

Force Engineering & Testing, Inc.

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Humble, Texas 77338
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www.forceengineeringtesting.com

Test Number: 49-0010T-16

Test Report Date: August 29, 2016

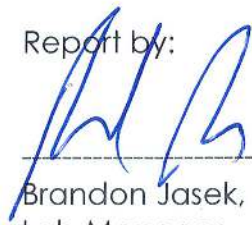
Test Material: 24 Ga. Tee-Lock 18" coverage

Test Procedure: The test was conducted in accordance of
ASTM E 1680-11 Standard Test Method for: Rate of Air Leakage
Through Exterior Metal Roof Panel System

ASTM E 1646-95 (Reapproved for 2011) Standard Test Method
For: Water Penetration of Metal Roof Panel Systems by
Uniform Static Air Pressure Difference

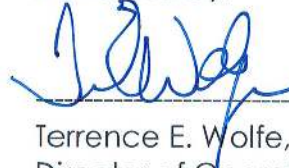
Test Location: Force Engineering & Testing, Inc.
19530 Ramblewood Drive
Humble, TX 77338

Report by:



Brandon Jasek, P.E.
Lab Manager

Reviewed by:



Terrence E. Wolfe, P.E.
Director of Operations



ACCREDITED
LABORATORY
TL-417



ACCREDITED
LABORATORY



TEXAS DEPARTMENT
OF INSURANCE
ACCREDITED LABORATORY
1 of 16

Project Number: 49-0010T16

PURPOSE:

The purpose of this test was to determine the air infiltration and water penetration on the roof panel system.

TEST DATE:

August 5, 2016

TEST SPECIMEN:

Manu./Client: Beridge Manufacturing Company
6515 Fratt Road
San Antonio, Texas 78218
Panel: Tee-Lock Panel, 24 Ga., 18" Coverage, 2 3/8" tall tee rib, tee
rib mechanically seamed.
Panel Properties: $F_y = 51.0$ ksi Steel, 0.024" thickness per ASTM E8 (See
Appendix)
Panel Seam Cap: 24 Ga. steel seam cap with factory applied vinyl strip. Vinyl
strip adhered to seam cap with Loctite 4471 adhesive.
Panel Clip: 6" long 16 Ga. Grade 50 Steel, Low Fixed Clip
Clip Fastener: (2) # 12-14 x 1" HWH SD per clip.
Panel Laps: (5) panel ribs and NO panel end laps.
Panel Length: 8'-11"
Panel Spans: 5'-0" and 3'-9"

TESTING APPARATUS:

High Pressure Blower: 15 hp, 900 cfm.
Test Chamber: 8' x 9' steel chamber.
Mounting Frame: 16-ga. Zee Interior, Steel Channel Perimeter
Pressure Indicator: Digital Pressure Indicator
Flowmeter: Laminar Flow Element
Equipment Calibration Date: 3/1/2016

Project Number: 49-0010T-16

PANEL INSTALLATION:

The panels were installed on the interior Zee with the panel clips. The perimeter was sealed with tape sealant and then fastened to the steel frame. Plywood strips were installed on the panel ends to allow ½" of water ponding.

ASTM 1680 Rate of Air Leakage Test Procedure:

1. The purlin was moved in either direction for total of (3) cycles
2. A positive preload of 15 psf (75% of building live load) was applied to the panels and held for 10 seconds and then released and allowed to recover for 2 minutes. Repeated 2 times for a total of 3 cycles.
3. A negative preload of 30 psf (50% of design wind load of 60 psf) was applied to the panels and held for 10 seconds and then released and allowed to recover for 2 minutes. Repeated 2 times for a total of 3 cycles.
4. The panel joints/ribs were taped and an initial reading was taken. The tape was then removed for a final reading.

ASTM 1646 Water Penetration Test Procedure:

1. The Panels were preloaded during the Air Leakage test therefore no preloading is required.

Test Conditions:

Ambient air temperature before testing: 86.0° F
Ambient air temperature during testing: 86.1° F
Panel Surface temperature before testing: 81.0° F
Panel Surface temperature during testing: 81.0° F
Water depth on panel during testing: ½"

SUMMARY OF TEST RESULTS

Test

Air Infiltration @ 1.57 psf

Leakage

0.002 cfm/sf
0.003 cfm/lf

Air Infiltration @ 6.24 psf

0.004 cfm/sf
0.006 cfm/lf

Water Penetration @ 6.24 psf

No Water Leakage

State of Florida
C.O.A.
28778



SEP 01 2016

Project Number: 49-0010T-16

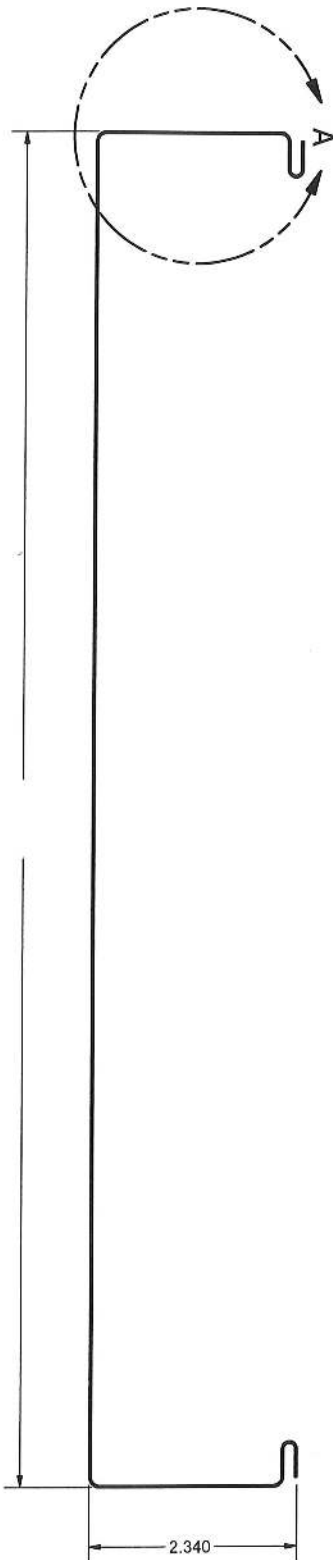
STATEMENT OF INDEPENDENCE

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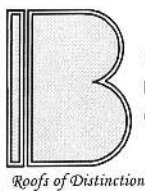
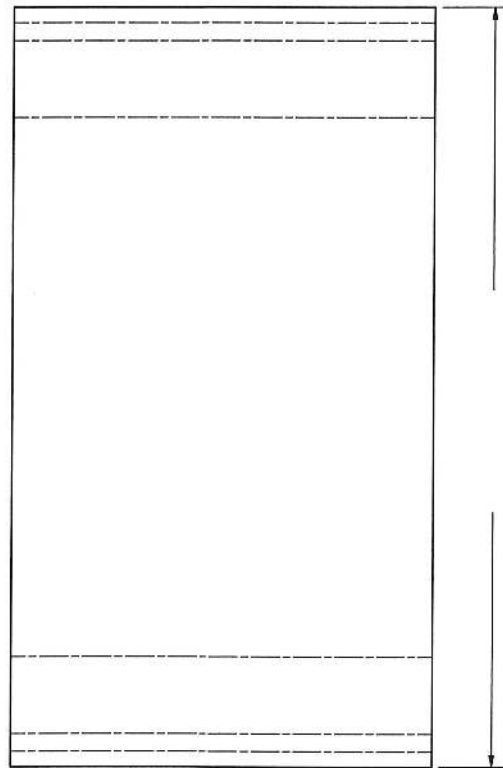
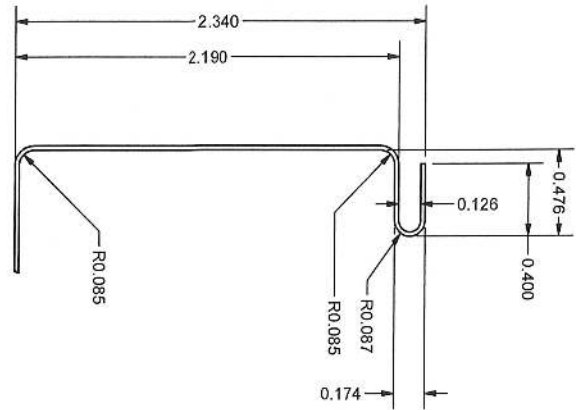
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Appendix

18" COVERAGE



DETAIL A
SCALE 1.50 : 1



BERRIDGE
MANUFACTURING
COMPANY

**TOLERANCES
EXCEPT AS NOTED**
.X/Y: $\pm 1/32$
.X: ± 0.030
.XX: ± 0.015
.XXX: ± 0.001

TEE-LOCK PANEL
FILE: TEE-LOCK PANEL - FINAL.IDW

DRAWN BY: WKS

MAT'L:

QTY:

00-00-0000

DATE: 08-21-13

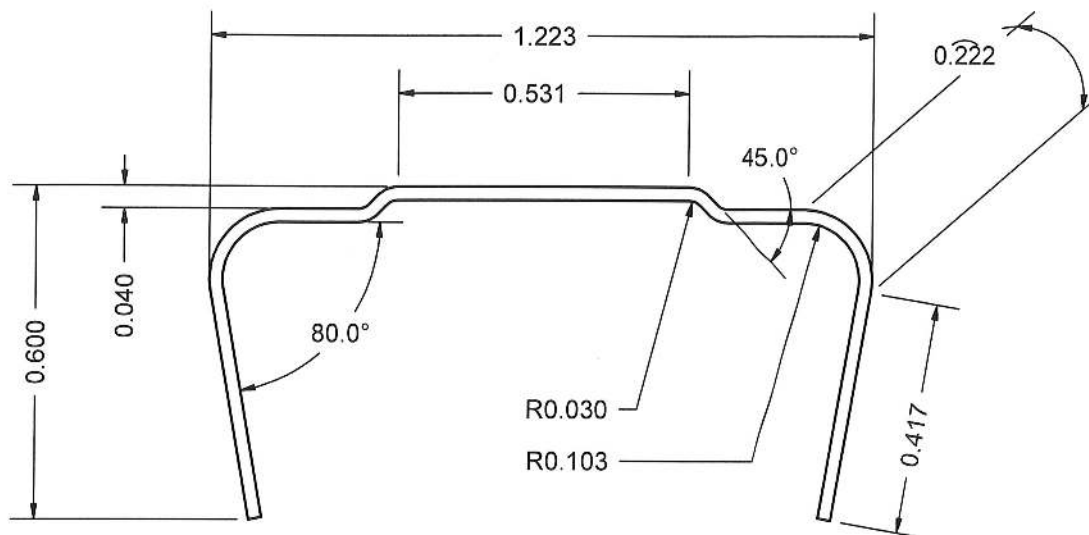
FINISH:

PART NO.: 00-0000

SYM

REVISION DESCR.

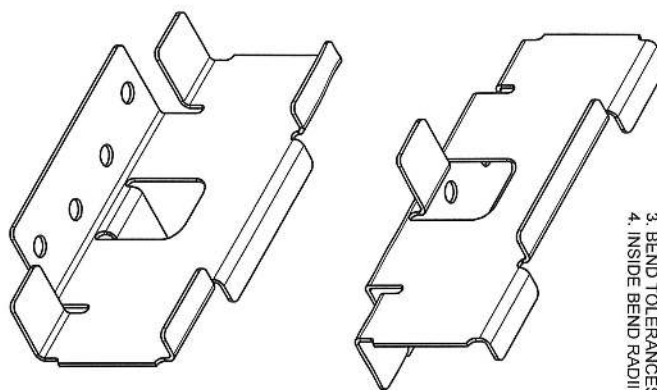
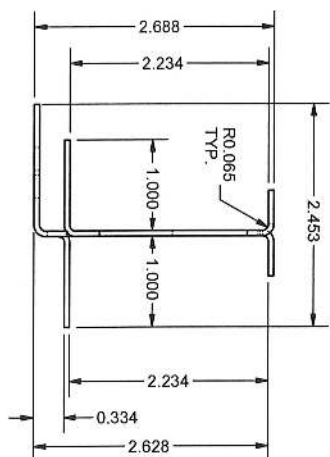
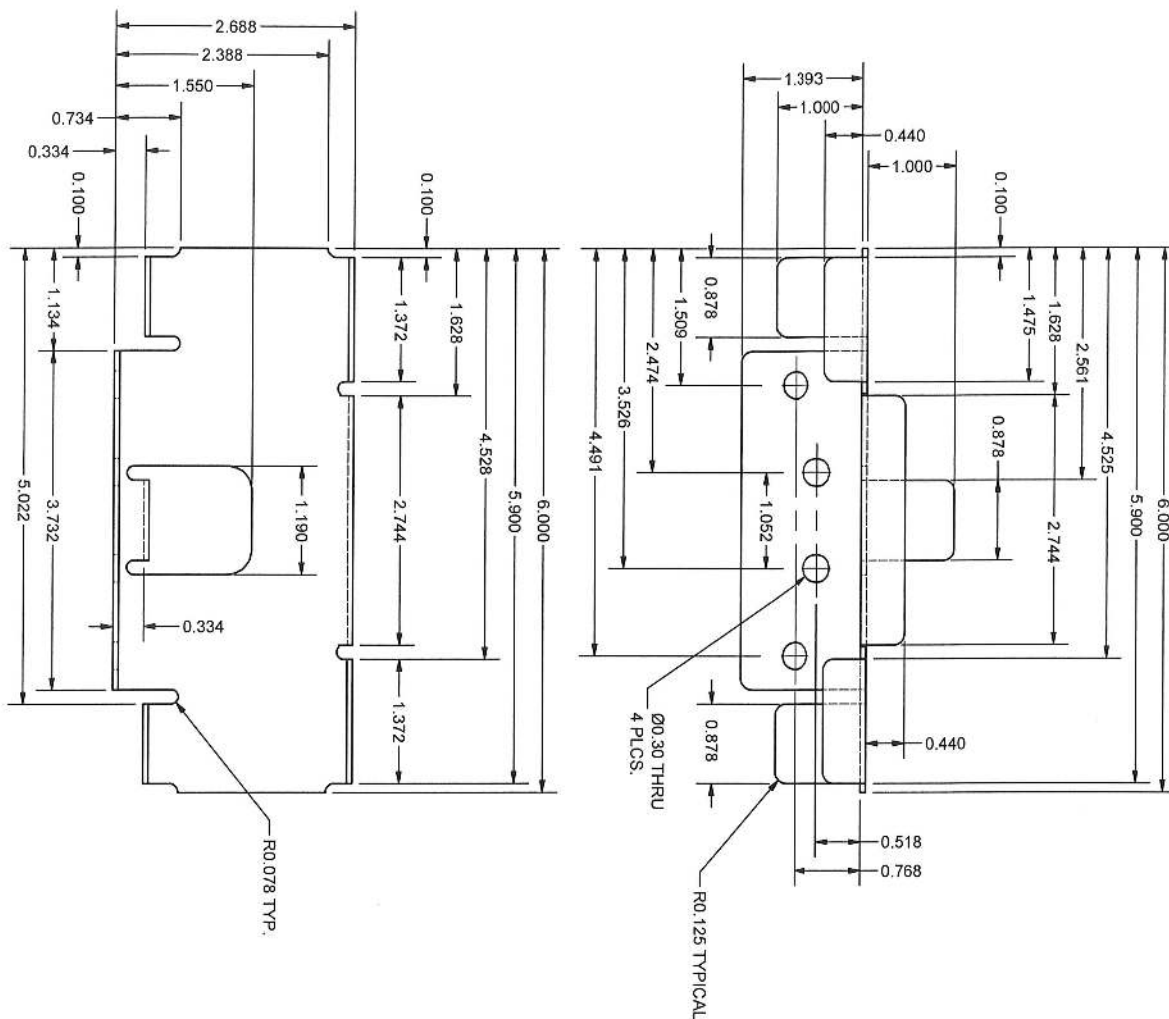
DATE



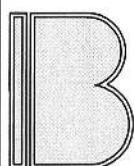
BERRIDGE MFG. CO.
 TEE-LOCK PANEL: SEAM CAP
 OPEN - FINAL

NOTE:
 MAT: 24 AND 22 GAUGE PAINTED
 STEEL, 0.032 AND 0.040 PAINTED
 ALUMINUM
 QTY: 1 PER MACHINE
 FINISH: NONE

P/N: Tee-Lock Panel -
 Seam Cap Open - FINAL
 DATE: 1/21/2011



- NOTES:
1. CALCULATED STRIP WIDTH: 4.455"
 2. MATERIAL: 16 GA. STEEL GRADE 50
 3. BEND TOLERANCES +OR- 2 DEG.
 4. INSIDE BEND RADIUS 0.065"



BERRIDGE
MANUFACTURING
COMPANY

Roofs of Distinction

**TOLERANCES
EXCEPT AS NOTED**

X/Y: $\pm 1/32$
X: ± 0.2
XX: ± 0.01
XXX: ± 0.005

**TEE-LOCK PANEL: CLIP
FINAL VERSION**

FILE: TEE-LOCK PANEL CLIP - FINAL

DRAWN BY: WKS

MAT'L: 16 GA. STEEL

QTY:

00-00-0000

DATE: 07-23-2014

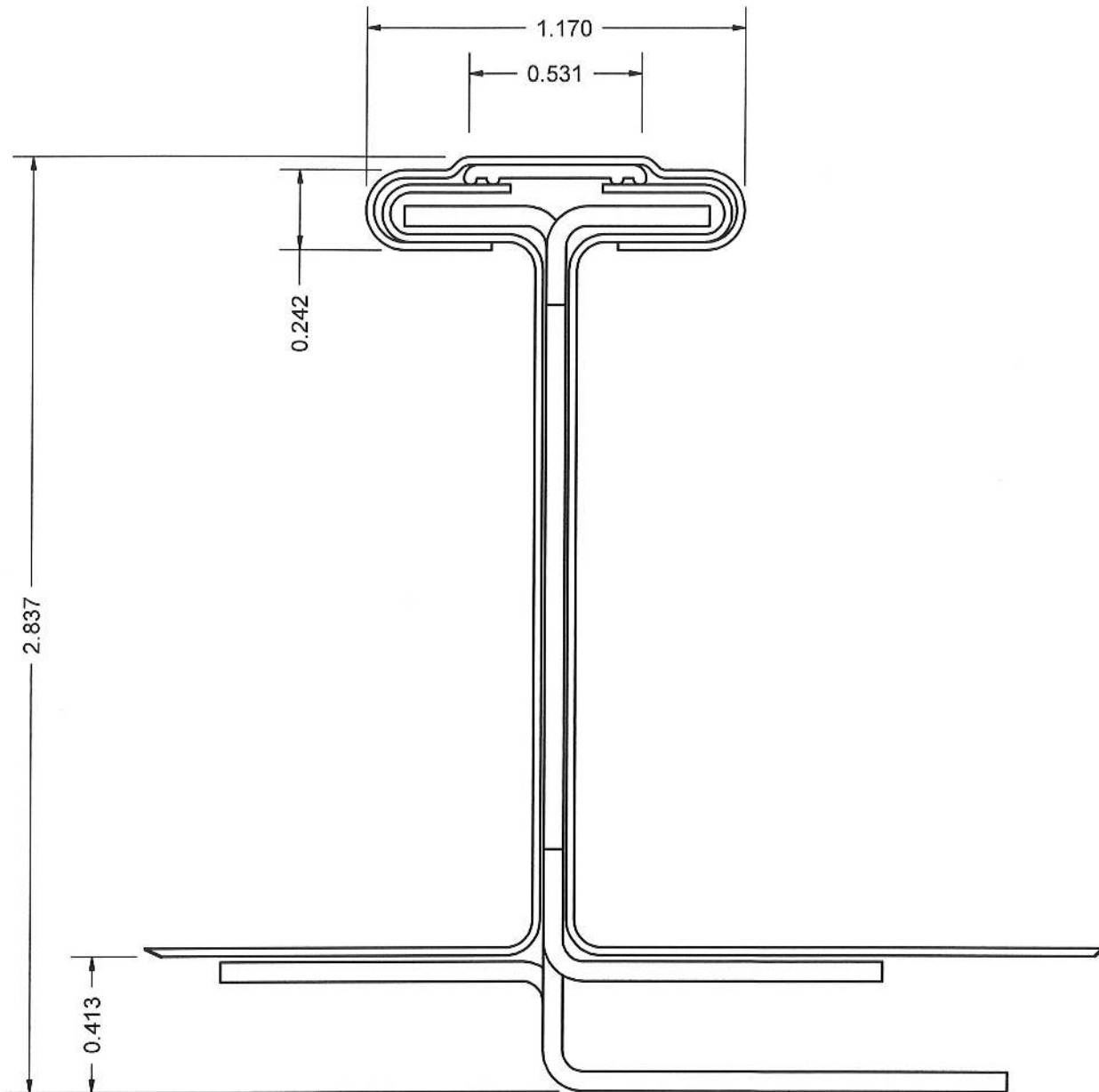
FINISH: NONE

PART NO.: 00-0000

SYM

REVISION DESCR.

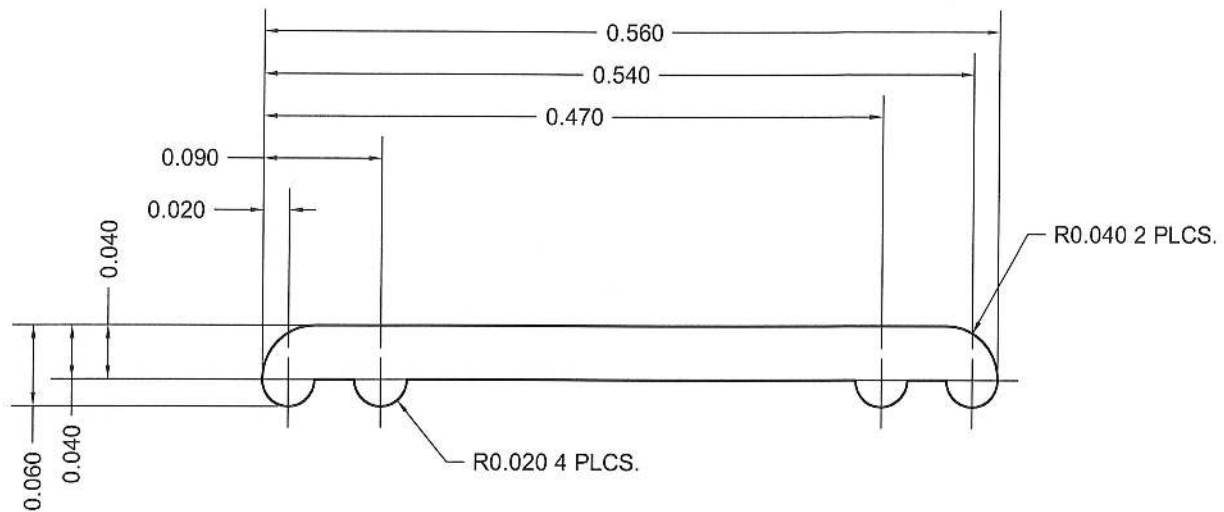
DATE



TEE-LOCK PANEL: ASSEMBLY - FINAL

TOLERANCES: 0.00 = ± 0.010 ;
0.000 = ± 0.005
MAT:
QTY: 1 PER MACHINE
FINISH: NONE

P/N: Tee-Lock Panel -
Assembly -
Panel-Clip-Seam Cap-Vinyl
DATE: 7/29/2014



BERRIDGE MFG. CO.
TEE-LOCK PANEL: VINYL - FINAL
VERSION

TOLERANCES: 0.00 = ± 0.010 ;
0.000 = ± 0.005
MAT:
QTY: 1 PER MACHINE
FINISH: NONE

P/N: Tee-Lock Panel - Vinyl
- FINAL
DATE: 5/3/2013

BERRIDGE MANUFACTURING COMPANY

LOCTITE® 4471™

January 2007

PRODUCT DESCRIPTION

LOCTITE® 4471™ provides the following product characteristics:

Technology	Cyanoacrylate
Chemical Type	Ethyl cyanoacrylate
Appearance (uncured)	Clear liquid ^{LMS}
Components	One part - requires no mixing
Viscosity	Medium
Cure	Humidity
Application	Bonding
Key Substrates	Wood, Leather and Foamed rubber

LOCTITE® 4471™ is designed for the assembly of difficult-to-bond materials which require uniform stress distribution and strong tension and/or shear strength. In addition to key substrates referred to above, the product bonds acidic surfaces such as chromated or freshly plated parts.

TYPICAL PROPERTIES OF UNCURED MATERIAL

Specific Gravity @ 25 °C	1.05
Viscosity, Brookfield - RVT, 25 °C, mPa·s (cP):	
Spindle 2, speed 20 rpm,	500 to 750 ^{LMS}
Flash Point - See SDS	

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:

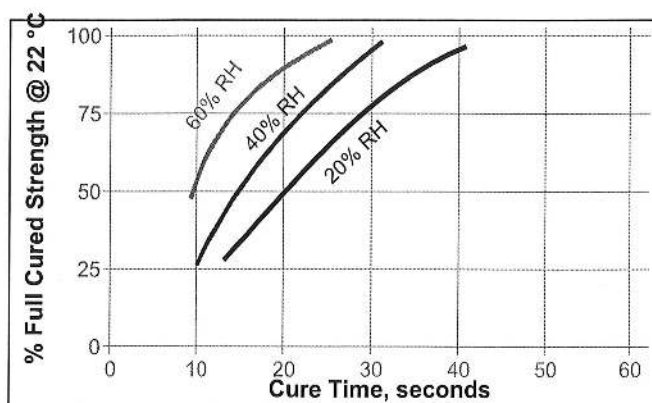
Steel (degreased)	10 to 20
Aluminum	2 to 10
Zinc dichromate	20 to 30
Neoprene	<5
Rubber, nitrile	<5
ABS	2 to 5
PVC	2 to 5
Polycarbonate	2 to 5
Phenolic	5 to 15

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, ISO 11359-2, K ⁻¹	100×10 ⁻⁶
Coefficient of Thermal Conductivity, ISO 8302, W/(m·K)	0.1

Electrical Properties:

Dielectric Constant / Dissipation Factor, IEC 60250:

0.1 kHz	2.3 / <0.02
1 kHz	2.3 / <0.02
10 kHz	2.3 / <0.02
Volume Resistivity, IEC 60093, Ω·cm	10×10 ¹⁵
Surface Resistivity, IEC 60093, Ω	40×10 ¹⁵
Dielectric Breakdown Strength, IEC 60243-1, 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	6 to 10
	(psi)	(870 to 1,450)
ABS	N/mm ²	4 to 8
	(psi)	(580 to 1,160)
PVC	N/mm ²	4 to 8
	(psi)	(580 to 1,160)
Polycarbonate	N/mm ²	3.5 to 8
	(psi)	(508 to 1,160)
Phenolic	N/mm ²	5 to 15
	(psi)	(725 to 2,175)
Neoprene	N/mm ²	5 to 15
	(psi)	(725 to 2,175)
Nitrile	N/mm ²	5 to 15
	(psi)	(725 to 2,175)

After 2 minutes @ 22 °C

Lap Shear Strength, ISO 4587:

Steel (grit blasted)	N/mm ²	≥5.2 ^{LMS}
	(psi)	(≥755)

After 10 seconds at @ 22 °C

Tensile Strength, ISO 6922:

Buna-N	N/mm ²	≥6.9 ^{LMS}
	(psi)	(≥1,000)

TYPICAL ENVIRONMENTAL RESISTANCE

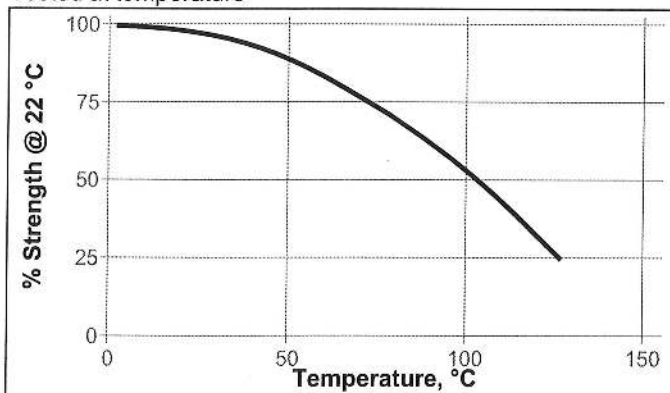
After 1 week @ 22 °C

Lap Shear Strength, ISO 4587:

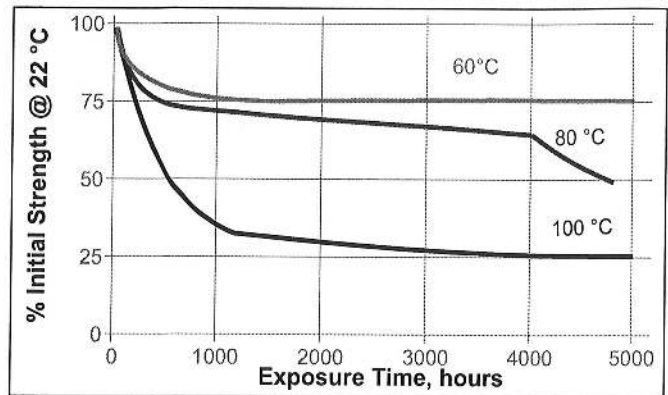
Mild steel (grit blasted)

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 h	500 h	1000 h
Motor oil (MIL-L-46152)	40	95	95	95
Gasoline	22	100	100	100
Water/glycol 50/50	22	100	100	100
Ethanol	22	100	100	100
Isopropanol	22	100	100	95
Freon TA	22	100	100	100

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 Safety Data Sheet (SDS).

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 September 23, 1998. 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 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

$(^{\circ}\text{C} \times 1.8) + 32 = ^{\circ}\text{F}$
 $\text{kV/mm} \times 25.4 = \text{V/mil}$
 $\text{mm} / 25.4 = \text{inches}$
 $\mu\text{m} / 25.4 = \text{mil}$
 $\text{N} \times 0.225 = \text{lb}$
 $\text{N/mm} \times 5.71 = \text{lb/in}$
 $\text{N/mm}^2 \times 145 = \text{psi}$
 $\text{MPa} \times 145 = \text{psi}$
 $\text{N}\cdot\text{m} \times 8.851 = \text{lb}\cdot\text{in}$
 $\text{N}\cdot\text{m} \times 0.738 = \text{lb}\cdot\text{ft}$
 $\text{N}\cdot\text{mm} \times 0.142 = \text{oz}\cdot\text{in}$
 $\text{mPa}\cdot\text{s} = \text{cP}$

Note:

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Laboratory Report - EAR-Controlled Data

Attn: Gianna Willits
Force Engineering & Testing Inc.
19530 Ramblewood Drive
HUMBLE, TX 77338 US

Report No: B16080433
Date Reported: 8/18/2016
P.O. No: 100

Material: Steel

Description: (1) Test Panel, Coupon 1: Tee Lock, Job# 49-0010T-16, Customer: Berridge MFG

Room Temperature Tensile Testing ASTM E8/E8M-15a, Parallel to Length of the Specimen, As Received

Width, Initial, in	Thickness, Initial, in	Tensile Strength, ksi	Yield (0.2% Offset), ksi	Elongation After Fracture (4W), %	Location of Fracture
0.503	0.0240	56	51	22	Inside Middle Half of Gage

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Approved by:

Maurice Cochran
Mechanical Testing Team Leader

Photos



PANEL ASSEMBLY