



LOCTITE® 4011

May 2004

PRODUCT DESCRIPTION

LOCTITE® 4011 provides the following product characteristics:

Technology	Cyanoacrylate
Chemical Type	Ethyl cyanoacrylate
Appearance (uncured)	Transparent, colorless to straw colored liquid ^{LMS}
Components	One part - requires no mixing
Viscosity	Low
Cure	Humidity
Application	Bonding
Key Substrates	Wood, Paper, Leather and Fabric

LOCTITE® 4011 is designed for the assembly of difficult-to-bond materials which require uniform stress distribution and strong tension and/or shear strength. LOCTITE® 4011 is particularly suited for bonding porous or absorbent materials such as wood, paper, leather and fabric. Suitable for use in the assembly of **disposable medical devices**. The product provides rapid bonding of a wide range of materials, including metals, plastics and elastomers.

ISO-10993

An ISO 10993 Test Protocol is an integral part of the Quality Program for LOCTITE® 4011. LOCTITE® 4011 has been qualified to Loctite's ISO 10993 Protocol as a means to assist in the selection of products for use in the medical device industry. Certificates of Compliance are available at www.loctite.com or through the Henkel Loctite Quality Department.

TYPICAL PROPERTIES OF UNCURED MATERIAL

Specific Gravity @ 25 °C	1.05
Viscosity, Brookfield - LVF, 25 °C, mPa·s (cP):	
Spindle 1, speed 30 rpm	90 to 140 ^{LMS}
Flash Point - See MSDS	

TYPICAL CURING PERFORMANCE

Under normal conditions, the atmospheric moisture initiates the curing process. Although full functional strength is developed in a relatively short time, curing continues for at least 24 hours before full chemical/solvent resistance is developed.

Cure Speed vs. Substrate

The rate of cure will depend on the substrate used. The table below shows the fixture time achieved on different materials at 22 °C / 50 % relative humidity. This is defined as the time to develop a shear strength of 0.1 N/mm².

Fixture Time, ISO 4587, seconds:

Steel (degreased)	5 to 20
Aluminum	2 to 10
Zinc Dichromate	10 to 20
Neoprene	<5
Rubber, Nitrile	<5
ABS	2 to 10
PVC	2 to 10

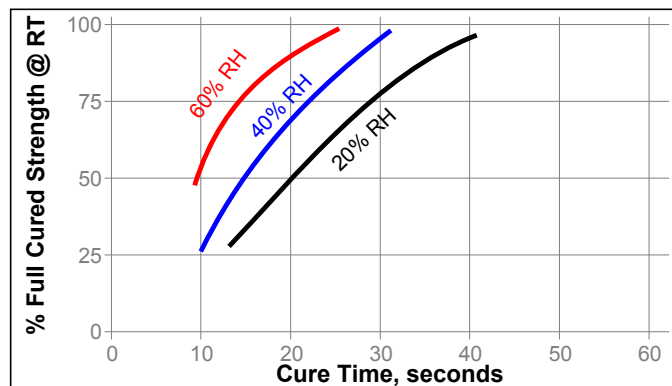
Polycarbonate	10 to 40
Phenolic	2 to 10
Wood (Balsa)	2 to 5
Wood (Oak)	90 to 180
Chipboard	30 to 90
Fabric	2 to 20
Leather	5 to 15
Paper	1 to 10

Cure Speed vs. Bond Gap

The rate of cure will depend on the bondline gap. Thin bond lines result in high cure speeds, increasing the bond gap will decrease the rate of cure.

Cure Speed vs. Humidity

The rate of cure will depend on the ambient relative humidity. The following graph shows the tensile strength developed with time on Buna N rubber at different levels of humidity.



Cure Speed vs. Activator

Where cure speed is unacceptably long due to large gaps, applying activator to the surface will improve cure speed. However, this can reduce ultimate strength of the bond and therefore testing is recommended to confirm effect.

TYPICAL PROPERTIES OF CURED MATERIAL

After 24 hours @ 22 °C

Physical Properties:

Coefficient of Thermal Expansion, ASTM D 696, K ⁻¹	80×10 ⁻⁶
Coefficient of Thermal Conductivity, ASTM C 177, W/(m·K)	0.10
Glass Transition Temperature, ASTM E 228, °C	120

Electrical Properties:

Dielectric Constant / Dissipation Factor, ASTM D 150:

0.10 kHz	2.75 / <0.02
1 kHz	2.75 / <0.02
10 kHz	2.75 / <0.02
Volume Resistivity, ASTM D 257, Ω·cm	10×10 ¹⁵
Surface Resistivity, ASTM D 257, Ω	10×10 ¹⁵
Dielectric Breakdown Strength, ASTM D 149, kV/mm	25

TYPICAL PERFORMANCE OF CURED MATERIAL**Adhesive Properties**

After 24 hours @ 22 °C

Lap Shear Strength, ISO 4587:

Steel (grit blasted)	N/mm ²	18 to 26
	(psi)	(2,610 to 3,770)
Aluminum (etched)	N/mm ²	11 to 19
	(psi)	(1,595 to 2,755)
Zinc Dichromate	N/mm ²	4 to 10
	(psi)	(580 to 1,450)
ABS	N/mm ²	6 to 20
	(psi)	(870 to 2,900)
PVC	N/mm ²	6 to 20
	(psi)	(870 to 2,900)
Phenolic	N/mm ²	5 to 15
	(psi)	(725 to 2,175)
Polycarbonate	N/mm ²	5 to 20
	(psi)	(725 to 2,900)
Nitrile	N/mm ²	5 to 15
	(psi)	(725 to 2,175)
Neoprene	N/mm ²	5 to 15
	(psi)	(725 to 2,175)

Tensile Strength, ISO 6922:

Steel (grit blasted)	N/mm ²	12 to 25
	(psi)	(1,745 to 3,625)
Buna-N	N/mm ²	5 to 15
	(psi)	(725 to 2,175)

After 10 seconds @ 22 °C

Tensile Strength, ISO 6922:

Buna-N	N/mm ²	≥6.90 ^{LMS}
	(psi)	(≥1,000)

TYPICAL ENVIRONMENTAL RESISTANCE

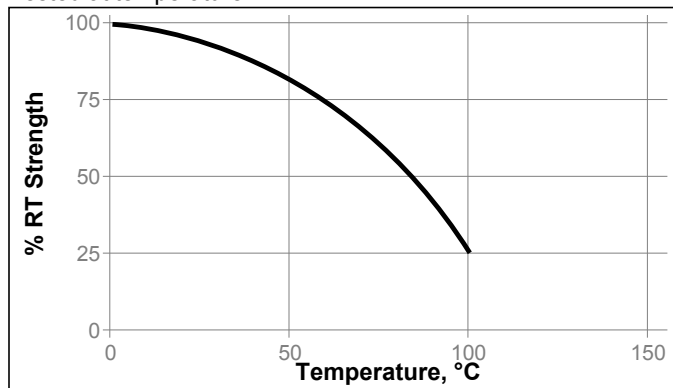
After 1 week @ 22 °C

Lap Shear Strength, ISO 4587:

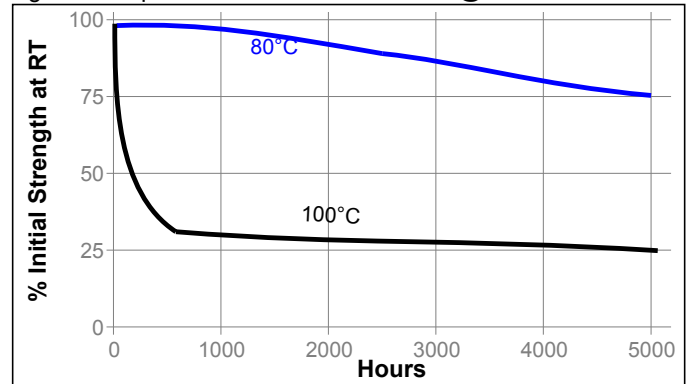
Mild steel (grit blasted)

Hot Strength

Tested at temperature

**Heat Aging**

Aged at temperature indicated and tested @ 22 °C

**Chemical/Solvent Resistance**

Aged under conditions indicated and tested @ 22 °C.

Environment	°C	% of initial strength		
		100 hr	500 hr	1000 hr
Motor Oil	40	95	95	95
Gasoline	22	100	100	100
Ethanol	22	100	100	100
Alcohol, Isopropyl	22	100	100	100
Freon TA	22	100	100	100
Heat/Humidity 95% RH	40	70	50	40
Heat/Humidity 95% RH on Polycarbonate	40	100	100	100

Effects of Sterilization

In general, products similar in composition to LOCTITE® 4011 subjected to standard sterilization methods, such as EtO and Gamma Radiation (25 to 50 kiloGrays cumulative) show excellent bond strength retention. LOCTITE® 4011 maintains bond strength after 1 cycle of steam autoclave. It is recommended that customers test specific parts after subjecting them to the preferred sterilization method. Consult with Loctite for a product recommendation if your device will see more than 3 sterilization cycles.

GENERAL INFORMATION

This product is not recommended for use in pure oxygen and/or oxygen rich systems and should not be selected as a sealant for chlorine or other strong oxidizing materials.

For safe handling information on this product, consult the Material Safety Data Sheet (MSDS).

Directions for use

1. For best performance bond surfaces should be clean and free from grease.
2. This product performs best in thin bond gaps (0.05 mm).
3. Excess adhesive can be dissolved with Loctite cleanup solvents, nitromethane or acetone.

Loctite Material Specification^{LMS}

LMS dated November 01, 2002. Test reports for each batch are available for the indicated properties. LMS test reports include selected QC test parameters considered appropriate to specifications for customer use. Additionally, comprehensive controls are in place to assure product quality and consistency. Special customer specification requirements may be coordinated through Henkel Loctite Quality.

Storage

Store product in the unopened container in a dry location. Storage information may be indicated on the product container labeling.

Optimal Storage: 2 °C to 8 °C. Storage below 2 °C or greater than 8 °C can adversely affect product properties.

Material removed from containers may be contaminated during use. Do not return product to the original container. Henkel Corporation cannot assume responsibility for product which has been contaminated or stored under conditions other than those previously indicated. If additional information is required, please contact your local Technical Service Center or Customer Service Representative.

Conversions

$(^{\circ}\text{C} \times 1.8) + 32 = ^{\circ}\text{F}$
 $\text{kV/mm} \times 25.4 = \text{V/mil}$
 $\text{mm} / 25.4 = \text{inches}$
 $\text{N} \times 0.225 = \text{lb}$
 $\text{N/mm} \times 5.71 = \text{lb/in}$
 $\text{N/mm}^2 \times 145 = \text{psi}$
 $\text{MPa} \times 145 = \text{psi}$
 $\text{N}\cdot\text{m} \times 8.851 = \text{lb}\cdot\text{in}$
 $\text{N}\cdot\text{mm} \times 0.142 = \text{oz}\cdot\text{in}$
 $\text{mPa}\cdot\text{s} = \text{cP}$

Note

The data contained herein are furnished for information only and are believed to be reliable. We cannot assume responsibility for the results obtained by others over whose methods we have no control. It is the user's responsibility to determine suitability for the user's purpose of any production methods mentioned herein and to adopt such precautions as may be advisable for the protection of property and of persons against any hazards that may be involved in the handling and use thereof. In light of the foregoing, **Henkel Corporation specifically disclaims all warranties expressed or implied, including warranties of merchantability or fitness for a particular purpose, arising from sale or use of Henkel Corporation's products. Henkel Corporation specifically disclaims any liability for consequential or incidental damages of any kind, including lost profits.** The discussion herein of various processes or compositions is not to be interpreted as representation that they are free from domination of patents owned by others or as a license under any Henkel Corporation patents that may cover such processes or compositions. We recommend that each prospective user test his proposed application before repetitive use, using this data as a guide. This product may be covered by one or more United States or foreign patents or patent applications.

Trademark usage

LOCTITE is a trademark of Henkel Corporation

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