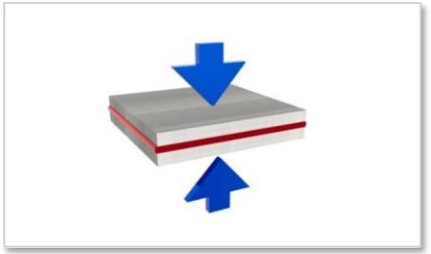
Bondline constructions

Loads in adhesive joints

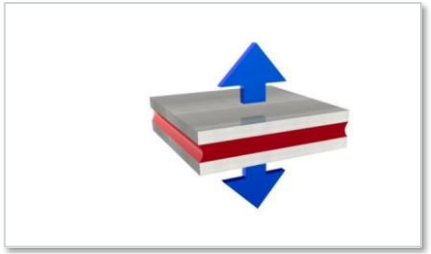
Shear



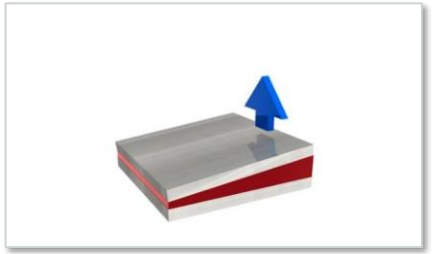
Compression



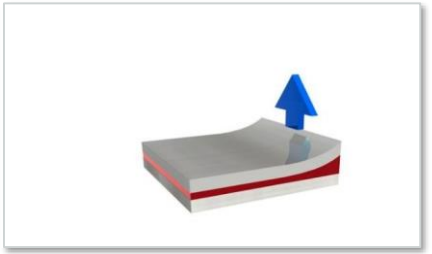
Tensile



Cleavage

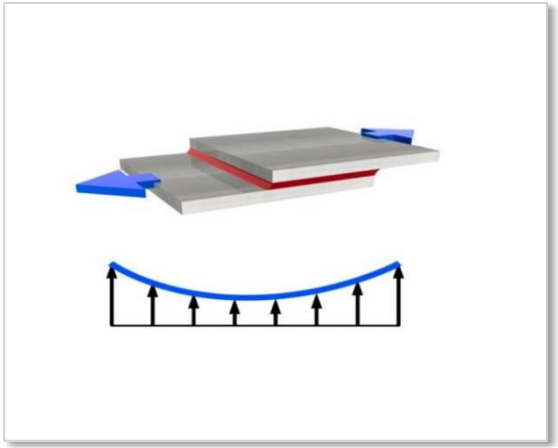
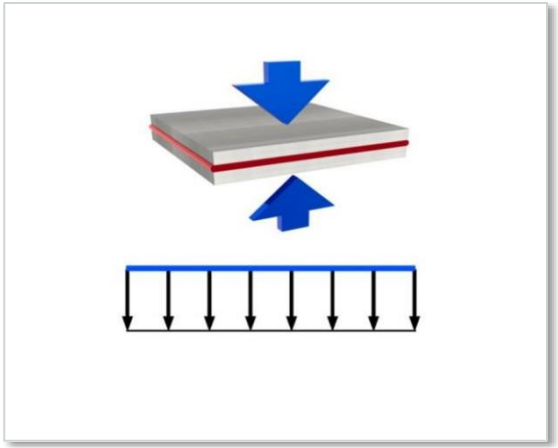
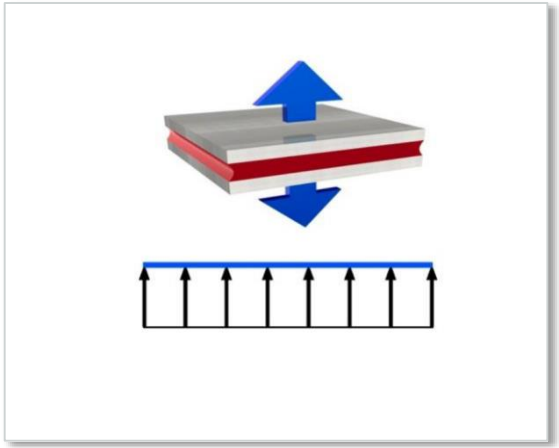


Peel



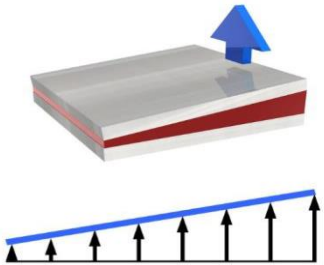
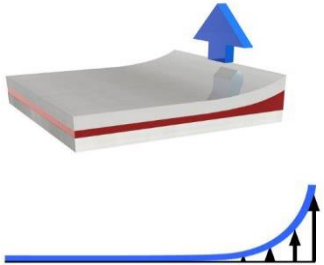
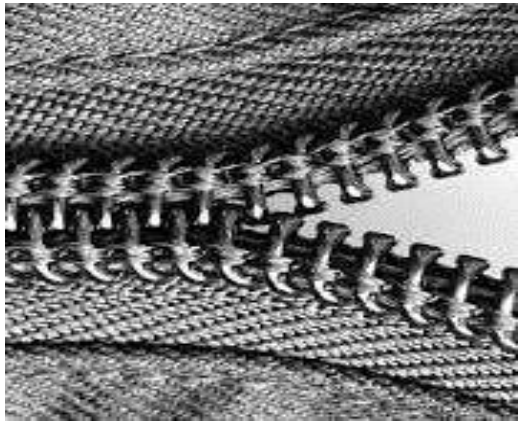
Bonding

Loads in adhesive joints

Shear	Compression	Tensile
		

Entire bond area used for load transmission

Bonding
Loads in adhesive joints

Cleavage on rigid parts	Peel on flexible parts	Zipper
		

Bond area only partly used for load transmission

Bonding durability

Structural bonding 20 years of warranty

Fatigue

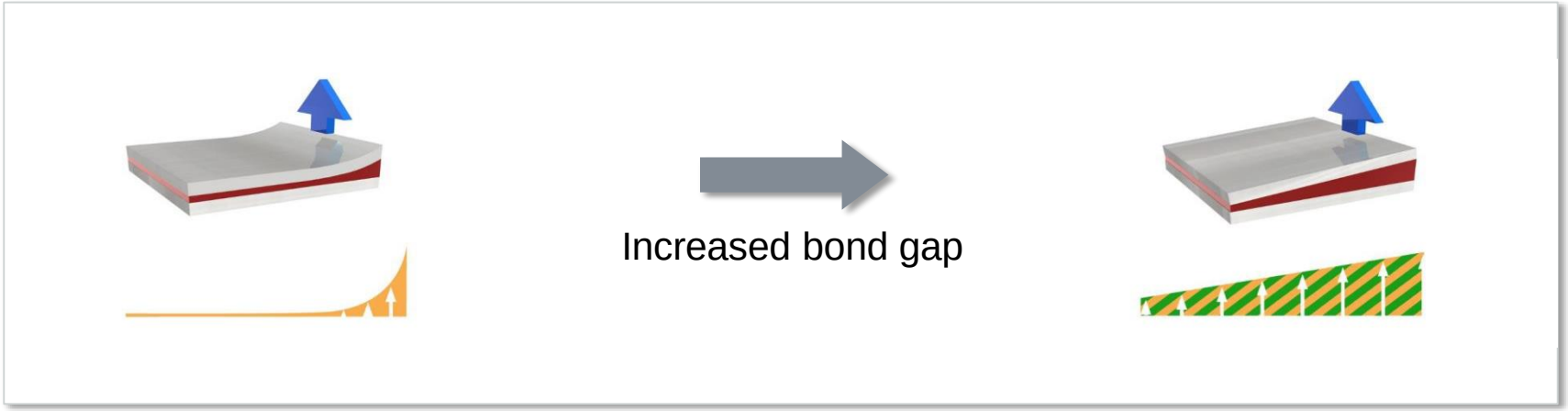
- Constant Vibration, different dynamic loads
  - Frequencies
  - Load changes in direction and intensity
  - Relative movements of counterparts
  - Not only bond line but also substrates deterioration

Ageing

- Outside weathering conditions
  - UV
  - Rain
  - Dust
- Temperature changes
- Humidity changes
- Corrosion (salt)
- Polymer destruction by cleaners

Definition of Adhesive

Improving of Load Conditions



improved spreading of load over the bond area by appropriate part design and appropriate adhesive

Adhesive & Design Selection

It is not a Lottery but systematic & conclusive

Adhesive & Design Selection

Engineering method

Adhesive & Design Selection

Engineering method

translate

Customer Input → **Bondline Criteria** → **Adhesive & Design**

select

Adhesive & Design Selection

Engineering method

translate

Customer Input → **Bondline Criteria** → **Adhesive & Design**

select

Adhesive & Design Selection

LOCTITE
TEROSON

translate

Customer Input

- Required functionalities
- Substrates
- Part Parameters
- Operating conditions
- Manufacturing parameters
-
- …

Translate via Henkel Expertise and Know-How

Bondline Criteria

- Strength
- Elasticity
- Adhesion profile
  Media resistance
- Temperature resistance
- Chemical resistance
- Surface preparation ...
-

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Adhesive & Design Selection

Engineering method

translate

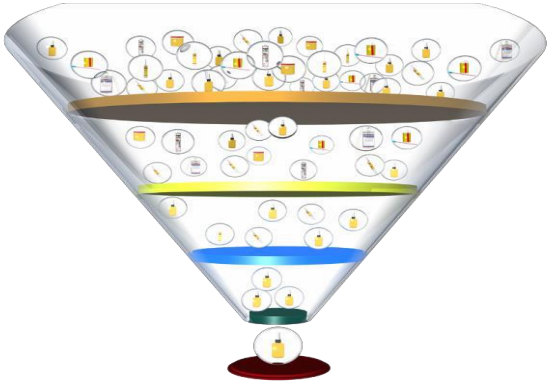
Customer Input → **Bondline Criteria** → **Adhesive & Design**

select

Adhesive & Design Selection

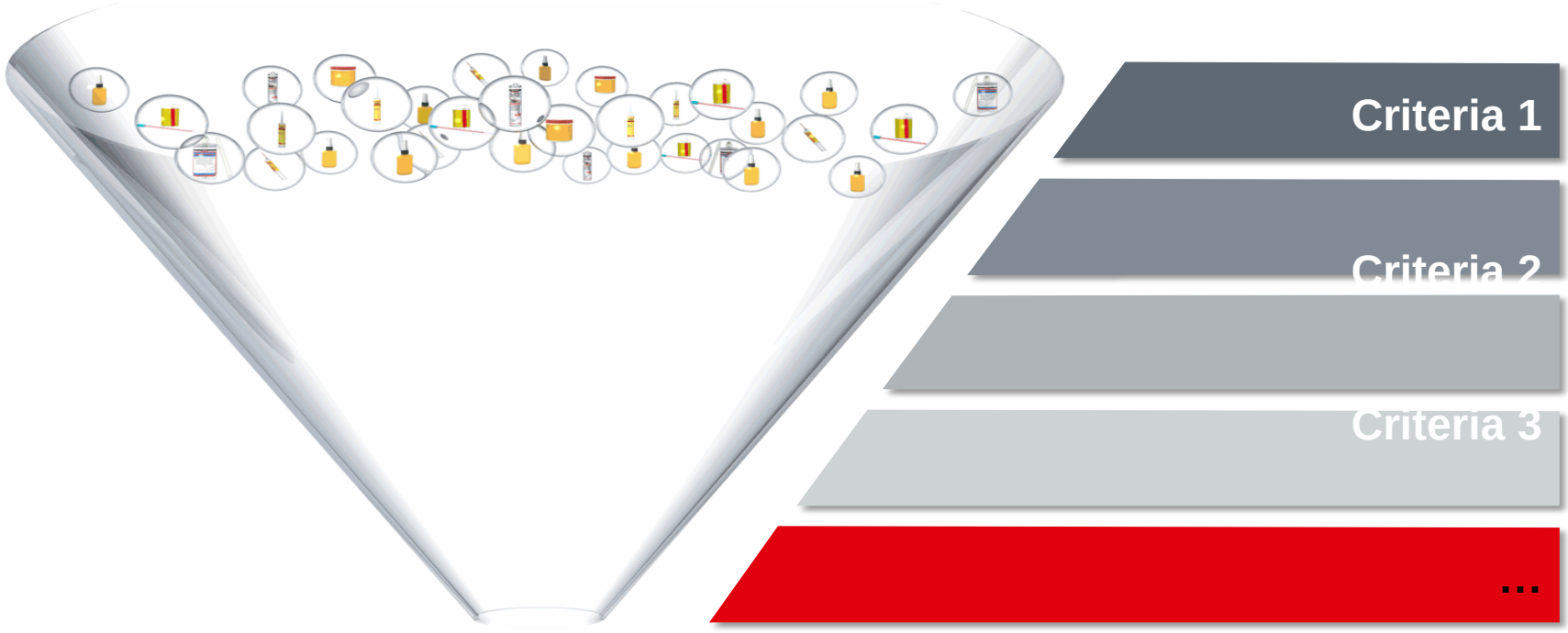
select

Bondline Criteria → **e.g. Funnel Technique** → **Adhesive & Design**



Adhesive & Design Selection

Funnel Technique



Bonding solution

Evaluation of the bonding solution

- Test on substrate
- Small parts testing

- Prototype testing
- Real part testing

- Set up manufacturing
- Training staff
- Quality control

Bonding Solution

Structural Adhesive Technologies

LOCTITE®
TEROSON®

Epoxies	Acrylics	Polyurethane	Silane Modified Polymers	Silicones
• Rigid bonding • 1- or 2-component solution • Excellent gap filling • Very high strength • For small to medium surface • Outstanding chemical resistance	• Rigid to slightly flexible bonding • 2-component solution • Very high strength • For small surfaces • Good chemical resistance	• Slightly flexible bonding • 1- or 2-component solution • Excellent gap filling (2C) • High strength • For medium to large surfaces • Good chemical resistance	• Flexible bonding • 1- or 2-component solution • Wide primerless adhesion on many substrates • High impact strength • Good UV and -weather resistance	• Flexible bonding • 1- or 2-component solution • Outstanding - temperature and UV resistance • Excellent chemical resistance

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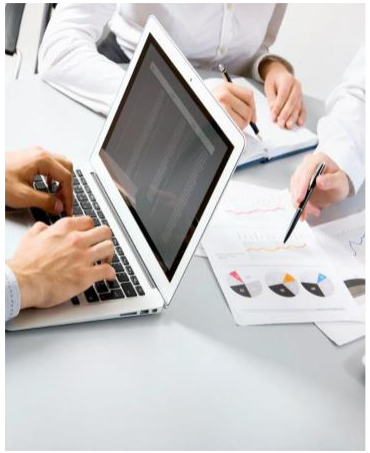
Thank you!

LOCTITE®
TEROSON®

This material has been visually improved with the help of our team at the Graphic Design Center in SSC Manila.
To know more about this service, please visit ***http://graphics*** in the Henkel portal.

Acrylic Technology Training



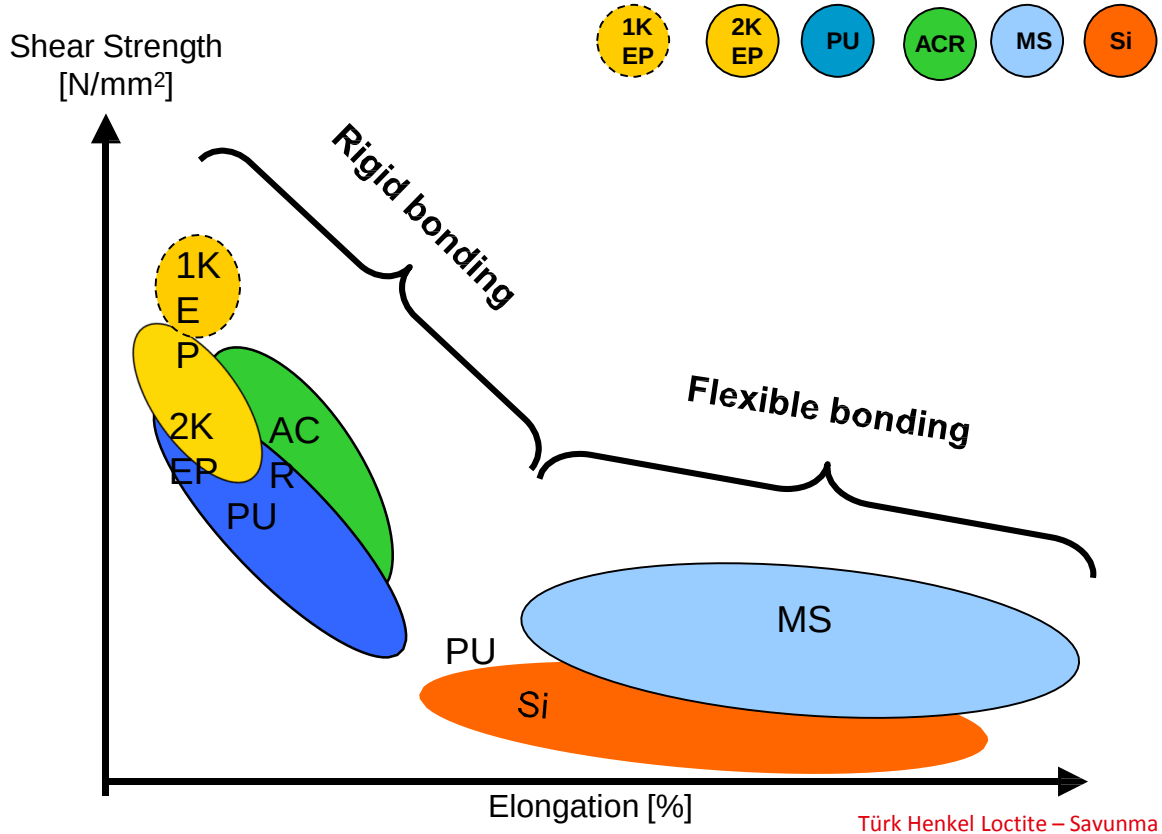
April 2015

Technology Description

- **Benefits:**
- ▪Adhesion to a wide range of substrates
- ▪High strength
- ▪Fast cure
- ▪Minimal surface preparation
- ▪Good chemical resistance
- ▪High adhesion to difficult-to-bond substrates
- ▪High mixing ratio tolerance (two-part acrylics)

- **Limitations:**
- ▪May have strong odor
- ▪Very limited gap filling (two-step acrylics)
- ▪May contain solvents (activator for two-step acrylics)
- ▪Flammable (MMA based)
- ▪Oxygen inhibition of cure (gummy squeeze-out)

Technology Positioning



Product Variants and Benefits

- **Product form**
  2-component no mix adhesives (two-step acrylics) vs. 2-component premix adhesives (two-part acrylics)
  Benefit: Flexible assembly time vs. higher gap tolerances

- **Toughness**
  Products/grades achieving high resistance against impact and peel loads

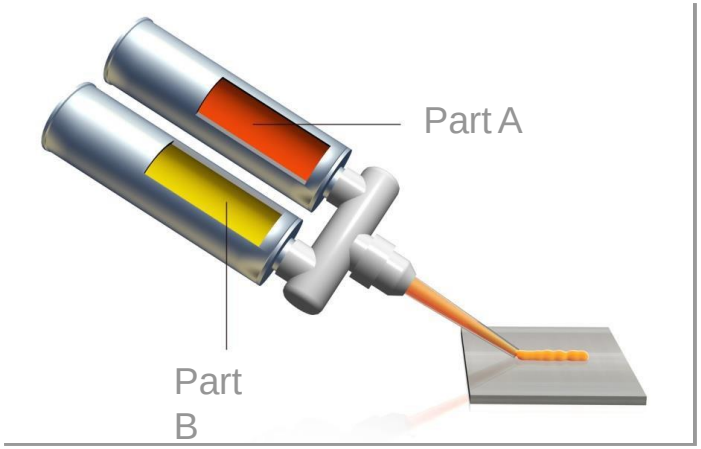
- **Adhesion Performance**
  Grades achieving excellent primerless adhesion on glass, ceramics, metals, different plastics e.g. polypropylene, polyethylene etc

- **Color**
  Clear vs. colored

Product Variants and Benefits

Two-part acrylic adhesives (2-component premix)

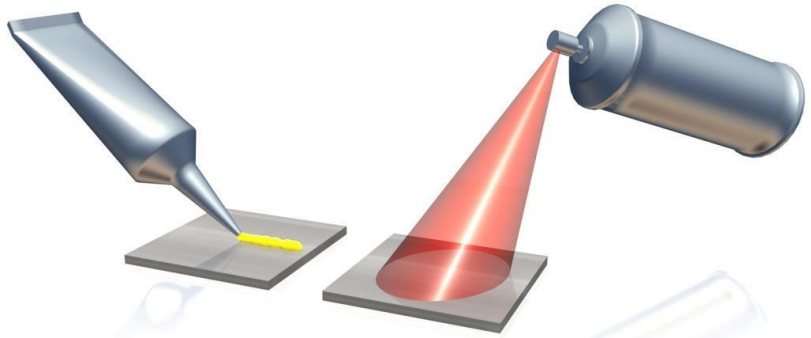
- The two components will be mixed (go through) in the static mixer mounted onto the cartridge. Mixing ratio is given through the package (dual cartridge), mixer provides well mixed product



Product Variants and Benefits

Two-part acrylic adhesives (2-component premix)

- Adhesive (one-component) application on one side, activator (initiator) on the other side. Curing reaction starts immediately after joining the two substrates



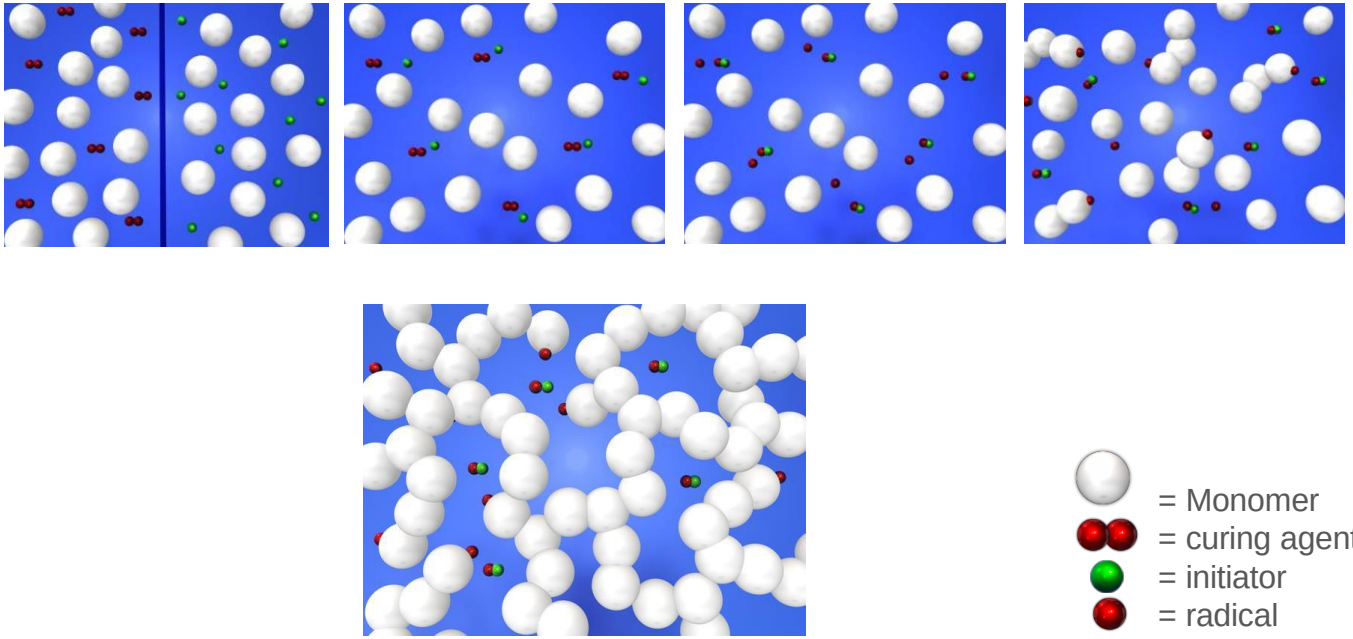
* Very limited gap cure capability

Curing Terminology

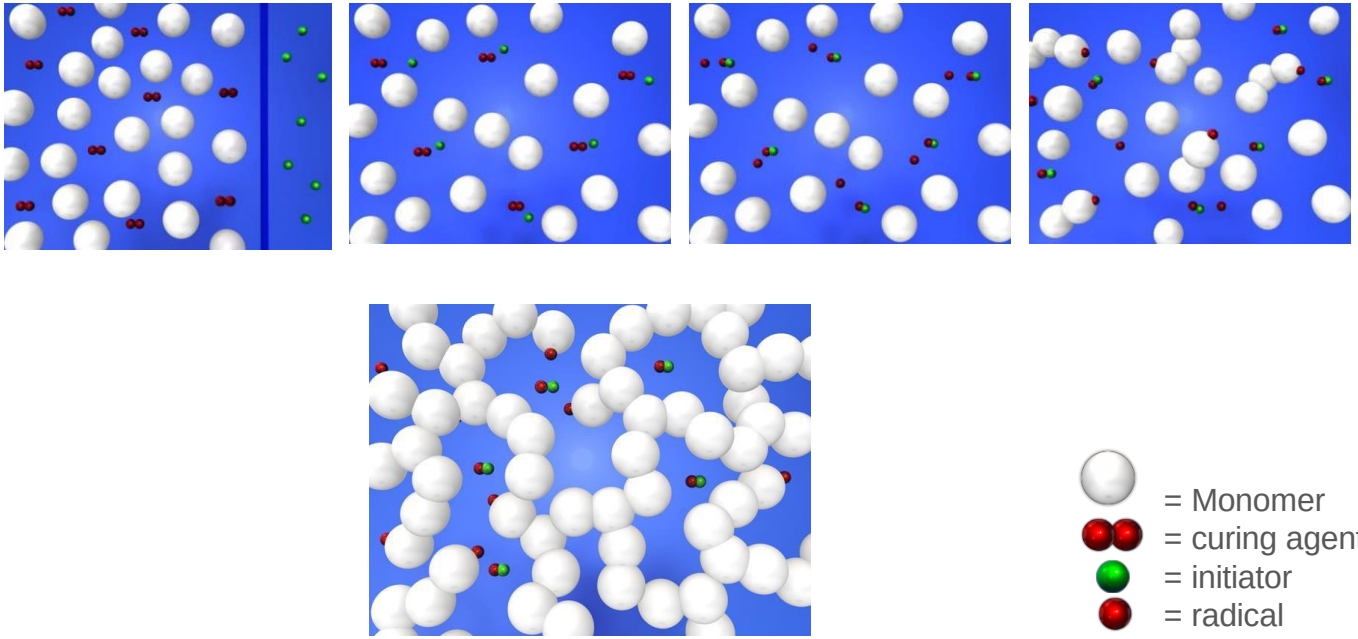
- **Working time**
- **On-part life**
- **Nozzle Life***
- **Open time**
- **Fixture time**
- **Initial setting time**
- **Full cure****

* “Nozzle life is application specific depending on nozzle type and product.”
** “Full cure is application specific depending on environmental conditions, bead size, bond area, substrate type, etc…”

Cure: Two-part Acrylics (premix)



Cure: Two-step Acrylics (no mix)



Application Areas

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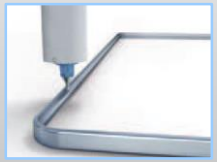
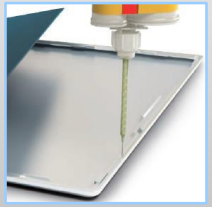
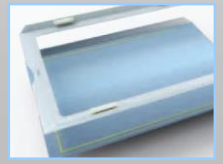
Hand Held Devices and Displays

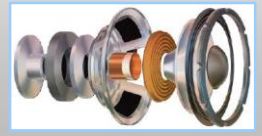



AgCon and Specialty Vehicles


Additional Markets





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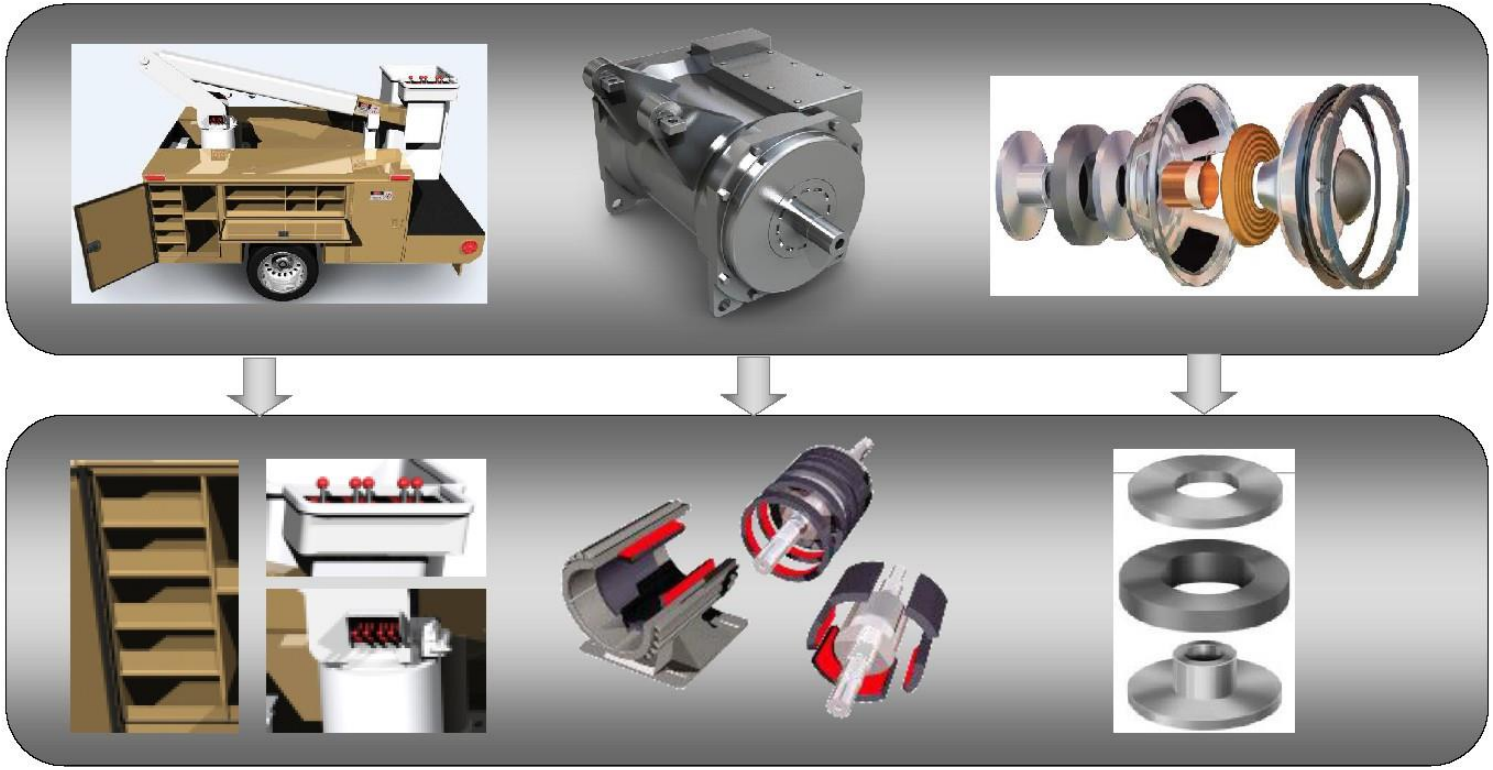
Application Examples



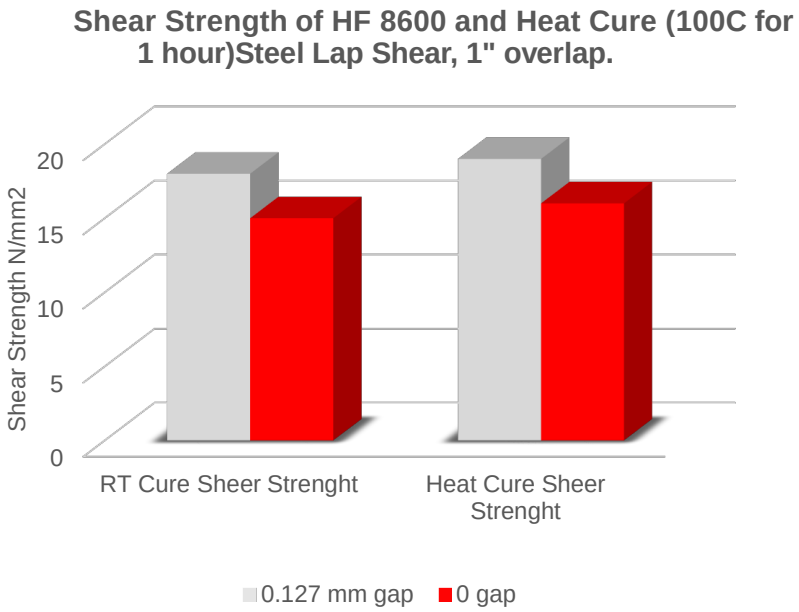
Products with Build-in Gap Control

Some acrylic adhesives incorporate glass beads to control glue line thickness

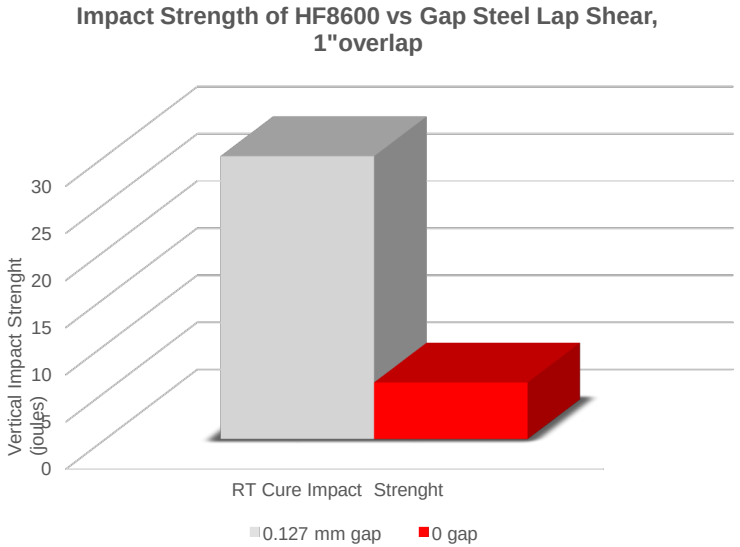
Control of bondline **(bigger)** gap provides
- Improved impact resistance
- Improved peel resistance
- Control of squeeze out

Two-Part Acrylics with Spacer Beads		
Two-Part Acrylic	Spacer Material	Spacer Size
3030	**glass beads**	**0.010" or (10 mil)**
3032	**polymeric (not glass) spacers (Polyethylene)**	**0.010" or (10 mil)**
3034	**polymeric (not glass) spacers (Polyethylene)**	**0.010" or (10 mil)**
H3151	**glass beads**	**0.0050" or (5 mil)**
H3152	**glass beads**	**0.0050" or (5 mil)**
H4710	**glass beads**	**0.0050" or (5 mil)**
H4720	**glass beads**	**0.0050" or (5 mil)**
H8010	**glass beads**	**0.010" or (10 mil)**
HF8025	**glass beads**	**0.0025" or (2.5 mil)**
H8110	**glass beads**	**0.015" or (15 mil)**
H8500	**glass beads**	**0.030" or (30 mil)**
H8510	**glass beads**	**0.030" or (30 mil)**
HF8600	**glass beads**	**0.0050" or (5 mil)**
H8600	**glass beads**	**0.0050" or (5 mil)**
H8610	**glass beads**	**0.0050" or (5 mil)**

Performance vs Gap



Impact performance improves with proper bondline gap



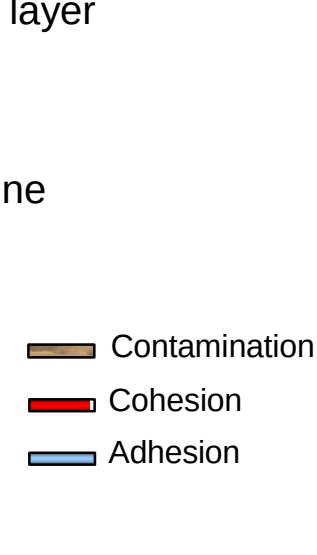
EU Acrylic Core Product

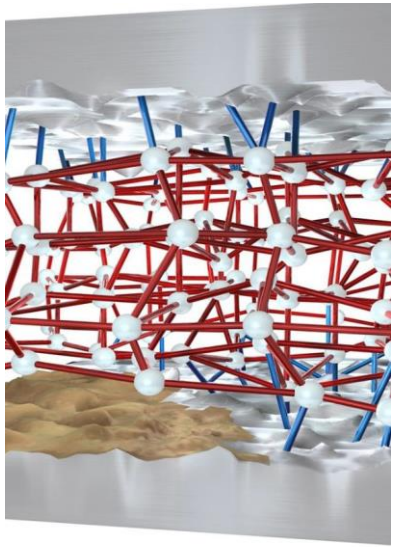
	Description/ Technology	Recommended	Mixing ratio by volume (A:B)	Viscosity (mPa/s)	Working time (min.)	Fixture time (min.)	Shear strength, GBMS (N/mm²)	Service temperature (° C)	Properties
Loctite® AA 3295	Pre-mix	-	1:1	17,000	4 10	5 to	25	120 product	▪ General purpose
Loctite® AA 3342	no mix	7386	-	90,000	- 1.5	1 –	15 – 30	180 resistance	▪ High temperature
Loctite® AA 3038	Pre-mix	-	1:10	12,000	4	>40	13 (PBT)	100	▪ Bond to untreated polyolefin substrates
Loctite® AA 3298	no mix	7386	-	29,000	-	3	26 – 30	120 glass	▪ Very good adhesion on
Loctite® AA V5004	Pre-mix	-	1:1	18,000	0.	3	12	80 curing	▪ Clear bond line after
Loctite® AA 3504	No mix	7649		5 1,050	-	-	22	120	▪ Low viscosity ▪ Can be UV cured
Loctite® AA 330	no mix	7388	-	67,500	-	3	15-30	100	▪ General purpose ▪ Bonding dissimilar substrates

Surface Preparation

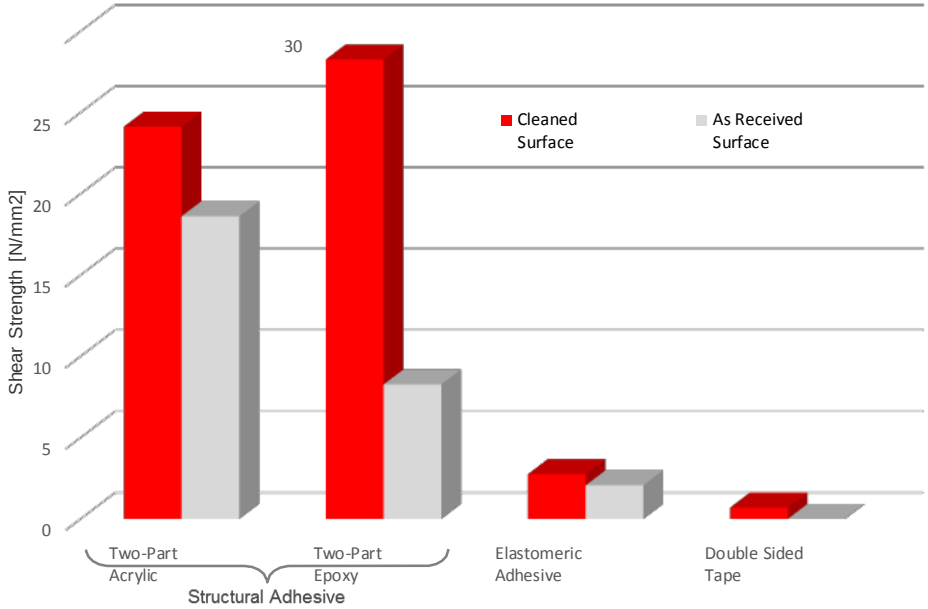
- **Cleaning**
  Surfaces to be bonded must be clean, oil free and dry to ensure proper contact between adhesive and surface.
  Surface could be abraded to remove oxidized layer

- **Surface pre-treatment**
  (e.g. corona, plasma)
  Improves strength and durability of the bond line





Effects of Surface Cleanliness on Adhesive Shear Strength Performance



Shear Strength on Cleaned vs. As Received Steel

Acrylics are more tolerant to surface contamination

* GBMS

1-component dispensing

- Manual handheld applicator

- Pneumatic handheld applicator

- Dual Channel Integrated Dispenser

- Digital Syringe Dispenser

2-component dispensing

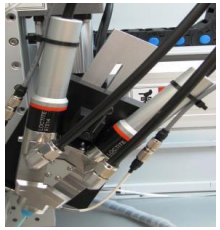
- Mechanical handheld applicator

- Pneumatic handheld applicator

Two-part Dispense Equipment

4530HC Precision Robotic Dispense System

Highly accurate control for applying drops or small beads of 2-part adhesives with a 1:1, 2:1, 10:1 mix ratio from cartridges and pails



Dual Rotor Pumps with Anti-Drip Valve set-up

Flow Monitoring System

Human/Machine Interface (HMI)

Structural Bonding Examples

Polyolefin Bonding

- Superior strength on polyolefins
- Good adhesion on metals and composites
- Resistance to moisture, salt, NP Solvent
- Various working and fixture times
- Bondline thickness controlled

Structural Bonding Examples

Fragile Materials – Magnets

- Higher magnetic field
- Noise reduction
- Allow process automation
- Better mass balance
- Simplified magnet design

Structural Bonding Examples

Invisible Joints – Glass Tables

- Invisible joints
- Innovative design
- Simplified process
- Parts reduction

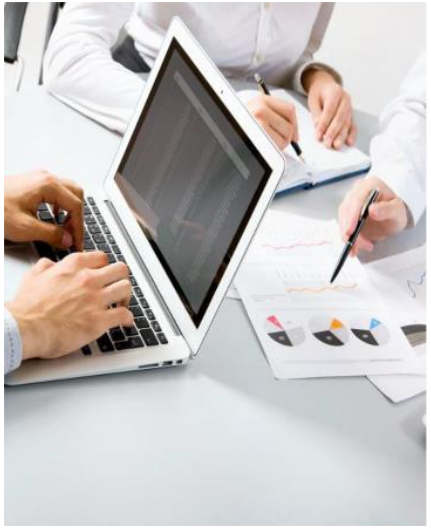
Structural Bonding Examples

Clear Plastic Bonding

Benefits of Loctite® V5004

- Clear bondline after curing.
- Fast Curing
- Good adhesion to metals and plastics

EPOXY Technology Training



April 2015

Typical Epoxy Properties

Benefits

- Room temperature or Heat cure
- **Excellent Thermal & Chemical Resistance**
- Adhesion to a wide range of substrates
  - **Especially for METALS**
- High cohesive strength, good shear and peel strength
- Excellent durability
- 100% solids - no volatile by-products formed during cure
- Unlimited gap fill capability *
- Low shrinkage
- Easy manual dispense
- Ease of cure- ability to cure from 5C to over 150C.
- Machineable
- Paintable
- Minimal surface preparation
- Variety of product formulation capability

** For 2-part systems (referring curing only)*

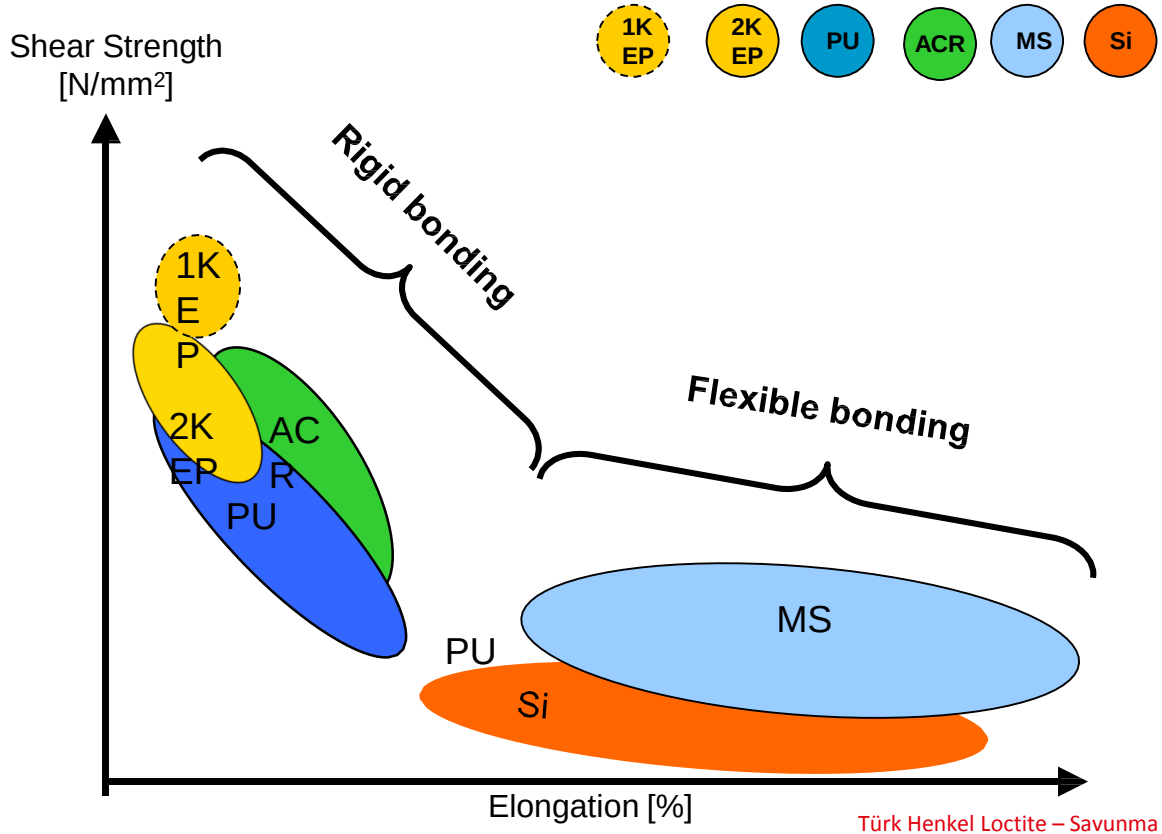
Typical Epoxy Properties

Limitations

- Slow cure
- Exotherm during cure
- Adhesion to plastics
- May need refrigerated storage*

* Applicable to 1-part (1K) Heat Cure Products ONLY

Technology Positioning



Epoxy Technology

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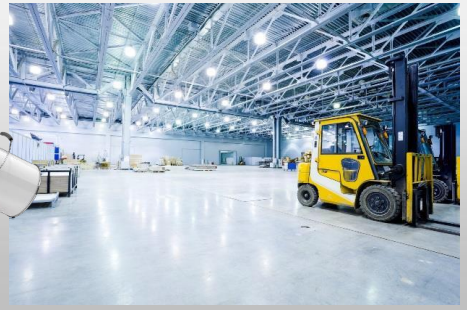
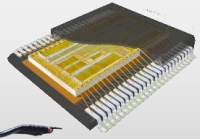
Bonding & Potting

Coating



Polymer Composites



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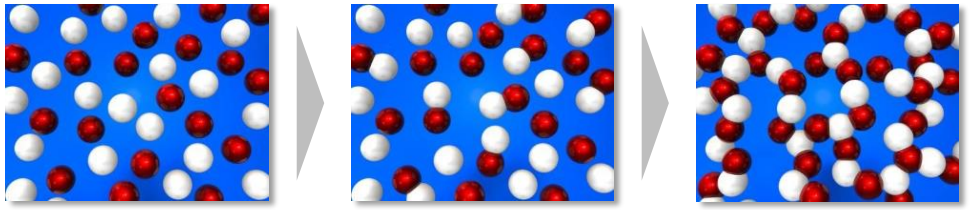
Technology Positioning

1-component vs. 2-component products

1-component	▪ No mix – hardener already formulated in ▪ Thermal cure needed ▪ Superior performance and fast cure ▪ May need refrigerated storage
2-component	▪ Mixing required ▪ Room temperature curing (can be accelerated by heat) ▪ Easy to use ▪ Shelf life “unlimited” – relative speaking to 1-C

Epoxy Adhesives

1- Component Cure



Pre-mixed/
Ready to use

Heat Cure

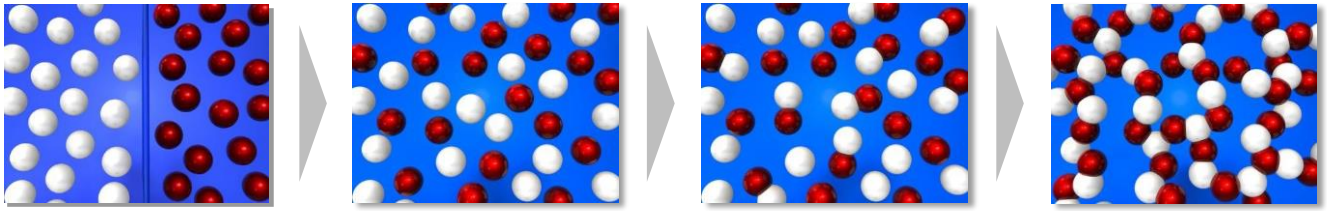
Thermoset
Polymer

= Hardener

= Epoxy resin

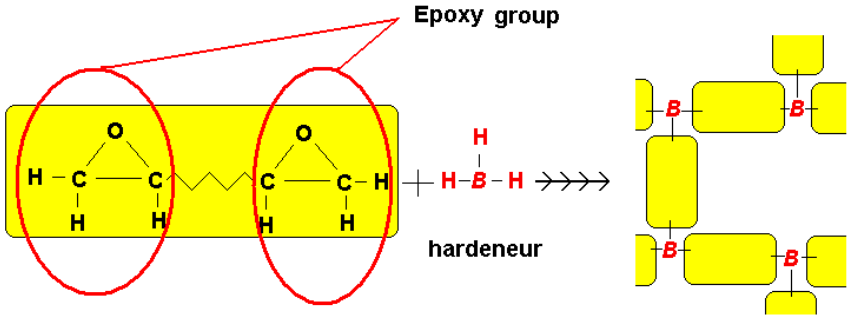
Epoxy Adhesives

2- Component Cure



Epoxy Adhesives

Mixing ratio for 2K is critical



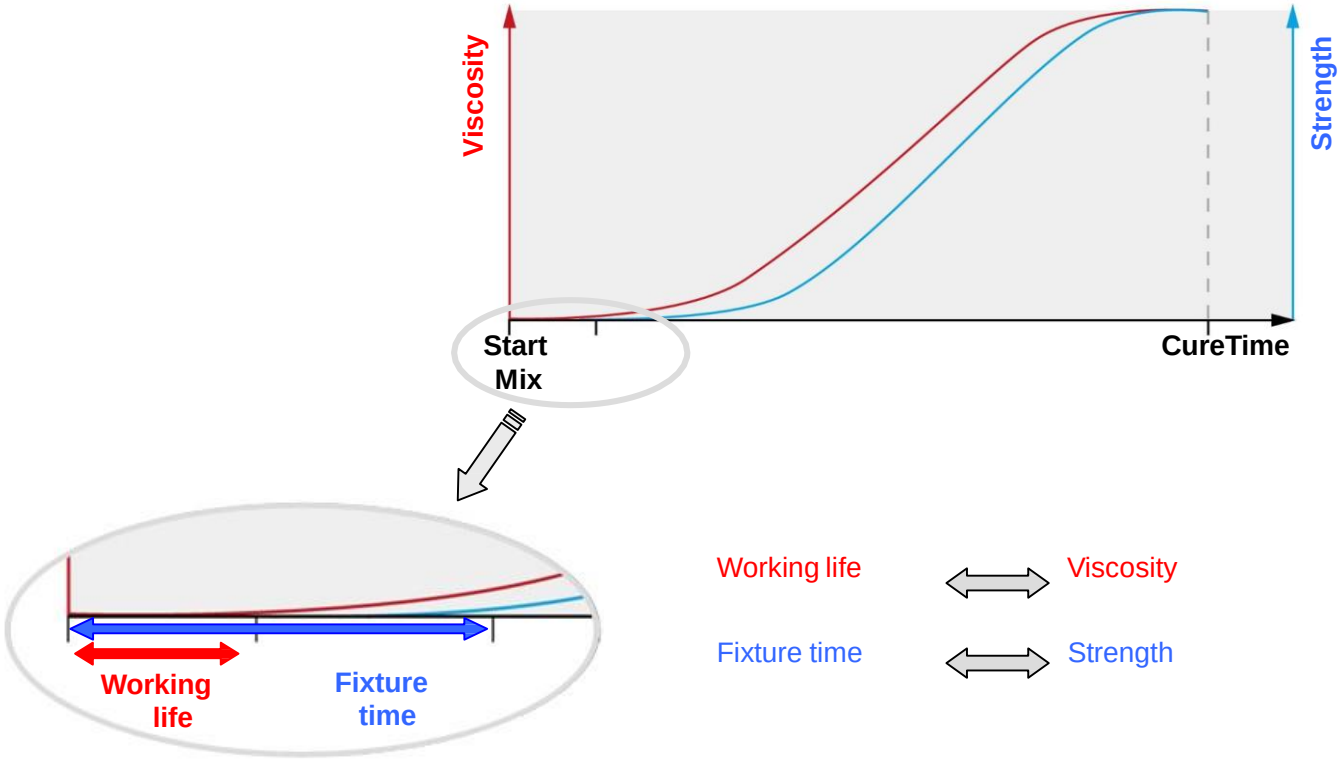
- Too much resin = reduction of mechanical performance
- Too much hardener = reduction of mechanical performance

Epoxy Adhesives

Cure Terminology

- Working life
  - Time in the mix nozzle before the product is too thick to dispense
- Pot life
  - Time for 100 gram mass to double in viscosity
- Fixture time
  - Time required to archive shear strength of 0.1 N/mm2
- Gel time
  - Subjective QC test based on repeatedly penetrating adhesive with probe.
- Blush
  - Hazing at air interface due to reaction with water and carbon dioxide

Epoxy Cure



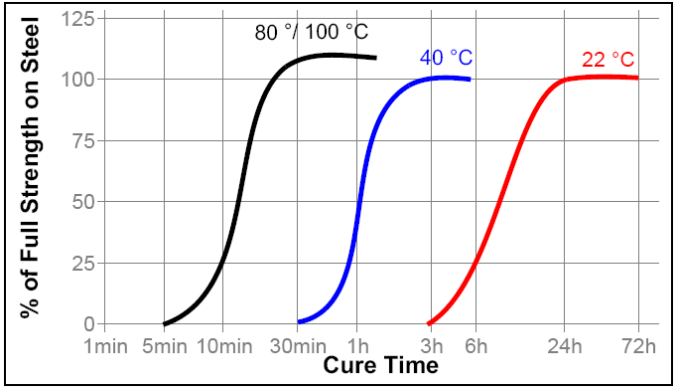
Working life ⟺ Viscosity

Fixture time ⟺ Strength

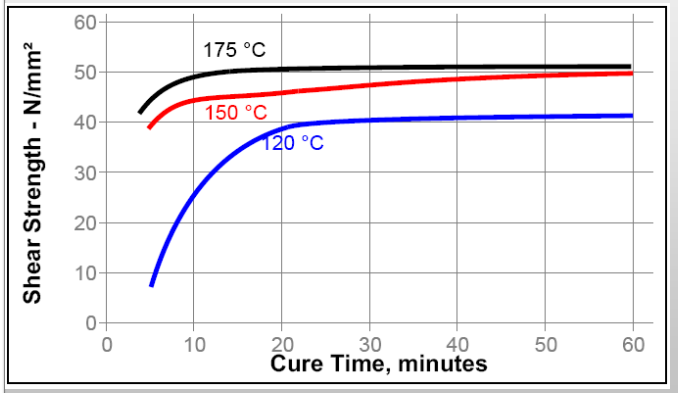
Epoxy Adhesives

Key factors for cure: Temperature and Time

2-component epoxy



1-component epoxy



Epoxy Adhesives

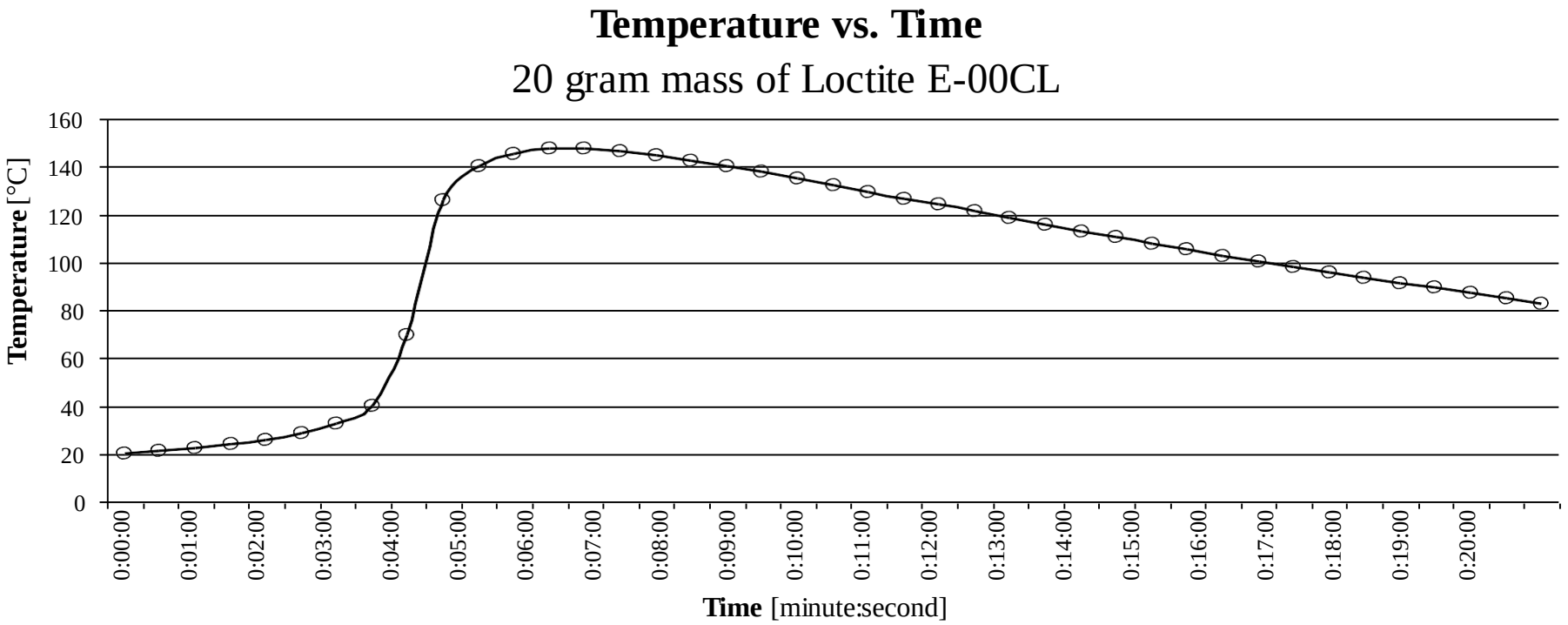
10°C Rule of Thumb for most reactions

Increase in temperature → increase in reaction rate

For each 10°C increase in temperature

- Reaction rate will approximately double
- Heat of reaction also will approximately double

Exotherm


Temperature vs. Time
20 gram mass of Loctite E-00CL
Temperature [°C]
160
140
120
100
80
60
40
20
0
0:00:00
0:01:00
0:02:00
0:03:00
0:04:00
0:05:00
0:06:00
0:07:00
0:08:00
0:09:00
0:10:00
0:11:00
0:12:00
0:13:00
0:14:00
0:15:00
0:16:00
0:17:00
0:18:00
0:19:00
0:20:00
Time [minute:second]

Epoxy Adhesives

LOCTITE
TEROSON

Product range and benefits

- **Viscosity -** liquid to pasty
  Easy to dispense and spread versus sag resistance

- **Cure Speed -** slow to fast
  Slow cure speed => long working time
  Fast cure speed => fast handling strength

- **Toughness**
  Grades available with high resistance impact and peel loads

- **Temperature resistance**
  Grades available with long term temperature resistance up to 200° C

- **Color -** Colorless, white, beige, grey, black

Henkel

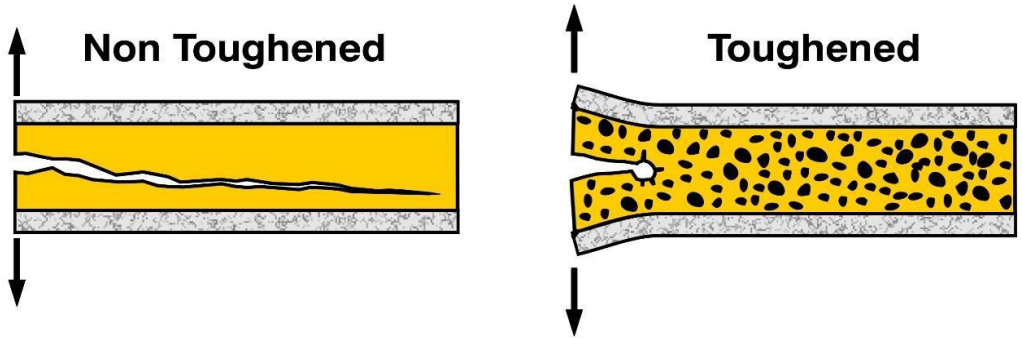
Epoxy Product Range

Performance Attributes:

- Non-Sag
- Non-Corrosive
- Flexible
- High Performance
- Ultra Tough
- Moisture Resistant
- High Temp
- Chemically Resistant
- Explosion Proof

Toughened Epoxy dhesives

- Epoxy adhesives can be toughened
- Rubber particles in adhesive matrix act as ‘crack arresters’
- Products are generally slower curing
- Adhesion, and peel strength enhanced.



Epoxy Product Line

GM European Core Products

	Mix ratio by volume (A:B)	Color	Viscosity (Pa.s)	Working time (min)	Fixture time (min)	Shear strength GBMS (N/mm²)	Operating temperature [° C]	Properties
Loctite® 3423	1:1	grey	300	45	180	17	120	▪Excellent chemical resistance
Loctite® 3430	1:1	clear	23	7	15	22	100	▪Fast fixture
Loctite® 9466	2:1	off-white	35	60	180	37	120	▪Highly toughened
Loctite® 9480	2:1	white	8,7	110	270	24	120	▪Food approved
Loctite® 9483	2:1	clear	7	30	210	23	150	▪Ultra-clear
Loctite® 9497	2:1	grey	12	180	480	20	180	▪High thermal conductivity
Loctite® 9514	1-comp	grey	45	Gel time: 5 min at 120 °C Cure time: 30 min at >120 °C		45	200	▪Superior performance

Epoxy Adhesives

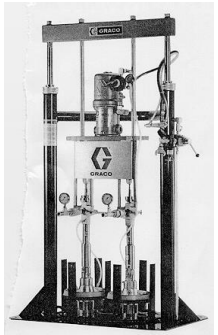
Approvals

Epoxy adhesives provide for a wide freedom of formulation. A variety of grades have been developed to meet the following approvals.

- Incidental Food Contact
- DVGW - Gas Approval
- ISO10993 - Medical biocompatibility
- NSF - Drinking Water
- UL - Flame retardency
- UL - Explosion proofing (Electric Motors)
- KTW - Potable water

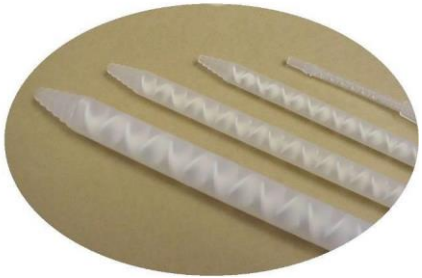
Dispensing Equipment

- 50 ml Manual & Pneumatic 2K Applicators
- 200 ml Manual & Pneumatic 2K Applicators
- 400 ml Manual & Pneumatic 2K Applicators
- Mix Nozzles
- Meter Mix Equipment - Special
- Pail/Drum Pumps – Special
- Dual Rotor Pump – NEW Standard



Two Comp. Mixing Nozzles

- Are crucial to proper mixing
- Dictate dispense time
  - Can be a process bottleneck
- Variables to consider
  - Diameter
  - Length
  - Aperture Size
  - Number of Elements
- Ribbon Tips



ACH – Cylindrical Bonding

LOCTITE
TEROSON

Addressing Concerns about Safety Issues

Use proper personal protection equipment (PPE)

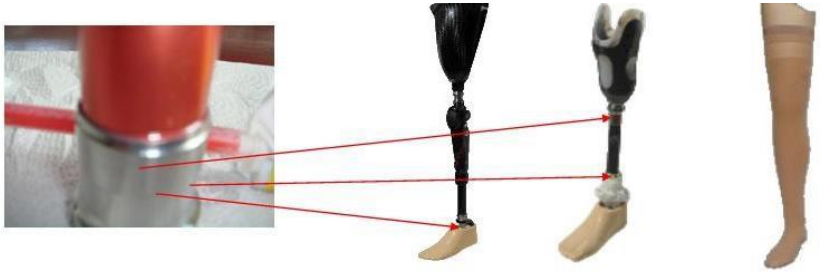
Dispense techniques and ventilation eliminates potential contact with hardeners.

Once cured the materials are inert.

Henkel

ACH – Cylindrical Bonding

Loctite 9466 – 2K Epoxy



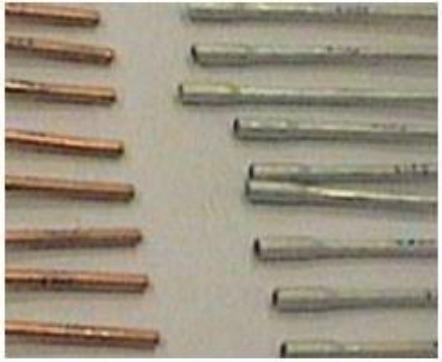
Cylindrical Bonding – Loctite 9466

After applications Loctite 9466

- Appropriate viscosity
- RT cure, long work life
- High bond strength
- High shear
- High impact resistance
- Overall lower manufacturing cost

ACH – Replace Brazing & Welding

Loctite E-214HP – 1K Epoxy



- Loctite E-214 HP is easily hand dispensed by production line operators to lower labor costs
- Heat cured batch processing increases output to eliminate the production bottleneck
- Henkel solution increases production speed, provides a reliable seal and an overall cost saving

ACH - Magnet Bonding

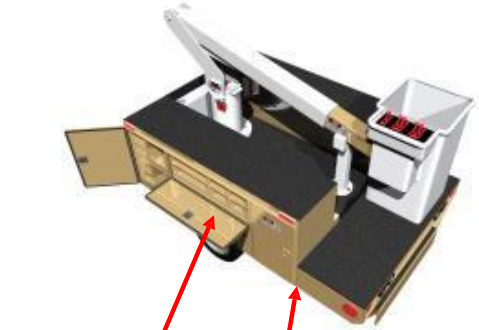
Loctite E-214HP – 1K Epoxy

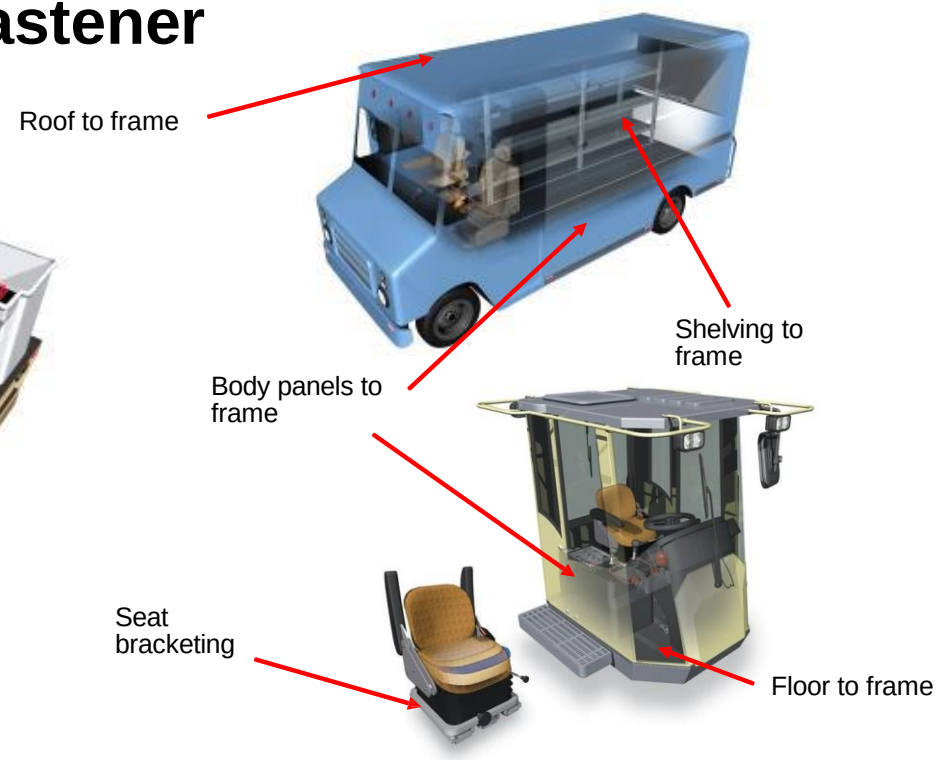
Elevator magnet loss at high temperatures

- Loctite E-214HP maintains excellent bond strength at temperatures up to 150 C.
- Higher temperature resistance improves the quality and reliability of their products

ACH – Metal Bonding

Replace Weld/Rivet/Fastener





ACH – Clear Bondlines

- Bonding plastic insert into alcad housing
  - Hysol E-30CL
- Bonding painted glass to stainless steel legs
  - Hysol E-30CL
    - Excellent resistance to paint heat cure cycle

ACH – e-motors

Securing a Bronze Bearing to PP Housing
Loctite 9483 with Loctite 7063 cleaner and Loctite 770 primer

- Substrates: Bronze and polypropylene
- Cleaned by Loctite 7063
- Primed by Loctite 770
- Bonded by Loctite 9483
- Bonding and retaining achievable in a single process

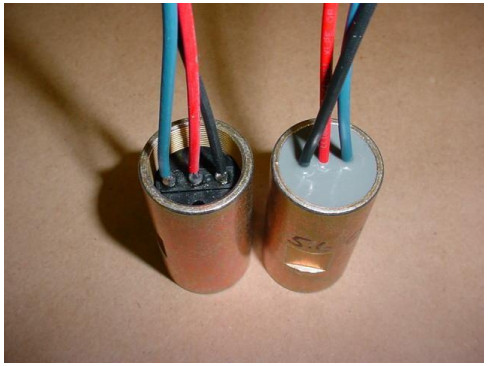
Epoxy for Potting

What is Potting?

- An assembly is completely buried in a surrounding material within a case
  - Device is positioned in a plastic or metal housing
  - Liquid resin system is poured in and cured
  - Housing is not removed and becomes integral part of assembly
- Examples:
  - Capacitors, Electrical Connectors, Transformers, Cable Splices
- Benefits:
  - Protect assemblies from oxygen, moisture, heat, cold, dirt, fungi, chemical exposure
  - Enhance mechanical strength and provide electrical insulation
  - Enhance ability to withstand vibration and shock

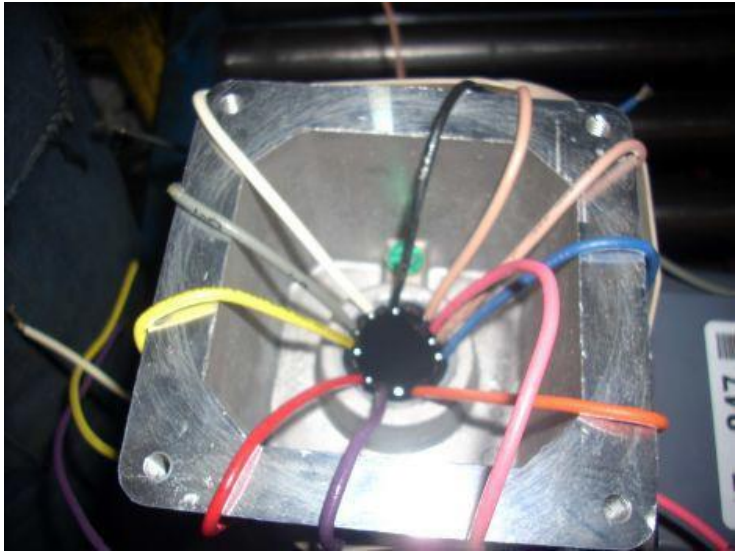
Toughened Epoxy for Potting

- Provide a hermetic seal on zinc dichromated pressure switches
- Hysol E-40FL
- Excellent adhesion to PVC
- High flexibility



ACH – Explosive Proof Epoxy Potting

Potting and Sealing Wire Conduits
2K Epoxy – Loctite E-40EXP



- Loctite E-40EXP meets UL-674 requirements for explosion proof motors
- Easy to dispense; waste from operator mixing is eliminated
- Product fixtures in less than one hour with a low exothermic reaction and minimal shrinkage

Troubleshooting Tips

- Poor Cure
- Cracking
- Delamination
- Bubbles

Troubleshooting Tips

- Poor Cure (tackiness) may be caused by:
  - Poor Mixing & Incorrect Mix ratio
    (Number 1 Cause of Problems)
  - Not Properly Premixing Filled Resins or Hardeners

Troubleshooting Tips

- Cracking may be caused by:
    - Excessive heat during cure
    - Diluents being extracted from potting compound due to aggressive thermal or chemical environment
    - Potting compound is too brittle for low temperature use

Troubleshooting Tips

With the use of a static mixer:

- Push out from cartridges some Resin and Hardener before attaching the mixer nozzle.
- Do not use the first 5 cm of product coming out of the static mixer
- Change the static mixer if you haven’t used the product longer than the working time
- After use, leave the static mixer in place and use it as a cap

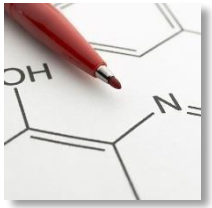
Application Hints

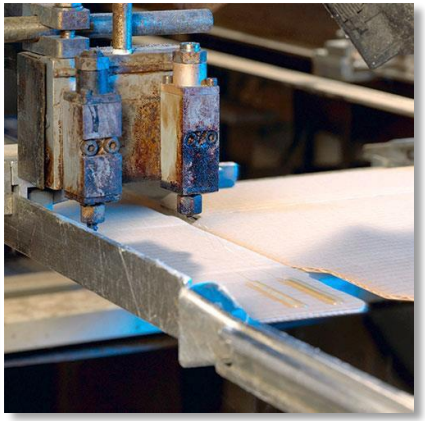
With a single component Epoxy:

- Store product in a cold area (below 10° C)
- Let product warm up to room temperature before using it
- Once used the product should be put back into cold storage.

Polyurethane Technology Training

April 2015





Henkel

Polyurethane History

- 1937 first synthesis by Otto Bayer in an IG Farben Lab.
- 1940 start of industrial production
- 1950 less than 500 tons in Leverkusen
- 1955 first Polyether polyols
- 1960 4500 tons of PUR foam

Structural Polyurethane Loctite UK / UR in Henkel

- Sold for more than 50 years
- 1990 manufacturing of the first 1000 mton PUR structural adhesives in Düsseldorf Germany
- Global production of 25.000 mton now
- Production facilities in all regions
- Almost all Steering Units

Water reaction in Polyurethane chemistry

Water reaction of ISOCYANATE

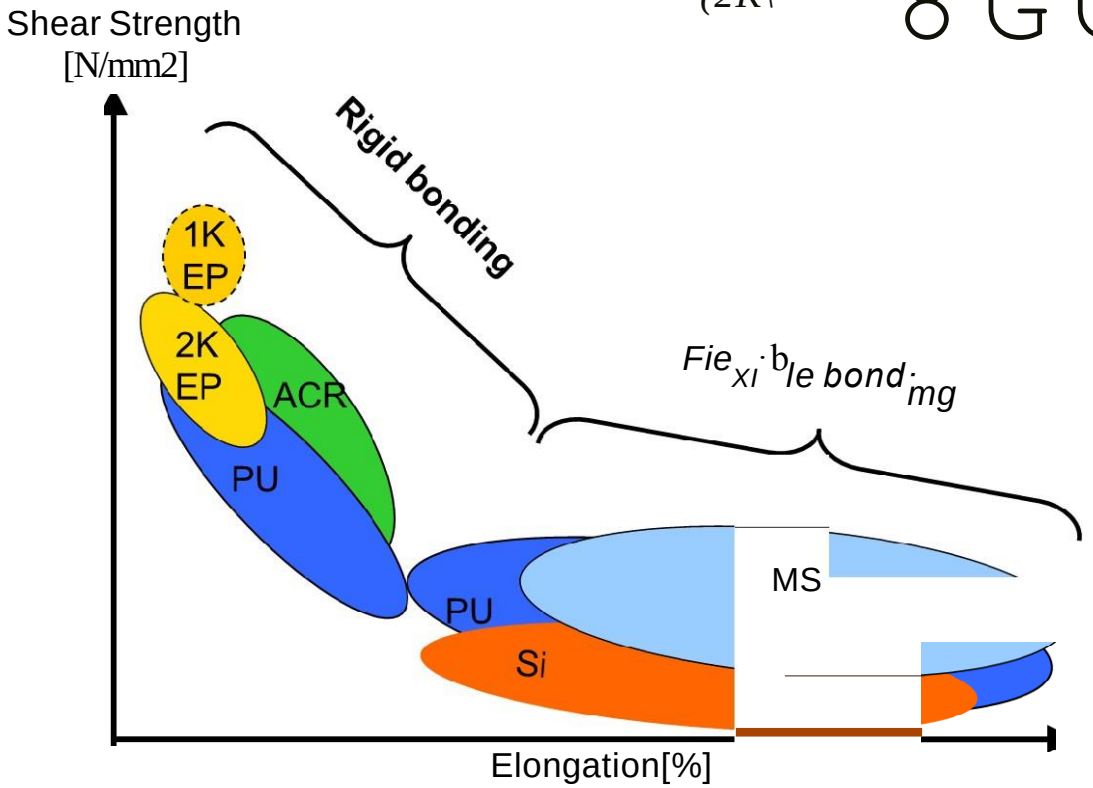
Iso + water -----→ Polyurea and CO_2

1 g water consume 15 g of Hardener
generating 1.24 liter of CO_2 (at normalized conditions)

General properties of structural Polyurethanes

- Wide range; from liquid to sag resistant (gap fill)
- Solvent free
- Manual and automatic application
- Can be used for small and large surfaces
- Operating temperature 80 °C, with new generation >120°C
- Excellent flexibility at low temperatures
- Exothermic reaction less than 100°C
- Good paintability
- Easy to use, wide processing range
- Extremely broad formulation latitude and product range

Technology Positioning of PUR

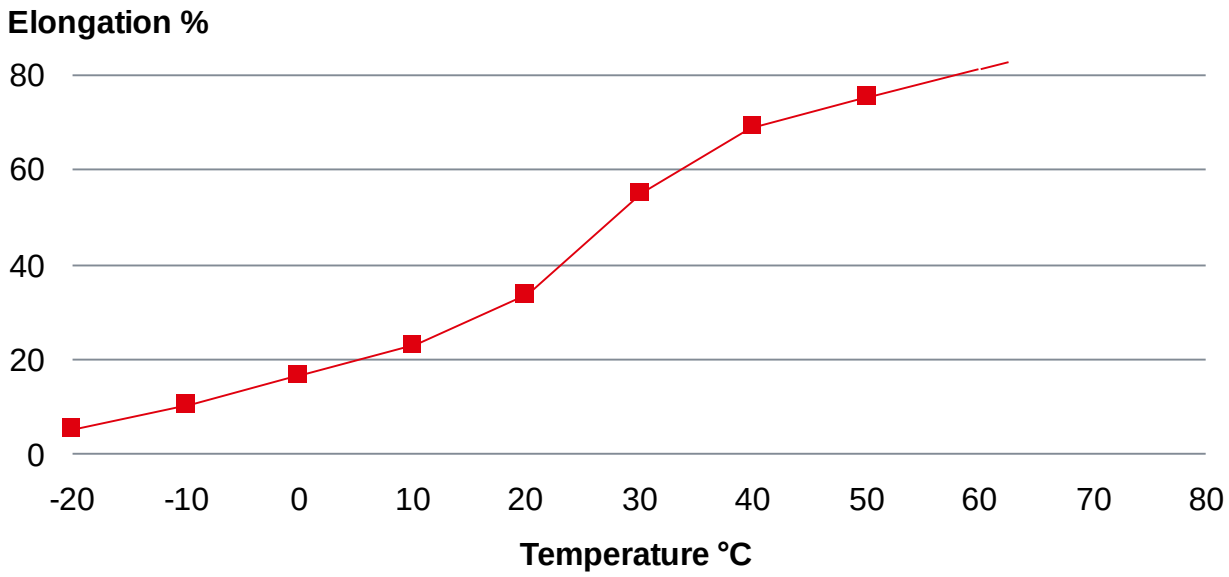


Physical properties of cured structural PUR 2 comp.

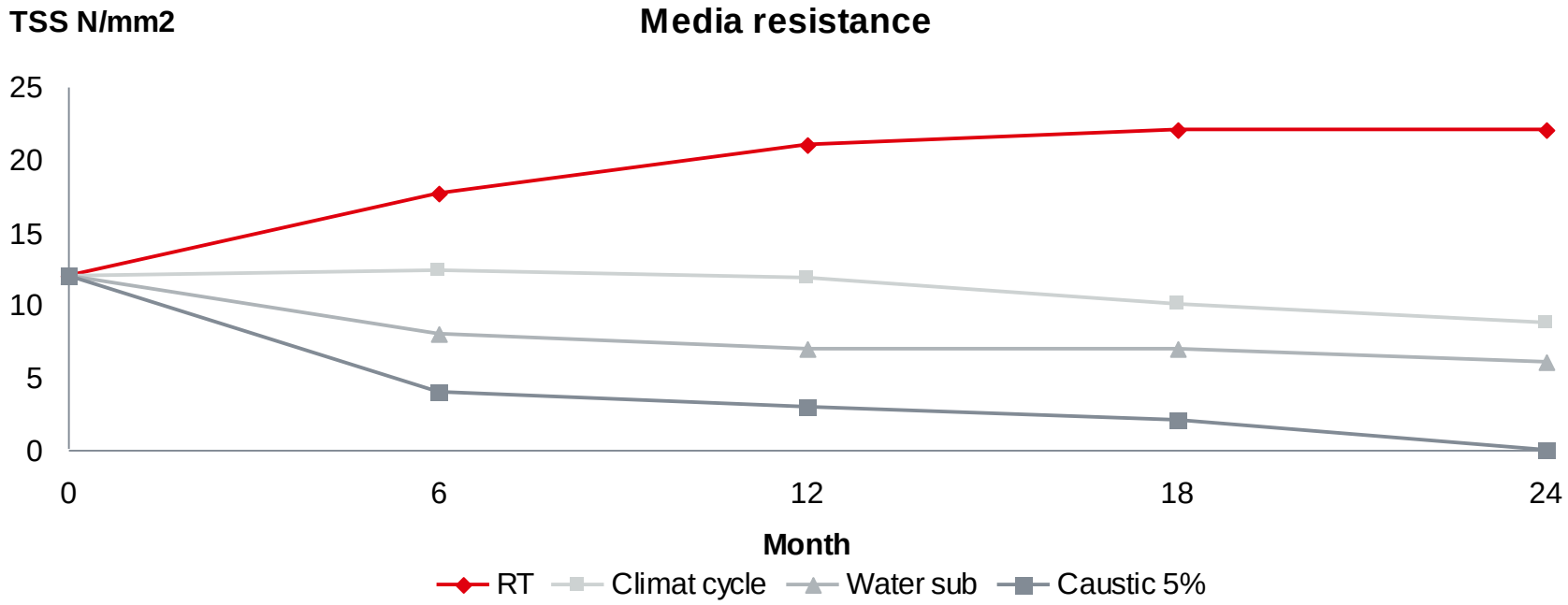
Glass transition (Tg)	-30°C to 100°C	°C
E Modulus	100 to 5000 MPa	MPa
Tensile strength	< 1 to 18 MPa	MPa
Elongation to break	1.5 to 1000%	%
Lap shear	1 to 45	MPa depending on substrates
Shore Hardness	0007 to D 90	
Density	0.5 (foam) to 1.5	gr/ cm^3
Wöhler Fatigue	< 40 % loss	10^7 Cycles on FRP
Shrinkage	1-2	%

Flexibility is temperature related

Elongation to break vs. Temperature



Aging of PUR Resins

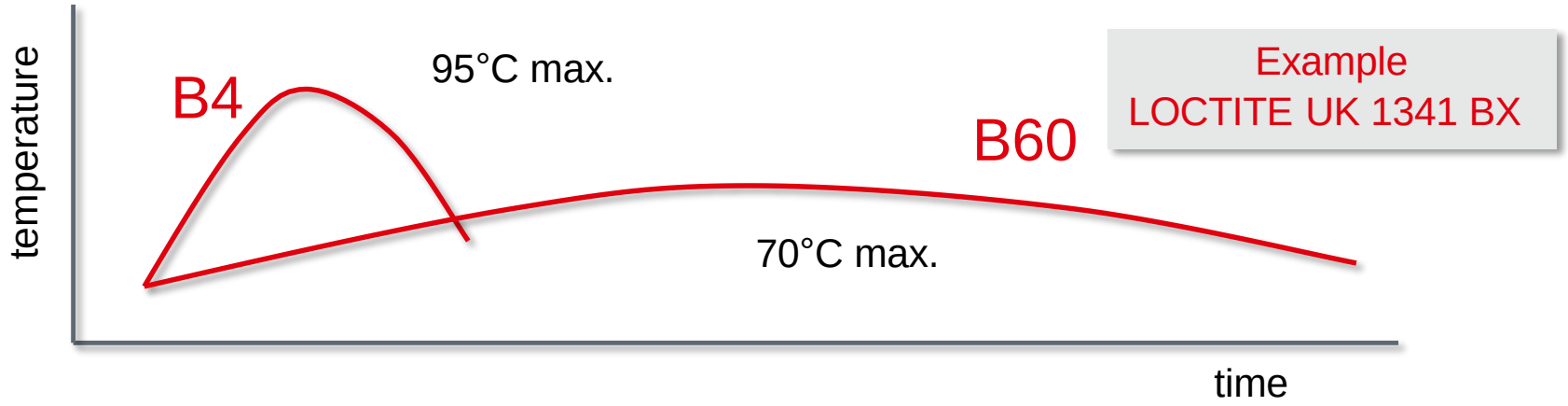


Typical process parameters PUR 2 comp.

Mix ratio	6:1 to 1:1	Resin / Hardener bw
Viscosity of mixture	1000 to Pasty	mPas
Potlife	20 sec. to 2.5 hrs.	23 °C / 50% r.h.
Open time	up to 6 hrs.	Depending on r.h.
Skin over time	10 to 60 Min	30 m° c and 75% r.h.
Cure time	6 times the potlife	23 °C 50% r.h.
Cure Temperatures	15-70	°C

Processing of PUR systems

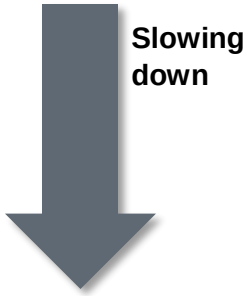
Exotherm (200g) depending on quantity and pot life



Example
LOCTITE UK 1341 BX

Potlife: Temperature dependent!

speed of reaction

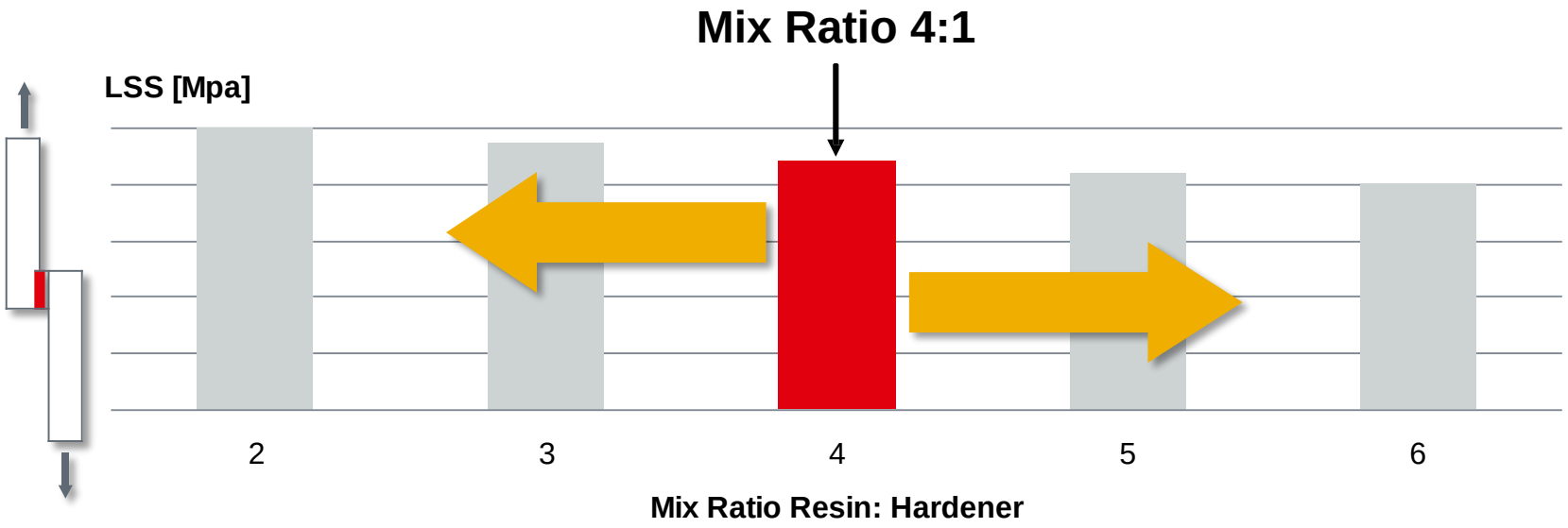


Potlife

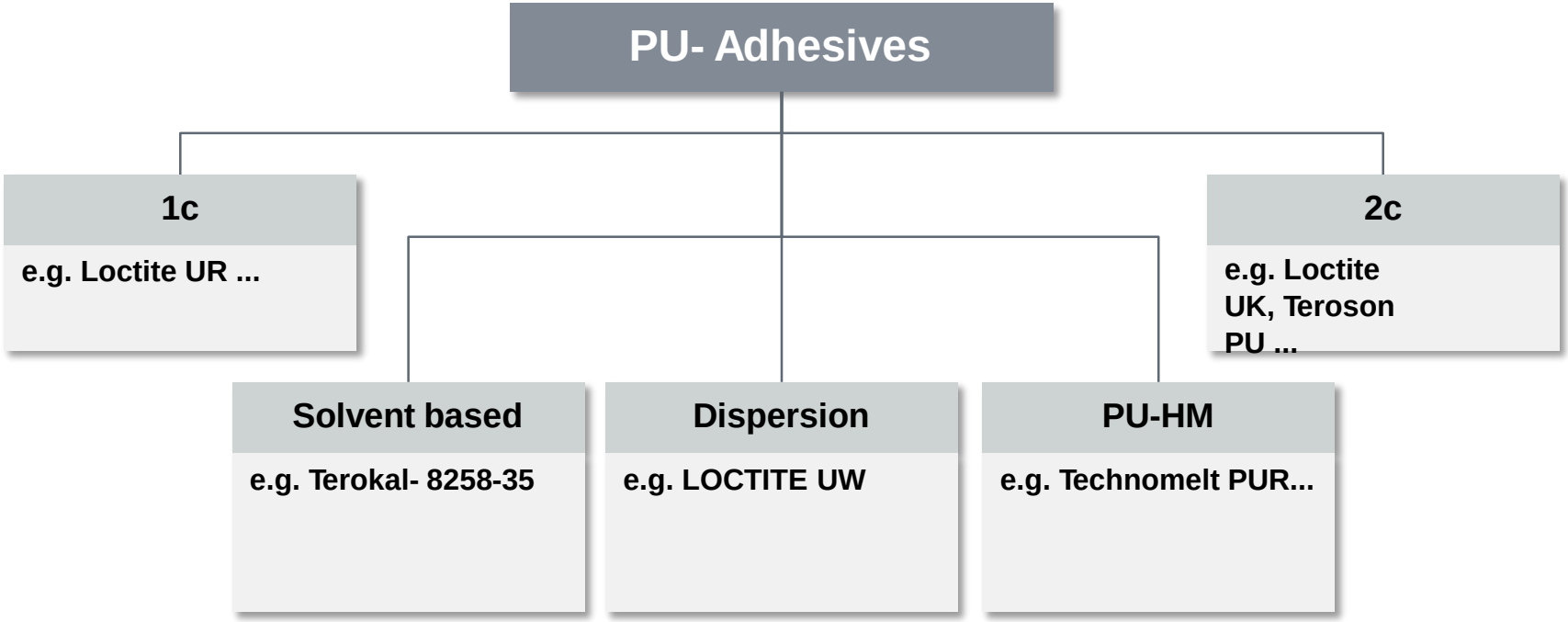
10°C 15 °C 20°C

Mix ratio tolerance

General Chemistry of Polyurethanes – 2c PU
Influence of different mixing ratios



Polyurethane adhesive technologies portfolio



Polyurethane Portfolio

Nomenclature 1C PUs

- Used in panel bonding Mainly Recreational Vehicle / Caravan and also Shipbuilding

Loctite UR

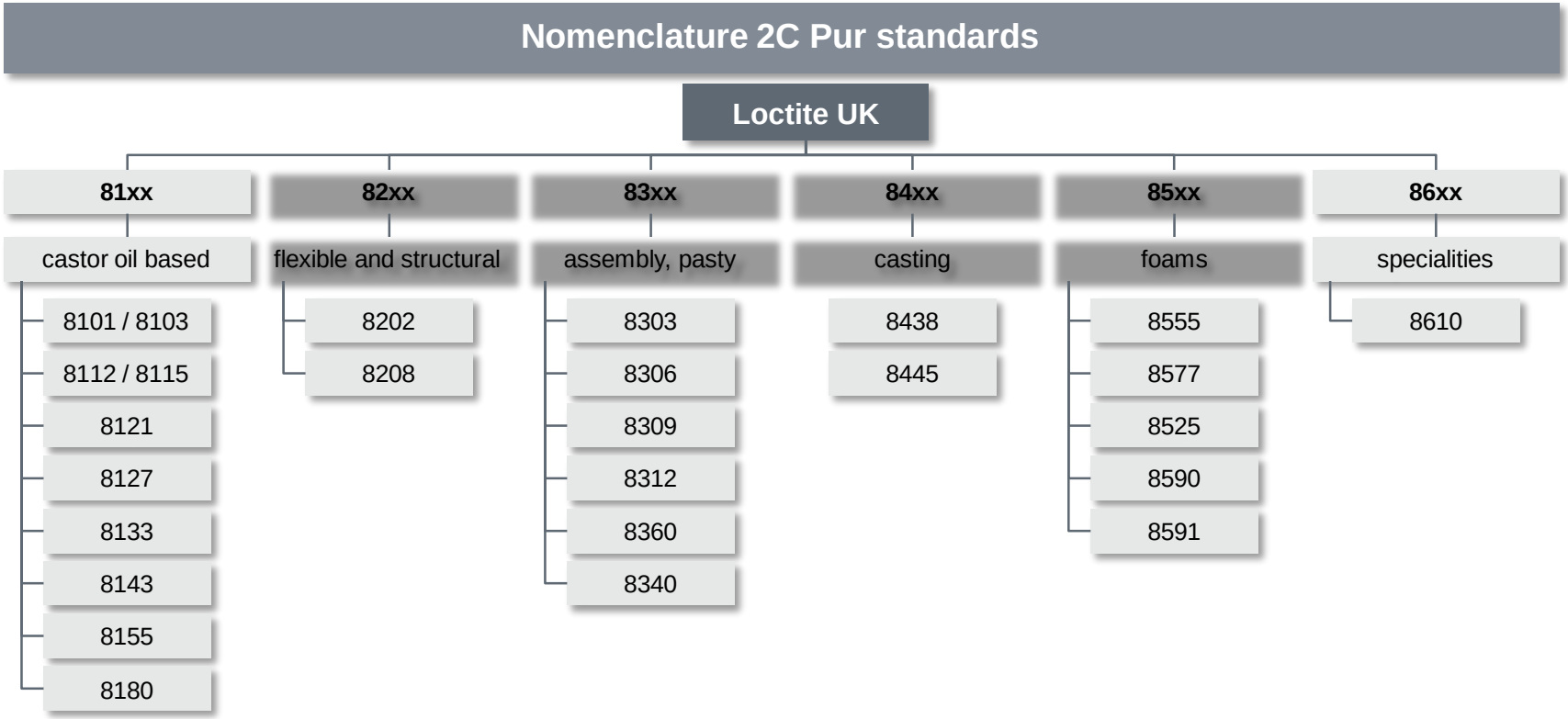
722x / 781x	738x	739x
medium viscous / low sales price	low viscous	low viscous and faster pressing
7220	7385 B	UR 7391
7221	7388	UR 7395 B
7225		UR 7398
7225B		UR 7399
7226		
7227		
7228		
7229 B		


Certificate No. CMC10047

EC-TYPE EXAMINATION (MODULE B) CERTIFICATE

Our latest standards

Polyurethane Portfolio



GM Polyurethane Core Products from Regions

Technology	WEU	NA	AP	EEU	IMEA	LAS
2K PU	LOCTITE UK 8303 B60		Loctite UK 8303/5400	Loctite UK 8303		Loctite UK 8303
2K PU		Loctite U-05 FL	Loctite U-05FL			Loctite UK 8147
2K PU	LOCTITE UK 1366 B10	Loctite UK 8639A/5639B	Loctite UK 1366 B10	Loctite UK 1366 B10	Loctite UK 1366 B10	
2K PU	LOCTITE UK 1351 B25		Loctite UK 1351 B25		Loctite UK 1351 B25	
2K PU	LOCTITE UK 8326 B30		Loctite UK 8101/5400			
2K PU	LOCTITE UK 8103		Loctite UK 8103/5400	Loctite UK 8103	Loctite UK 8103	Loctite UK 8103
2K PU			Loctite UK 8202/5400			
2K PU	TEROSON PU 6700		Loctite UK 8160/5400	Teroson PU 6700		
2K PU	TEROSON PU 860 ME		Loctite U-09FL	Teroson PU 9225 SF ME		
2K PU			Loctite CR 6127/CR 4300			
1K PU		Loctite 3370				Loctite 3370
1K PU					Loctite UR 7396	Loctite UR 7226
1K PU DGX					Teroson PU 8597	
1K PU DGX					Teroson PU 92	

How to apply PUR

Manual application LOCTITE UK 8202

PUR specific adhesive application

Spray application with laboratory equipment- LOCTITE UK 8202

Automatic robot Application

Bead application

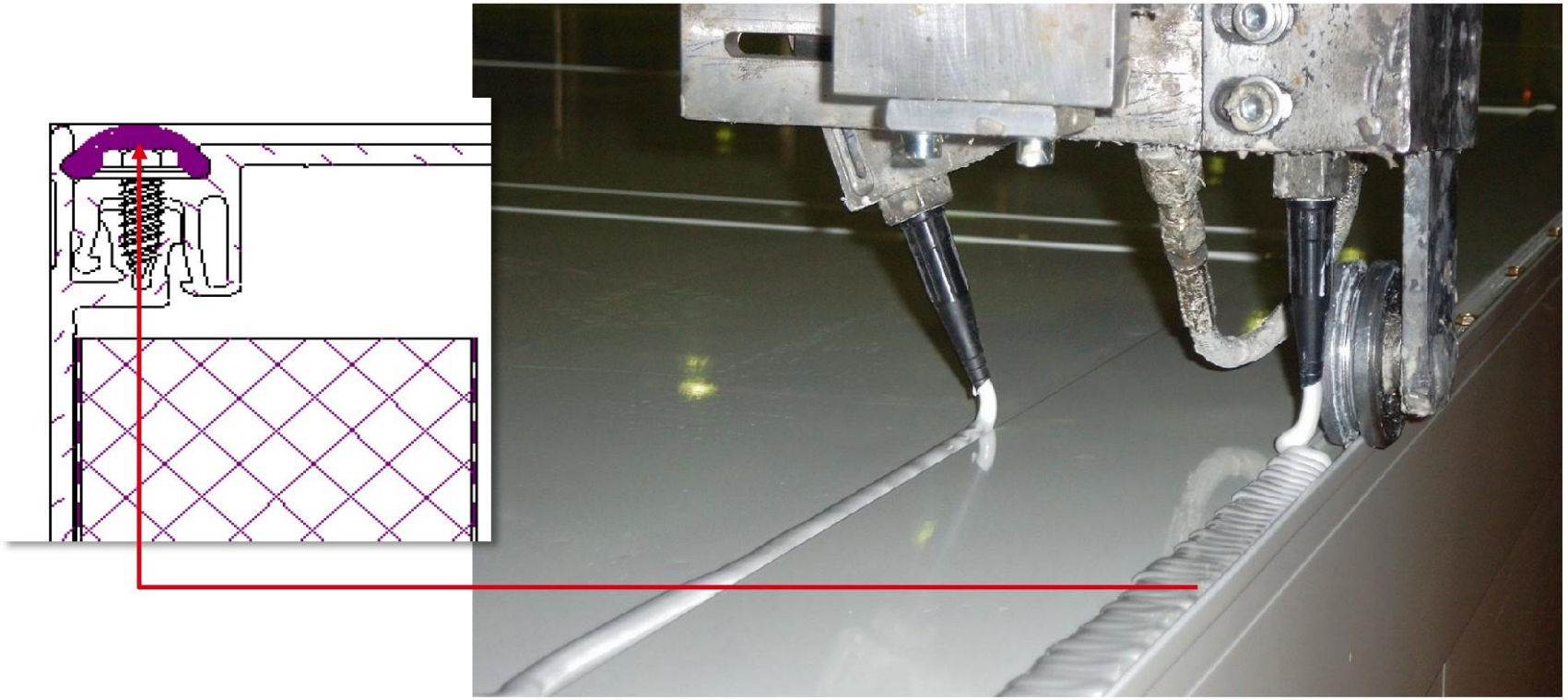
Automatic line application

Automatic adhesive lay down

Single lines for Profile bonding

Automatic dispensing

Roof sealant



Application Case History

LOCTITE UK 8160

LOCTITE UK 8160

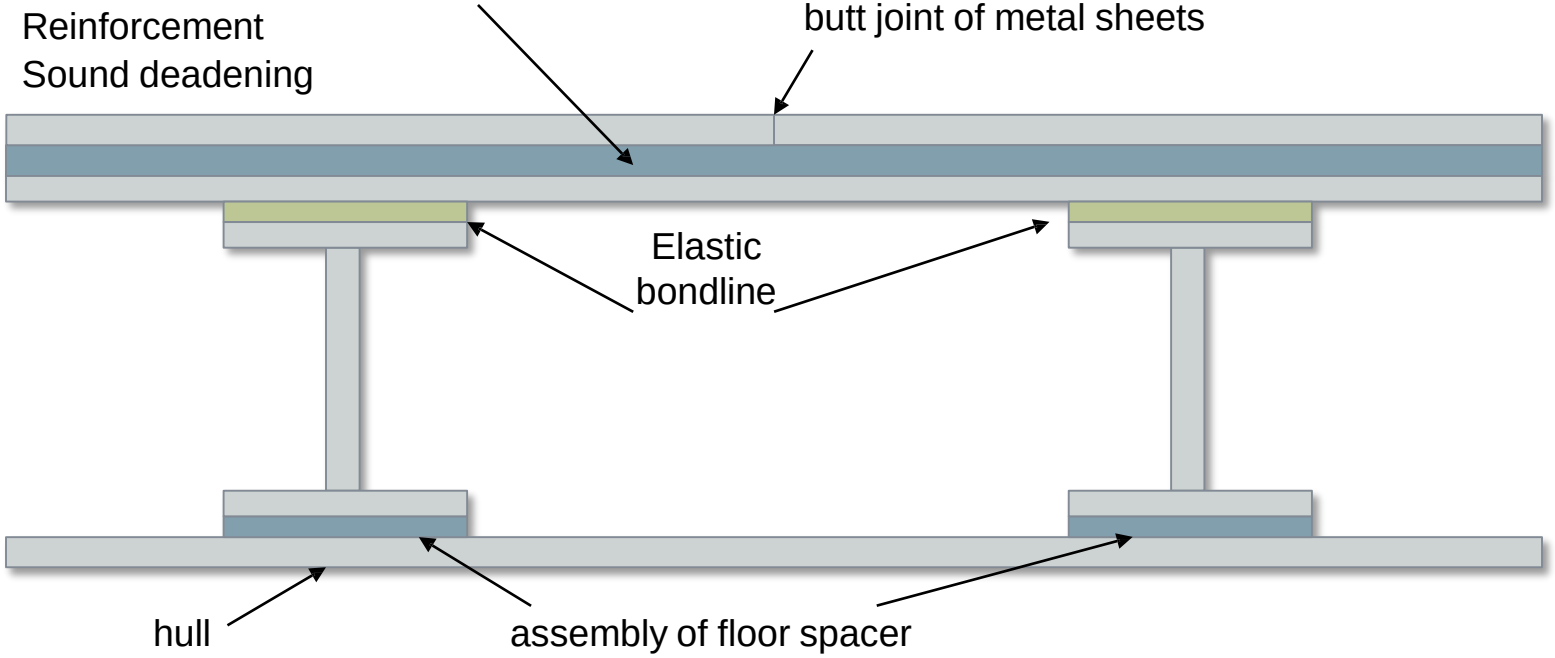
Product	LOCTITE UK 8160
Market	Shipbuilding
Application	Bonding of double flooring in ship industry
Requirements	IMO 653, good compression strength vibration dampening
Henkel USP	Working package, adjusted flow control, long term experience in shipbuilding applications, established in the marine market

LOCTITE UK 8160

Product: LOCTITE UK 8160

UK 8160 bonded metal floor sheets for

- Reinforcement
- Sound deadening



Application Case History

LOCTITE UK 8326 B30

LOCTITE UK 8326

Product	LOCTITE UK 8326 B30
Market	Truck body
Application	Assembly of truck bodies
Requirement	Adhesion to stainless steel
Henkel USP	High strength, good elasticity, good sag resistance, primerless adhesion on metals

Application Case History

LOCTITE UK 1366 B10

LOCTITE UK 1366

Product	LOCTITE UK 1366 B10
Market	Wind Power
Application	Bonding of PVC and aluminium trailing edges on wind blades
Requirements	Cartridge grade, primerless adhesion to Epoxy-GRP, Aluminium (sandblasted), PVC, cartridge size >400ml
USP	Primerless adhesion on metal, good adhesion on PVC, suitable viscosity and mix ratio for cartridge application

LOCTITE UK 1366

Product: LOCTITE UK 1366 810

Application Case History

LOCTITE UK 8202

LOCTITE UK 8202

Product	LOCTITE UK 8202
Market	Shipbuilding LNG/LPG Gastanker
Application	Bonding of sandwich panels for gas tank insulation
Requirement	Good flexibility at low temperatures (-190°C)
USP	Good flexibility, excellent cold stability Long term approval for Moss Rosenberg & Mark III -Technology

LOCTITE UK 8202

Transportation

LNG ships

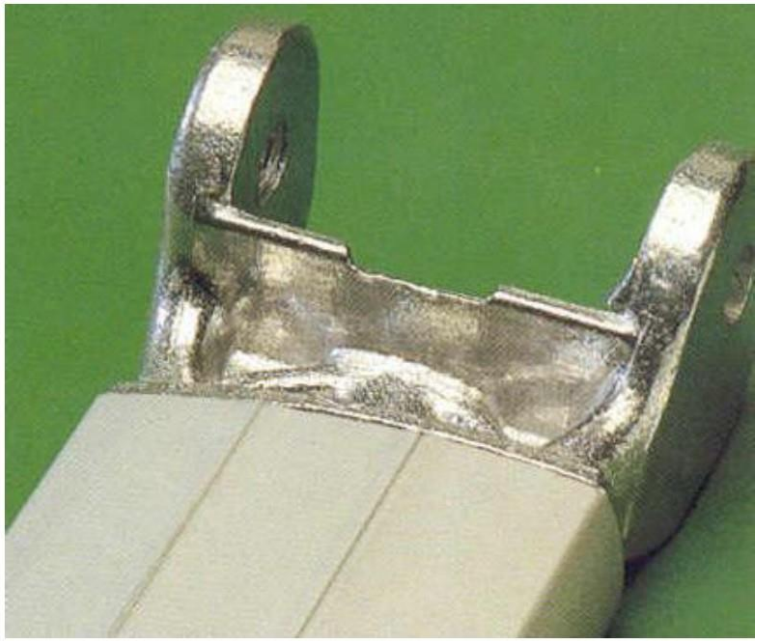
Application Case History

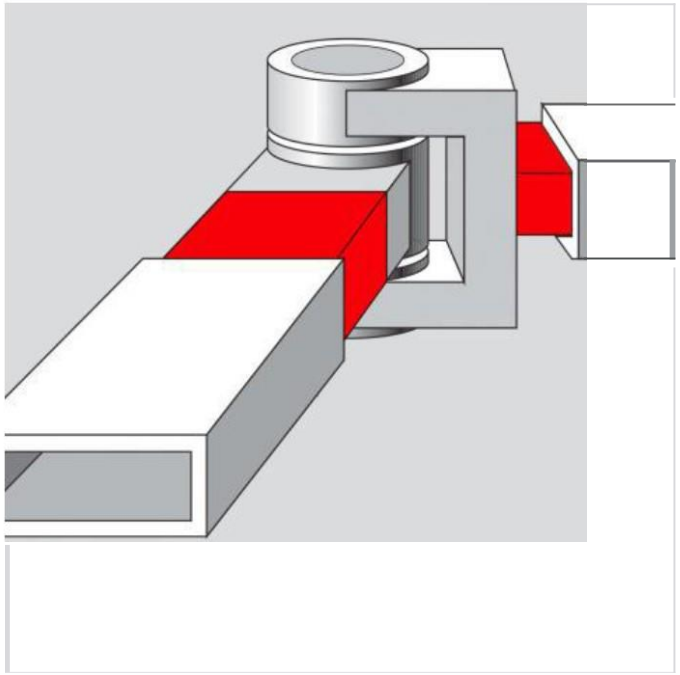
Teroson PU 6700

Teroson PU 6700

Product	Teroson PU 6700
Market	OEM
Application	Bonding of marquee hinges
Requirement	Structural bonding, cartridge grade, fast setting
USP	Fast curing, available packaging: 50ml cartridge to 200l drum

Teroson PU 6700





Henkels adhesive systems value proposition

- Henkel has great experience in many different applications
- We have a best in class quality attitude
- Our products have wide physical property range
- Our products have processing range
- Our products are easy to use
- Our products have the best quality
- Our products are also easily adaptable for changing processing and application needs
- Our products have excellent machine ability
- Our products are actually delivered at a good price for the performance that can be achieved with our products!

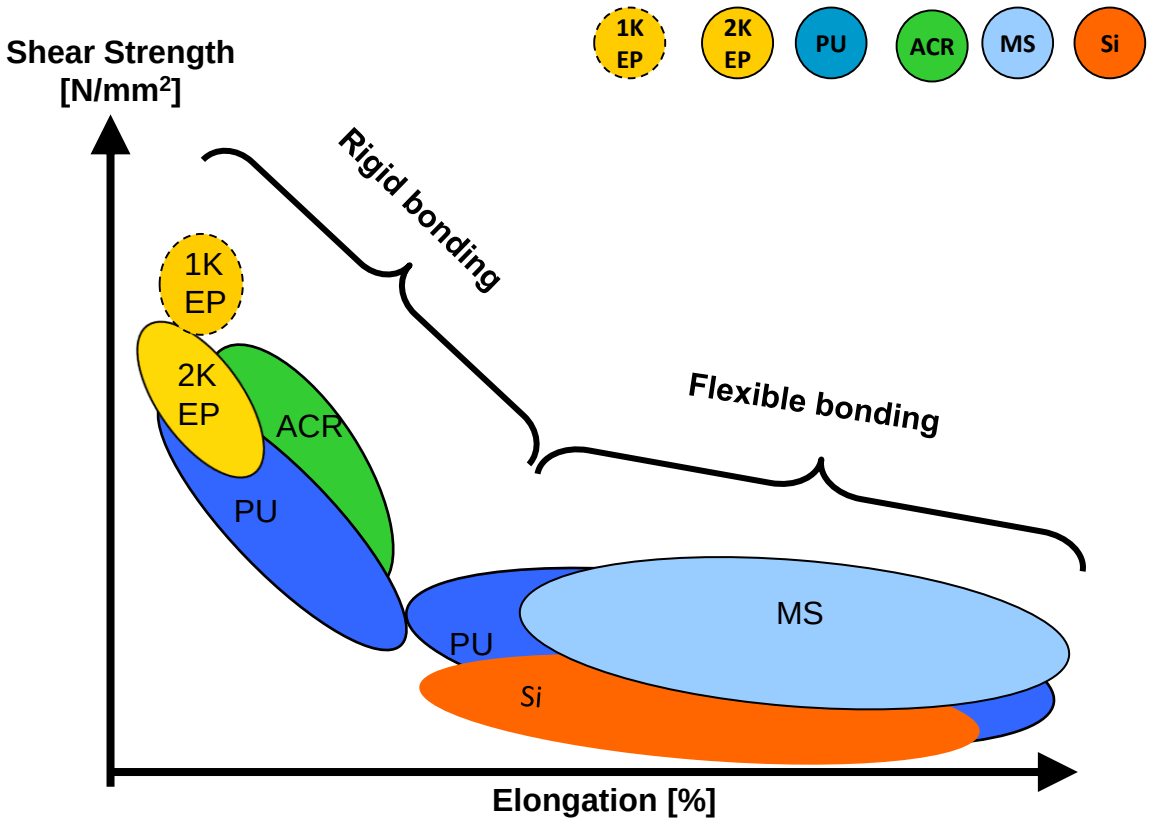
PUR adhesive systems value proposition

- Through catalysis achieve highest possible manufacturing efficiency
- We can heat cure up to 70°C
- We deliver wide adhesion spectrum to a variety of substrates and combinations
- We deliver deep temperature flexibility for cryogenic applications
- We have built in shock absorber with intelligent Tg placement
- Our products can be used in medical filter applications due to no toxicity and health compatibility of the polymer
- PUR adhesives can be easily disposed of
- They have very low shrinkage on curing and low exotherm.
- Many cure at room temperature curing
- Also we have many certifications such as G.L. NV, IMO, KWT.

Silicone Technology Training

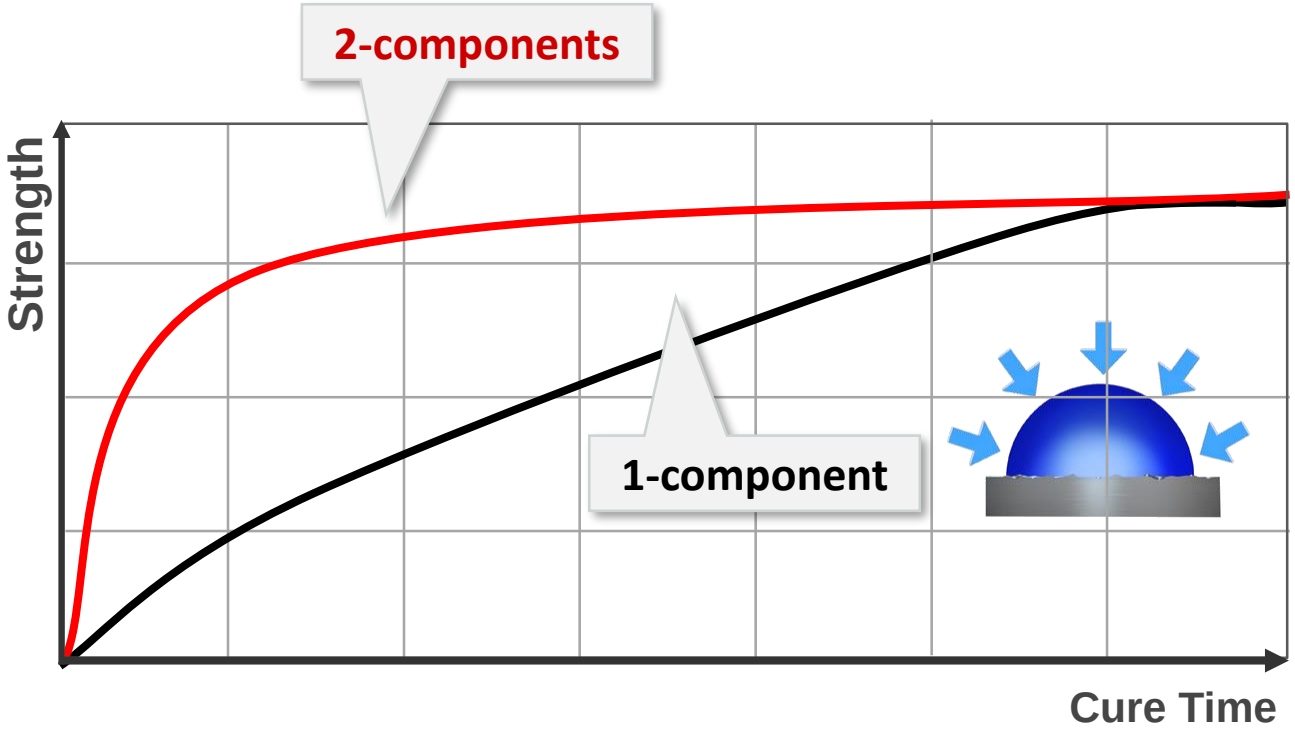
Global Training Program
2015

Silicone technology Positioning



Silicone technology description

1-Component versus 2-Component



Characteristics of Silicone

- Biocompatibility, prosthetic devices, drug delivery
- Ultraviolet resistance, outdoor applications
- Dielectric property, electronic applications
- Surface property, lubrication, cosmetics, fabric softening
- Hydrophobicity, water proof, sealing
- Thermal stability, (-)50° to >200°C
- Oxidation resistance, construction sealant, out door applications
- Permeability, face mask, drug delivery, contact lens

Silicone Features & Benefits

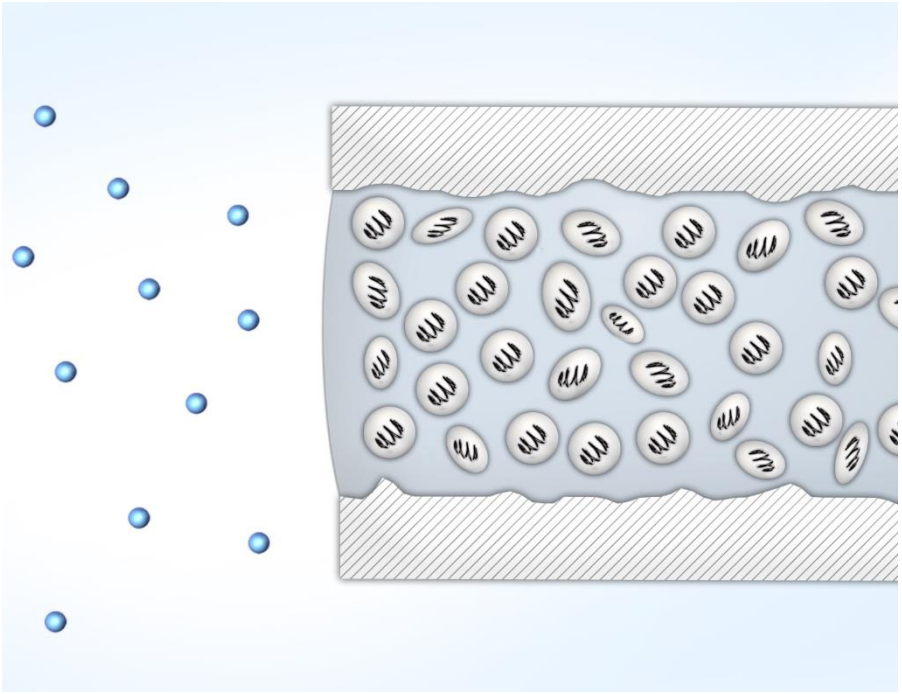
- Excellent Thermal Resistance
  - Up to 400ºF Continuous, 600ºF Intermittent
- Superior Flexibility From -85°F to 400°F
- Good Resistance to Polar Solvents
  - Coolant, Water, Isopropyl Alcohol
- Excellent Weatherability – UV, Moisture, etc.
- Good Adhesion to Metals and Plastics

2-Component RTV Silicone Features & Benefits

- Fast Cure
  - The Speed you Need!
- Unlimited Cure Through Depth
- High Temperature
  - 400ºF
- High Elongation
  - >150%
- High Strength
  - Metal, Plastic and Glass
  - 250 psi tensile strength
- Mixing ratio 2:1, 4:1, 10:1
- Various fixture time (5~60mins)

Silicone Technologies

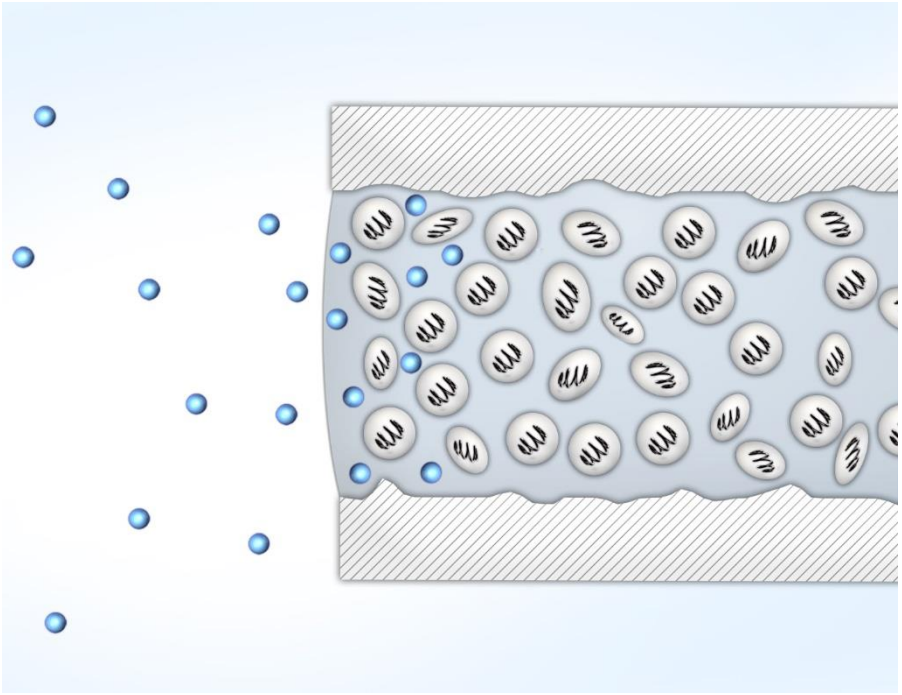
1-Component RTV



- Uncured Adhesive
- Flexible Pre-Polymer
- Moisture

Silicone Technologies

1-Component RTV



- Uncured Adhesive
- Flexible Pre-Polymer
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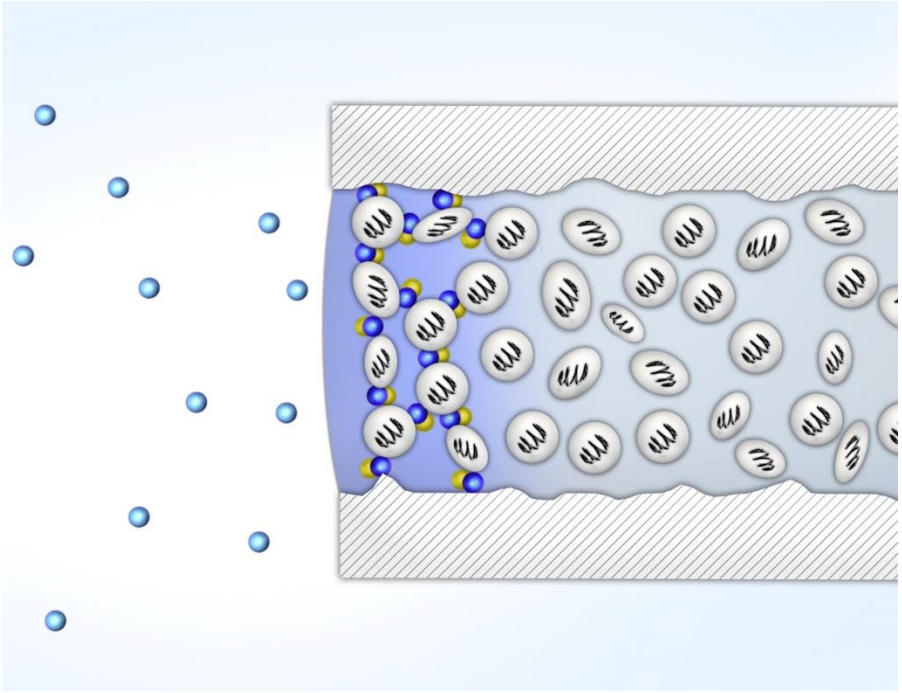
Silicone Technologies

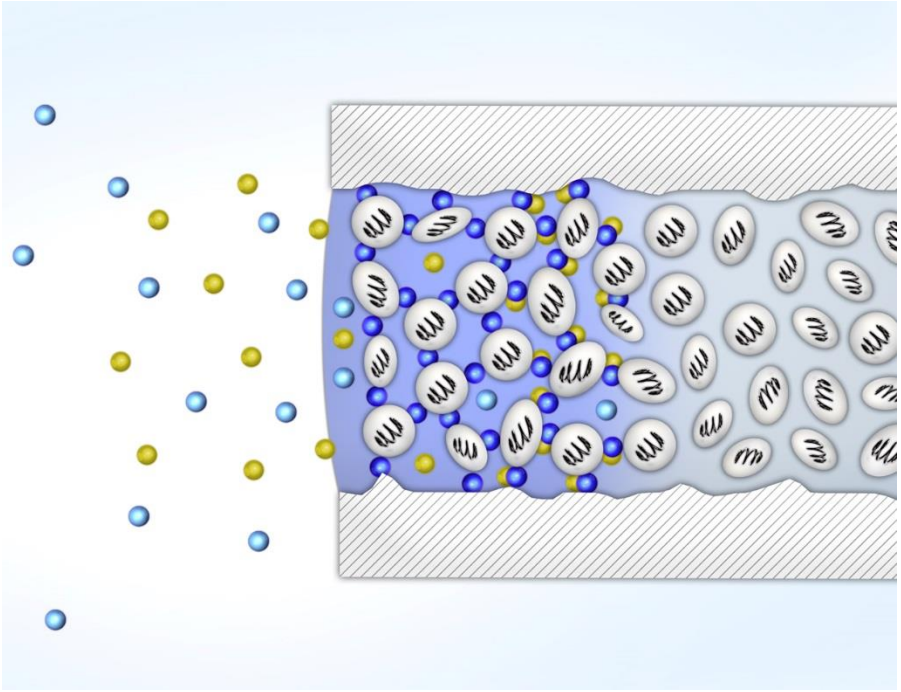
1-Component RTV



- Uncured Adhesive
- Flexible Pre-Polymer
- Moisture
- Cross link
- By product
- Curing Polymer

Silicone Technologies

1-Component RTV



- Uncured Adhesive
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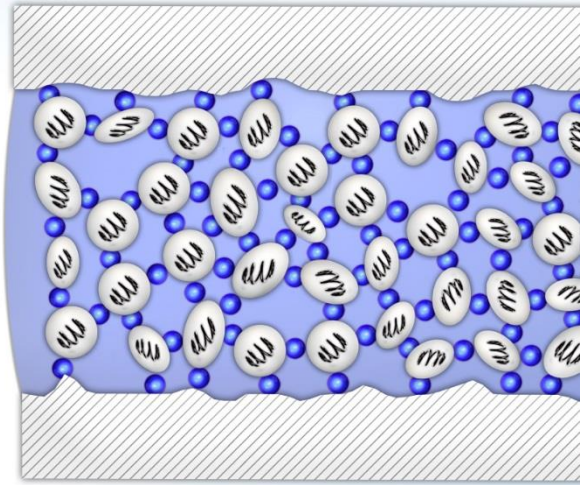
Silicone Technologies

1-Component RTV

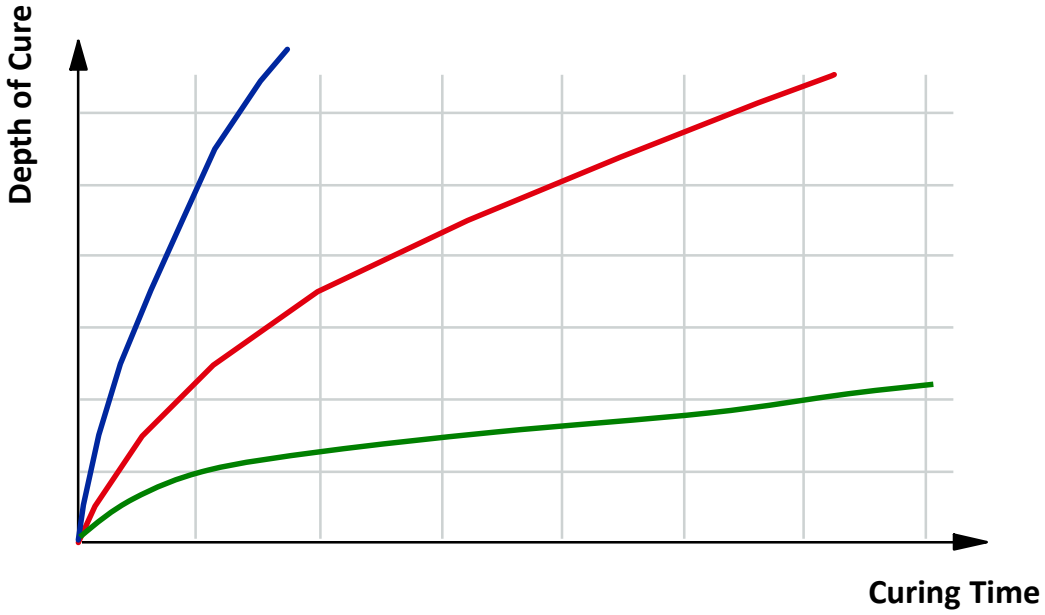


- Cross link
- Cured Polymer

Silicone Technologies

1-Component RTV

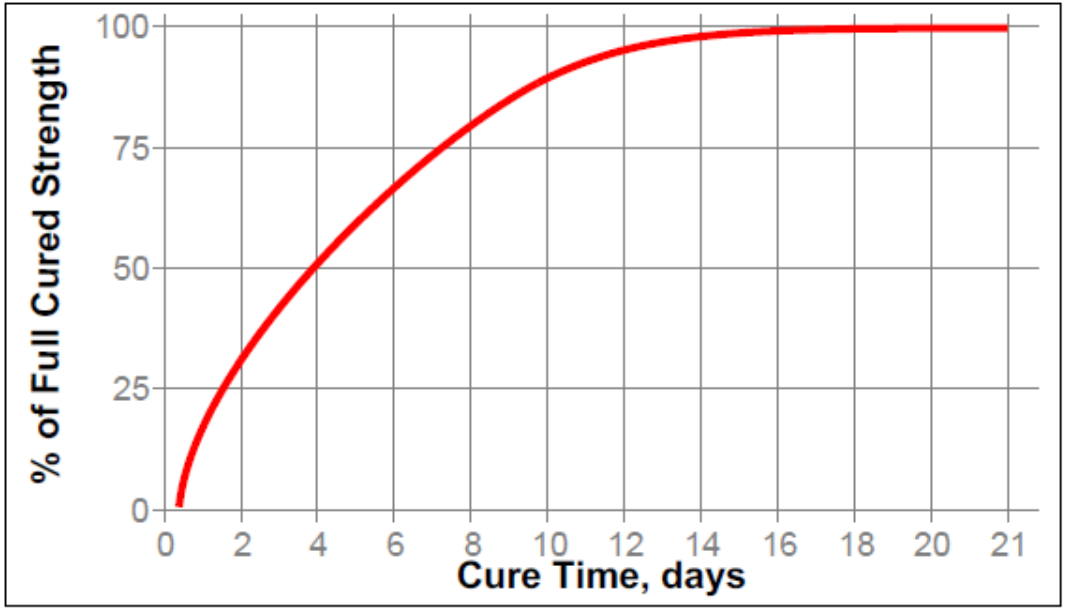
- The higher the **humidity** the faster the cure
- The higher the **temperature** the faster the cure



Silicone Technologies

1-Component Cure Time (Example)

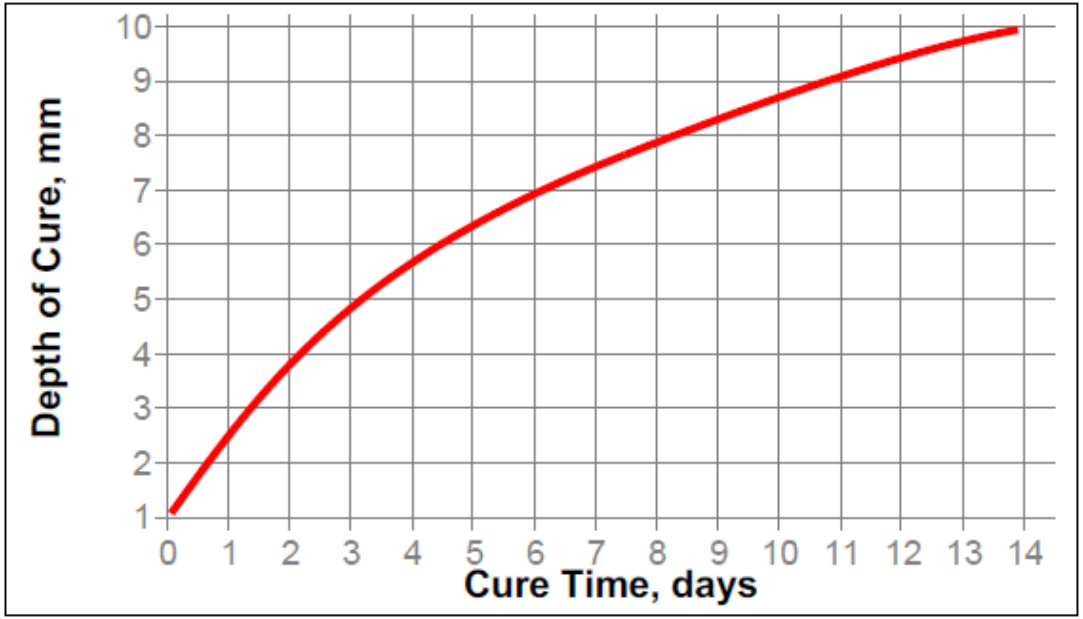
- Loctite 598



Silicone Technologies

1-Component Depth of Cure (Example)

- Loctite 598



2-Component RTV Silicone – Cure Mechanism

- Also known as 2-Part or 2K Silicones
- Used for structural bonding and sealing applications

Curing Mechanism

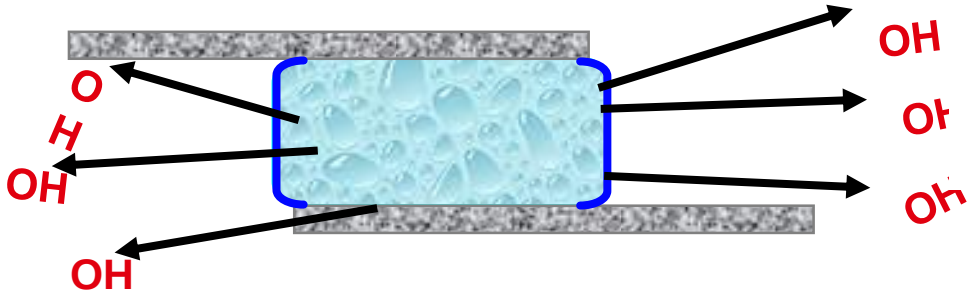
Condensation Reaction

Part A + Part B = Cure!

When mixed in proper ratio a chemical reaction occurs initiated by the catalyst reacting with water (in formulation)

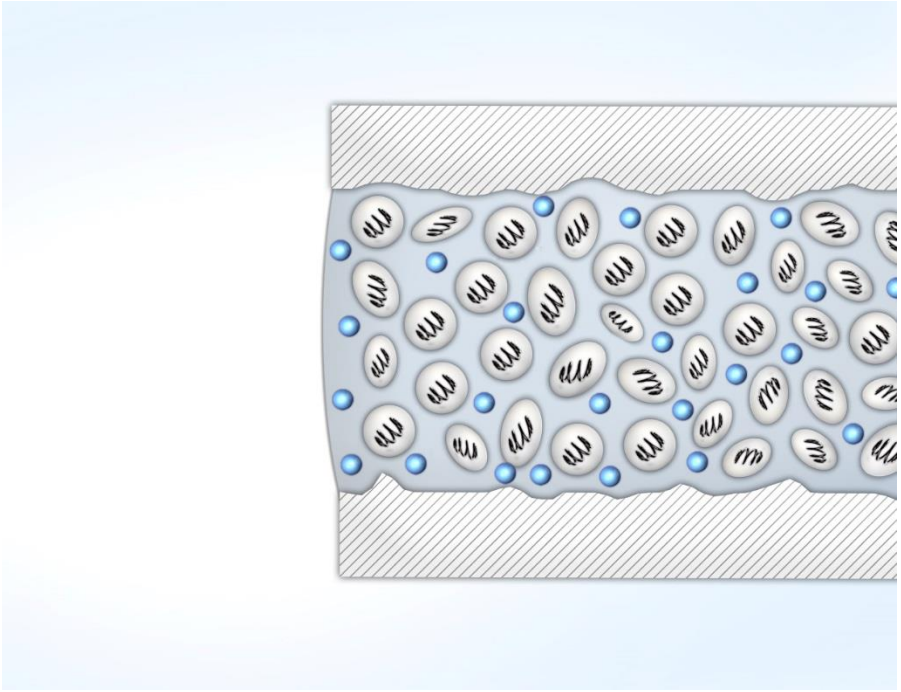
By-product (for Alkoxy cure)

Alcohol (OH) out



Silicone Technologies

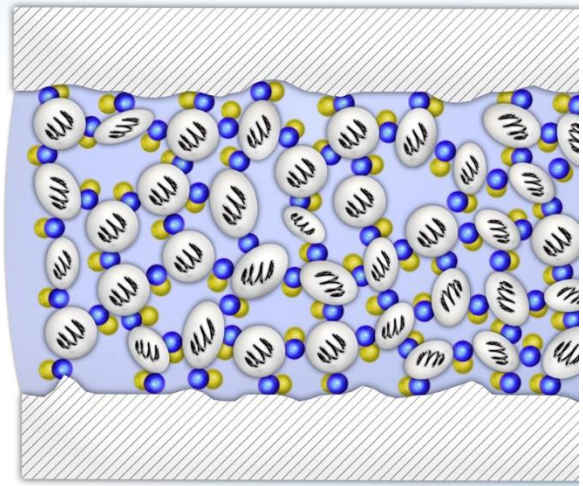
1-Component RTV



- Uncured Adhesive
- Flexible Pre-Polymer
- Moisture

Silicone Technologies

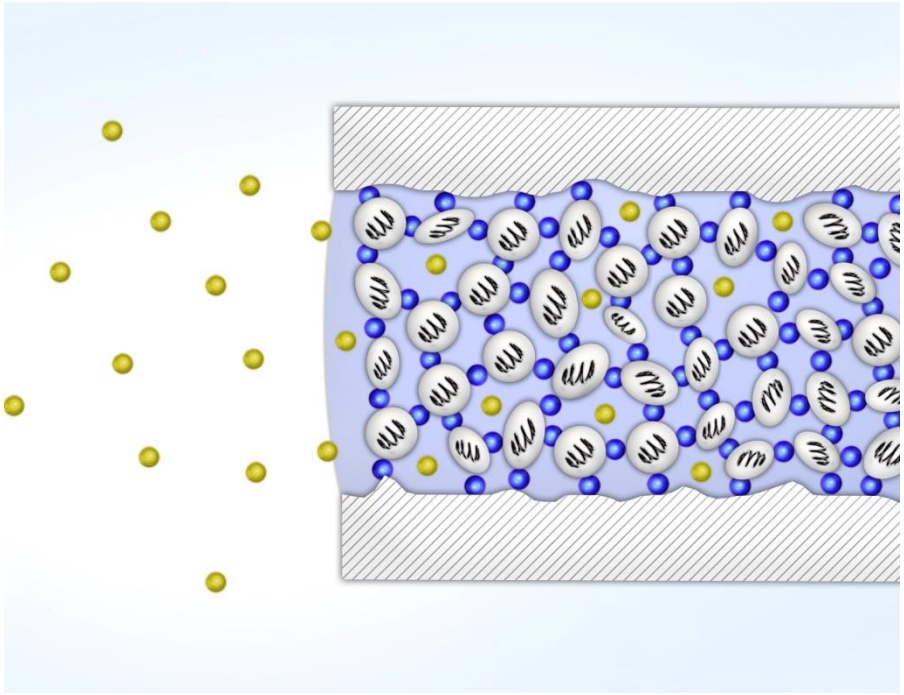
2-Component Cure



- Flexible Pre-Polymer
- Cross link
- By product
- Curing Polymer

Silicone Technologies

2-Component Cure



- Cross link
- Cured Polymer

2-Component Silicone Target Applications

4 High Strength Grades

- Appliances
  - Edge sealing/bonding glass cook tops
  - Bonding support brackets
  - Bonding glass doors
  - Bonding door handles
- Solar Panels
  - Potting onto glass panels
  - Bonding glass panels to frames
- **Window & Door Glazing**
  - Bonding glass windows to frames
  - Bonding glass doors to frames
- **General Gasketing**

3 Ultra Clear Grades

- Industrial Lighting – bonding lenses to frames
- Potting LED's

1-Component RTV Silicone

Product Listings

Product	KEY PROPERTY	TEMP. RANGE	EXTRUSION RATE grams/min	DURO METER (Shore A)	% ELONGATION
587 Blue	Non-corrosive oil resistant	-52C ~ 230C	300	33	400
593 Superflex	Black	-52C ~ 230C	100	27	600
594 Superflex	White	-52C ~ 230C	100	27	600
595 Superflex	Clear	-52C ~ 230C	100	27	600
596 Superflex	Red	-52C ~ 230C	180	33	370
598 Black	non-corrosive exc. oil resist.	-52C ~ 230C	325	33	300

1-Component RTV Silicone

Product Listings (Continued)

Product	KEY PROPERTY	TEMP. RANGE	EXTRUSION RATE grams/min	DURO METER (Shore A)	% ELONGATION
5699 Gray	high modulus transmission compatible	-52C ~ 230C	250	55	160
5900 Black HB	blow-out resistant instant seal high elongation	-52C ~ 230C	40	30	550
5910 Black	high elongation	-52C ~ 230C	400	30	550
5920 Copper	high temperature	-52C ~ 300C	400	31	355
5999 Gray HB	high modulus blow-out resist	-52C ~ 230C	105	47	175

2C Silicone Products

	5600	5610	5604	5605	5606	5607	5611S	5611F	5615	5616	5612
Color	black gray almond	black	black gray almond	gray	gray	gray	gray	gray	black	white	red
Mix atio	2:1	2:1	4:1	4:1	4:1	2:1	10:1	10:1	2:1	2:1	4:1
Viscosit	paste	paste	paste	paste	paste	paste	self leveling	self leveling	paste	paste	paste
Fix time (mins)	5	7	10	5	20	50	50	15	15	15	
Air gun											
Manual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High temp	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Source											Yes
UL	NA 746C	Fas	NA 746C	NA	NA 94HB F2	NA	NA 94 V0	NA 94 V0	Fas	Fas	Fas

6. Cleaner / Primer Overview

Loctite 7063

- Solvent-based general parts cleaner
- Removes most greases, oils, lubrication fluids, metal cuttings and fines from all surfaces
- Fast evaporation

Loctite 7070

- Solvent-based general parts cleaner
- Usable as spray or in immersion cleaning process at RT
- Removes special heavy oils
- For most plastic parts without the risk of stress cracks

Terostat-450

- Isopropanol-based general parts cleaner
- Contains adhesion promoter
- Detectable with UV-light

Silicone Technology
1-Component Dispensing

- Manual or pneumatic handheld applicator
- Automatic dispensing equipment

2C Silicone
Dispensing Equipment

Pneumatic Cartridge Dispense

Item # 983439

Bulk Dispense

Mix Tips

Item # 98667 or 98457

1-Component RTV Silicone - Considerations

- Slow Cure – 24 hours full cure, 7 days full adhesion
- Low Cohesive/Tensile Strength
- Poor Resistance to Non-polar solvents
- Surface Tackiness/Coefficient of Friction
- Poor adhesion to elastomers
- Volatiles Can Contaminate Other Processes (PAINT)
- Corrosivity
- Limited Depth of Cure (3/8”)

2-Component Silicone Considerations

- Poor Resistance to Non-polar solvents
- Surface Tackiness/Coefficient of Friction
- Clarity
- Poor adhesion to elastomers
- Volatiles Can Contaminate Other Processes (PAINT)
- Worklife in the Mix Nozzle- Now Longer Open Time Options!
- Capital equipment to dispense 2K

SMP technology
Advanced Level Training

2015



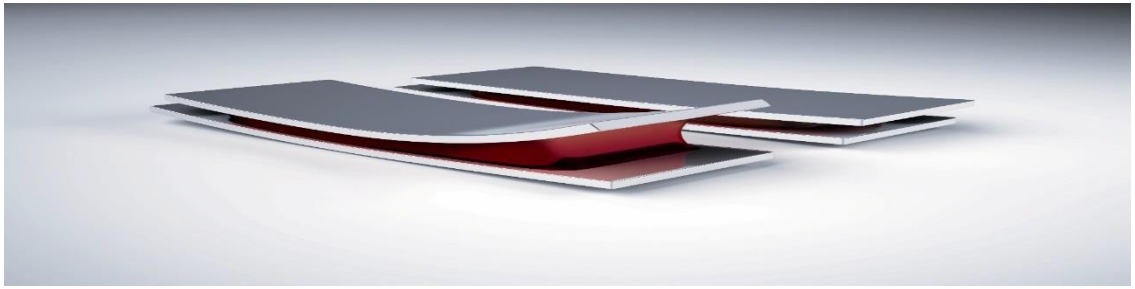




SMP Technology
Technology Description

SMP = Silane Modified Polymer

Silane Modified Polymers are **elastic** sealants / adhesives.



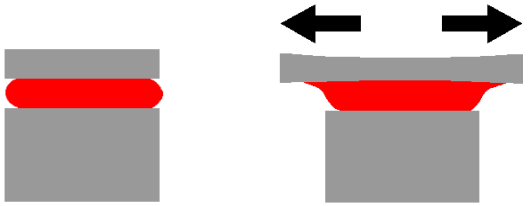
Henkel Brand: **Teroson MS** (former Terostat MS)

SMP Technology

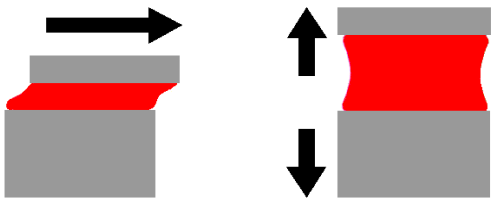
Technology Description

What does “elastic” mean ?

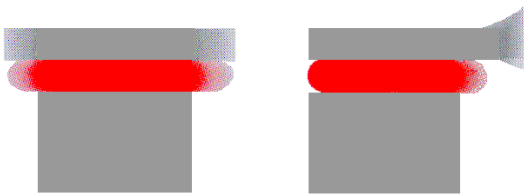
Compensation of differing material expansion



High elongation recovery under shear or tensile stress



High vibration absorption capability



High resistance to peel forces

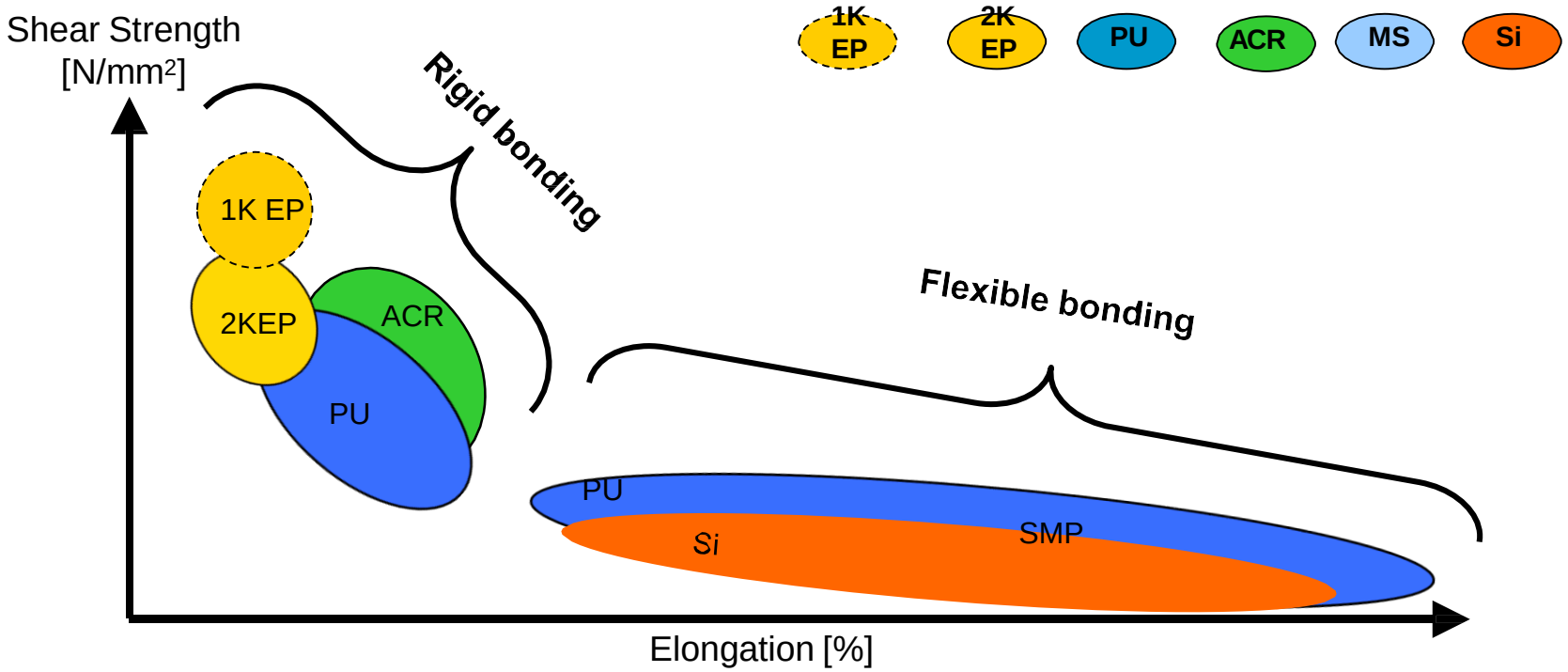
High impact and shock absorption capability

SMP Technology
Technology Description

- Teroson MS products belong to reactive adhesives and sealants.
- They cure in the presence of moisture/air humidity to an elastic material.
- They are easy to apply at room temperature – and even at lower temperatures = 5-10°C

SMP Technology

Technology Description



SMP Technology
Technology Description

Positioning SMP versus comparable technologies (Polyurethane=PUR, Silicone)

	Silicone	PUR	SMP
Temperatures of use [min/max]	-40°C TO + **250°C**	-50°C TO + 100°C	**-50°C** TO + 100°C
Elasticity	High (140-400 psi)	HIGH (140-1100 PSI)	High (140-850 psi)
Primerless adhesion	Several substrates	most substrates	**On most substrates**
UV + weather resistance	**Good**	Limited (MDI based)	**Good**
Ability to be overpainted	No	**Yes**	**Yes**
Chemical resistance	**Very good**	Good	Good
Gap fill	Good	Good	Good
Health and safety labelling	Some grades	Some grades	**No**
Room temperature cure (RTV)	Yes	Yes	Yes
Odour	Often unpleasant Odour until complete Curing	Odourless before and After curing – except Solvent based grades	**Odourless before And after curing**

SMP Technology
Technology Description

General properties

- Flexible bonding and sealing
- Room temperature, neutral curing
- Excellent (primerless) adhesion to a wide range of substrates
- Good gap fill
- High and Low temperature resistance
- UV and weather resistant
- Good chemical resistance
- Paintable
- Good health and safety labelling

SMP Technology
Product Variants and Benefits

Cure Technology	**1**-component versus **2**-component (easy to use versus controlled cure)
Viscosity	Low (self levelling) to high (good gap fill)
Application method	Bead, spray, brush, potting
Cure Speed	Slow (days) to very fast (just a few minutes)
Colour	White, grey, black (other colours on request)
Flammability	Flame retardant grades available
Temperature resistance	-50°C UP TO +100°C
Weathering and UV resistance	Good
Adhesion properties	Excellent adhesion to a wide range of substrates

SMP Technology
Product Variants and Benefits

Product properties – positive features

- High resistance against peel forces
- Capability to absorb / compensate dynamic stresses
- Capability to bond dissimilar substrates
- Capability to compensate tolerances between the joined parts
- Capability to compensate movements between the joined parts
- Capability to compensate stress caused by different thermal expansion of the joined parts

SMP Technology
Cure Mechanism

1 omponent product
Cures by humidity / atmospheric moisture to a cross-linked polymer

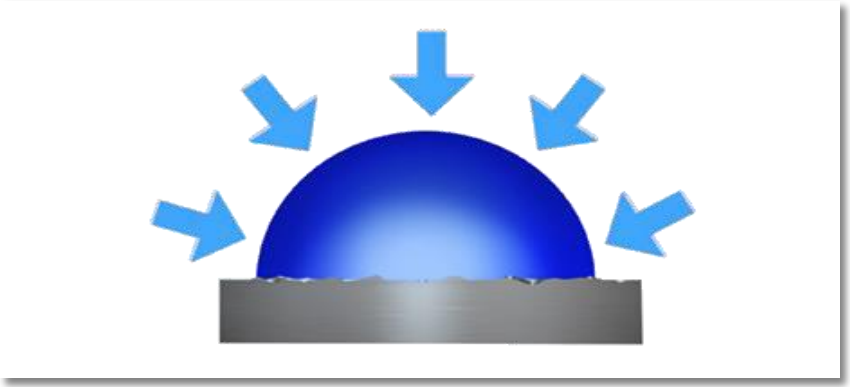
2 omponent product
Properly mixed before application. Cures independent from atmospheric moisture

Cure speed can be accelerated by increasing the temperature !
(increase of 10°C doubles cure speed)

SMP Technology
Cure Mechanism

1-component product (1c)

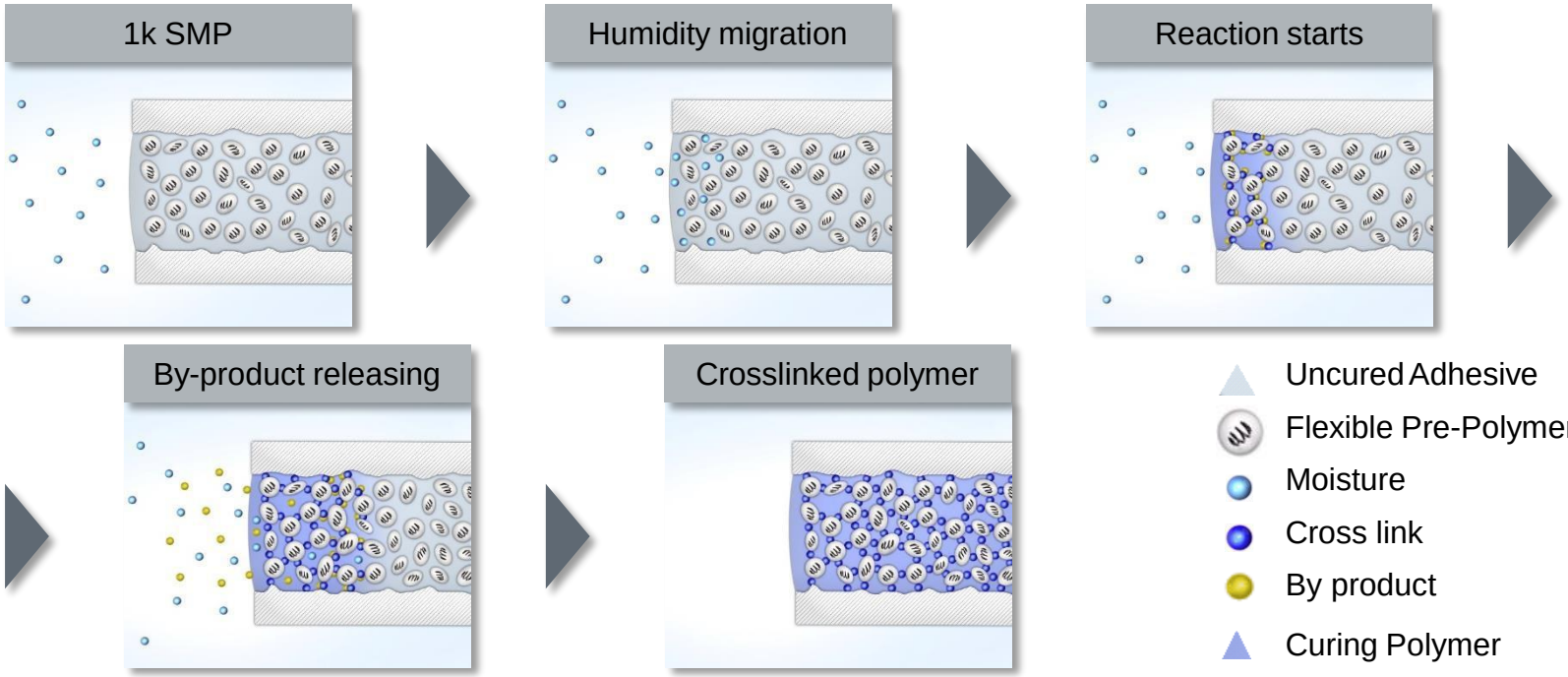
- Curing is initiated by moisture (air humidity) and starts with skin formation
- Curing from outside to inside
- Forming an elastic cross-linked polymer.



Depth of cure is approx 3-5 mm/day

Cure Mechanism

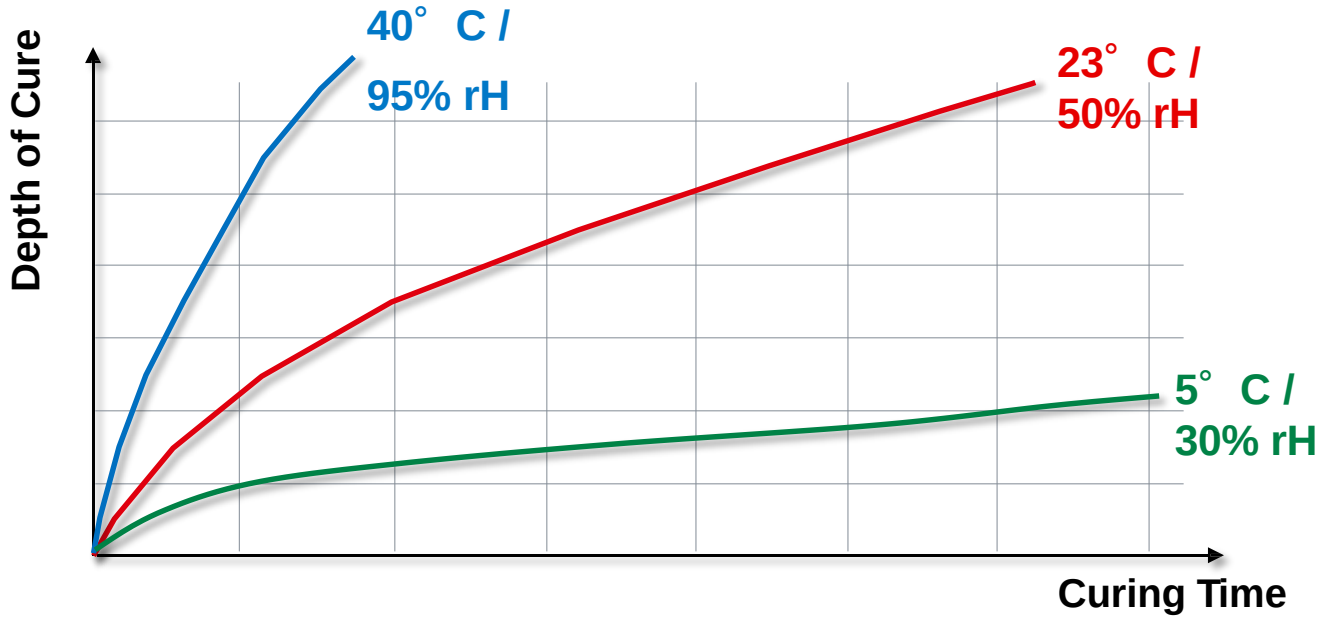
1 component product (1c)



Cure Mechanism

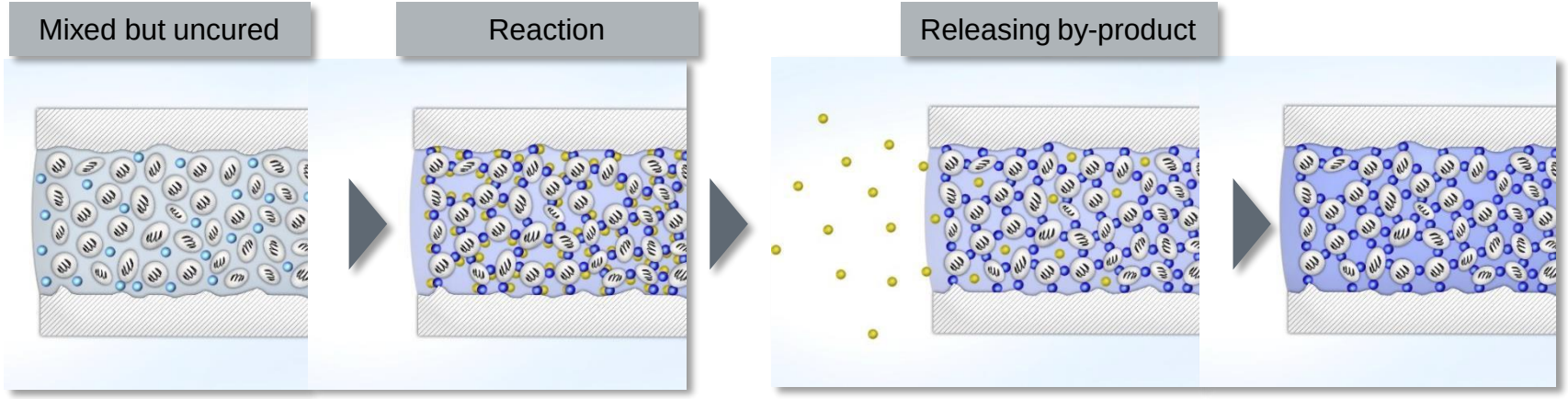
1 component product (1c)

- The higher the **humidity** the faster the cure
- The higher the **temperature** the faster the cure



Cure Mechanism

2 component product (2c)



- Uncured Adhesive
- Flexible Pre-Polymer
- Moisture

- Flexible Pre-Polymer
- Cross link
- By product
- Curing Polymer

- Cross link
- Cured Polymer

SMP Technology
Cure Mechanism

SMP Cure – why use 1c or 2c product?

	1K SM	2K SMP
+	• Room temperature curing • No mix	• Room temperature curing • Fast cure • Full bulk cure in short time
-	• Cure from outside to inside • Low cure speed	• Mixing operation

Cure Mechanism
Terminology

- **Skin over time** – Time a skin is formed (valid for 1c only)
- **Mix tip pot life** – Time until the mixer is blocked (valid for 2c only)
- **Open time** – Time until the parts have to be joined at the latest
- **Fixture time** – Time to reach a minimum strength for handling the bonded parts
- **Bulk cure** – Time to reach the final strength of the product

SMP Technology
Application areas

Bonding

Sealing

Coating

SMP Technology
Application areas

- Refrigerated transport containers
- White goods assembly
- Automotive aftermarket
- Truck manufacturing
- Railway carriages
- Marine applications
- Recreational vehicles
- Prefabricated construction elements
- Renewable energies (solar, wind





SMP Technology
Applications- examples

SMP Technology

Product Range

Henkel‘s SMP – Products for Industrial Applications

Elastic Adhesives > 280 PSI	Potting Self leveling	Thick film Coatings (0,5 – 5mm) Spray-/brushable	Elastic Sealants < 200 P
Teroson MS 935 Teroson MS 937 Teroson MS 939 (5512) Teroson MS 939 FR Teroson MS 9360 (5572) Teroson MS 9380 Teroson MS 9000 PL Loctite 5570 (White) Teroson MS 9399 (5590)	Teroson MS 931 Teroson MS 9306	Teroson MS 9320 Teroson MS 9320 SF Teroson MS 9302	Teroson MS 930 Teroson MS 930 FR Teroson MS 510 Loctite 5510 .....

Elastic Sealants

Teroson MS 930	• standard elastic sealant)
Teroson MS 930 FR	• standard elastic sealant)
Teroson MS 935	• (higher strength sealant with good chemical and Short term temperature resistance, e.g. paint oven cycle)
Teroson MS 930	• (lower cost sealant with good mechanical properties = high elastic recovery)

Elastic Coatings (thick film > 1 mm)

Teroson MS 9302	• (sprayable 1-component)
Teroson MS 9320 SF 6 in1	• (sprayable 1-component with good paintability)

Elastic Potting Compounds

Teroson MS 931	• (low viscos 1-comp., self levelling)
Teroson MS 9306	• (low viscos 1-comp., slightly thixotropic)

SMP Technology

Surface treatment – support products

Teroson SB 450

- (Isopropanol-based general parts cleaner
- Contains adhesion promoter
- Detectable with UV-light

Teroson FL

- Universal Cleaner based on petroleum spirit
- Removes most greases, oils, and dust from all surfaces
- Usable in immersion cleaning process at RT

Teroson PU 8550

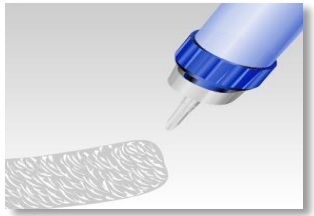
- Isopropanol based cleaner
- Designed to clean glass, ceramic coatings and painted surfaces
- Usable in immersion cleaning process at RT

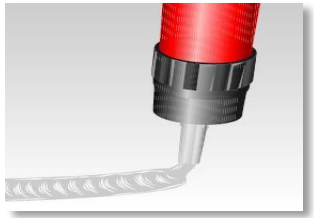
Teroson PU 8519 P

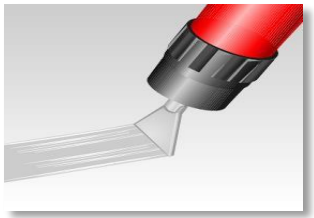
- Black solvent-based primer
- Excellent UV resistance
- Improves the adhesion on glass, glass ceramic and metall

SMP Technology
Dispensing equipment

Manual handheld pneumatic applicator dispensing equipment







TCS Technical Training

Soft Press Pneumatic Applicator IDH # 250052

Product Description Sheet
Soft Press hand held Pneumatic Applicator
Item No. 250052

Product Description
The Soft Press Handheld Pneumatic Applicator is designed to dispense high viscosity adhesives and sealants that are packaged in 400ml, 570ml, or 20oz soft packs commonly known as Sausage Packs or Foil Packs. The Applicator easily applies beads, dots or dashes of material depending on the application. An integrated air regulator allows for precise adjustment of material flow rate.

Product features
- Drawn Aluminum Barrel
- Instant Air Dump Valve
- Floating Pusher action with Secure Cord
- Adjustable Air Regulator – 125 PSI Max Output
- Silenced Air Exhaust
- Quick Release End Cap
- Air Hose connector and Nozzle included

Technical data
Max air pressure input – 145 psi Max
regulated air pressure – 125 psi
Weight (excluding adhesive) .7 kg (1.5lb)

Replacement Parts
Soft Press Applicator Nozzle, Item Number 582416

SMP Technology
Dispensing equipment

1-component Dispensing “Sausage Pack”

Package Preparation:

Remove tip of package with a pair of sharp cutters

Remove front barrel cap from applicator and insert nozzle. Cut nozzle at desired position and angle with a sharp knife.

Place the open package into the barrel

Replace front cap and ensure a tight fit to barrel.

Dispensing Material

Rotate knob counterclockwise to reduce material flow. Turn knob clockwise to increase flow.

Squeeze trigger fully to dispense material. Release trigger to stop flow.

SMP Technology
Dispensing equipment

2 omponent Dispensing

Mainly static mixing !

Various types of mixers can be used – depending on required machine output

- Manual or pneumatic
- Automatic 2-component dispension equipment (20 or 200l drum)

SMP Technology
Dispensing equipment

2 component Teroson MS products - options

Mix ratio 10:1

- accelerator = Teroson MS 9371 B

Mix ratio 100:2

- accelerator = Teroson MS 9372 B

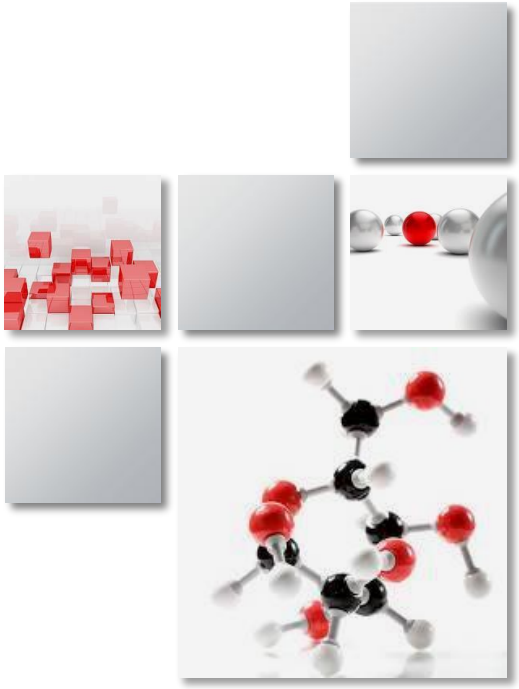
Important: every Teroson MS product can be accelerated using Teroson MS 9371B or 9372B
except Teroson MS 500 (hot applied) and Teroson MS 9399 (1:1 mix ratio)

SMP Technology
Dispensing equipment

Cleaning automatic equipment - options	
A) Teroson MS Cleaning Paste	• suitable for cleaning both pumps (comp. A and B) of all 2 component Teroson MS products
B) Technomelt PUR Cleaner 02	• suitable for cleaning heated (hotmelt!) equipment for application of Teroson MS 500

SMP Technology
Technology limitations

- maximum long term temperature resistance = 100°C
- (often) not suitable for bonding plastics like **PMMA, PC or PS** - due to the **stress cracking** issue. Materials covered with special coatings or with low tensions in the plastic may work!
- bonding of PE, PP only after surface treatment = corona, flame, plasma



SMP Technology
Approvals

Approvals – available for different Teroson MS products:

- fire resistance
- food contact
- anti fungi / bacteria
- electrical safety (UL)
- mechanical safety (UL)
- outgassing

See Loctite Approval Database / Homepage !

SMP Technology
Approvals

HENKEL UL LISTED / RECOGNISED PRODUCTS

Detailed information about the listings and the values achieved you can find here:

www.ul.com

Go to: **online certifications directory**

Write: **Henkel** in the column **„company name“** and press the **„search“** button

- You will get an overview of all Henkel listings at UL and you can choose the solar related listings when you **click** on the relevant category (QMFZ2, QOQW2, QIHE2) in the right **„link to file“** column

SMP Technology
Additional Information

Literature

- Brochure Teroson MS
- product selector
- Brochure structural bonding campaign

- **Link to global presentations, such as sales modules, e-learning structural bonding**

SMP Technology
Safety

- Use personal protective equipment !
- Dispense Techniques and Ventilation Eliminates Potential Contact with hardeners.
- Once cured the materials are inert.

SMP Technology
Application case history

Current Main Market for MS 5510 & 5570
RV, special Busses

Elastic Bonding Side Wall to Frame Loctite 5570

Elastic Sealing Loctite 5510

SMP Technology
Application case history

SMP based sealants and adhesives in vehicle applications

Bonding glass mirror to ABS plastic frame

Sealing GRP and metal parts on roof elements

SMP Technology
Application case history

SMP based sealants and adhesives in vehicle applications

Concentrated Solar Thermal Power – Mirror Bonding Solutions

Building Integrated Photovoltaik – Framing of PV modules

Elastic Side Wall Bonding

Busses, caravans, mobile homes

- Loctite 5570
- Loctite 5590 2k
- Terostat MS 9360 2k

New Project: 2k SMP for Special Alum Paint Process

SG 1305-11717

Future Topic:
Displacement
of rivets

Elastic
Sealant

Possible Future Targets: Trailers, Trucks, …

Replacement of rivets by elastic adhesives

- Sidewalls, roofs, ….
- US > 95 % are riveted
- Central Europe < 10 % are riveted

RIVETS

Hybrid Training Program

2017

Part 1

Agenda

Part 1

1. Training objectives
2. Introduction to structural bonding
3. Hybrid bonding technology

Part 2

4. Product line review
5. Application equipment
6. Sales tools

Training Objectives
After this training you will be able to …

PART 1

Position Hybrid Technology;

- Describe the **Value Proposition** of Hybrid Technologies as Structural Bonders
- Define the key **benefits** (and limitations) vs competing technologies (EP, MMA, PU)

PART 2

Select the best product for all applications;

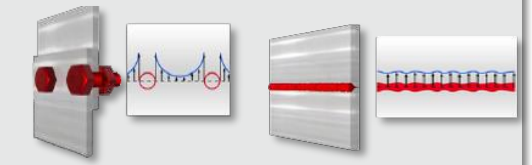
- Define **Target Applications** & **Focus Markets** for each Product
- **Benchmark** specific Hybrid grades against internal and external **competition**
- Define **Dispensing Options** for manual and automatic dispense

Structural Bonding

Introduction to Structural Bonding

The better joining technique because of…

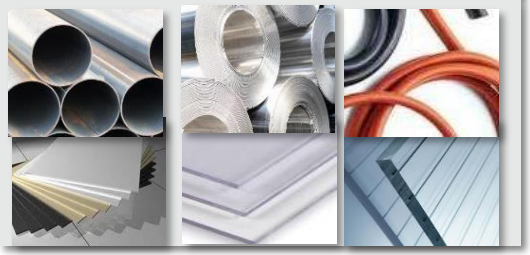
Different stress distribution -> Reliability of product



Skilled labor -> Increased cost & time

Environmental Exposure -> Durability of product

Using various substrates -> Design Limitations



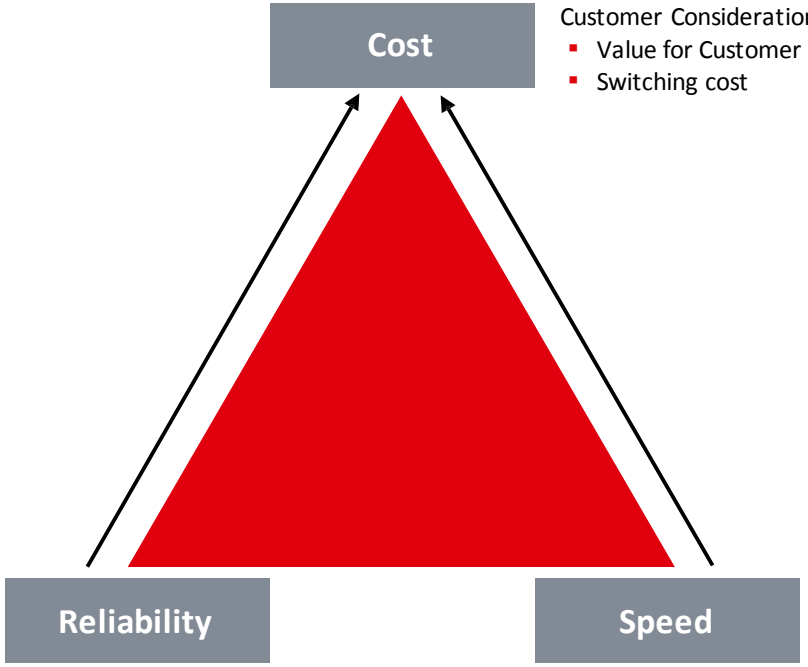
Increased weight of end product -> Increased

Mechanical Fastening -> Affects overall Aesthetics

Introduction to Structural Bonding
Market Trends

- Rising demand for weight reduction
- Rising demand for reduced manufacturing time and cost
- Increasing penetration of composites and other new enabling substrates
- Increasing demand for high performance structural adhesives
- Increasing demand for low hazardous and sustainable structural adhesives
- Rising demand from developing countries
- Dependence on economic cycle

Introduction to Structural Bonding
3 Main customer decision criteria



Customer Considerations:
- Value for Customer
- Switching cost

Customer Considerations:
- Affect on end product quality
- Safer for buyer's and workers
- Less chance to fail if production tolerances or substrate tolerances
- Etc..

- Strength
- Impact
- Adhesion capabilities
- H&S

Customer Considerations
- Faster Production Cycle's
- Less storage time
- Less downtime
- Less storage space
- Etc.

Structural Bonding - Technology Overview
Advantages and Limitations

	1K Epoxy	High Performance 2k Epoxy	5 minute Epoxy	2K MMA	2-step Acrylic	2K PU	1K PU	SMP	Silicone
+	Highest Strength Fast cure Chemical resistance High temp resistance	High Strength Toughness Chemical Resistance High temp Resistance	Fast-cure Strength (metals) Chemical resistance	Plastic Bonding Impact Resistance Fast Cure	Very fast fixture Easy to use (no-mix) Multi-substrate Toughness	Fatigue resistance Multi-substrates Low cost	Elasticity Fast fixture (HM PUR) Multi-substrate Low cost	Elasticity Gap-filling Multi-substrate Non-hazardous	High temp resistance Elasticity Gap-filling
−	Requires heat cure Not suitable for plastics Limited Shelf-life	Slow cure Limited plastic adhesion May be corrosive	Temp resistance Limited plastic & Rubber adhesion	Strong odour Flammable Limited temp resistance	Limited Gap Fill Fillet Cure	Limited temp resistance Contains Isocyanate	Low strength Limited temp resistance Contains isocyanate	Low strength Temp resistance	Slow cure (1k) Low strength Non-paintable Outgassing

Rigid-Bonding ⟵ ⟶ Elastic-Bonding

Introduction to Structural Bonding

Hybrid's can help to overcome limitations…

Long Fixture Speed -> Production delays

Product Reliability -> Warranty Claims

Product Durability -> Defects, Rework, Scrap

Using various substrates -> Design Limitations

Need more than one adhesive -> Increased inventory costs

Health & Safety and handling

From Instant Bonding to Structural Bonding

What is a Hybrid?

Opportunities:

1. New universal structural bonder
2. Shift more of traditional structural to faster, safer technology

CA
s
- 1K
- Fast cure
- High perform
- Safe to handl

Hybrid
s
- **Fast cure through high gap**
- **Universal adhesion**
- **Very good structural and environmental durability**
- **Safe to handle**

Structurals
- High gap fill

ructural performance
nmental durability
mance on metals

Relative

Ease of Use **Structural Durability**

Application Examples

- **Instant bonding applications where speed replacing counts, e.g. Plastic Tube Bonding, Rubber bonding, mat fixation, Gasket Bonding, Instant bonding,**
  Repair, etc.
- **Applications that requires speed and structural integrity**
- **Structural bonding applications mechanical fasteners, e.g. metal composite bonding, plastic**

magnet bonding, dissimilar substrates bonding

Hybrid bonding technology
Value Proposition

Globally Available!!

Hybrid Technology in General		
Properties	**Advantage**	**Customer Benefit**
Multi-Substrate Adhesion	**High strength assemblies using plastics/rubbers allows freedom in design and material selection**	Reduce weight, reduce material costs, improve reliability
Fast cure (rapid fixture) – robust low temperature cure	**Fast fixture speeds up production and simplifies assembly process. Fixture is largely independent of external environment (MRO applications)**	Reduce WIP and manufacturing costs – eliminate rework
Thermal and Environmental durability	**Allows existing designs to operate in wider performance envelope – higher temperature or chemical resistance**	Improves reliability
Sustainability - Improved H&S and reduced environmental Impact	**Non-flammable, non-corrosive, non-toxic to Aquatic organisms, no isocyanate, lower odor**	Mitigated risk to workers, simplified storage

Henkel

Current structural bonding market situation

Heat map comparing traditional structural technologies

Feature	Performance Attribute	Hybrids	2k 5min Epoxies	2k HP Epoxies	2k MMA's	2k PU's	2k CA
Productivity	Fixture Time						
	Full cure Time						
Universal Bonder	Adhesion to Plastics						
	Adhesion to Metals						
	Adhesion to Rubbers						
	Adhesion to Glass*						
	Adhesion to Wood						
Durability	Toughness/Impact Strength						
	Chemical Resistance						
	Moisture Sensitivity						
Safe to Handle	EH&S Ratings						
	Odor						

Hybrid technology creates PATENTED universal bonders that offer robust performance across many key performance attributes

*Hybrids show good initial adhesion to glass but limited long-term durability

Hybrid bonding technology
Health & Safety

	Hybrids	MMAs	EP	PU	Comments
Flammability					Many MMAs are flammable which creates storage and transport issues
Health/Safety Labeling					Hybrids do not have the dead fish/dead tree, exploding man or corrosive pictograms on labels
Odor					Hybrids have a CA like odor, but muted compared to MMA odor

Hybrid technology is safer to handle than traditional structural bonders

Part 2

Agenda

Part 1

1. Training objectives
2. Introduction to structural bonding
3. Hybrid bonding technology

Part 2

4. Product line review
5. Application equipment
6. Sales tools

Key Markets

Maintenance Repair (MRO/VRM)

Assembly (GM/IA)

The New LOCTITE Hybrid Line

Maintenance / Repair

HY 4060 GY 5 minute

- 2c hand-mix (4090 grey), 25ml
- Benchmark: 5 min EPs

✓ **Substrate versatility**
✓ **Gap fill**
✓ **Temperature resistance**

HY 4070 Ultra fast

- 2c with nozzle & plunger, 10ml
- Benchmark: 2k repair CAs

✓ **Substrate versatility (improved metal adhesion vs. 3090)**
✓ **Temperature resistance**

Assembly

HY 4080 GY Toughened

- 2c with pistol & nozzle, 50 & 400 ml
- Benchmark: MMAs, PUs

✓ **Toughness (impact, vibration & shock resistance)**
✓ **Temperature resistance**
✓ **Health & Safety**

HY 4090 GY Fast & Strong

- 2c with pistol & nozzle, 50 & 400 ml
- Benchmark: 2k EPs, Acrylics, CAs

✓ **Substrate versatility (e.g. metal to rubber)**
✓ **Speed & strength**
✓ **Moisture & temperature resistance**

LOCTITE HY 4090 & HY 4090 GY

- General Purpose, Fast, Strong Structural Bonders

LOCTITE HY 4090 & HY 4090 GY
Fast & Strong, Structural Bonders

- **Highest combination** of critical attributes in one product
  - Suitable for a variety of substrates, including metals, most plastics and rubbers
  - Fast cure speed
  - Good moisture, temperature and chemical resistance
  - Applications in cold temperatures
  - Non corrosive, reduced environmental impact
- Opens **new application** areas
- **Unique** Henkel hybrid technology
  - First product in line of LOCTITE hybrid adhesives
  - Patent protected
  - Available in grey formulation for mix indication

LOCTITE HY 4090/4090 GY
Summary Benefits & Limitations

- Fast and robust fixture (3-4 min even at low temperatures)
- Universal adhesion – metals, plastics, rubbers, woods, etc…
- Excellent hot strength performance
- Good environmental resistance
- Improved H&S

- Limited strength retention on glass
- Modest toughness – rigid adhesive

Key Value Drivers – Customer Benefits
LOCTITE HY 4090/4090 GY

Reliability
- Improve end product quality
- Less chance to fail if production tolerances or substrate tolerances

Speed
- Faster fixture means increased productivity

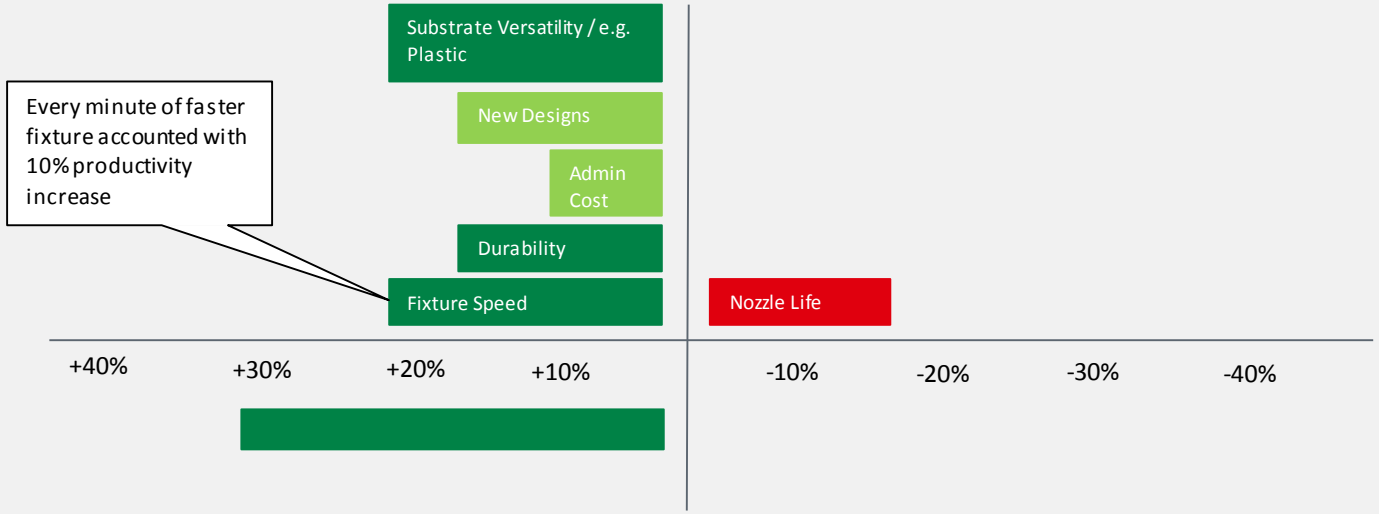
Versatility
- Open‘s up new design options
- Combination of multiple substrates possible
- Could reduce process steps, need for multiple application equipment

H&S
- Safer for workers (Odor & Less Precautions)
- Better for the environment

Simplify / Reduce Complexity
- One product for multiple applications
- Simplifies adhesion selection process
- Chance to reduce number of suppliers
- Reduce complexity

Key Value Drivers – Value Calculation vs. Comp A (5-min EP)

Value Calculation



We share the value with our customers

Loctite HY 4090 Larger Package

18kg Packages for high volume applications

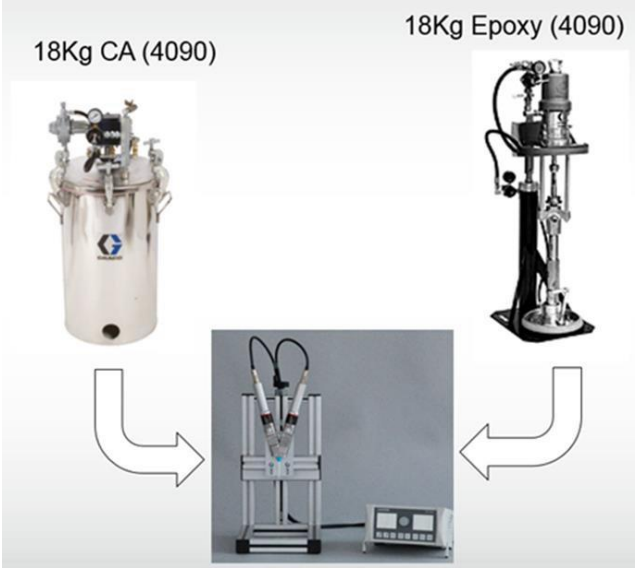
Part A (CA) IDH 1254804

- 25L UN COMPOSITE DRUM

Part B (Epoxy) IDH 557573

- 20L Plastic Mauser drum

Equipment Configuration



Dispensing out of pails requires custom dispensing equipment

LOCTITE HY 4090 & 4090 GY

How to Identify Opportunities

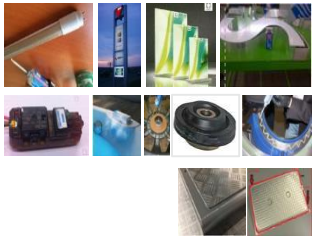
Main Customer Targets:

- New or existing customers unsatisfied with current application

Main reasons for choosing this product in these applications:

- Fast fixture to reduce assembly time
- Robust cure at low temp/large gap
- Adhesion and strength on plastic or plastic/metal combinations
- Adhesion and strength on rubber materials
- Good moisture, temperature resistance
- Good chemical resistance to withstand chemical processing in the line

LOCTITE HY 4090 & 4090 GY
Target Applications



General Applications

- *General assembly applications involving mixed substrates – especially moulded plastic/rubber or poorly-fitting parts - in a high-volume, semi-automated or manual assembly line*

Key Vertical Markets

- *Electrical & Optical Goods/Lighting/Loudspeaker/e-Motor*
  - Wire harness bonding; Gasket bonding; Retaining compound for plastic to metal
  - Sealing and bonding of LED lighting fixtures; Speaker/motor bonding applications
- *Durable goods*
  - Logo/label bonding, plastic/rubber-trim bonding, Tags to stainless steel, ID tags
  - Sign bonding
  - Hand tools
  - Sports equipment especially with water exposure

LOCTITE HY 4090

Application Case History – Sign manufacturer bonding stainless steel to plastic

CHALLENGE	▪ Assembly method using hand cut double sided tape slowed sign production ▪ Tape strength to PMMA (polymethylmethacrylate) plastic is poor and loss of trim pieces lowered customer satisfaction ▪ Visibility of the tape detracted from sign's aesthetic appeal
SOLUTION	▪ LOCTITE 4090 ▪ Adhesive dispensed into a groove on the plastic sign and stainless steel trim piece is hand pressed into the groove to complete assembly
BENEFITS	▪ Easy dispensing and quick fixture reduces assembly time and labor ▪ Provides superior bond strength to prevent previous trim loss issues ▪ Colorless, eliminates blooming and resolves previous appearance issues

Henkel recommends that you test all new adhesive applications under simulated or actual end-use conditions to ensure the adhesive meets or exceeds all required product specifications.

LOCTITE HY 4090

Application Case History – Aromatherapy bath manufacturer bonding stainless steel grid to small plastic batonnet

CHALLENGE	▪ An instant adhesive is needed that cures in low humidity environments. ▪ Separate adhesives must be used for bonding plastics and metals, increasing inventory costs. ▪ Defective parts must be reworked or scrapped, increasing the total product cost.
SOLUTION	▪ LOCTITE 4090 ▪ Bath cartridges assembled with one adhesive
BENEFITS	▪ Eliminates issues resulting from low seasonal plant humidity ▪ Single adhesive bonds all materials in all conditions to improve quality and reduce inventory ▪ Dramatically reduces defective parts which reduces rework and scrap ▪ Optimizes production output

Henkel recommends that you test all new adhesive applications under simulated or actual end-use conditions to ensure the adhesive meets or exceeds all required product specifications.

LOCTITE HY 4080 & HY 4080 GY

- Tough & Robust Structural Bonders

LOCTITE HY 4080 & 4080 GY

Tough & Robust Structural Bonder

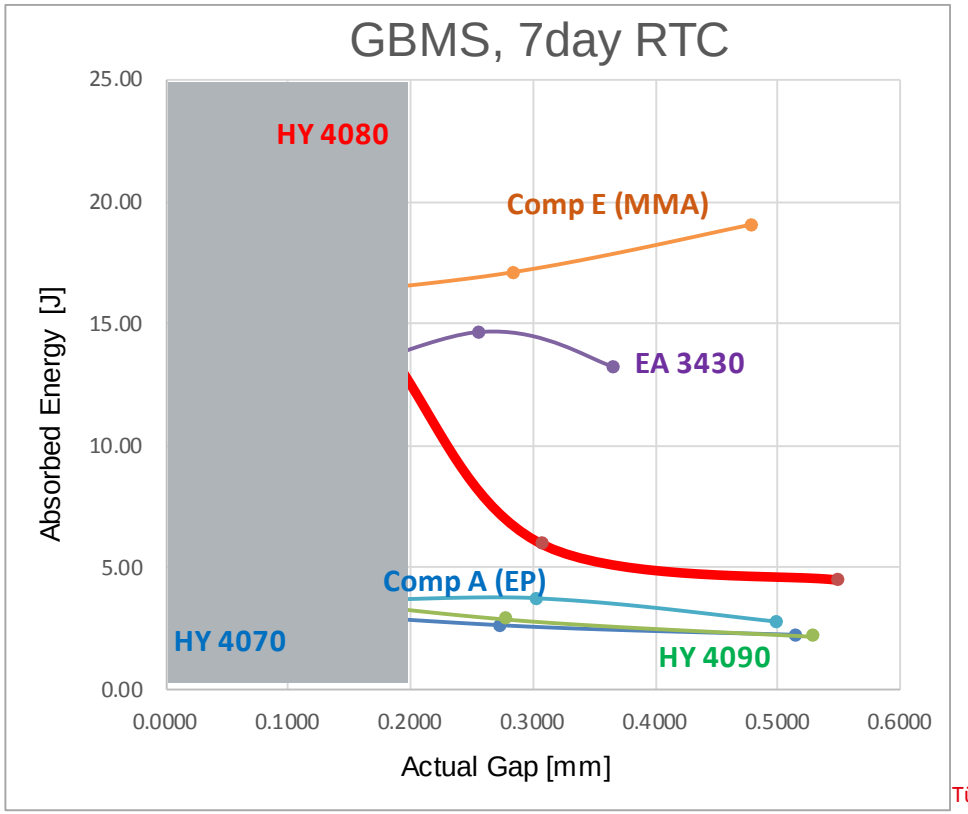
Structural Bonding product with Good Impact Resistance

- Suitable for a variety of substrates, including metals, most plastics and rubbers
- Medium Fixture speed (~10 mins)
- Rapid strength development (full cure <24 hours)
- Excellent resistance to shock loading
- High performance especially in large gaps
- Good moisture, temperature and chemical resistance

Unique Henkel hybrid technology

- Patent protected
- Available in grey formulation for mix indication

Key Value Driver – Toughness & Impact Resistance
LOCTITE HY 4080/4080 GY



- Excellent Impact Resistance – especially in normal gaps (<0.2mm)
- **Note:** Impact strength drops at larger gaps (>0.2mm) compared to rubber toughened MMA and High Performance Epoxies
- Good T-Peel performance on Aluminium and Steel (see next slide)

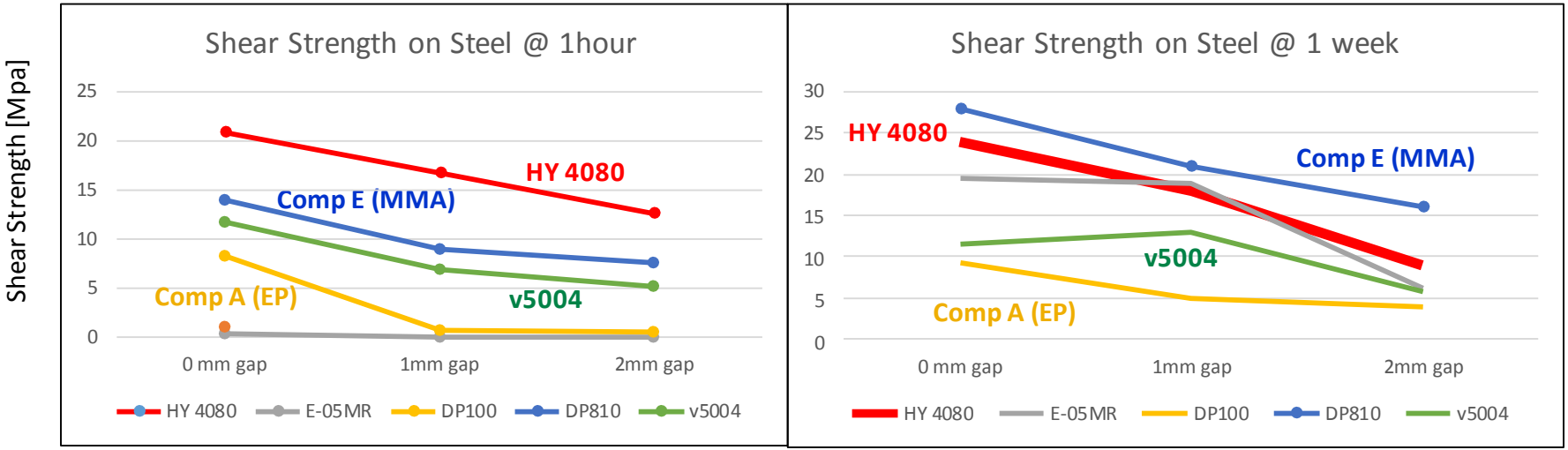
Key Value Driver – T-Peel at 0mm gap
LOCTITE HY 4080/4080 GY

Determination of peel strength for bonded assemblies									
All substrates were grit blasted and IPA wiped. Specimens were cured for 5 days at room temp									
	HY 4080	**406**	**3430**	**20HP**	**60HP**	**H4500**	**H8000**	**H8700**	**H4710**
	Hybrid	1k CA	5 min Epoxy	2k Epoxy	2k Epoxy	2k MMA	2k MMA	2k MMA	2k MMA
Description	**CA-MA Hybrid**	Instant adhesive	5 minute, ultra clear, high strength	20 min work life, toughened, high peel/shear	60 min work life, toughened, high peel/shear	Structural, high performance	High performance, Alu bonder, 15 min work life	Metal bonder, paint process compatible, temperature resistant, toughened	High Performance, corrosion resistant, 10 min work life
T Peel GBMS (N/mm)	7.1	0.8	0.8	2.5	5.4	4.2	9	4.8	8
T Peel GBAlu (N/mm)	5	1.9	1.3	1.8	4	4.4	5.7	3.3	4.8

Key Value Driver – Speed and Performance in Large Gap

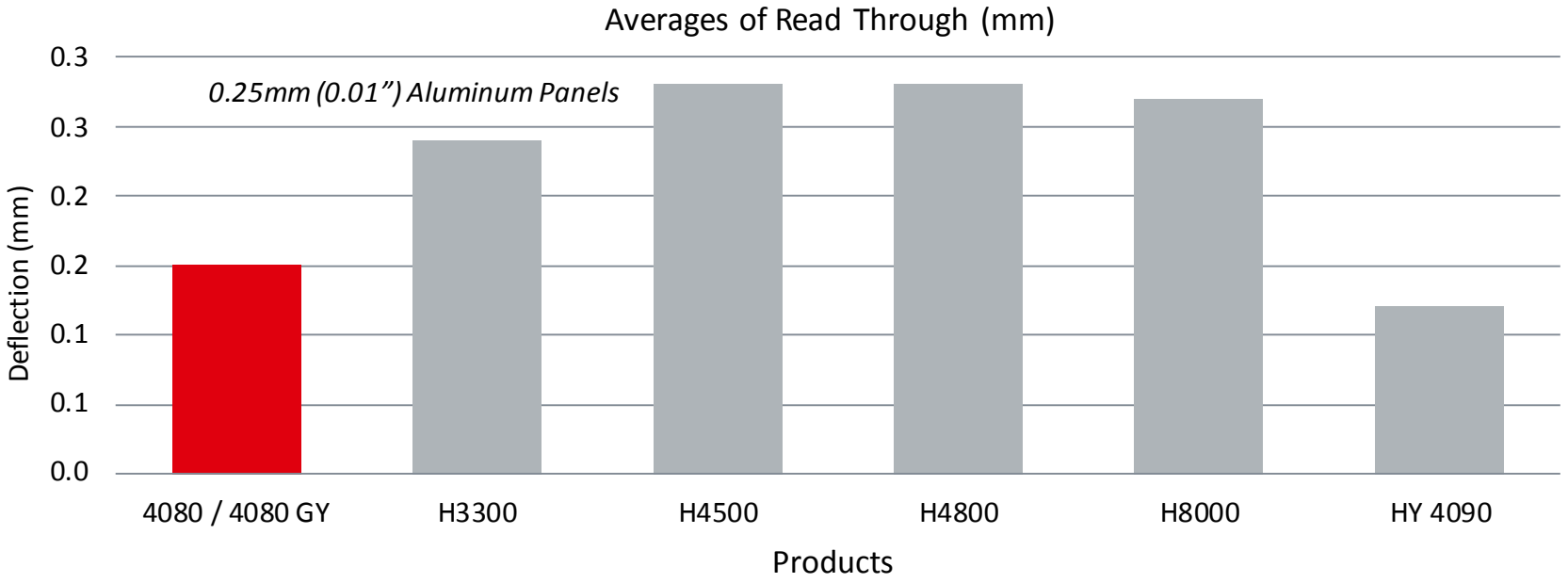
LOCTITE HY 4080/4080 GY

On Mild Steel, RT Curing



4080/4080 GY grows in strength quickly & maintains consistent performance in large gaps

Added Benefit – “Read Through” Comparison
LOCTITE HY 4080/4080 GY



4080/4080 GY show significant read through reduction compared to other MMA’s on deflection

LOCTITE HY 4080/4080 GY
Summary Benefits & Limitations

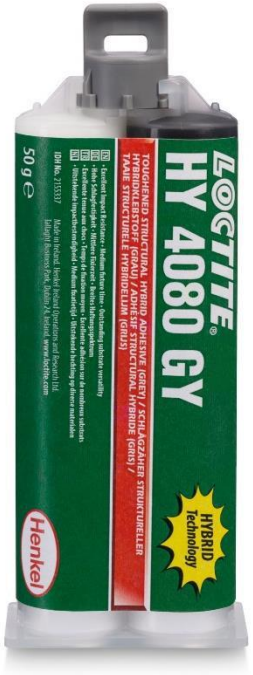
- Universal adhesion – metals, plastics, rubbers, woods, etc…
- Excellent toughness and impact strength
- High strength at large gap (up to 5mm)
- High elongation – ~80%
- Low-read through
- Improved H&S
- Lower odor than MMAs

- Strength after humidity conditioning is good, but less than traditional MMAs and PUs

- Slightly tacky surface for up to 7 days

➢ HINT: Cure at 60°C for 60 secs to eliminate any surface tack or spray with Loctite SF 7649

Key Value Drivers – Customer Perspective
LOCTITE HY 4080/4080 GY



Versatility

- Open‘s up new design options
- Combination of multiple substrates possible
- **Universal Adhesion**

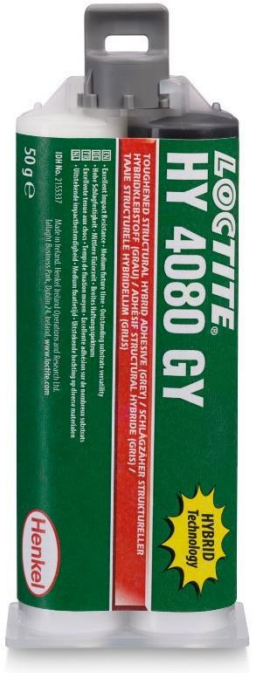
H&S

- Safer for workers (Odor & Less Precautions)
- Reduced environmental impact
- **Labelling** – non-flammable, no carcinogens, non-corrosive

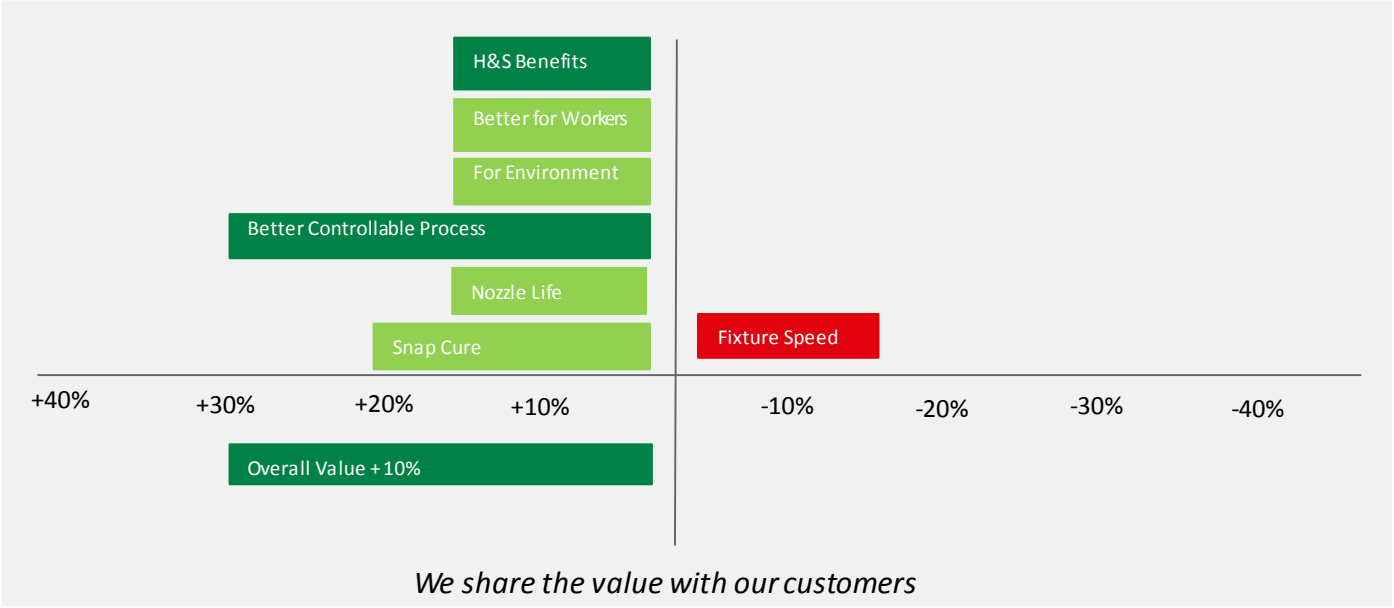
Simplify / Reduction

- One product for multiple applications
- Simplifies adhesion selection process
- Chance to reduce number of suppliers
- Could reduce process steps, no need for multiple application equipment
- Better controllable process
  - Longer Production
  - Snap Cure via Heat
- **Overall Adhesion**
- **Cure Speed**

Key Value Drivers – Value Calculation vs. Comp E (MMA)
LOCTITE HY 4080/4080 GY



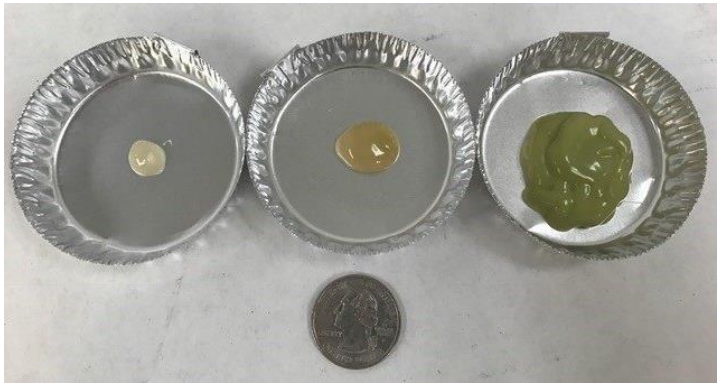
Value Calculation



We share the value with our customers

Hybrids Tips – Color Change vs Exotherm
LOCTITE HY 4080/4080 GY

- 4080 & 4080 GY change color with temperature during cure
  - This is only an aesthetic change due to the presence of copper, no performance differences



Initial dispense

Off white

~7-9min of curing

can go to yellow or even green/brown depending on volume

LOCTITE HY 4080 & 4080 GY

How to Identify Opportunities

Main Customer Targets:

- New or customers unsatisfied with current application
- Existing MMA users who benefit from improved H&S and low odour

Main reasons for choosing this product in these applications:

- Fast fixture to reduce assembly time – especially in large gaps
- High strength on plastic or plastic/metal combinations
- Good Impact resistance – subject to drop tests or shock loading
- Good elasticity – parts subject to relative movement
- Accurate dispensing in small beads (non-stringing)

LOCTITE HY 4080 & 4080 GY
Target Applications

General Applications

- *Assemblies involving mixed substrates – especially moulded plastic or poorly-fitting parts subject to impact loading - in semi-automated or manual assembly lines subject to impact loading*

Key Vertical Markets

- *Electrical & Optical Goods/Lighting/Loudspeaker/e-Motor*
  - Magnet Bonding (plasto-ferrite magnets); Frame bonding, Cover bonding
- *Durable Consumer goods*
  - Handheld electrical devices, Hand/power tools
- *General Bonding*
  - Stiffener bonding (Marine/SV etc.), Internal Panel bonding, Office furniture, Elevators
  - Appliance & White goods (hoses & ducting)
- *Sporting Goods*
  - Gold Clubs, Hockey sticks, Sports rackets etc.

LOCTITE HY 4070

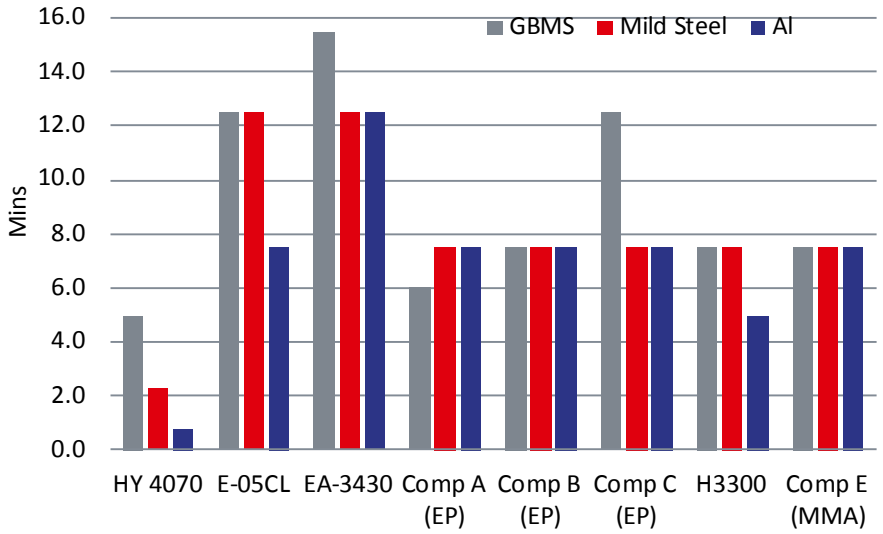
Ultra Fast, Universal Repair Adhesive

LOCTITE HY 4070
Ultra Fast, Universal Repair Adhesive

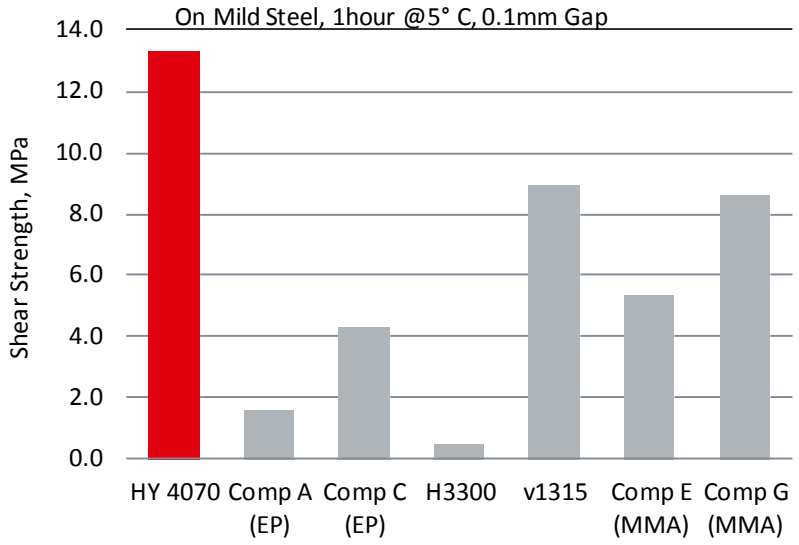
- **New Opportunity: The must-have, quick repair adhesive needed in every toolbox for virtually any application**
  - < 60 second fixture speed
  - Rapid strength development
  - Great on most substrates, including metals, most plastics and rubbers
  - Excellent gap-fill ability, up to 5mm
  - Rapid strength development (full cure <24 hours)
  - Good moisture, temperature and chemical resistance
- **Unique** Henkel hybrid technology
  - Patent protected

Key Value Driver – Fast Cure
LOCTITE HY 4070

Fast Fixture



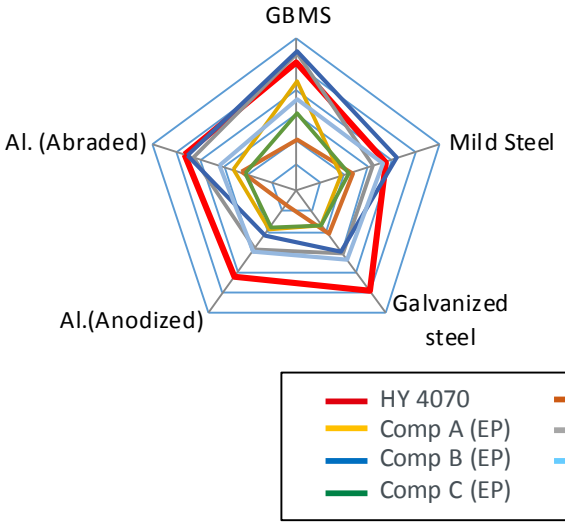
Rapid Strength Development

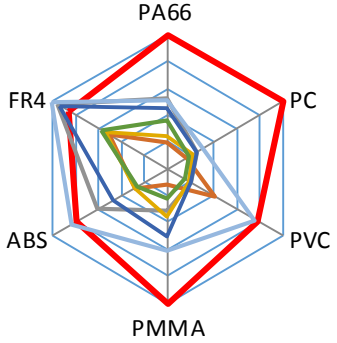


HY 4070 provides CA like fixture speeds + fast build up of strength over time

Key Value Driver – Universal Adhesion
LOCTITE HY 4070

Metal	Plastic	Rubber





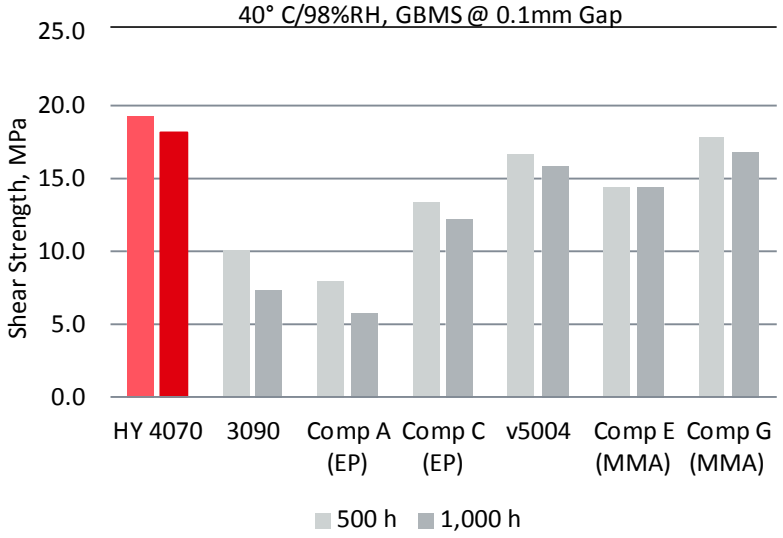
	4070	E-05MR	E-05CL	EA-3430	Competitor A (5-min EP)	Competitor B (5-min EP)	Competitor C (5-min EP)
NBR	SF	SF	SF	M	P	G	M
Neoprene	SF	M	G	G	M	SF	M
SBR	SF	SF	SF	SF	G	SF	SF
Butyl	M	M	P	P	P	G	P
Buna-N	SF	SF	SF	SF	P	SF	SF
EPDM	M	M	M	G	M	M	P

* Tensile Shear. P: Poor; M: Medium; G: Good; SF: Substrate Failure

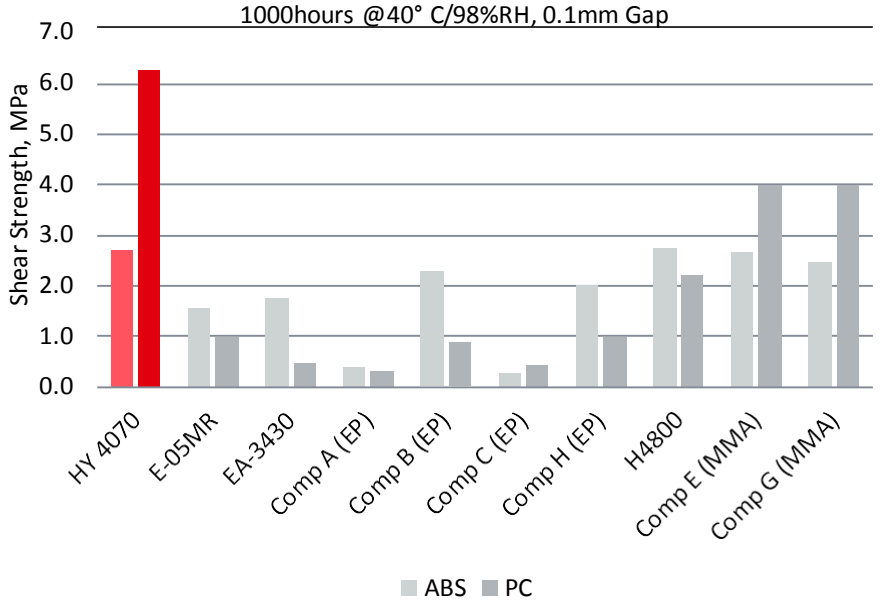
4070 has great multi-substrate bonding capabilities (metal, plastic, rubber, wood, composite, etc.)

Key Value Driver – Durability
LOCTITE HY 4070

Heat Aging On Metal



Heat Aging On Plastics



4070 has equal durability on metals and improved durability on plastics

LOCTITE HY 4070
Summary Benefits & Limitations

- **Ultra fast fixturing**, as fast as 20 seconds
- Maintains **long nozzle life** (3-4min, when compared to 3090 which is 2min)
- Universal adhesion – metals, plastics, rubbers, woods, etc…
- Good chemical and thermal resistance
- Improved H&S vs traditional structural products
- Ready to use Pack - no gun required

- Slower fixture through gap than Loctite 3090
- Moderate toughness and impact strength
- Currently, only available in 10 ml package

Key Value Drivers – Customer Perspective
LOCTITE HY 4070

Reliability & Repeatability

- Job Done Right – First Time, Every Time
- High performing

Need Speed?

- Fast repair < 1 minute but long nozzle life (3-4min)
- Ready to use package, no dispense gun required

Versatility

- 1 product for all your quick repair needs
- Great on plastics, metal and rubber
- Durable – excellent temperature, humidity and chemical resistance

Irregular surfaces / Gap?

- Surfaces don't have to be perfectly mated
- Gap is not a problem (fixture will be slower at larger gaps)

LOCTITE HY 4070

How to Identify Opportunities

Main reasons for choosing this product in these applications:

- Fast fixture to reduce assembly time
- Adhesion and strength on plastic or plastic/metal combinations
- Adhesion and strength on rubber materials
- Good moisture, temperature resistance
- Good chemical resistance to withstand chemical processing in the line
- Accurate dispensing in small beads, transparent appearance

LOCTITE HY 4070
Target Applications

General Applications

- *Maintenance applications where instant fixture is required in variable gaps with mixed substrates. Tacking/Temporary location of parts before permanent fixture. Emergency repair of moulded plastic or metal parts. Rebuilding plastic lugs/mounts*

Key Vertical Markets

- *Vehicle Repair and Maintenance*
  - Under bonnet clips, furniture/seat repair (lugs and brackets), automotive interiors
- *Electrical & Optical Systems*
  - Wire tacking, Cable tie installation, Bracket bonding
- *General Bonding*
  - Label bonding, rubber repairs, wear-strip bonding, plastic threadlocker

LOCTITE HY 4060 GY

Durable, 5-Minute Repair Adhesive

LOCTITE HY 4060 GY
Durable, 5-Minute Repair Adhesive

- The go-to adhesive for durable, general-purpose repair on a variety of substrates
  - Ideal replacement for traditional 2K 5-minute epoxies
    - Fast, 5-minute cure speed
    - Great on most substrates, including metals, most plastics and rubbers
    - Machinable
    - Good gap-fill ability, up to 5mm
    - Excellent low-temperature cure capability
    - Good moisture, temperature and chemical resistance

- **Unique** Henkel hybrid technology
  - Patent protected

LOCTITE HY 4060 GY
Summary Benefits & Limitations

- Ready to use Pack - no gun required + no nozzle required
- Faster fixturing, as fast as 4-6 minutes (even at low temperatures)
- Universal adhesion – metals, plastics, rubbers, woods, etc…
- Good thermal and environmental resistance
- Can be machined after curing

- Designed for manual mixing, difficult to dispense with a mix nozzle

Key Value Drivers – Customer Perspective
LOCTITE HY 4060 GY

Reliability

- Longer lasting repairs
- Reduces possibilities to fail
- Increases customers confidence in your service quality
- **Durability**

Speed

- Less downtime
- Ready to use package, no dispense gun or mix nozzle required
- **Fast Fixture Time**

Versatility

- Combination of multiple substrates possible
- Machinable
- **Universal Adhesion**

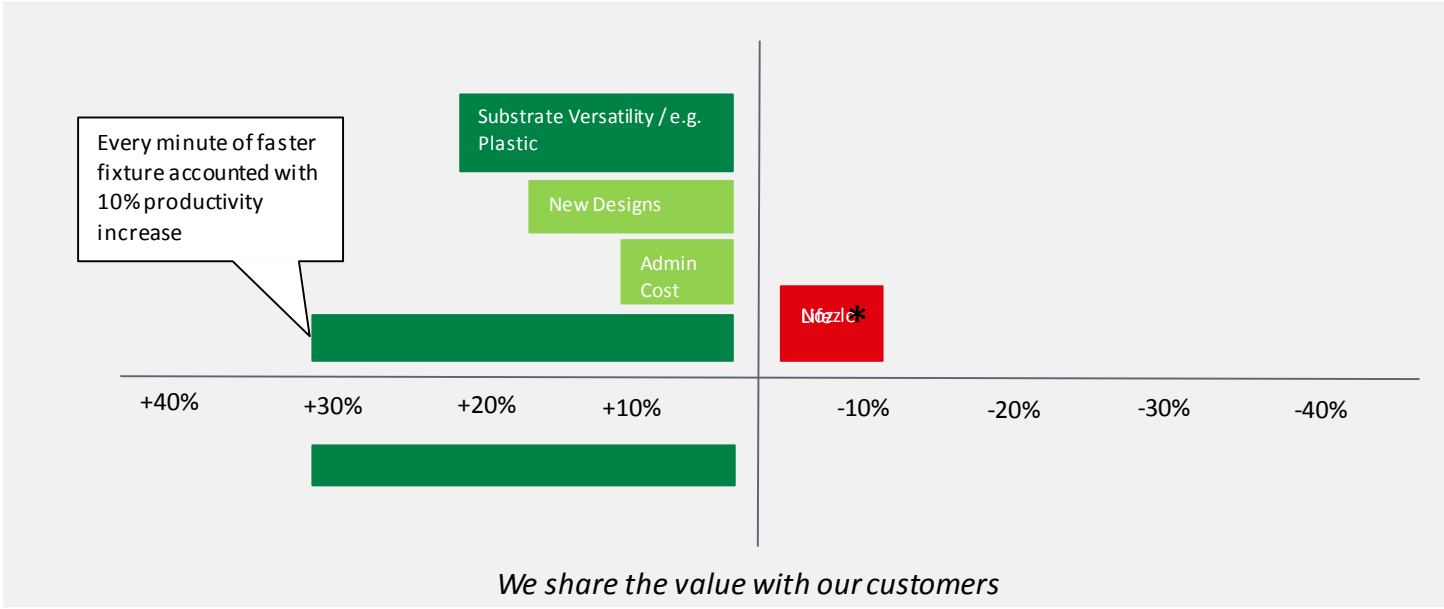
Simplify / Reduce Complexity

- One product for multiple applications -> reduces complexity
- Simplifies adhesive selection process
- Chance to reduce number of suppliers
- Can reduce storage space
- **Universal Adhesion**

Key Value Drivers – Value Calculation vs. Comp C (5-min EP)

LOCTITE

Value Calculation



We share the value with our customers

*Recommend no nozzle, manual mixing

LOCTITE HY 4060 GY

How to Identify Opportunities

Main Customer Targets:

- Maintenance customers who use traditional 2K 5-minute epoxies

Main reasons for choosing this product:

- Fast fixture to reduce assembly time
- Adhesion and strength on plastic or plastic/metal combinations
- Adhesion and strength on rubber materials
- Can be machined after cure
- Good moisture, temperature and chemical resistance
- Cures in a wide range of operating conditions
- Easy to use – Hand mix - No dispensing gun required

LOCTITE HY 4060 GY

Target Applications – 5-minute Epoxies

General Applications

- *General maintenance applications where fast fixture is required in variable gaps with mixed substrates. Emergency repair of metal/plastic parts with high durability*

Typical Applications

- *Electrical & Optical Systems*
  - General potting/encapsulation, Cable tie installation, Bracket bonding
- *Vehicle Repair and Maintenance*
  - Repair of plastic clips, furniture/seat repair (lugs and brackets), automotive interiors
- *General Repair*
  - Surface rebuilding of plastic/metal parts, Label bonding, rubber repairs, wear-strip bonding, plastic threadlocker

LOCTITE HY 4060 GY
Ordering & Storage Information

Product	Package Size(s)	Shelf Life & Storage	Color	Recommended Mix Nozzle
4060 GY	25ml 1:1 ratio by volume	12 months @ 2-21°C (room temp) <50% RH	Part A = Black Part B = White Mixed = Grey	NO NOZZLE, recommended manual mix

LOCTITE HY 4092 GY

Self-Leveling, Flexible Structural Bonder

LOCTITE HY 4092 GY
Summary Benefits & Limitations

- Universal adhesion – metals, plastics, rubbers, woods, etc…
- High elongation
- Improved H&S
- Good thermal resistance
- Good impact resistance
- Lower odor than 5 min epoxies

- Moderate adhesion to metals and certain rubbers
- > 5 min fixture time for bonding applications

〉 Can be used for bonding or potting

Product Summary

Product Line Summary

	Repair Range		Assembly Range				
	Repair Structural Hybrid Adhesives		Multi Purpose Structural Hybrid Adhesives			Toughened Structural Hybrid Adhesives	
Product Name	Loctite HY 4070	Loctite HY 4060 GY	Loctite HY 4090 GY	Loctite HY 4090	Loctite HY 4092	Loctite HY 4080	Loctite HY 4080 GY
Mix Ratio (by volume)	10:1	1:1	1:1	1:1	1:1	1:1	1:1
Pack Size	10ml	25ml	50ml	50ml, 400ml, 18 kg	50ml, 400ml	50ml, 400ml	50, 400ml
External Benchmark	Devcon 5 min Epoxy, DP 810	DP 100, DP 110, Devcon 5 min Epoxy, Araldite 2014	DP 100, DP 110, Devcon 5 min Epoxy, Araldite 2014	DP 100, DP 110, Devcon 5 min Epoxy, Araldite 2014	DP 410, another low viscous epoxy	DP 810, DP 8810	DP 810, DP 8810
Product Descriptor	Fast Structural Repair Hybrid Adhesive	Highly durable Structural Repair Hybrid Adhesive (Grey)	Structural Hybrid Adhesive (Grey)	Structural Hybrid Adhesive	Low Viscosity Structural Hybrid Adhesive (Grey)	Toughened Structural Hybrid Adhesive	Toughened Structural Hybrid Adhesive (Grey)
Main Advantages	▪ Ultrafast fixture ▪ Outstanding substrate versatility ▪ Very precise mixing by nozzle	▪ Excellent environmental and temperature resistance ▪ Outstanding substrate versatility ▪ simple hand mix solution	▪ High Strength combined with fast fixture ▪ Outstanding substrate versatility ▪ Excellent environmental and temperature resistance	▪ High Strength combined with fast fixture ▪ Outstandin g substrate versatility ▪ Excellent environmental and temperature resistance	▪ Self levelling ▪ Fast fixture ▪ Outstanding substrate versatility ▪ Great environmental and temperature resistance	▪ Tough ▪ Medium fixture ▪ Outstanding substrate versatility, especially plastics ▪ Non-flammable, improved H&S	▪ Tough ▪ Medium fixture ▪ Outstandin g substrate versatility, especially plastics ▪ Non-flammable, improved H&S

Dispense Options

Hybrid Dispense Equipment
Overview

1. Equipment based on standard range
2. Manual and automatic applications
3. Mixer nozzle to suit product and application method
4. Customized Equipment Solution (18Kg)

Hybrid Dispense Equipment
Dispense Equipment Options

Product	Mix Ratio	Pack Size	Equipment required
Loctite HY 4060 GY	1:1	25ml	No (ready to use)
Loctite HY 4070	10:1	10ml	Mixer nozzles only
Loctite HY 4080, HY 4080 GY, HY 4090, HY 4090 GY, HY 4092 GY	1:1	50ml	Manual/pneumatic handguns & MM10
	1:1	400ml	Pneumatic handguns & MM25 cartridge system
Loctite HY 4090 GY	1:1	18Kg	MM25 and Customised supply system

Hybrid Manual Dispense Equipment
50ml Handguns (All 50ml Packs)

50 ml Dual Cartridge Manual Applicator

- 1:1 mix ratio
- Ratcheting plunger
- Cost effective
- B Type Cartridges

50 ml Dual Cartridge Pneumatic Applicator

- 1:1 mix ratio
- Regulated pressure control
- Minimised operator fatigue
- B Type Cartridges

Hybrid Manual Dispense Equipment

400ml Handgun (All 400ml Packs)

400 ml Dual Cartridge Pneumatic

- 1:1 mix ratio
- Regulated pressure control
- Minimised operator fatigue
- Important - **Maximum operating pressure 2 bar**

400ml Hybrids are not recommended for manual hand gun application, pneumatic only

50ml & 400ml Directions for Use

LOCTITE® Hybrids

50 g Dual Cartridge – Instructions for Use

Step 1

Stand the dual cartridge upright for 1 minute.

Step 2

Keeping the cartridge upright, insert it into the application gun.

Step 3

Remove the cartridge cap and expel a small amount of adhesive upwards to be sure both sides are flowing evenly and freely.

Step 4

Attach the mixing nozzle.

Step 5

Dispense and discard a bead as long as and as wide as the static mixing nozzle, to ensure sufficient mixing.

Step 6

50 g Cartridge is now ready for immediate use!

After use, remove the mixing nozzle and replace the cartridge cap. Please note, once the cartridge has been opened the remaining life of the material is related to the amount of humidity in the environment. To maximise shelf-life, store with cartridge cap in place and refrigerate. If the opened cartridge will be used again within 24 h, refrigeration between use is not required.

Next Use

If refrigerated, allow cartridge to reach room temperature and then follow instructions for use from Step 1.

LOCTITE® Hybrids

400 g Dual Cartridge – Instructions for Use

Important Information

NOTE: A pneumatic application gun is required to apply the product from the 400 g dual cartridge, at maximum dispense pressure of 2 bar.

Step 1

Stand the dual cartridge upright for 1 minute.

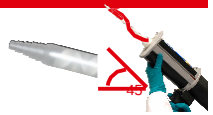
Remove the cartridge cap and locking ring, attach the mixing nozzle and secure with locking ring.

Step 3

Load cartridge into the application gun, so that the yellow label on cartridge is visible above the nozzle.

Step 4

Holding the application gun at a 45° angle with the nozzle tip pointing upwards, begin dispensing the adhesive until the product reaches the nozzle tip.



Step 5

Dispense and discard a bead as long as and as wide as the mixing nozzle, to ensure sufficient mixing.

Step 6

400 g cartridge is now ready for immediate use!

Storage Recommendations

After use, store with used mixing nozzle and locking ring attached. Please note, once the cartridge has been opened the remaining life of the material is related to the amount of humidity in the environment. To maximise shelf-life, store with cartridge cap in place and refrigerate. If the opened cartridge will be used again within 24 h, refrigeration between use is not required.

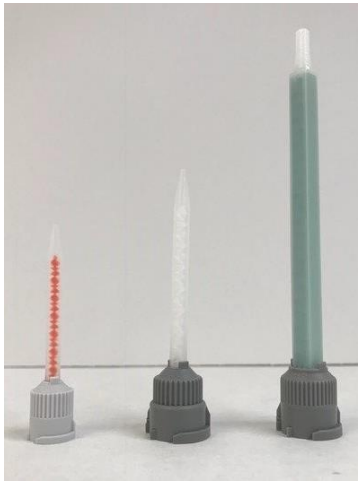
Next Use

If refrigerated, allow cartridge to reach room temperature and then follow instructions for use from Step 1.

Hybrid Dispense Equipment
Mixer Nozzles

- Different mix nozzles are available for use with different Hybrid products
- Manual and automatic applications use different nozzles

- Important to use correct nozzle for each product to achieve required mixing
- There must be enough elements to ensure the two components are thoroughly mixed



Hybrid Automatic Dispense Equipment

MM10 50ml Dual Cartridge Dispenser (All 50ml Packs)

- Simple and precise dispenser
- Independent cartridge pressure and actuation functions to control adhesive flow rate
- Fluid components suited for Hybrid products
- Accepts precision anti-drip dispense valve 1444139 (sold separately)
- Easy cartridge change-over
- Light-weight design; able to be used on any Loctite® Precision Adhesive Dispensing Robot system
- Dispenses complete Hybrid range in 50ml

Hybrid Automatic Dispense Equipment

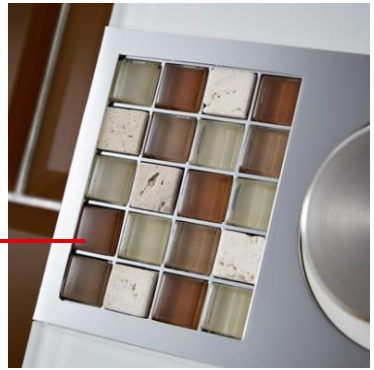
MM10 50ml Dual Cartridge Dispenser (All 50ml Packs)

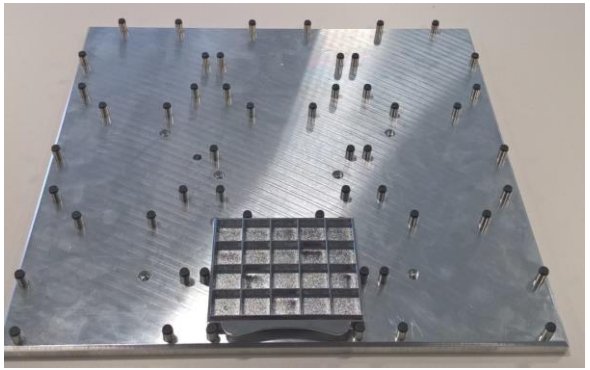
Hybrid Automatic Dispense Equipment
Mixer Nozzle Life – MM10

- Volume dispensed decreases with nozzle residence time
- The full volume of the ‘round’ nozzle (0.683g) should be purged within the following time:
  - HY 4080 – 100s
  - HY 4080 GY – 90s
  - HY 4090 – 80s
  - HY 4090 GY – 10s
  - HY 4092 GY – 10s (Quadro mixer required for correct mixing)

Hybrid Automatic Dispense Equipment
Case History – Aqualisa (UK)

- Loctite 4090 x 50ml - Bonding decorative panels to shower fascias
- Benchtop robot, Syringe Dispenser and Pneumatic applicator gun
- Approx 0.3g per drop
- Addition of MM10 would provide far greater dispense control



Hybrid Automatic Dispense Equipment

Dual Volumetric Rotor Pump MM25 (IDH1774437) + 97160 (IDH1533495) (All 400ml Packs)

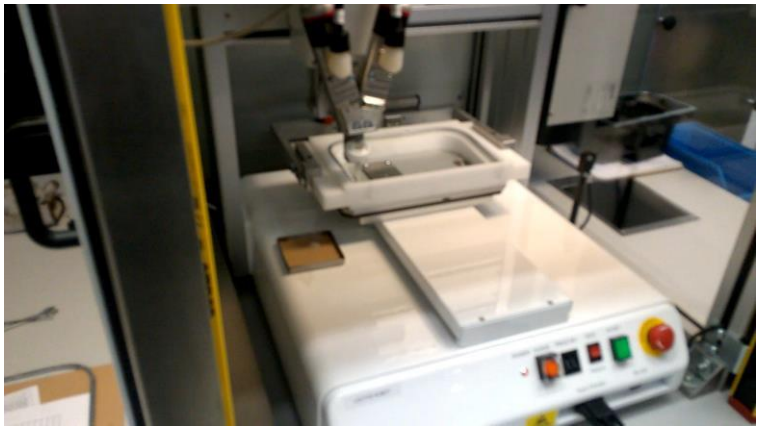
Video of application coming soon

Hybrid Automatic Dispense Equipment
MM25 - General Guidelines

- Always follow 'Directions for Use' to remove any air bubbles within product pack
- Maximum system idle time 7 days
- Flush using De-bonder or similar
- Leave mixer nozzle in place when not dispensing
- Pressure sensor recommended to prevent over-pressurizing due to cured mixer nozzle
- Apply small amount of silicone grease to cartridge Adaptor
- Set purge time to match mixer nozzle life

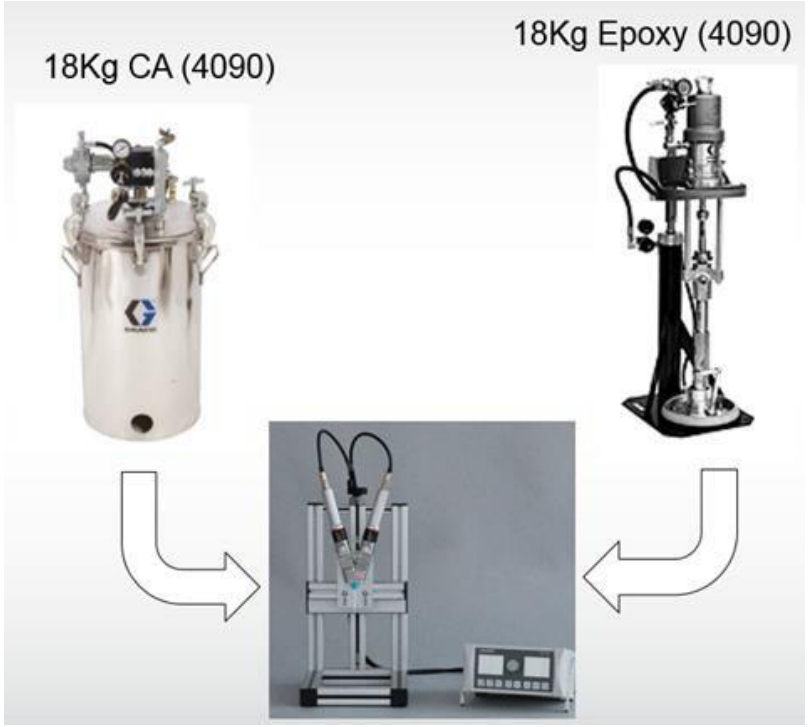
Hybrid Automatic Dispense Equipment
Case History - Cascade Engineering (Hungary)

- Loctite 4090 x 400ml
- Bonding décor chromed baton to cup holder - 0.35g per part
- Equipment supplied to a machine integrator
- Benchtop robot, MM25, MM30 and 97160 controller



Hybrid Automatic Dispense Equipment
Customised Solution (18Kg Pack)

- Based on MM25/97160 Dual Compact Rotor Pump System
  - 20L Drum Pump – Graco
  - High Pressure Regulator - Graco
  - 20L Pressure Reservoir + LL – Walter Pilot
- Special Equipment Package
- Contact European Equipment TCS team at: equipmenttcs.europe@henkel.com



Clover Compounds

Clover Compounds

What are they?

Water or Petroleum Base Carriers combined with an Abrasive Solid.

- The Water Mix is referred to as Pat Gel.
- The Petroleum Base is referred to as Grease Mix.

Clover Compounds

Carrier differences:

- Pat Gel can be thinned and cleaned using water.
- Waste by product is easier to dispose of.
- Great option where solvents may not be compatible.

- Grease Mix requires a solvent to thin and clean up. One product that has worked effectively is PPE Mold Cleaner, aerosol spray MC-012. It is a non-chlorinated mold cleaner. Highly flammable and no CFC's.
- Waste by product is more difficult and expensive to dispose of.
- Great choice for precision gauge's where rust is not an option.

Clover Compounds

- Clover Compounds are also referred to as Machining Compounds.
- The carriers deliver the abrasive solids.
- The abrasive solids are artificial crystalline forms that come in a wide range of particle/grit sizes.
- Clover compound ranges in grit sizes from 80 to 1200.

Clover Compounds

Common Abrasive Materials

	MOHS Hardness Scale
▪ Silicone Carbide	9.5
▪ Aluminum Oxide	9.0
▪ Cubic Boron Nitride	9.9
▪ Diamond	10.0

Clover Compounds

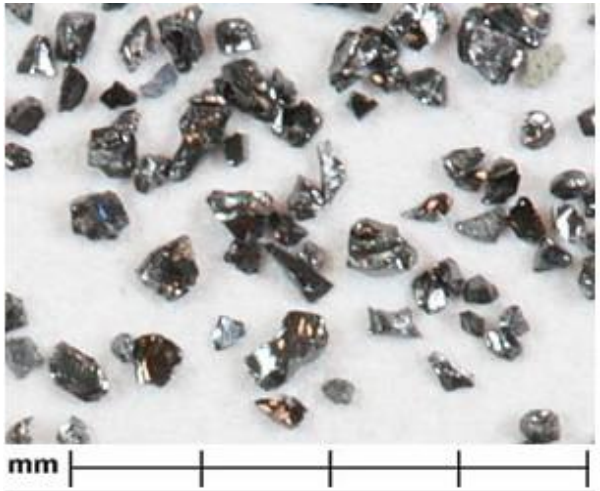
What are the differences:

- Silicone Carbide – fused, hard crystalline abrasive
  (Henkel only offers Silicone Carbide products)
- Aluminum Oxide – fused crystalline abrasive
- Cubic Boron Nitride – synthetic abrasive
- Diamond – hard, sharp, synthetic abrasive

Clover Compounds

- Silicone Carbide is one of the hardest known materials. Right up there next to diamond.

- It is also inexpensive.



This image is a close-up photo of 60/90 ungraded silicon carbide grit. The scale at the bottom of the photo has one millimeter increments. You can clearly see that there are a range or particle sizes as expected in an ungraded grit.

Clover Compounds

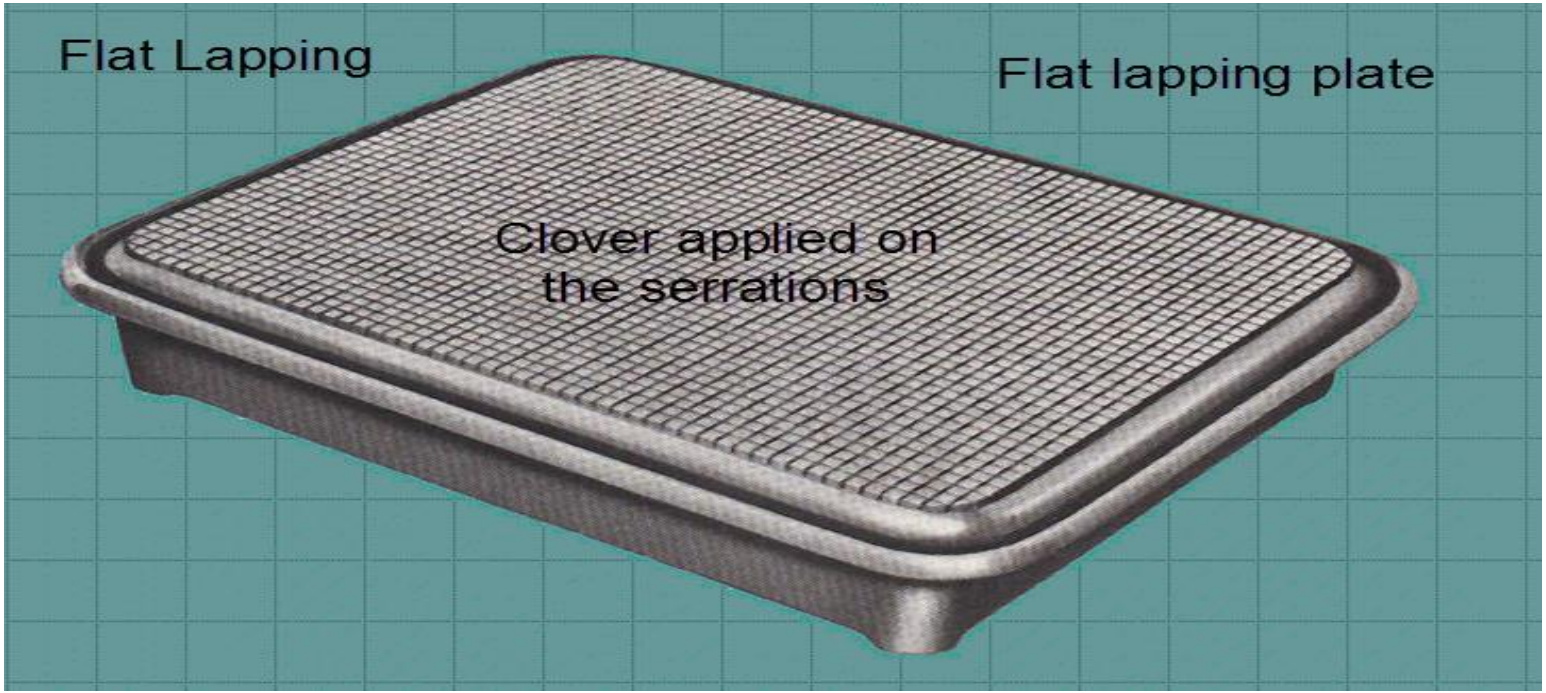
Machining compounds are used for:

- Lapping
- Grinding
- Cleaning and Polishing
- Honing, Sharpening
- Use on large gears to help mesh teeth together
- Rock tumbling, reinstalling prop blades

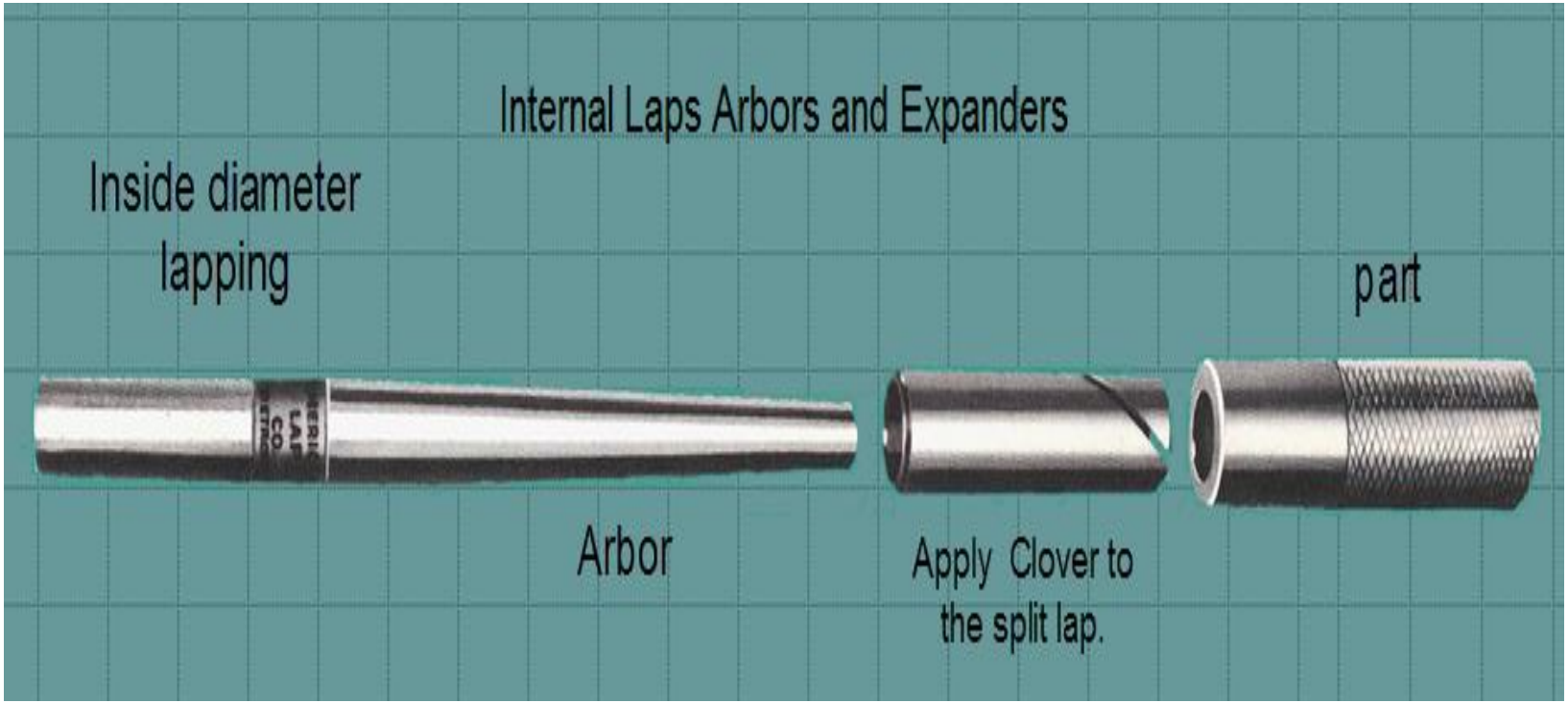
Clover Compounds

* Spitfire lapping machine.
* Uses rotation and pressure over a serrated plate.
* Liquid cooled.
* Parts being lapped are in the circular holders.

Clover Compounds



Clover Compounds



Clover Compounds

Clover Compounds

Clover being used to help mesh the gears together.

Simply being applied with an acid brush.

Clover Compounds

Benefits:

- Produce ultra flat & smooth surfaces
- Clean mold cavities and die surfaces
- Remove metal or hard materials
- Good substitute when you’re short on tooth paste.
- Solvents like Acetone, Xylene, MEK, and Naptha can remove the grease carrier.

Clover Compounds

Loctite® Clover® Silicon Carbide Grease Mix

The standard abrasive paste for fast metal removal. Produces a smooth, flat surface but not a polished one. Leaves a rust-preventing film on lapped surfaces.

P/N	Package Size	Grit
39401	1 lb. can	Grade A – 280 Grit
39510	1 lb. can	Grade 1A – 320 Grit
39523	1 lb. can	Grade 2A – 400 Grit
39549	1 lb. can	Grade 4A – 600 Grit
39561	1 lb. can	Grade 5A – 800 Grit
39587	1 lb. can	Grade 7A – 1,200 Grit
39589	25 lb. pail	Grade 7A – 1,200 Grit
39413	1 lb. can	Grade B – 240 Grit
39426	1 lb. can	Grade C – 220 Grit
39439	1 lb. can	Grade D – 180 Grit
39463	1 lb. can	Grade F – 100 Grit
39473	1 lb. can	Grade G – 80 Grit

Loctite® Clover® Silicon Carbide Pat Gel® Water Mix

Paste formulation for fast metal removal. Biodegradable, recommended for applications where cleanup with water is required.

P/N	Package Size	Grit
39406	1 lb. jar	Grade A – 280 Grit
39515	1 lb. jar	Grade 1A – 320 Grit
39528	1 lb. jar	Grade 2A – 400 Grit
39541	1 lb. jar	Grade 3A – 500 Grit
39554	1 lb. jar	Grade 4A – 600 Grit
39566	1 lb. jar	Grade 5A – 800 Grit
39579	1 lb. jar	Grade 6A – 1,000 Grit
39592	1 lb. jar	Grade 7A – 1,200 Grit
39431	1 lb. jar	Grade C – 220 Grit
39444	1 lb. jar	Grade D – 180 Grit
39468	1 lb. jar	Grade F – 100 Grit
39478	1 lb. jar	Grade G – 80 Grit

Clover Compounds

Loctite® Clover® Duplex Packaging Kit

Contains Clover Silicon Carbide Grease Mix Grades E/A

Loctite® Clover® Silicon Carbide Grease Mix in two convenient grit sizes (120 and 280).

P/N	Package Size	Grit
39598	Kit – 4 oz. duplex can	Grade E/A – 120/280 Grit

Suggested for valve grinding.

Loctite® Clover® Silicon Carbide Reel Sharpening Mix

Water-Soluble

This compound clings to blades for superior honing action. Washes away for easy cleanup.

P/N	Package Size	Grit
39712	25 lb. pail	Grade D – 180 Grit
39715	25 lb. pail	Grade F – 100 Grit

Suggested for Reel sharpening.

Loctite Anti Seize Lubricants

What is Anti-Seize?

Grease

+

Special solid components

= Anti-Seize

What is Anti-Seize?

Chemistry

There are two lubricating steps in an anti-seize formulation:

STEP ONE:

- Minute particles, typically metal, are suspended in a high quality grease
- The grease serves as a lubricant up to approx. 400°F
- At higher temperatures, the grease begins to dissipate

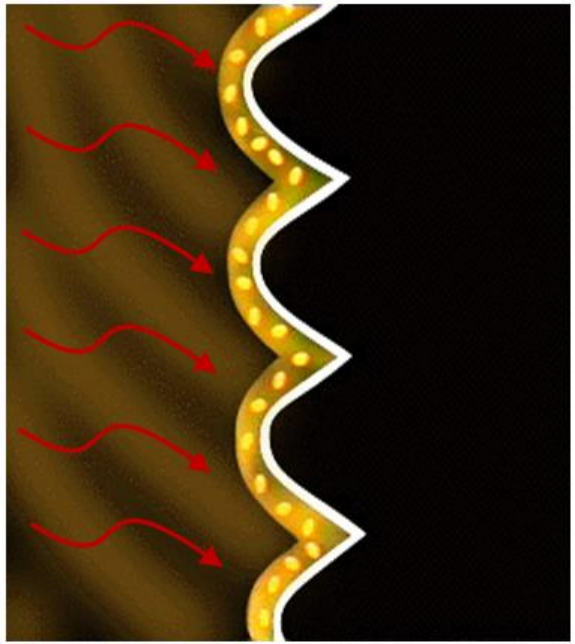
What is Anti-Seize?

Chemistry

At high temperatures:

STEP TWO:

- The remaining particles plate the surface, forming a protective finish that prevents against:
  - Fusion
  - Galling
  - Metal seizure



What is Anti-Seize?

Chemistry: Formulation

General Anti-Seize Contents:

- Oil
- Grease
- Lubricating Solids
- Thickeners

What is Anti-Seize?

Chemistry: Formulation

- **Petroleum Based Oils:** Mineral oil, Naphthenic oil
- **Synthetic Oils:** Silicone, diesters, olefins, glycols and polybutenes
- **Petroleum Oil Based Greases:** Mineral or Naphthenic oil thickened with sodium, aluminum, calcium, lithium soaps or their complexes or thickened with chemically treated bentonite clays, silica or polymer thickened oil such as polyurea greases
- **Synthetic Oil Based Greases:** Thickened with silica or soap
- **Thickeners:** Silica, chemically treated bentones, castor oil derivatives, polyamides, petroleum waxes

What is Anti-Seize?

Chemistry: Formulation

- **Additives:** Rust inhibitors, EP additives, surfactants, antioxidants
- **Metallic Solids:** Element Metal powder or flakes such as copper, nickel, aluminum, zinc, lead
- **Metal Oxides:** Calcium oxides, magnesium oxide, tin oxide, zinc oxide, titanium oxide, barium oxide, antimony oxide
- **Metal Hydroxides:** Calcium hydroxide, magnesium hydroxides
- **Non-Metallic Solids:** Graphite, molybdenum disulfide, boron nitride, polytetrafluoroethylene (PTFE), mica, talc, tungsten disulfide

What is Anti-Seize?

Static or Dynamic Load Lubricant?

- **Static Load:**

  A force that is applied and held in a fixed position.

- **Dynamic Load:**

  A force that is applied and changes in direction and degree of force.

Anti-Seize is a **static** load lubricant!

Applications & Markets

Where should it be used?

- Anti-seize is best used in metal joints that will need to be serviced in the future.
- Protects in environments exposed to:
  - Rust
  - High pressures
  - High temperatures
  - Water washout
  - Bi-metallic corrosion
  - Chemical attacks

Applications & Markets

Where should it be used?

- studs
- tappings
- threaded surfaces
- wire rope
- adjusting screws
- broaching tools
- castings
- catalytic cracker
- condensers
- coolers
- couplings
- drawing, extruding and forming dies (metals or plastics)
- drill collars
- forging dies
- friction rings
- fuel nozzles
- gas burners
- heat exchangers
- lathe centers
- manhole studs
- pivots
- pumps
- splines
- tool joints
- bolts
- bushings
- pipes
- fittings
- flanges
- gaskets
- headers
- nuts
- packing
- press-fits
- plugs
- screws
- tubing
- valve retaining rings
- valve shoes and well pumps
- boiler and oven parts
- jet engines
- industrial turbines
- manifolds
- cylinders heads
- drive chains
- rock drills
- lathe ways

Applications & Markets

Benefits

- **Benefits:**
- Ease of assembly and disassembly
- Protection of mated metal parts
- Extends life of expensive fittings
- Reduces downtime due to seizure
- Reduces part breakage

High quality base grease:

- High pressure resistance
- Resists water washout

Solid components:

- High temperature resistance
- Lubricates up to 2400°F
- Specific metal compatibility

Applications & Markets

Limitations

- Generally not for plastics or elastomers.
- Not for oxygen service. (i.e. O_2 gas)
- Metal content may be undesirable for specific operating environments.

Applications & Markets

Markets

- Mines
- Processing plants
- Power generation plants
- Nuclear power plants
- Pulp and paper
- Chemical plants
- Quarries
- Transportation
- General Industry

Applications & Markets

Markets

- Food processing plants
- Breweries
- Wineries
- Hospitals
- Water treatment plants
- Pharmaceutical manufacturing

Product Line
Overview

- General Purpose
- High Performance
- Specialty
- High Purity

- 15 formulas available to fulfill just about every need in the industry
- Specific anti-seize products for all types of operating environments

Product Line
Selection Criteria

- Temperature
- Chemical resistance
- Type of fasteners
- Lubricity
- High purity
- Electrical conductivity
- Low speed, high load
- Water resistance
- Food contact

Product Line

General Purpose

C5-A® Copper Based:

- Good for 80% of ALL anti-seize applications.
- Most requested product.
- Most package sizes.
- Good for soft metals such as steel or stainless.
- Anti-seize protection up to 1800°F.

- Limitations:
  - Some chemical processes cannot tolerate copper. (e.g., reaction with platinum catalysts in refinery)
  - Traces of copper can accelerate the spoilage of edible oils.
  - May induce stress corrosion cracking in Nuclear power plant.

Product Line
General Purpose

Silver Grade:

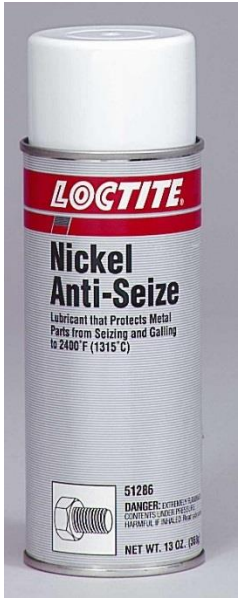
- Similar properties as C5-A®.
- American Bureau of Shipping Approved.
- CFIA Approved.
- Silver colored.
- General purpose.
- Fine particles for fine fittings.
- Anti-seize protection up to 1600°F.

Product Line

General Purpose

Nickel Anti-Seize:

- Extreme temperature applications up to 2400°F.
- American Bureau of Shipping Approved.
- Applications where acids, chemical corrosion and oxidation are present.
- Will not poison catalyst beds or reaction chambers.
- Ideal for stainless steel and titanium applications.



Product Line
High Performance

Heavy Duty Anti-Seize:

- For metal-free environments.
- For protection up to 2400°F.
- Recommended for stainless steel, nickel, titanium and high temperature alloys.
- Approved by GE for Gas Turbine.

Product Line
High Performance

Marine Grade:

- Superior water wash-out and water spray resistance.
- Metal-free formulation
- Excellent lubricity
- Protects to 2400°F
- American Bureau of Shi Approved

Product Line
High Performance

White Hi-Temp:

- Metal-free formulation.
- Less messy than traditional anti-seize. (cleaner appearance of white color).
- Protects to 2000°F.

Product Line
Specialty

Food Grade:

- Joints, fittings and flanges where approval for incidental food contact is required (i.e. NSF H1)
- Recommended on stainless steel parts
- Metal-free formulation
- Applications up to 750°F

Product Line
Specialty

Graphite-50:

- Highly electrically conductive in metal-to metal joints.
- Metal-free formulation.
- For service up to 900°F.
- Mil-T-5544 (canceled 12/97. No replacement)

Product Line
Specialty

Moly Paste:

- Lowest friction anti-seize in our product line.
- Works up to 750°F.
- Metal-free formulation.
- Allows maximum clamping from available torque.
- Protects equipment during break-in, under high static, or slow moving loads.

Product Line
Specialty

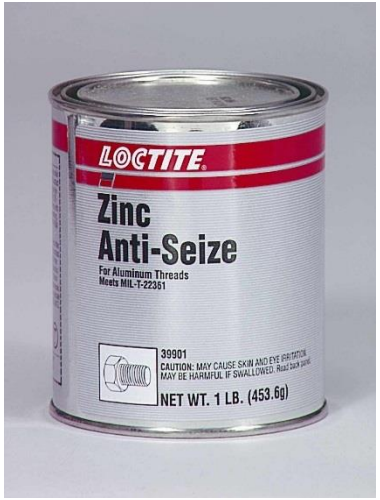
Moly-50:

- General purpose anti-seize.
- Metal-free formulation.
- For service up to 750°F.
- Excellent lubricity.
- Mil -PRF-83483.

Product Line
Specialty

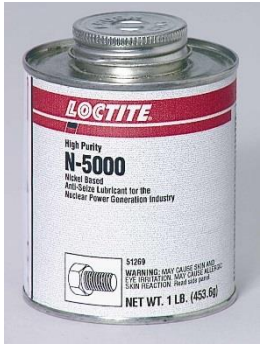
Zinc Anti-Seize:

- Prevents seizing during assembly/ disassembly of metal fittings, particularly aluminum or aluminum alloy parts
- Provides corrosion protection for aluminum and ferrous metal
- MIL-T-22361 (superseded by AA-59313 in 2/99, which we do not meet)
- Applications up to 750ºF



Product Line
High Purity

- **N-7000** -metal free -up to 2400°F
- **N-5000** -nickel -up to 2400°F
- **N-5000 HP*** -nickel -up to 2400°F
- **N-1000** -copper -up to 1800°F



- Formulated for nuclear Class 1, 2 and 3 systems.
- Fittings in reactors, steam generators and turbines.
- Alloy bolting in fossil fuel, steam and nuclear power plants.
- Each batch is tested and certified.
- = N-5000 HP = N-5000 High Performance

Mold Release Solution

Introduction to Release Agents

- What is a mold release agent?
  - Any material that prevents bonding between a part and the mold.
- Can be a variety of materials and chemicals
  - Liquids
  - Solids
  - Pastes
  - Films

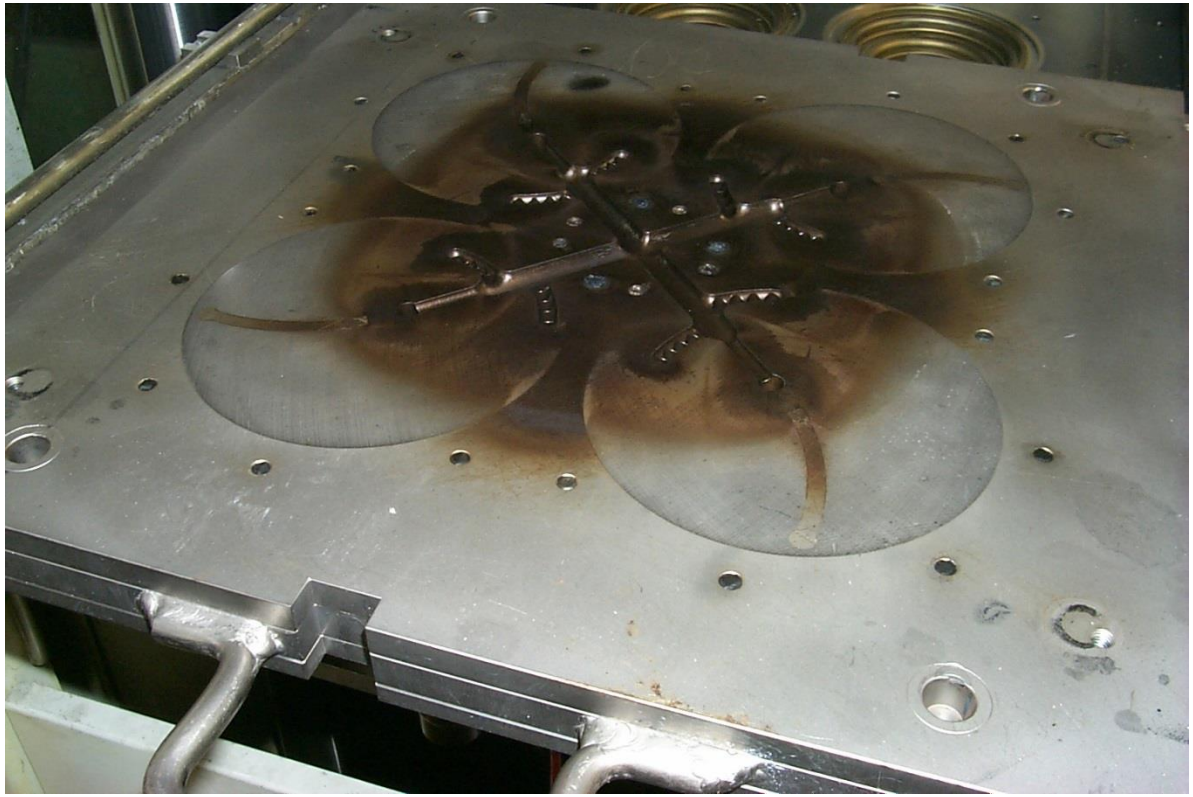
Introduction to Release Agents

- Polymers Based (Semi-permanent) – i.e. Frekote
- Silicones (Sacrificial) – we have a few
- Wax (Sacrificial)
- Teflon® (Permanent)
- Internal Mold Releases (IMR's)
- Soaps, Films, Etc. (Sacrificial) – we have a few

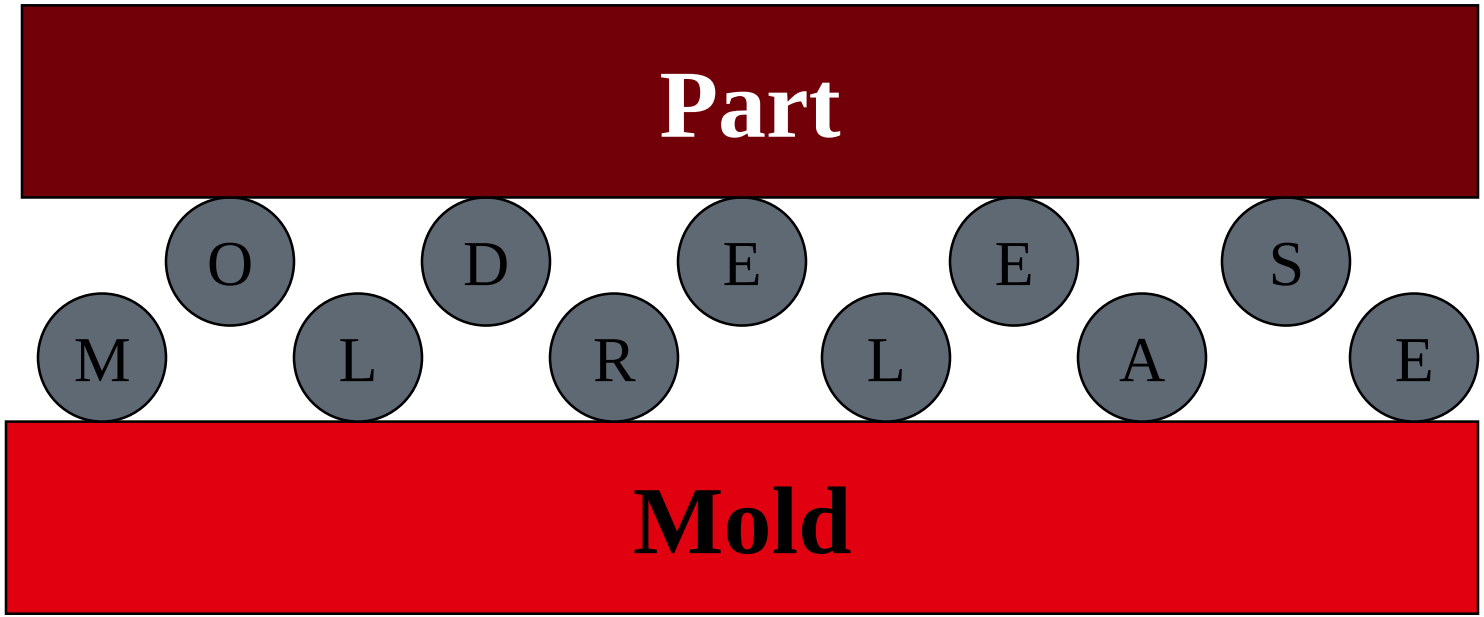
Release Agent Terminology

- NC = Non **C**hloro**F**luoro**C**arbon
  - CFCs are ozone depleting chemicals (ODC)
- VOC = Volatile Organic Compound
- LV = Low VOC
- HS = High Slip
- HL = High Slip Low VOC
- WOLO = Wipe On Leave On
- SOLO = Spray On Leave On
- SPRA = Semi-permanent release agent

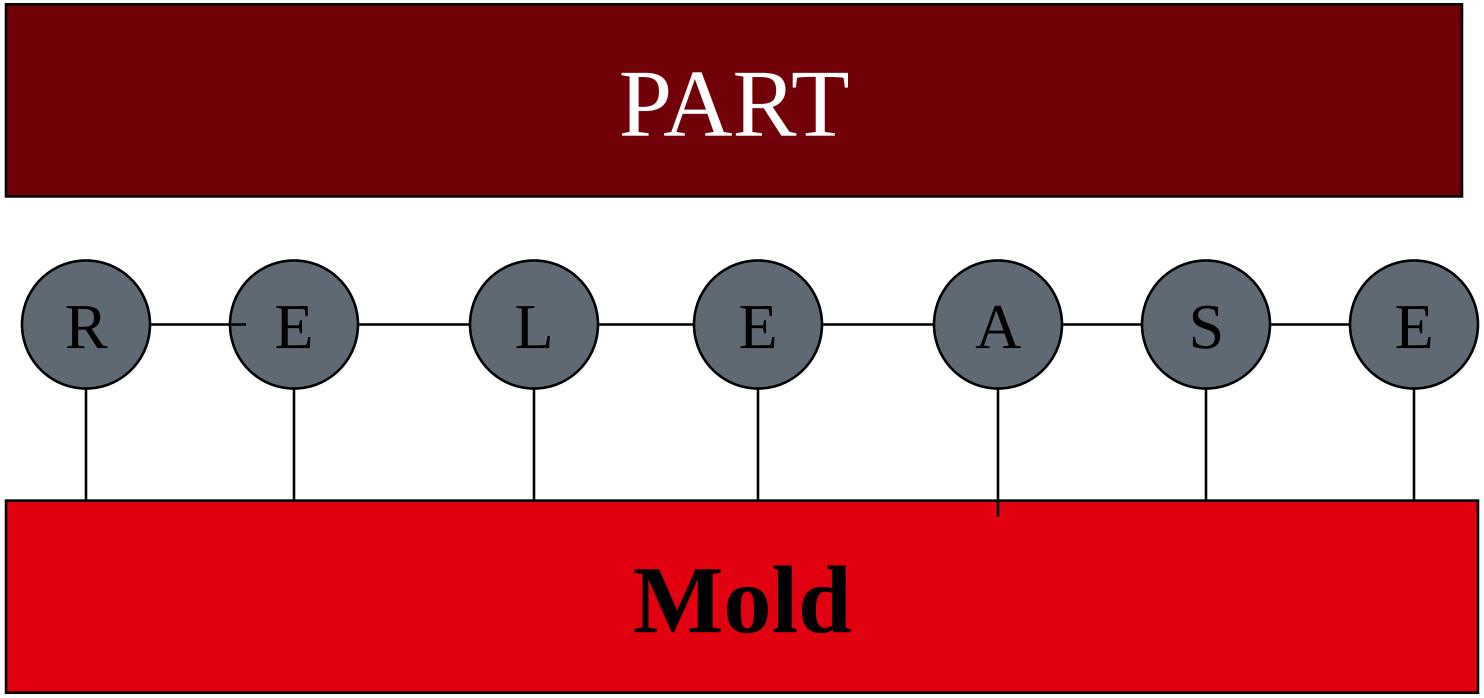
Mold Fouling



Chemistry of a Sacrificial

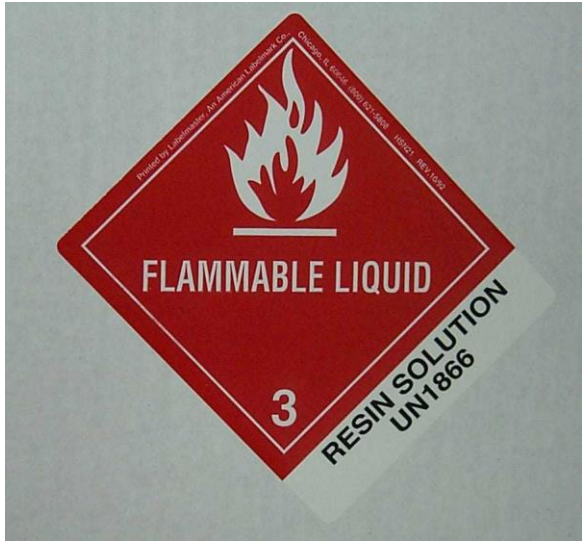


Chemistry of Frekote



Introduction to Frekote®

- All are liquids
- Most use proprietary polymer resins
- Water-based (Aqualine™)
  - Milky-white
  - Ships as Non-Hazardous
- Solvent-based (“NC”)
  - Generally water-clear
  - Distinct solvent smell
  - All are Flammable



Introduction to Frekote® Solvent-based

- Semi-permanent or polymer release agents
  - Known for allowing multiple releases without contamination

- Solvent-based products are used when molding……
  - Epoxies
  - Vinylesters
  - Polyesters
  - Phenolics

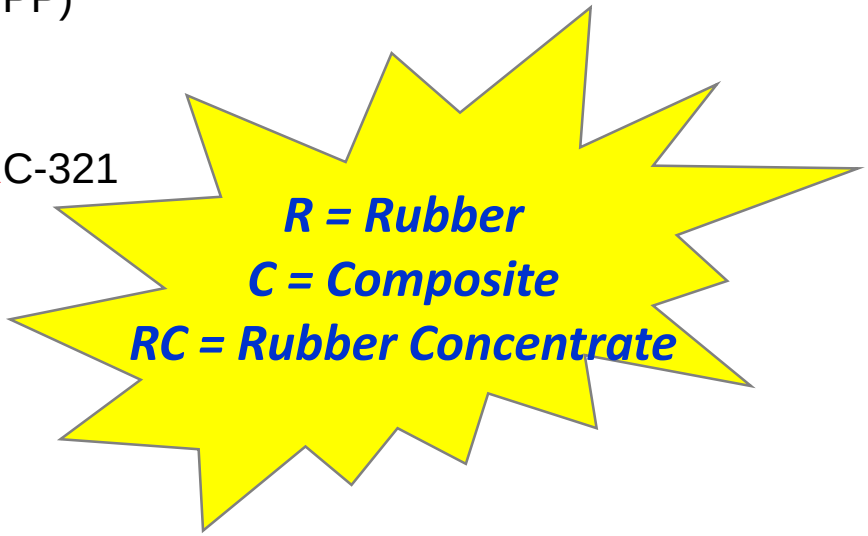
- Which solvent based products do we have?
  - 44-NC, 55-NC, 700-NC, 770-NC, 720-NC
  - WOLO, SOLO, WOLO-HL, WOLO-HS
  - FMS-100, B-15

- New Low VOC Release:
  - 710-LV
  - WOLO-LV

Introduction to Frekote® Water-based

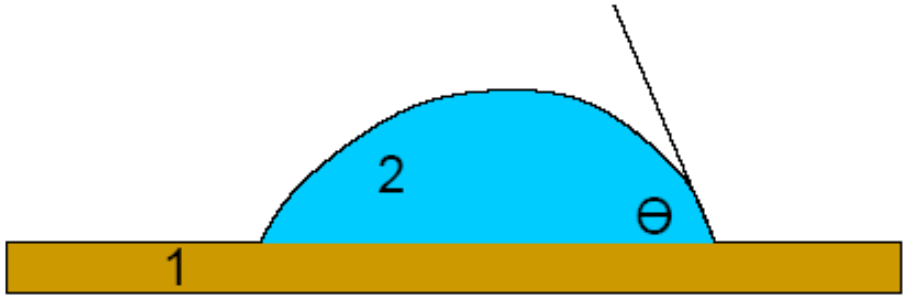
- Water-based products are generally used when molding……
  - Molding rubber compounds
  - High temperature composites
  - Rotationally molded thermoplastics (PE, PP)

- Which water based products do we have?
  - Aqualine R-120, R-150, R-180, R-220, RC-321
  - Aqualine C-200, C-600
  - Rotolease

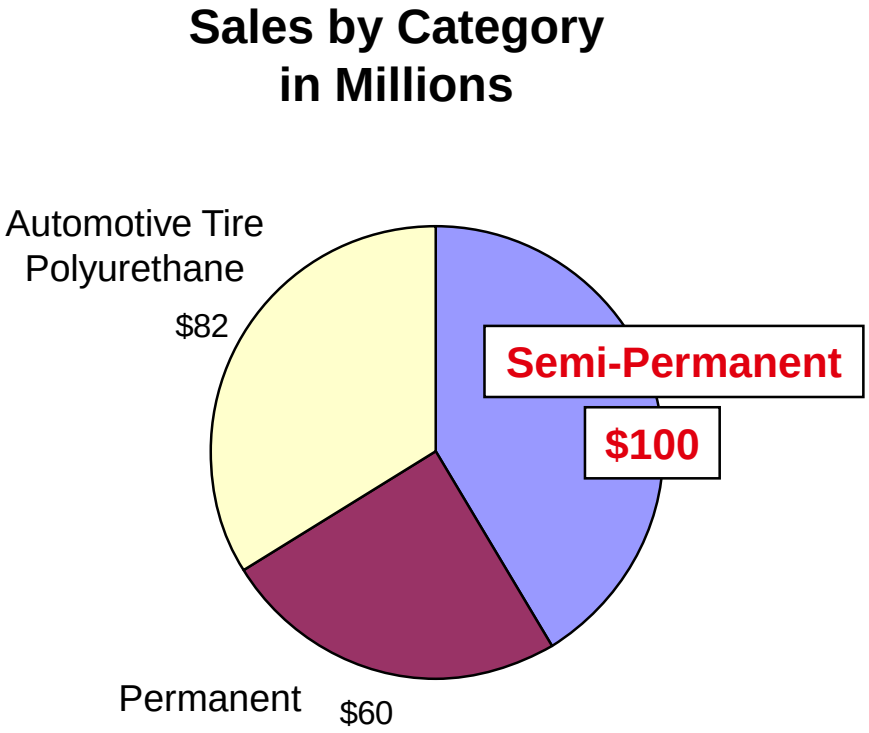


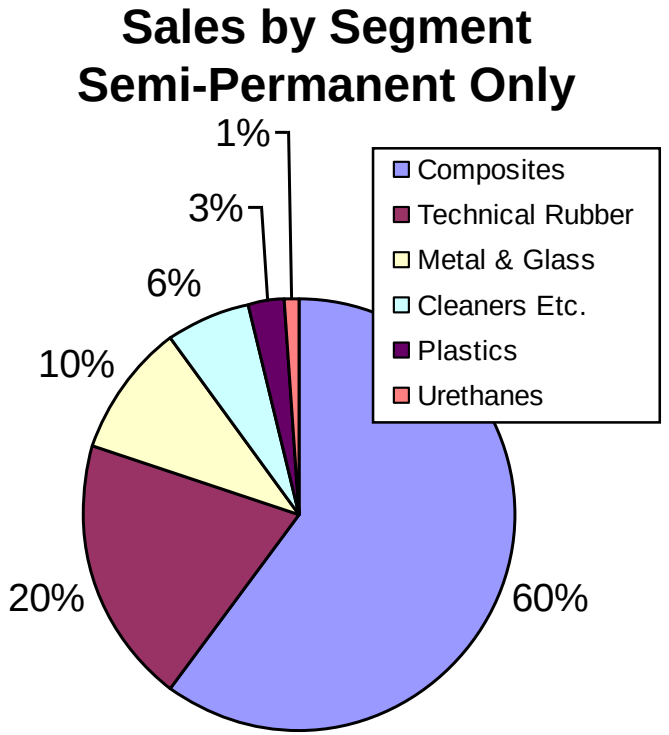
How Does Frekote Work?

- Creates a low surface energy for easy release
  - Water = 73 dynes / sq cm (@ 20 ^{o}C)
  - 6063 Aluminum = 45 dynes / sq cm
  - 301 Stainless Steel = 44 dynes / sq cm
  - Wax = 35 dynes / sq cm
  - SPRA = 24 dynes / sq cm
  - Teflon = 18 dynes / sq cm
- Contact angle



Why Do You Want to Know Frekote?





Market Scheme

- FRP Composite
  - Gel-coat polyester resins
  - Marine
  - Tub & shower
- Other Composite
  - Storage tanks
  - Wind blades
  - Cultured marble/solid surface
  - Bathroom vanities
- Plastics
  - Roto-molding PP and PE
  - Injection molding
  - Kayaks
  - Truck bed liners
- Rubber Molding
  - Compression molding
  - Transfer molding
  - Injection molding
  - Tire molding

Composites Industry

Composites

Composites

Composite Molding Processes
Wipe On Leave On

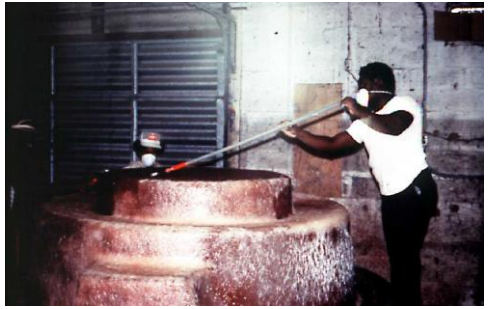
Composite Molding Processes
Wipe On Leave On

Composites Industry Processes

RTM - Resin Transfer Molding

Vacuum Bagging/Autoclave

Hand Lay-Up



Filament Winding

Core Products for Composites

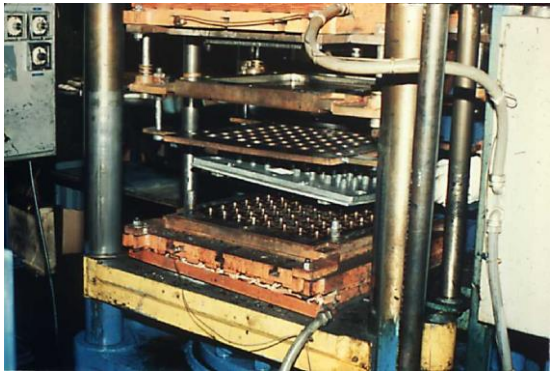
- Step 1: Clean Mold Surface
  - PMC
  - 915WB
- Step 2: Seal Mold Surface
  - FMS-100
  - B-15
- Step 3: Apply Release Agent
  - WOLO, SOLO
  - 55-NC, 770-NC, 720-NC
  - C-200, C-600

Rubber Industry

Core Products for Composites

Frekote for the Rubber Industry
Types of Molding Processes

- Compression Molding
- Transfer Molding
- Injection Molding



Frekote for the Rubber Industry
Core Products

- Cleaners
  - PMC
  - 915WB
- Sealers
  - RS-100
- General Release Agents
  - R-120
  - R-180
  - R-220
  - RC-321
  - Rotolease

Frekote for the Rubber Industry

Common Molding Compounds

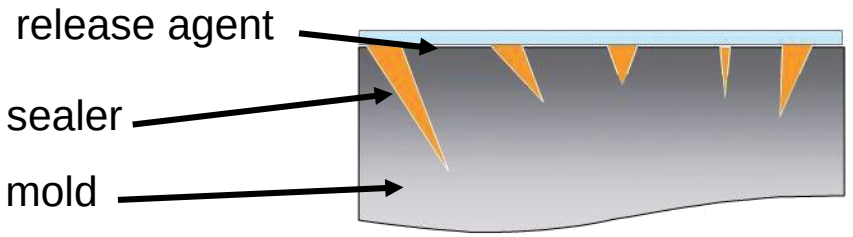
Ease of Release	Compound	Release Agent
Very Easy	Natural Rubber	R-120
Easy	Synthetics - Vamac®, Viton®, Fluorel®	R-150
Moderate	Butyl	R-180
Moderate	SBR	
Moderate	Neoprene	
Moderate	Nitrile	
Difficult	EPDM	R-220
Difficult	HNBR	

Tire Industry Breakthrough

- How you can increase mold productivity by reducing mold downtime
  - through increase intervals between cleaning
  - through less frequent application of release agent
  - through less “stuck” molds/scrap parts
- What our system can offer to lower consumption of release agent.
- How our system reduces mold cleaning costs.
- How this can improve the tire finish/aesthetics, i.e. gloss grade.

Frekote® Aqualine RS-100 and R-150

Application Method



Why use a mold sealer?

- Applied prior to release agent
- Seals micro-porosities of mold
- Increases the number of releases achieved with release agent
- Emergency release if release agent is exhausted

How many coats?

- 4 to 6 coats of the RS-100
- 4 to 6 coats of the R-150

MAKE SURE TO CURE RS-100 PROPERLY (i.e. Time and Temp)

Tire Industry Typical Results

- Increase of mold productivity by reducing mold downtime
- Increase intervals between cleaning (3-4x longer)
  - Less build up because it is semi-permanent
- Less frequent application of release agent (5-12x less often)
  - Applying twice a day vs. once every week
- Lower consumption of release agent
  - Due to less frequent application: consumption cut by at least 50%
- Reduction in mold cleaning costs (by factor 3-4x)
  - Reduction of mold reconditioning costs – less grinding and icing
- Superior tire finish/aesthetics

Urethane Industry

Frekote in the Polyurethane Market

- New release agent developed for PU releases
  - PU is very difficult to release
  - PU can have compatibility issues with “normal” sacrificial mold releases
  - Unlikely to get multiple releases with PU

Frekote in the Polyurethane Market

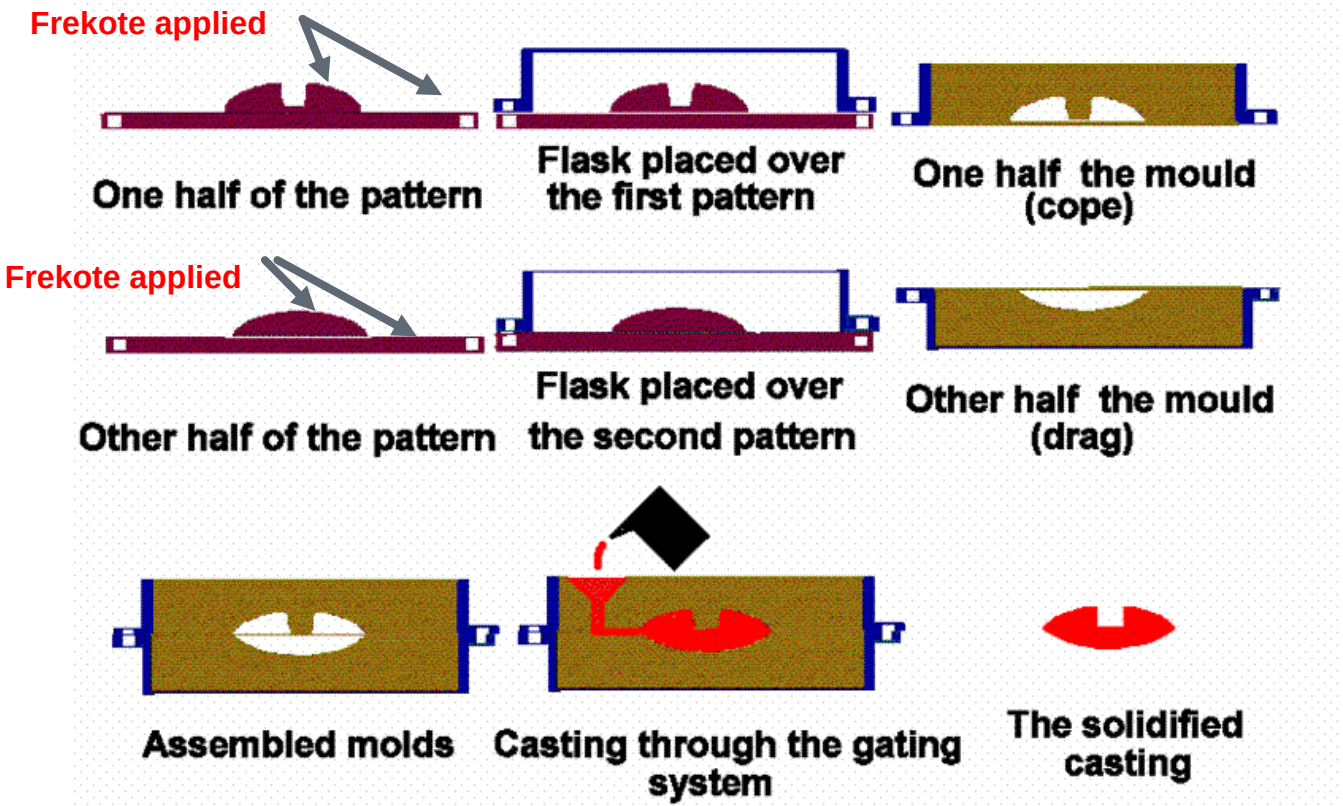
- Three products released for PU release applications
- PU 7200
  - Mold sealer for PU molding process
  - Apply to mold prior to mold release product
- PU 7000
  - Release Agent
  - Gloss finish mold release product
- PU 7001
  - Release Agent
  - High-gloss/high-slip mold release product

Frekote in the Polyurethane Market

- All three PU Frekote products should be sprayed on
  - Can be wiped on, but not recommended
- Although sacrificial, apply as you would any SPRA
  - Allow the product to flash, reapply, repeat

- Polyurethane Markets:
  - Rigid - Decorative trim, AAM car parts, bracketing
  - Semi-rigid foam - Office furniture, auto seating
  - Expanded foam - Bedding, pillows, specialty sports paraphernalia

A METAL CASTING POURED IN A SAND MOLD



Product Selection

Frekote Selector Guide

	FREKOTE® BRAND MOLD RELEASE AGENTS	44-NC™	55-NC™	700-NC™	770-NC™	800-NC™	810-NC™	C-200™	901WB™	FREWAX®	FRP-NC™	HMT™	HMT-2™	R-110™	R-120™	R-150™	R-180™	R-500™	S-50™	WOLO™	WOLO-HS™	SOLO®
POLYMER	Epoxy (Non Gel-Coat)	○	○	○	○			○	○			○	○									
	Polyester Gel-Coat – Glossy			◆	◆					◆	○									○		○
	Polyester Gel-Coat – Matte	○	◆									○	◆									
	Polyester Gel-Coat / Resin – Low Shrink		◆	○	○						◆		◆							◆	○	◆
	Polyamide (PA / Nylon)	○	◆	◆	◆			○	○			○	◆									
	Polyester (Non Gel-Coat)	◆	◆	○	○						◆	◆	◆									
	Polyethylene (PE)	◆	◆	◆	○			○	○			◆	◆									
	Polypropylene (PP)	◆	◆	◆	○			○	○			◆	◆									
	Vinyl Ester	◆	◆	○	○							◆	◆									
COMPOUND	Butyl														○	○	○	○				
	EPDM														◆	○	○	○				
	HNBR															○	○	○				
	Natural													○	○	○	○	○				
	Neoprene														◆	◆	◆	○				
	Nitrile														◆	◆	◆	○				
	Silicone															◆	◆		○			
	Thermoplastic Urethane (TPU)															○	○	◆				
	Vamac														○	○	○	◆				
	Viton														◆	◆	◆	◆				
PROCESS	Cast Polymer / Solid Surface	◆	◆	◆	◆					◆	○	◆	◆							○		
	Compression / Transfer / Vacuum Bagging	○	○	○	○			○	○			○	○	○	○	○	○	○	○			
	Filament Winding			◆	○																	
	Hand Lay up / Spray up	◆	◆	◆	◆					◆	○	◆	◆							○		
	Injection Molding													◆	◆	○	○	◆	○			
	Rotational Molding				○			○	○													
	Rubber-to-Metal Bonding					◆	◆							○	○	○	○	○	◆			
	Tire Treads															◆	○	○	◆			

○ Highly Recommended ◆ Recommended