

Original Green

Test Results

KLINGERSIL[®] materials are hard to beat. So, competitors have cleverly posed their compressed gasket materials as KLINGERSIL[®] green (C-4401). Of course, their offerings aren't equal in quality, performance or specification. And just because it's green doesn't mean it's KLINGERSIL[®]. To ensure you're getting what you want and need in your compressed gasket materials, whether green, gray, tan, black or white, look for the KLINGERSIL[®] logo repetitively printed on one side of the sheet. Then you'll know it's the Original KLINGERSIL[®].



Quality Assured

The KLINGERSIL[®] logo imprinted on your gasket sheet is the best assurance of quality and performance. But if you're skeptical, ask your local Thermoseal sales representative for a live hot compression test. You'll see for yourself the difference between KLINGERSIL[®] and the other brands.

Hot Compression Test

A key factor in maintaining a seal is the load bearing properties of the gasket. This criteria can be observed using the KLINGER Hot Compression test, which applies both constant pressure and temperature. This measures the compression set of the product, including stress/creep relaxation resistance and reserve. You can see for yourself from the following photos that a product stating it's the same as KLINGERSIL[®] C-4401 is never true.

[Click here to view test results](#)

[return to top](#)

General Application Gasketing

KLINGERSIL® C-4201

- Synthetic Fiber
- Nitrile Binder
- Excellent Resistance to Oil & Solvents
- Good Anti-Stick Properties
- Excellent OEM Material

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits

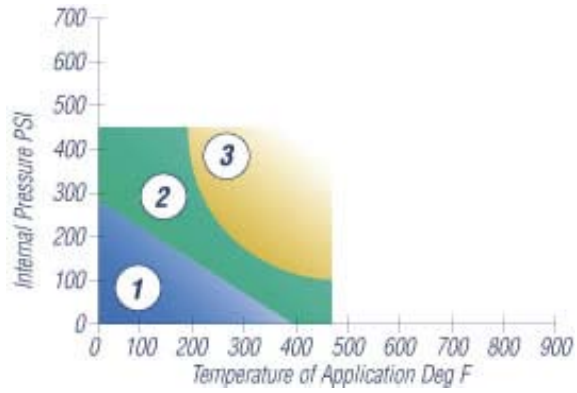


Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.5 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	7%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	11% initial
Thickness Decrease 572°F (300°C)	19.5% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-5%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-5%
Dielectric Strength	
ASTM D149-95a	14 kV/mm
ASTM F104 Line Call Out	F712121B3E11K6M5
Leachable Chloride Content	
FSA Method (Typical)	200 ppm
Density ASTM F1315	119 lb/ft ³ (1.9 g/cc)
Color (Top/Bottom)	White or Black

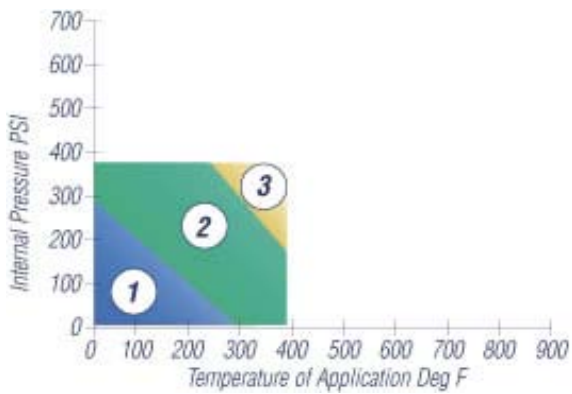
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com
info@thermosealinc.com

Compressed Inorganic Fiber

KLINGERSIL® C-4324

- Recycled Fiberglass & Aramid Blend
- Nitrile Binder
- Low Pressure Steam, Water & Gases
- Good for Oils and Fuels

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



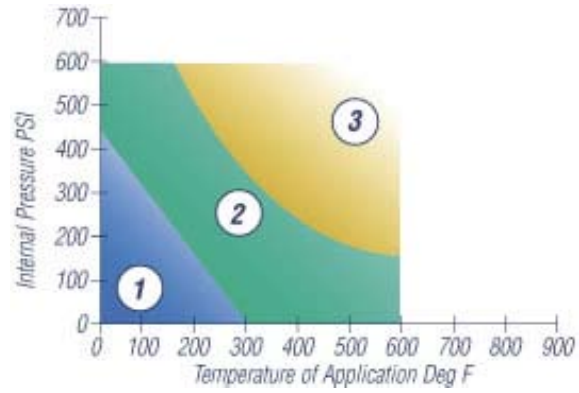
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 fx: 937.498.4911
 info@thermosealinc.com

Creep Relaxation ASTM F38B (1/32")	25%
Sealability ASTM F37A (1/32")	<0.5 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	8%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	12% initial
Thickness Decrease 572°F (300°C)	15% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	12% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-5%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-7%
Dielectric Strength	
ASTM D149-95a	13 kV/mm
ASTM F104 Line Call Out	F712132B4E32K6M4
Leachable Chloride Content FSA Method (Typical)	250 ppm
Density ASTM F1315	112 lb/ft ³ (1.8 g/cc)
Color (Top/Bottom)	Green/Grey

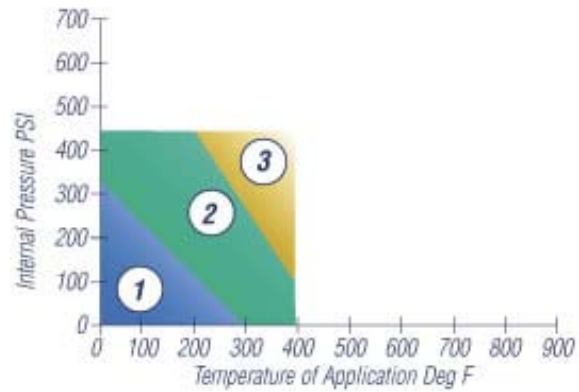
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



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General Application Gasketing

KLINGERSIL® C-4300

- Synthetic Fiber
- Nitrile Binder
- Good Sealability
- Good Chemical Resistance
- General Purpose Sheet

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits

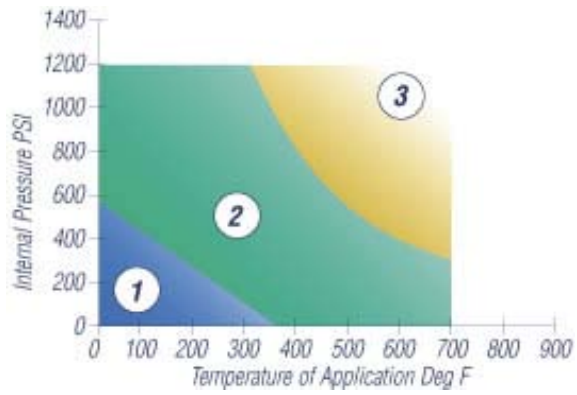


Creep Relaxation ASTM F38B (1/32")	25%
Sealability ASTM F37A (1/32")	<0.25 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	10%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	10% initial
Thickness Decrease 572°F (300°C)	25% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-5%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-10%
Dielectric Strength	
ASTM D149-95a	18 kV/mm
ASTM F104 Line Call Out	F712111B4E12K6M4
Leachable Chloride Content	
FSA Method (Typical)	200 ppm
Density ASTM F1315	100 lb/ft ³ (1.6 g/cc)
Color (Top/Bottom)	White or Black

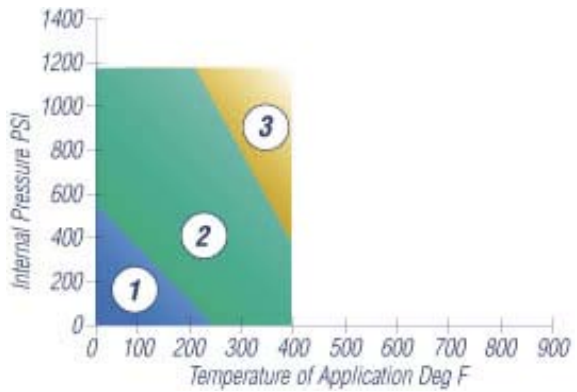
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



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General Application Gasketing

KLINGERSIL® C-4401

- Synthetic Fiber
- Nitrile Binder
- Excellent Sealability
- Excellent Chemical Resistance
- Good Creep Relaxation
- General Purpose Sheet

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



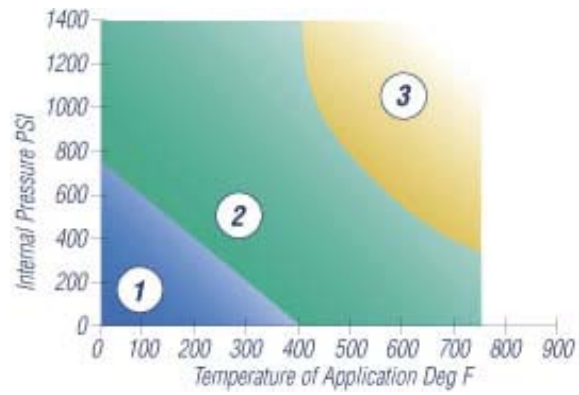
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 fx: 937.498.4911
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Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.25 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	7%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	10.5% initial
Thickness Decrease 572°F (300°C)	17% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-5%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-7%
Dielectric Strength	
ASTM D149-95a	14 kV/mm
ASTM F104 Line Call Out	F712121B3E12K6M5
Leachable Chloride Content	
FSA Method (Typical)	100 ppm
Density ASTM F1315	112 lb/ft ³ (1.8 g/cc)
Color (Top/Bottom)	Green

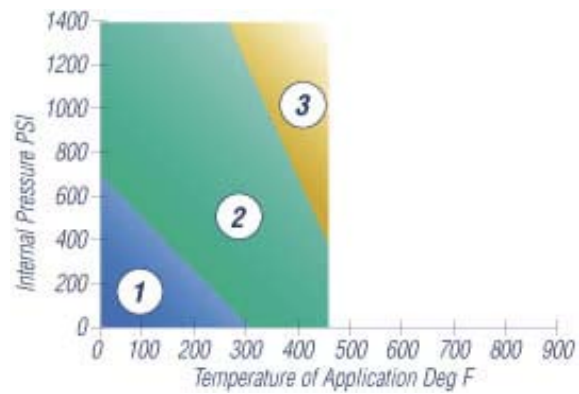
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



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Metal Reinforced Gasketing

KLINGERSIL® C-4408

- Synthetic Fiber
- Nitrile Binder
- High Temperature & Stress
- Fluctuating Temperatures & Pressures
- Vibration
- Low Carbon Steel Woven Mesh Insert

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



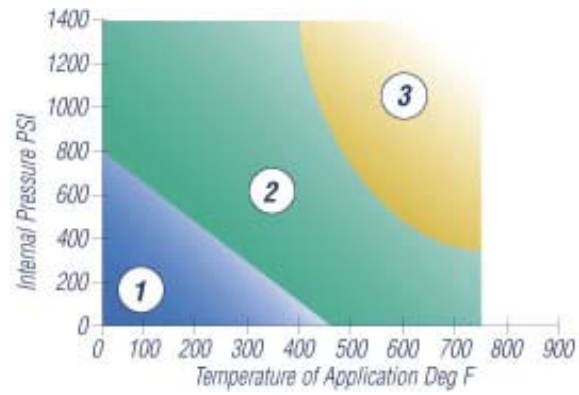
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Creep Relaxation ASTM F38B (1/32")	20%
Compressibility ASTM F36J	8%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	10% initial
Thickness Decrease 572°F (300°C)	22% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-5%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-5%
Dielectric Strength	
ASTM D149-95a	n/a
ASTM F104 Line Call Out	F712112B3E11M6
Leachable Chloride Content	
FSA Method (Typical)	n/a
Density ASTM F1315	119 lb/ft ³ (1.9 g/cc)
Color (Top/Bottom)	Black

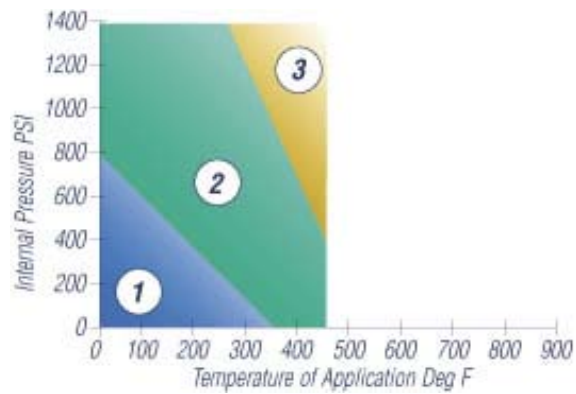
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Metal Reinforced Gasketing

KLINGERSIL® C-4409

- Synthetic Fiber
- Nitrile Binder
- High Temperature & Stress
- Excellent in Hot Gases
- Replaces Spiral Wounds
- Vibration
- Galvanized Low Carbon Steel Insert

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



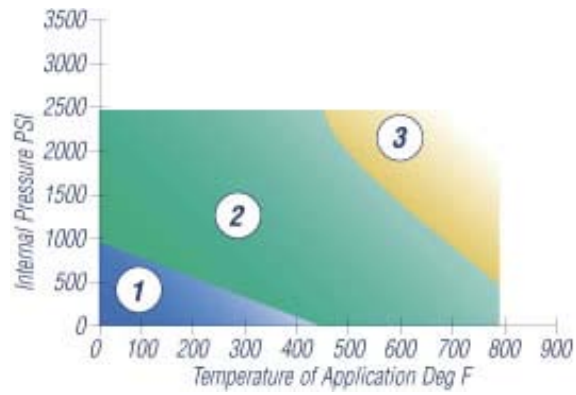
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Creep Relaxation ASTM F38B (1/32")	20%
Compressibility ASTM F36J	7%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	10% initial
Thickness Decrease 572°F (300°C)	10% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-3%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-5%
Dielectric Strength	
ASTM D149-95a	n/a
ASTM F104 Line Call Out	F712112B3E11M8
Leachable Chloride Content	
FSA Method (Typical)	n/a
Density ASTM F1315	125 lb/ft ³ (2.0 g/cc)
Color (Top/Bottom)	Green

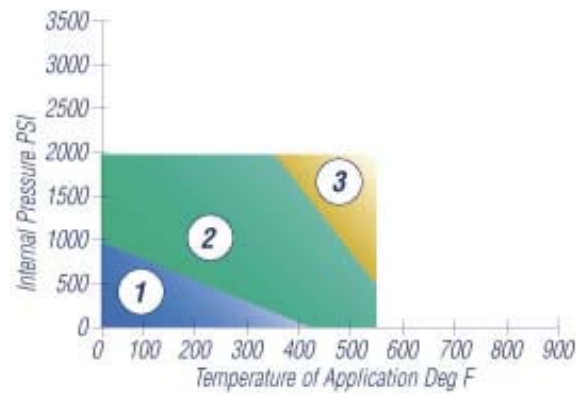
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Compressed Inorganic Fiber

KLINGERSIL® C-4430

- Fiberglass and Aramid Fibers
- Nitrile Binder
- Excellent Steam Sheet
- Excellent Chemical Resistance
- Good Creep Relaxation
- General Purpose Sheet

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



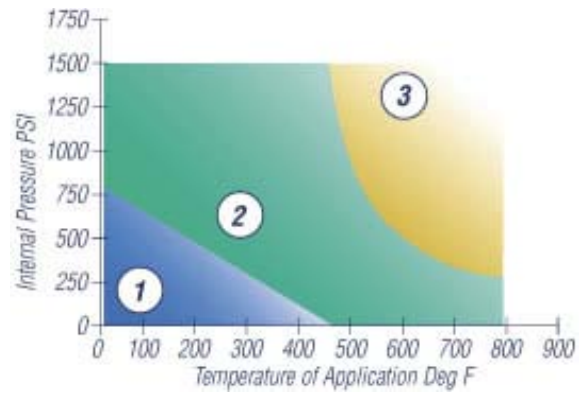
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Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.5 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	9%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	8% initial
Thickness Decrease 572°F (300°C)	11% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in	
ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-3%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-5%
Dielectric Strength	
ASTM D149-95a	16 kV/mm
ASTM F104 Line Call Out	F712132B3E11K6M5
Leachable Chloride Content	
FSA Method (Typical)	150 ppm
Density ASTM F1315	96 lb/ft ³ (1.55 g/cc)
Color (Top/Bottom)	White/Green

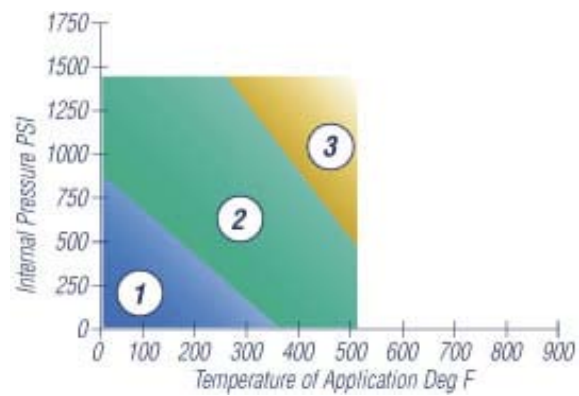
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Compressed Inorganic Fiber Sheet

KLINGERSIL® C-4433

- Fiberglass, Aramid & Inorganic Fibers
- Nitrile Binder
- Ultimate Steam Sheet
- Outstanding Load Bearing
- Excellent Creep Relaxation
- Best General Purpose Sheet

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits

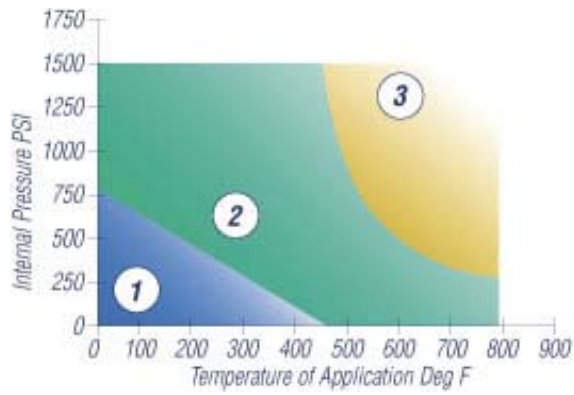


Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.5 ml/hr
Gas Permeability DIN 3535/6	<0.2 ml/min
Compressibility ASTM F36J	7%
Recovery ASTM F36J	60% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	7% initial
Thickness Decrease 572°F (300°C)	8% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-4%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-7%
Dielectric Strength	
ASTM D149-95a	21 kV/mm
ASTM F104 Line Call Out	F712132B3E12K6M5
Leachable Chloride Content	
FSA Method (Typical)	150 ppm
Density ASTM F1315	112 lb/ft ³ (1.8 g/cc)
Color (Top/Bottom)	Red

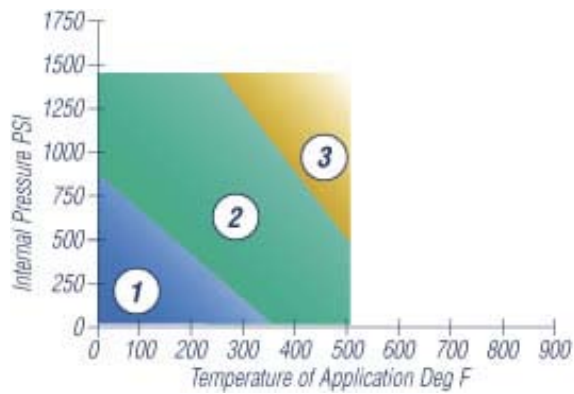
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Metal Reinforced Gasketing

KLINGERSIL® C-4439

- Fiberglass, Aramid & Inorganic Fibers
- Nitrile Binder
- High Temperature & Stress
- Vibration
- Galvanized Low Carbon Steel Insert

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



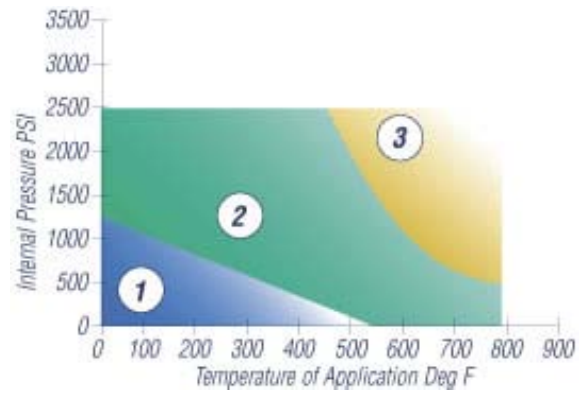
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 info@thermosealinc.com

Creep Relaxation ASTM F38B (1/32")	20%
Compressibility ASTM F36J	8%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	8% initial
Thickness Decrease 572°F (300°C)	4% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	9% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-5%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	5-10%
Dielectric Strength	
ASTM D149-95a	10 kV/mm
ASTM F104 Line Call Out	F712112B3E12K6M8
Leachable Chloride Content FSA Method (Typical)	150 ppm
Density ASTM F1315	131 lb/ft ³ (2.1 g/cc)
Color (Top/Bottom)	Red

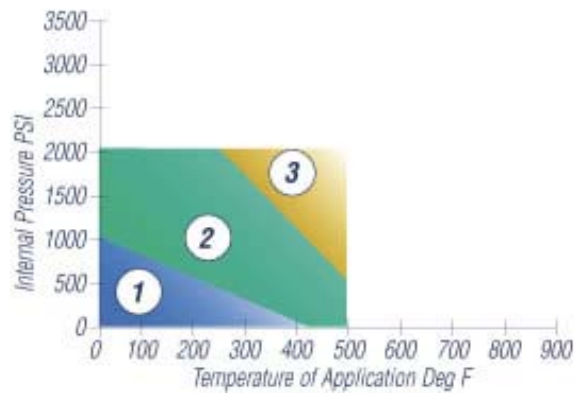
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Carbon Fiber Gasketing

KLINGERSIL® C-4500

- Carbon Fiber
- Nitrile Binder
- High Temperature
- High Internal Pressure
- Good Steam Sheet
- Suitable for a Wide Range of Chemical Applications

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits

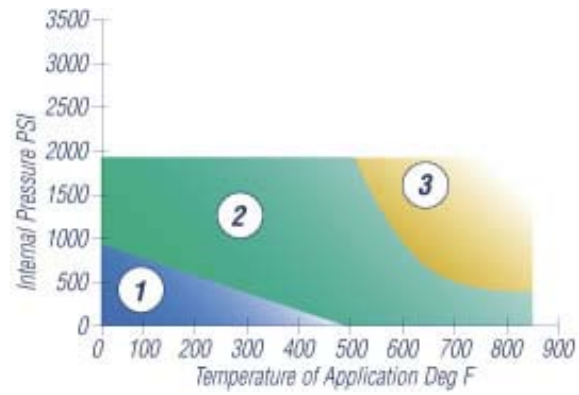


Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.30 ml/hr
Gas Permeability DIN 3535/6	<1.0 ml/min
Compressibility ASTM F36J	12%
Recovery ASTM F36J	60% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	10% initial
Thickness Decrease 572°F (300°C)	15% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-3%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-5%
Dielectric Strength	
ASTM D149-95a	1.5 kV/mm
ASTM F104 Line Call Out	F712122B3E11K6M5
Leachable Chloride Content	
FSA Method (Typical)	200 ppm
Density ASTM F1315	87 lb/ft ³ (1.4 g/cc)
Color (Top/Bottom)	Black

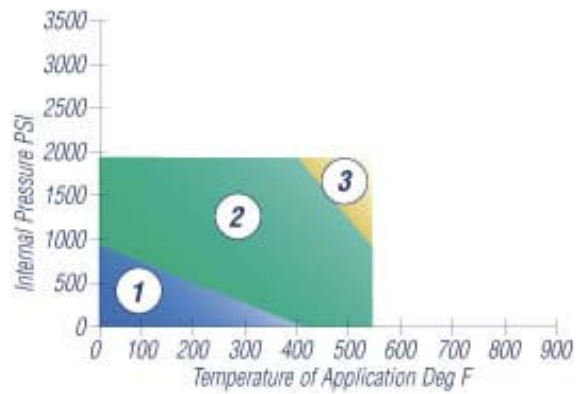
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



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Metal Reinforced Gasketing

KLINGERSIL® C-4509

- Carbon Fiber
- Nitrile Binder
- Good in High Load Applications
- Vibration
- Galvanized Low Carbon Steel Insert

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



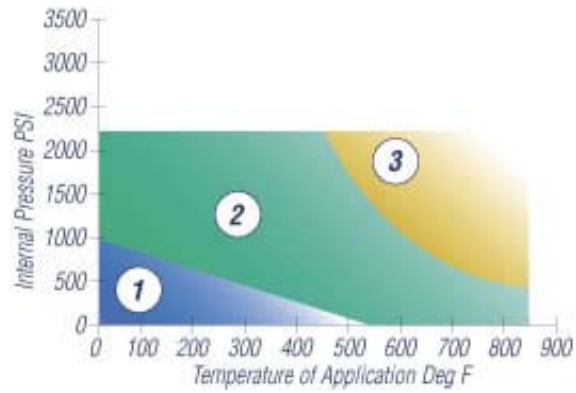
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 fx: 937.498.4911
 info@thermosealinc.com

Creep Relaxation ASTM F38B (1/32")	20%
Compressibility ASTM F36J	12%
Recovery ASTM F36J	70% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	9% initial
Thickness Decrease 572°F (300°C)	7% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	0-3%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-5%
Dielectric Strength	
ASTM D149-95a	n/a
ASTM F104 Line Call Out	F712112B3E11M8
Leachable Chloride Content	
FSA Method (Typical)	n/a
Density ASTM F1315	125 lb/ft ³ (2.0 g/cc)
Color (Top/Bottom)	Black

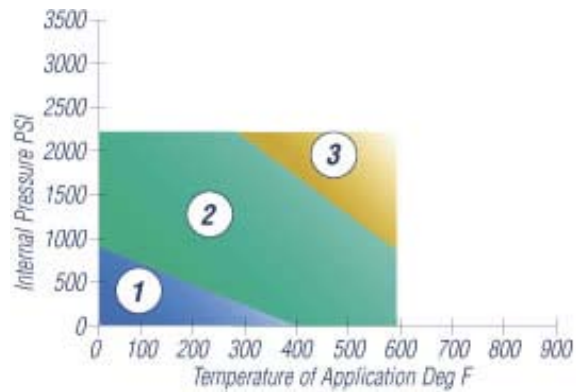
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



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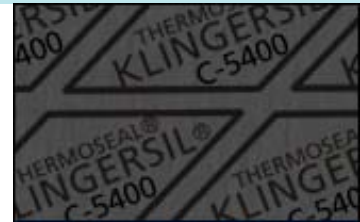
Neoprene

KLINGERSIL® C-5400

- Synthetic Fiber
- Neoprene Binder
- Chemically Stable
- Good Anti-Stick Properties

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



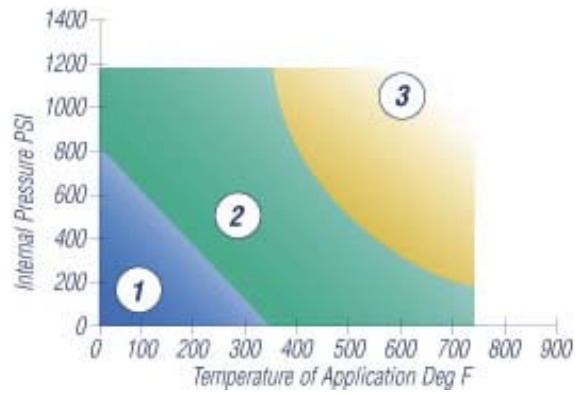
Thermoseal Inc.
 ph: 800.990.7325
 fx: 937.498.4911
info@thermosealinc.com

Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.20 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	8%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	11% initial
Thickness Decrease 572°F (300°C)	21% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	15% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	5-20%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-10%
Dielectric Strength	
ASTM D149-95a	18 kV/mm
ASTM F104 Line Call Out	F712232B3E22K6M5
Leachable Chloride Content FSA Method (Typical)	500 ppm
Density ASTM F1315	106 lb/ft ³ (1.7 g/cc)
Color (Top/Bottom)	White or Black

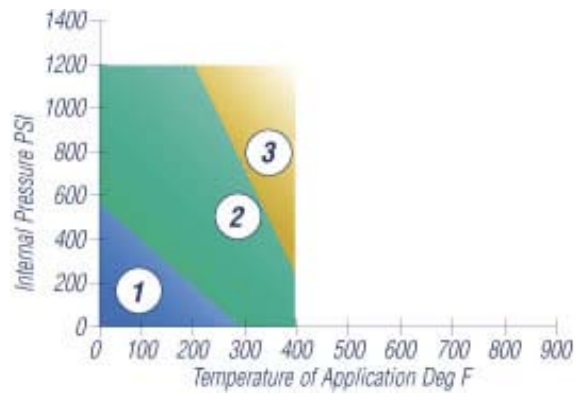
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

SBR Binder Gasketing

KLINGERSIL® C-6327

- Synthetic Fiber
- Modified SBR Binder
- Controlled Swell
- Use for Low Temperatures and Low Pressures
- Good with Low Bolt Loads

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



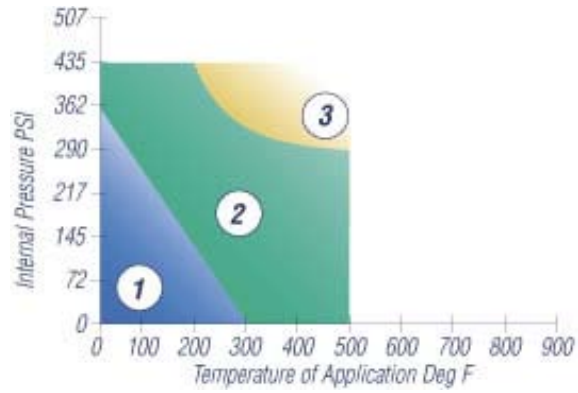
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 ph: 800.990.7325
 fx: 937.498.4911
 info@thermosealinc.com

Creep Relaxation ASTM F38B (1/32")	35%
Sealability ASTM F37A (1/32")	<0.20 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	15%
Recovery ASTM F36J	40% minimum
Klinger Hot Compression Test	(tested to 392°F [200°C])
Thickness Decrease 73°F (23°C)	16% initial
Thickness Decrease 572°F (300°C)	25% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	35% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-10%
ASTM Oil IRM903, 5h/300°F (149°C)	30-40%
ASTM Fuel A, 5h/73°F (23°C)	0-15%
ASTM Fuel B, 5h/73°F (23°C)	20-35%
Dielectric Strength	
ASTM D149-95a	13 kV/mm
ASTM F104 Line Call Out	F714532B6E56K6M4
Leachable Chloride Content	
FSA Method (Typical)	150 ppm
Density ASTM F1315	100 lb/ft ³ (1.6 g/cc)
Color (Top/Bottom)	White

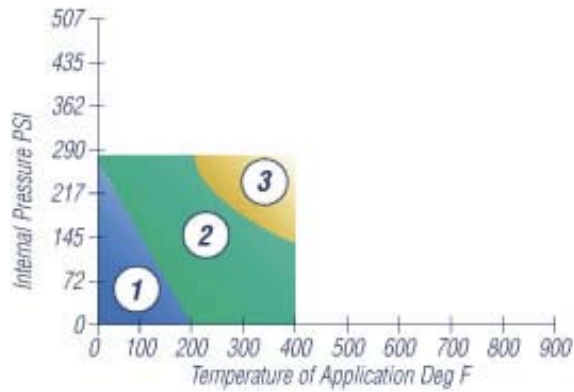
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

SBR Binder Gasketing

KLINGERSIL® C-6400

- Synthetic Fiber
- SBR Binder
- Good Anti-Stick Properties
- Good Steam Sheet

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits



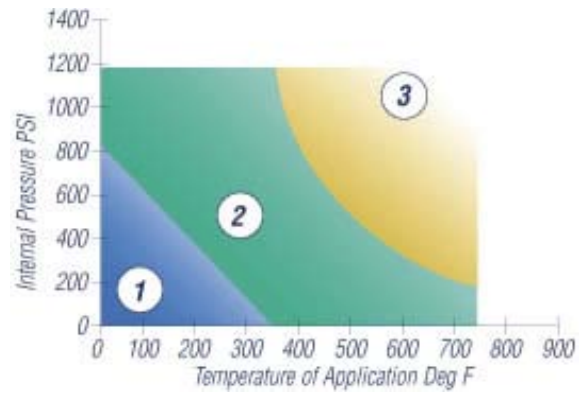
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 fx: 937.498.4911
info@thermosealinc.com

Creep Relaxation ASTM F38B (1/32")	20%
Sealability ASTM F37A (1/32")	<0.20 ml/hr
Gas Permeability DIN 3535/6	<0.3 ml/min
Compressibility ASTM F36J	8%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	
Thickness Decrease 73°F (23°C)	12% initial
Thickness Decrease 572°F (300°C)	11% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	25% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-10%
ASTM Oil IRM903, 5h/300°F (149°C)	10-25%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-10%
Dielectric Strength	
ASTM D149-95a	16 kV/mm
ASTM F104 Line Call Out	F71341B3E42K6M5
Leachable Chloride Content	
FSA Method (Typical)	200 ppm
Density ASTM F1315	112 lb/ft ³ (1.8 g/cc)
Color (Top/Bottom)	White or Black

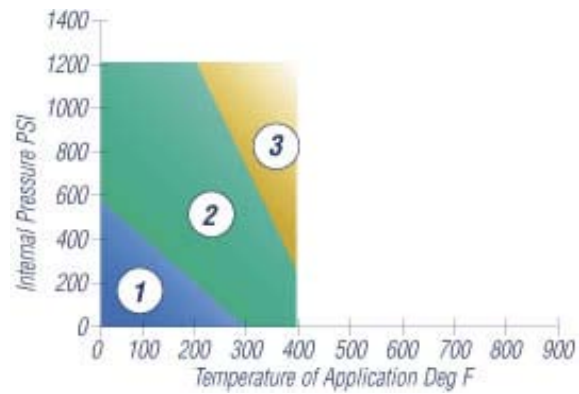
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Chemical Resistant Gasketing

KLINGERSIL® C-7400

- Synthetic Fiber
- EPDM Binder
- Moderate Caustics and Acids
- Good Oil Swell Characteristics
- Excellent Aging Properties
- Good in Light Duty Steam

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits

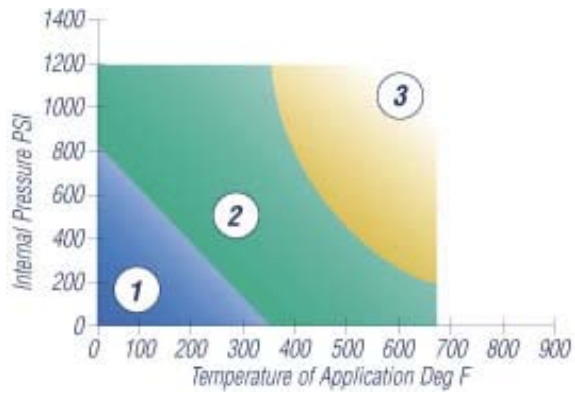


Creep Relaxation ASTM F38B (1/32")	25%
Sealability ASTM F37A (1/32")	<0.30 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	7%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	(tested at 3,625-psi gasket stress)
Thickness Decrease 73°F (23°C)	9% initial
Thickness Decrease 572°F (300°C)	5% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	15% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-15%
ASTM Oil IRM903, 5h/300°F (149°C)	15-30%
ASTM Fuel A, 5h/73°F (23°C)	0-20%
ASTM Fuel B, 5h/73°F (23°C)	5-20%
Dielectric Strength	
ASTM D149-95a	22 kV/mm
ASTM F104 Line Call Out	F712441B4E24K6M5
Leachable Chloride Content	
FSA Method (Typical)	200 ppm
Density ASTM F1315	94 lb/ft ³ (1.5 g/cc)
Color (Top/Bottom)	White/Grey

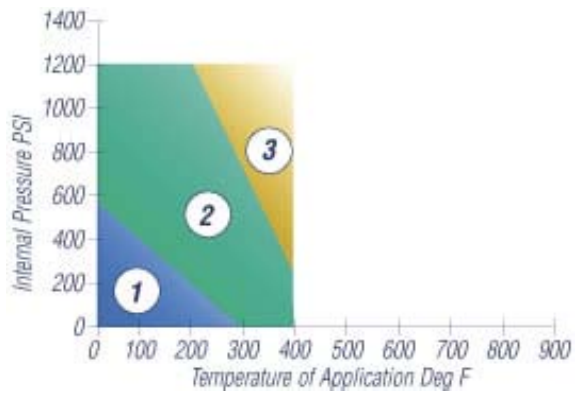
Pressure & Temperature Graphs ([Click here to learn more about graphs](#))

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Chemical Resistant Gasketing

KLINGERSIL® C-8200

- Synthetic Fiber
- Hypalon® Binder
- Acid Resistant
- Good Oil-Fuel Resistance
- Good Gas Sealability
- No Color Added

Typical values refer to 1/16" material unless otherwise specified.

See graphs for temperature & pressure limits

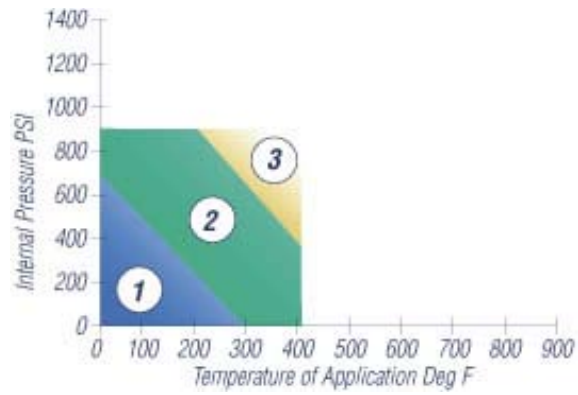


Creep Relaxation ASTM F38B (1/32")	30%
Sealability ASTM F37A (1/32")	<0.30 ml/hr
Gas Permeability DIN 3535/6	<0.5 ml/min
Compressibility ASTM F36J	9%
Recovery ASTM F36J	50% minimum
Klinger Hot Compression Test	(tested at 3,625-psi gasket stress, and to 392°F [200°C])
Thickness Decrease 73°F (23°C)	7% initial
Thickness Decrease 572°F (300°C)	17% additional
Weight Increase	
ASTM F146 after immersion in Fuel B 5h/73°F (23°C)	10% maximum
Thickness Increase	
ASTM F146 after immersion in ASTM Oil 1, 5h/300°F (149°C)	0-5%
ASTM Oil IRM903, 5h/300°F (149°C)	5-10%
ASTM Fuel A, 5h/73°F (23°C)	0-5%
ASTM Fuel B, 5h/73°F (23°C)	0-10%
Dielectric Strength	
ASTM D149-95a	9 kV/mm
ASTM F104 Line Call Out	F712100B5E22K6M5
Leachable Chloride Content	
FSA Method (Typical)	n/a
Density ASTM F1315	106 lb/ft3 (1.7 g/cc)
Color (Top/Bottom)	Off White

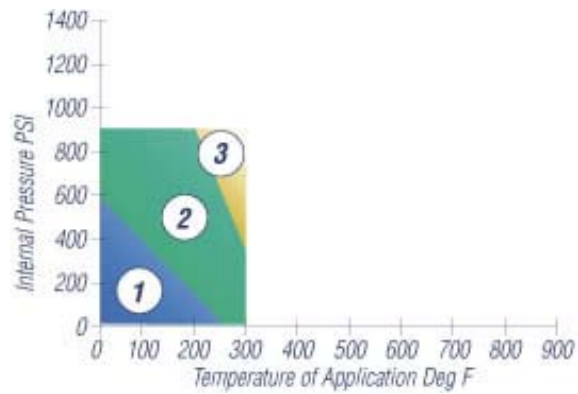
Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

Material Thickness: 1/16"

Liquids



Gases & Steam



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

PTFE

soft-chem®

Thermoseal® soft-chem® expanded PTFE sealing material provides excellent corrosion resistance and impermeability along with superior creep resistance and sealability for use in all types of applications. The material's high compressibility enables it to deform under load and conform to irregularities in flange faces for a tight seal with low, minimum sealing stress. Standardizing with it also helps to reduce maintenance, simplify inventory, and save money.

- Can be used with more fragile piping systems
- Ideal for boiler applications because it's largely unaffected by steam or condensate for longer life and trouble-free sealing
- BAM approval for gaseous oxygen
- Indefinite self life
- FDA compliant

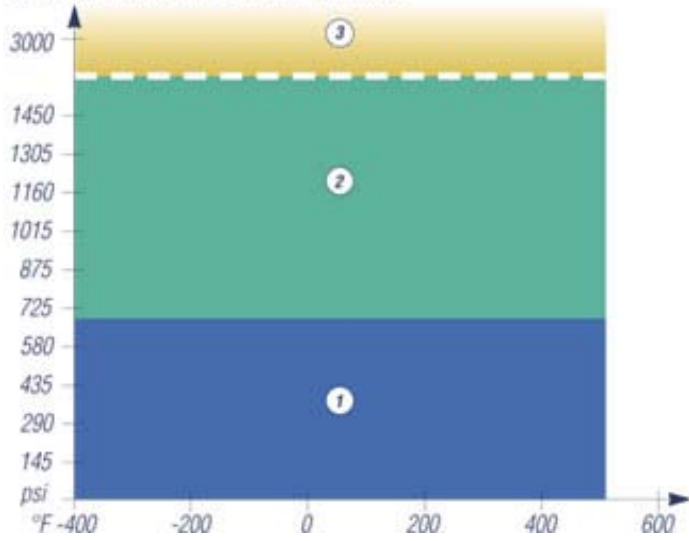
See graphs for temperature & pressure limits

Creep Relaxation ASTM F38B (1/32")	35%
Sealability ASTM F37 B Fuel A	.002 ml/min
Gas Leakage DIN 3535/6	.12 ml/hr
Klinger Hot Compression Test	
Thickness Decrease ambient, 3625 psi	37%
Thickness Decrease Hot, 572°F (300°C)	28.6%
Compressibility ASTM F36	60%
Recovery ASTM F36	12% min
Tensile ASTM 152	1,500 psi
Vacuum to Full Pressure	3,000 psi
Chemical Resistance	0-14 ph
Density	.85 g/cm ³
Gasket constants as tested by Ecole Polytechnic	1/16"
G_D	1,260 psi
a	.20 psi
G_S	3.5 psi

Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)



Pressure/Temperature Selection Criteria



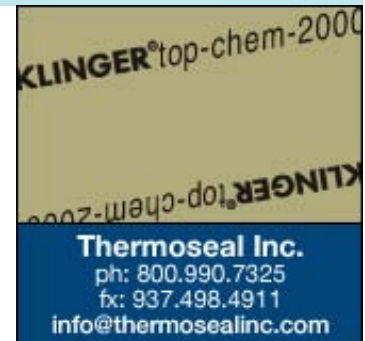
For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Thermoseal PTFE Products

KLINGER®top-chem-2000

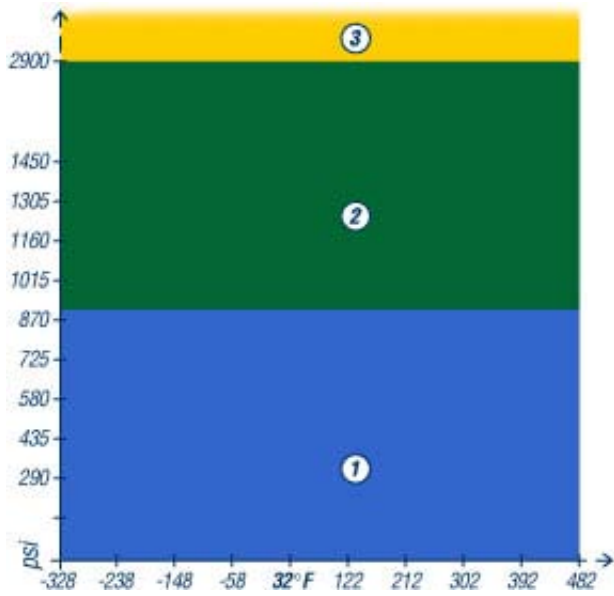
- Fire Tested - API 6FA
- Universal application use in the chemical and petrochemical industries
- FDA compatible
- Ideal for higher temperatures and pressures
- Holds shape for thermal cycles

See graphs for temperature and pressure limits.



Ref. Thickness of Measured Values	1.5 mm
Density	2.5 g/cm ³
Compressibility ASTM F36	2%
Recovery ASTM F36	55%
Stress Relaxation	
DIN 52913, 16h 7,250 psi, 570°F	35 MPa
DIN 52913, 16h 4,350 psi, 300°F	28 MPa
Klinger Cold/Hot Compression	
75°F/7,250 psi	2%
480°F/7,250 psi	5%
Sealability	
DIN 3535/6	0.5 ml/min
DIN 28090-2	0.05 mg/sm
Thickness/Weight Increase	
H ₂ SO ₄ , 100%: 18h/75°F	1-1%
HNO ₃ , 100%: 18h/75°F	1-2%
NaOH, 33%: 72h/230°F	1-3%
Permits/Certifications	BAM certification KTW proposal DIN-DVGW permit Fire Tested API 6FA FDA conformity TA-Luft certification Germanischer Lloyd United States Coast Guard Registro Italiano Navale Det Norske Veritas AS RoHS Certificate 2002/95/EG

Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)

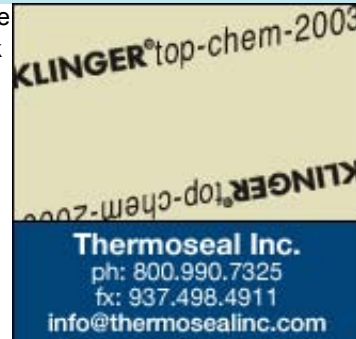


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Thermoseal PTFE Products
KLINGER®top-chem-2003

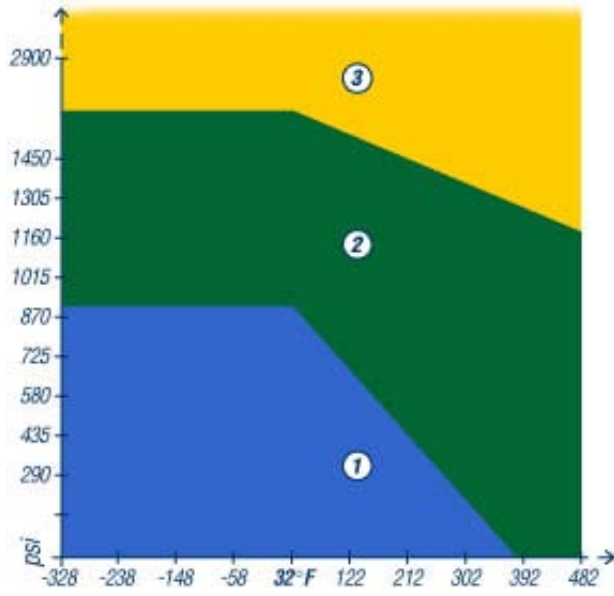
- Ideal for low bolt applications or where flanges are delicate
- Excellent chemical resistance to acidic and alkaline attack
- Highly compressible
- FDA compatible
- Ideal for higher temperatures and pressures
- Holds shape for thermal cycles

See graphs for temperature and pressure limits



Ref. Thickness of Measured Values	2 mm
Density	1.7 g/cm ³
Compressibility ASTM F36	18%
Recovery ASTM F36	40%
Stress Relaxation	
DIN 52913, 16h 4,350 psi, 300°F	13 MPa
Klinger Cold/Hot Compression	
75°F/3,625 psi	9%
480°F/3,625 psi	38%
Sealability	
DIN 3535/6	0.1 ml/min
DIN 28090-2	0.01 mg/s m
Thickness/Weight Increase	
H ₂ SO ₄ , 100%: 18h/75°F	n/a - 1%
HNO ₃ , 100%: 18h/75°F	n/a - 5%
NaOH, 33%: 72h/230°F	n/a - 2%
Permits/Certifications	
	KTW proposal
	DIN-DVGW permit
	FDA conformity
	TA-Luft certification
	Germanischer Lloyd

Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)



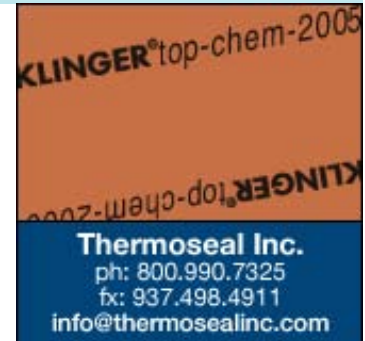
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Thermoseal PTFE Products

KLINGER®top-chem-2005

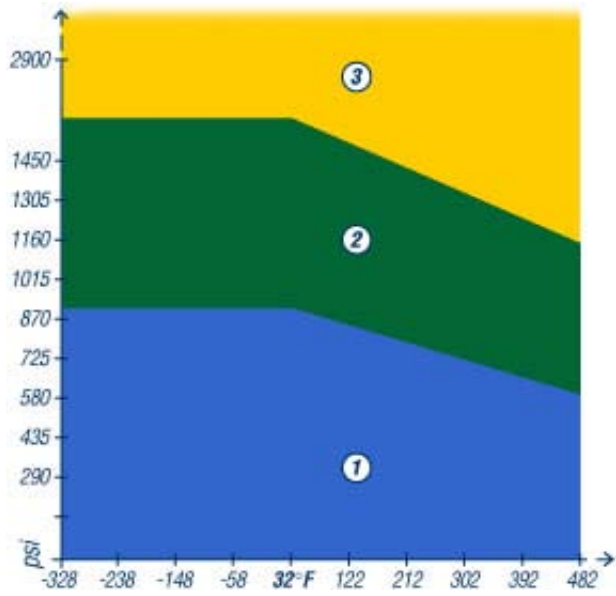
- Economical alternative when service conditions are moderate
- Suitable for a wide range of applications in the chemical industries
- Excellent chemical resistance in strongly acidic applications
- FDA compatible
- Holds shape for thermal cycles

See graphs for temperature and pressure limits



Ref. Thickness of Measured Values	1.5 mm
Density	2 g/cm ³
Compressibility ASTM F36	7%
Recovery ASTM F36	35%
Stress Relaxation	
DIN 52913, 16h 4,350 psi, 300°F	25 MPa
Klinger Cold/Hot Compression	
75°F/7,250 psi	10%
480°F/7,250 psi	30%
Sealability	
DIN 3535/6	0.2 ml/min
DIN 28090-2	0.02 mg/s m
Thickness/Weight Increase	
H ₂ SO ₄ , 100%: 18h/75°F	2 - 2%
HNO ₃ , 100%: 18h/75°F	2 - 7%
Permits/Certifications	KTW proposal DIN-DVGW permit FDA conformity TA-Luft certification Germanischer Lloyd

Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)



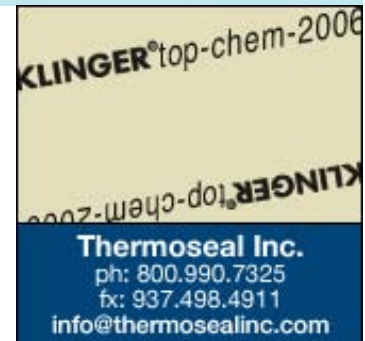
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Thermoseal PTFE Products

KLINGER®top-chem-2006

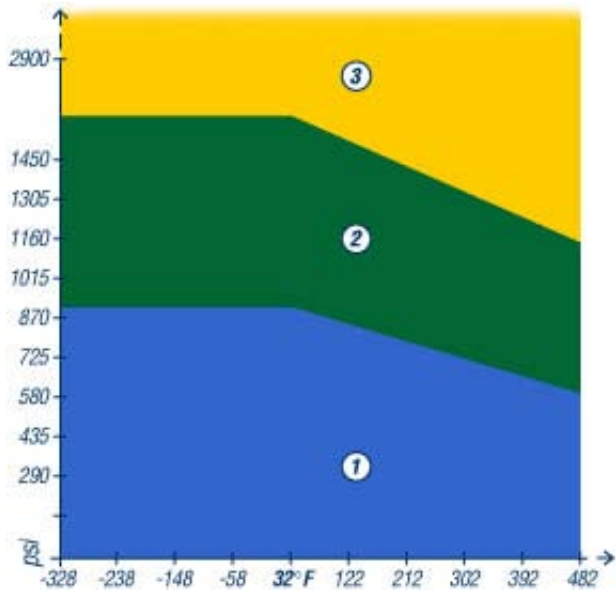
- FDA compatible
- Good resistance in strong alkaline applications
- Good choice for a broad range of chemical process applications
- Free of pigments

See graphs for temperature and pressure limits



Ref. Thickness of Measured Values	1.5 mm
Density	2.9 g/cm ³
Compressibility ASTM F36	4%
Recovery ASTM F36	40%
Stress Relaxation	
DIN 52913, 16h 4,350 psi, 300°F	18 MPa
Klinger Cold/Hot Compression	
75°F/7,250 psi	10%
480°F/7,250 psi	40%
Sealability	
DIN 3535/6	0.01 ml/min
DIN 28090-2	0.01 mg/s m
Thickness/Weight Increase	
H ₂ SO ₄ , 100%: 18h/75°F	2 - 7%
HNO ₃ , 100%: 18h/75°F	12 - 24%
Permits/Certifications	BAM certification KTW proposal DIN-DVGW permit FDA conformity TA-Luft certification Germanischer Lloyd

Pressure & Temperature Graphs [\(Click here to learn more about graphs\)](#)



For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

PTFE

SEALEX[®]

Sealex joint sealant can be used wherever reliable gasketing is required.

- Fume ducts
- Concrete lids
- Glass joints
- Heat exchangers
- Fiberglass reinforced plastic vessels
- Pump or compressor housing flanges
- Steam vessel flanges
- Ceramic joints
- Water systems
- Valves and piping



Sealex[®] joint sealant, specially processed, 100% pure PTFE on a roll, provides soft, highly compressible gasketing for longer life and trouble-free sealing. Its form-in-place versatility also cuts maintenance and storage costs. The high compressibility of Sealex[®] enables it to effectively fill flange imperfections for a tight, leak-free seal. Under pressure, it provides a very wide, thin ribbon-like joint sealant. Unlike conventional PTFE which is prone to cold flow, Sealex[®] has good creep resistance and bolt torque retention properties.

Sealex joint sealant does not support bacterial growth or cause product contamination and is FDA compliant. It has virtually no shelf-life concerns since PTFE is unaffected by normal environmental conditions.

Sealex has excellent resistance properties to chemical attack. It is ideal for most chemical services at temperatures to 500°F (260°C) and pressure to 2,000 psi (138 bar). It is also suitable for cryogenic use to -321°F (-196°C).

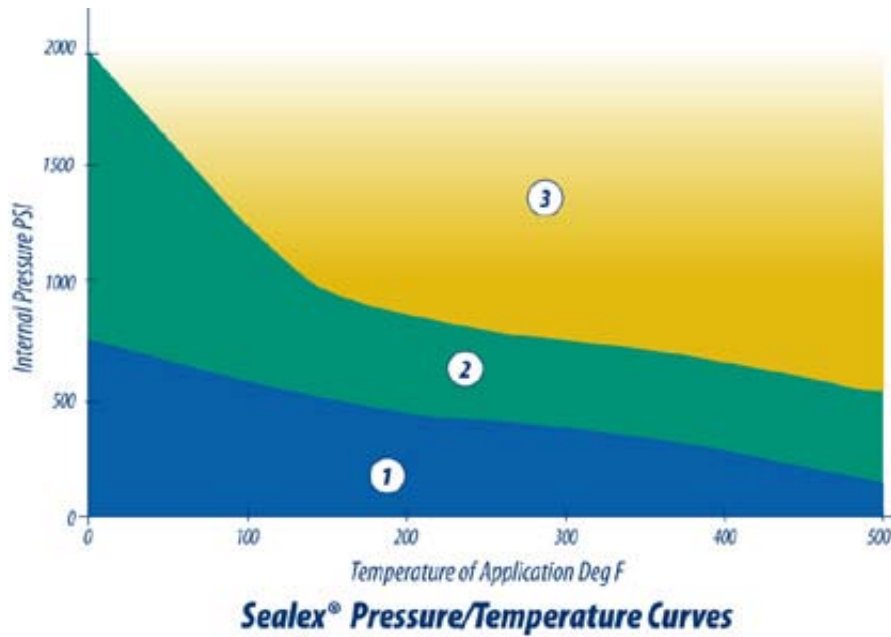
The sealant is available in roll form which helps reduce storage space, and is available in a wide variety of thicknesses and lengths.

Easy to Use Sealex:

Just follow the simple installation instructions.

Select the size Sealex: Use a size with nominal width of between 1/3 and 1/2 of the effective flange sealing width.

1. Make sure that the sealing flanges are clean.
2. Cut off a length of Sealex just a little longer than the actual circumference of the perimeter of the seal.
3. Peel off the adhesive protection strip, and press the Sealex into position. Cross the free ends of the Sealex adjacent to the bolt hole.
4. Bolt up the mating surfaces using the recommended clamping force and bolt tightening patterns.



Graph Key:

- (1) Suitable for gas and liquid
- (2) Suitable for liquid only
- (3) Refer to Thermoseal's technical support service

Size selection/torques required to seal ANSI 150lb flanges

Nominal Flange Size (in)	Number Bolts (N)	Bolt Size (in)	*Approx. Sealex Length (in)	Suggested Sealex Size (in)	Sealing Stress (lbs/in)	Torque (lb/ft)
1/2	4	0.5	4.3	3/16	1570	30
3/4	4	0.5	5.2	3/16	1570	30
1	4	0.5	6.2	3/16	1570	30
1-1/4	4	0.5	7.4	3/16	1570	30
1-1/2	4	0.5	8.3	1/4	2140	30
2	4	0.625	10.2	1/4	2140	60
2-1/2	4	0.625	12.2	1/4	2140	60
3	4	0.625	13.9	1/4	2140	60
4	8	0.625	17.9	3/8	2620	60
5	8	0.75	20.9	3/8	2760	100
6	8	0.75	24.1	3/8	2625	100
8	8	0.75	30.9	3/8	2625	100
10	12	0.875	37.9	3/8	2750	160
12	12	0.875	45.4	1/2	3000	160

* Based on mean sealing diameter

Milam Mica Laminate

Milam Mica PSS 130

- Type PSS
- High Quality Mica Sheet
- Laminated on Pegged Stainless Steel Insert

All Milam laminates are suitable for use in hot, dry gas applications such as exhaust manifolds, turbines, turbo chargers and air heat exchangers.



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info@thermosealinc.com

Compressibility ASTM F36A	12-15%
Recovery ASTM F36A	38-45%
Ignition Loss DIN 52911	<5%
Stress Relaxation DIN 52913 50 MPa/300°C	4,786 psi
Stress Relaxation DIN 52913 40 MPa/300°C	4,061 psi
Tang Insert Stainless Steel Thickness	AISI 316 .004"
Continuous Service Temperature	1,652°F maximum
Gas Leakage DIN 3535/6	>100 ml/min
Stress	14,503 psi maximum
Thickness	.051"
Thickness Tolerance	+/- 5% of nominal thickness
Sheet Sizes (Nominal)	47" x 40"
Color	Metallic Tan

For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Milam Mica Laminate

Milam Mica PSS 150

- Type PSS
- High Quality Mica Sheet
- Laminated on Pegged Stainless Steel Insert

All Milam laminates are suitable for use in hot, dry gas applications such as exhaust manifolds, turbines, turbo chargers and air heat exchangers.



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info@thermosealinc.com

Compressibility ASTM F36A	12-16%
Recovery ASTM F36A	40-50%
Ignition Loss DIN 52911	<5%
Stress Relaxation DIN 52913 50 MPa/300°C	5,801 psi
Stress Relaxation DIN 52913 40 MPa/300°C	4,641 psi
Tang Insert Stainless Steel Thickness	AISI 316 .004"
Continuous Service Temperature	1,652°F maximum
Gas Leakage DIN 3535/6	>100 ml/min
Stress	13,050 psi maximum
Thickness	.059"
Thickness Tolerance	+/- 5% of nominal thickness
Sheet Sizes (Nominal)	47" x 40"
Color	Metallic Tan

For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.

Milam Mica Laminate

Milam Mica PSS 300

- Type PSS
- High Quality Mica Sheet
- Laminated on Pegged Stainless Steel Insert

All Milam laminates are suitable for use in hot, dry gas applications such as exhaust manifolds, turbines, turbo chargers and air heat exchangers.



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Compressibility ASTM F36A	18-23%
Recovery ASTM F36A	48-53%
Ignition Loss DIN 52911	<15%
Stress Relaxation DIN 52913 50 MPa/300°C	4,351 psi
Stress Relaxation DIN 52913 40 MPa/300°C	2,900 psi
Tang Insert Stainless Steel Thickness	AISI 316 .004" x 2
Continuous Service Temperature	1,652°F maximum
Gas Leakage DIN 3535/6	>100 ml/min
Stress	11,602 psi maximum
Thickness	.125"
Thickness Tolerance	+/- 5% of nominal thickness
Sheet Sizes (Nominal)	47" x 40"
Color	Metallic Tan

For Additional Information Call Toll Free 1.800.990.7325 or email info@thermosealinc.com.



Thermoseal®

A Passion for Quality

Gasket Selection Assistance

It is the aim of KLINGER®expert to provide solutions to your gasketing problems based on years of experience, technical information and laboratory test results.

The innovative software takes your specifications and suggests the right KLINGERSIL® compressed gaskets grades, along with homogeneous graphite metal laminates and KLINGERtop-chem® PTFE sealing element. KLINGER®expert shows you all of the variable parameters and allows you to change them on the screen. You choose the relative importance of function, cost, and handleability.

You can choose between standard ANSI and DIN flanges or enter details of your own specific flange. KLINGER®expert will automatically calculate maximum and minimum sealing stress and fastener torque in all popular grades [Click here for more information.](#)

Or, you can complete and send us the [Technical Service Questionnaire](#) and we will be pleased to make a recommendation or ask about purchasing your own program for your gasket selection requirements.

Gasket Factors

ASME VIII Pressure Vessel code *m* & *y* values for KLINGERSIL[®] compressed non-asbestos "C" grades

	<i>Thickness</i>	<i>m</i>	<i>y (psi)</i>
Sealing liquids	Up to 1/16"	2.75	2,000
	Above 1/16"	6.4	2,900
Sealing gases	Up to 1/16"	2.75	3,700
	Above 1/16"	6.4	5,000

The use of these values will not guarantee the performance of the gasket. Factors not in the control of the gasket material manufacturer can influence the operation of the gasket, and the *m* & *y* concept itself is being questioned as a valid design tool.

The PVRC and ASTM are actively working on replacing the current *m* & *y* values with new gasket factors that, if adopted, will be used for pressure vessel flange design. Although these factors have not yet been adopted, Thermoseal Inc. contracted with Ecole Polytechnique to run the necessary tests based on the current draft procedure required to determine the new factors which are designated G_b , a , G_s as follows:

	G_b (psi)	a	G_s (psi)
KLINGERSIL [®] C-4430	1377	0.220	3.4
KLINGERSIL [®] C-4433	255	.430	1.1
KLINGERSIL [®] C-4439	1566	0.304	0.5
KLINGERSIL [®] C-4500	1475	0.204	205
Thermoseal soft-chem [®]	504	0.284	2.57×10^{-5}
KLINGERtop-chem [®] -2000	56	0.616	0.05843
KLINGERtop-chem [®] -2003	123	0.416	4.82×10^{-7}
KLINGERtop-chem [®] -2006	1055	0.230	2.9
Sealex [®] Joint Sealant	700	0.249	2.1E+00

Although we are satisfied with the results performed by Ecole Polytechnique and the reduction of the data, we have no direct knowledge of these factors being used, and hence cannot commit to their appropriateness for gasket stress determination.

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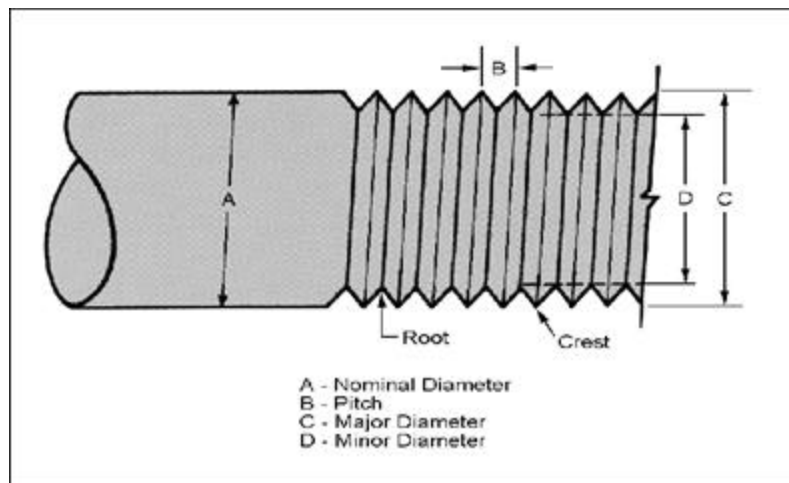
For product safety information, warranty and damage limitations, refer to the Material Safety Data Sheet (MSDS).

Bolts and Screws

Bolts and Screws

A mechanical joint must provide sufficient flange pressure to create and maintain a seal. Bolts or screws are the fasteners commonly used to give the clamping load that provides the pressure at the flanges.

Bolts and screws are among the many types of threaded devices referred to collectively as fasteners. There is some overlap between the definitions of bolts and screws. Generally, if the fastener is designed for use with a nut, and if it is tightened by applying a torque to the nut, then the fastener is a bolt. If it is designed for insertion into a hole with internal threads (as in an engine block), and if it is tightened by applying a torque to its head, then the fastener is a screw. Stud bolts are headless fasteners or threaded rods. In the chemical industry, where standard pipe flanges are usual, through bolts are used almost exclusively. In other industries, most flat-faced flanges are clamped together with tap bolts or cap screws.



In the above figure, the arrows point to the root and the crest of the threads. The pitch of the thread is the distance from the crest of one thread to the crest of the next thread. This measurement is used to determine the number of threads per inch, or millimeters per thread, data that are usually supplied by the fastener manufacturer. The one most frequently used term in designating the size of a bolt or screw fastener is its nominal diameter.

Screw Thread and Material Strength Systems

Basically, screws and bolts are described according to their diameters, thread pattern, and material strength. There are English and metric systems for both sets of properties.

English unit designations for bolt sizes and screw threads follow the **unified** standard thread system in the United States. Unified standard threaded fasteners are available in three series of diameter-and-pitch combinations: unified coarse (UNC), unified fine (UNF), and unified extra fine (UNEF). The UNC coarse series finds the most common use with gaskets and is recommended for general assemblies where vibration is not a problem and where disassembly may be needed.

A shorthand notation that includes the nominal diameter, the number of threads per inch, and the thread-pitch series is used to identify unified thread bolts and screws on drawings or in parts lists. For example, 1/4" 20 UNC indicates a bolt or screw with a nominal diameter of 1/4", with twenty threads per inch and with unified coarse threads. Fastener sizes frequently encountered in gasketing applications include 1/4"-20 UNC, 5/16"-18 UNC, 3/8"-16 UNC, and 5/8"-11 UNC.

Currently proposed U.S. standards for metric-size fasteners call for only one series of diameter-pitch combinations. Metric threads are designated by a capital letter M, followed by the major diameter in millimeters, followed by the symbol "X," and then followed by the pitch distance in millimeters. For example, M6 x 1 indicates a metric thread with a major diameter of 6 mm and a pitch of 1 mm. The diameter is approximately 1/4 in., and the pitch is approximately 25 threads/inch similar to, but not the same as, 1/4"-28 UNF. Unified series and metric fasteners cannot be interchanged.

In addition to size and thread type, fastener specifications also include material tensile strength properties. As a screw or bolt is tightened, it first stretches elastically, then yields, and ultimately fails and breaks. Four load or stress levels describe this process. As the fastener is tightened, increasing tensile (stretch) load is created until a recommended **preload** is reached. This is the load that sufficiently stretches the bolt/screw to give a tight joint and overcome any forces tending to pull the joint apart. If the bolt were tightened further, the **proof** load would be reached, the maximum load that still allows a sufficient margin of safety before yield. Further tightening would stress the bolt/screw until the **yield load** was reached, the load at which the fastener begins to permanently stretch and not behave elastically. Finally, further tightening would take things to the ultimate load which is the greatest load the fastener can withstand. Still further tightening will cause significant plastic flow and failure. Typically, the preload is 75-85% of the proof load; the proof load is typically 90-95% of the yield strength and approximately 65% of the **ultimate load**.

These bolt/screw strength properties are quantified in terms of tensile stress in SAE grade designations and metric property classes. The SAE grades (2, 5, 7, 8) specify proof load stress (psi), minimum tensile strength (psi), alloy composition, and treatment requirements for fastener steel. Within a grade, the requirements may depend on the fastener diameter. SAE grade 8 requirements are the most stringent. Metric requirements include proof stress measured in megapascals (MPa), minimum tensile strength (MPa), minimum yield strength (MPa), and maximum and minimum Rockwell hardness.

Bolting Guidelines

To achieve a trouble free joint, one of the most important aspects to consider is the bolts or studs. Reliability depends on achieving and maintaining an acceptable level of tension in each bolt. The target tension level for most applications can be calculated using Klinger's gasket design system.

However, the method employed to tighten the bolts is very important and can result in significant variations from those anticipated. As a guide the following table shows the variation of bolt tension with the tightening method.

Method Used	Tools Required	Variation of tension from mean value
Wrench (No Torque Control)	Spanner or Wrench	±50%
Wrench (With Torque Control)	Calibrated Torque Wrench	±30%
Hydraulic Tensioner	Multiple Stud Tensioners	±10% to ±30%
Direct Strain Measurement	Rotabolt pre-set Studs	±5%

If the initial bolt stress is too low the total amount of strain (stretch in the bolt) is low and under these circumstances any subsequent reduction in thickness of the gasket due to creep will quickly result in loss of bolt strain and subsequent leakage.

Within reason, it is better to approach the maximum bolt stress recommended by the manufacturer. This is often 80% of the yield strength at the operating temperature.

Other points to consider are:

- The crushing strength of the gasket.
- That the hydrostatic end thrust will increase the bolt tension at the operating internal pressure.
- Using a bolt stress which represents less than 50% of the yield strength will cause problems and should only be considered under certain circumstances.

- Most flanges are tightened with ordinary wrenching methods and it is often advantageous to have design bolt stresses which require no more than this. The probable bolt stress developed manually is often expressed as

$$S_b = \frac{1560}{\sqrt{d_b}} \text{ N/mm}^2$$

Where:

S_b = bolt stress achieved on assembly

d_b = bolt diameter in mm

For smaller bolts this results in excessive stress unless care is exercised. For larger bolts, however, it is often impossible to develop the required stress by hand.

REMINDER: As the temperature increases, the yield strength of the bolt material decreases.

The ability of a gasket material to make and maintain a seal depends not only on the quality of the gasket material, but also on medium being sealed, the flange design, the amount of pressure applied to the gasket by the bolts and how the gasket is assembled into the flanges and tightened.

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Torque to Achieve Bolt Utilization (Unlubricated Bolts)

Nominal Diameter (in.)	SAE J429 Grade 5 (ft-lbf)		SAE J429 Grade 8 (ft-lbf)		ASTM A193 Grade B7 (ft-lbf)		ASTM A193 Grade B8 (304SS) (ft-lbf)		
	Yield	50%	70%	50%	70%	50%	70%	50%	70%
1/4		9	12	12	17	10	14	3	4
5/16		17	24	25	34	20	28	6	9
3/8		30	42	42	59	33	47	11	15
7/16		45	65	66	92	53	74	17	23
1/2		75	105	105	145	84	120	27	37
9/16		105	150	150	210	120	165	38	53
5/8		145	205	205	290	165	230	53	74
3/4		255	360	360	505	290	405	92	130
7/8		410	575	575	805	460	645	150	205
1		615	860	860	1205	690	965	220	310

The ability of a gasket material to make and maintain a seal depends not only on the quality of the gasket material, but also on medium being sealed, the flange design, the amount of pressure applied to the gasket by the bolts and how the gasket is assembled into the flanges and tightened.

FOLLOW BASIC GASKET INSTALLATION PROCEDURES:

1. Clean and inspect flanges.
2. Clean and inspect gasket. Make sure the right gasket is used (No substitutes).
3. Install gasket in accordance with instructions for gasket type. Do not apply tape, lubricant or gasket adhesive unless specified.
4. Check flange alignment for parallel and high-low.
5. Install bolts without driving them in. Friction factors are irrelevant when threads are damaged.

CONTROL FRICTION:

1. Check threads on the bolt/stud and nut for damage or flaws. Repair or replace the damaged part. The nut should run on the bolt by hand past the point of travel.
2. If applying lubricant, apply the correct lubricant to the bolt throughout and past the point of travel. Apply lubricant to nut threads and nut face. When using washers, apply lubricant to the washer on nut side. Always apply consistently from bolt to bolt. **This will affect the torque value so be sure to re-calculate torque based on reduced friction factor. Torquing a lubricated fastener using specs for unlubed bolts can cause over-compression.**
3. Use hardened steel washers if specified. The hard surface and increased footprint allow for uniform load from bolt to bolt.
4. Be sure the bolts align properly in the flange holes. Even slight angles on the bolt will affect friction, load and relaxation.

TIGHTENING SEQUENCES:

1. Bolt patterns or tightening sequences are used to help pull in the flange and load the gasket evenly without damaging the gasket. Use star/cross pattern during installation. Clockwise tightening alone can cause canting of the flange.
2. Following a bolt pattern still creates cross-talk between the bolts. A tightening and loosening effect takes place in the other bolts as one bolt tightens. Multiple passes are made during installation and at full torque to counter this effect.

MULTIPLE PASS:

1. For multiple passes, start at a low torque value, usually 20-30% of final torque desired. Complete the first pass and increase torque to 60-70% and repeat pattern. The third pass is done at desired torque or 100%. In some cases a 4th and 5th pass is specified, usually for critical service applications. The fourth pass is at 100% and a chase pattern is used. As if facing a clock, start at 12 moving towards 3, 6, and 9 and back to 12, tightening each fastener at 100% of desired torque. Upon completing the fourth pass at 100% of torque, conduct a 5th pass at desired torque (Chase Pattern), however counter clockwise.

2. Multiple passes can provide the following:
 - a. Control the pressure on the gasket and the load of the bolt,
 - b. Pull the flanges up evenly,
 - c. Allow relaxation to take place as you tighten, and
 - d. Control the relaxation so that you don't see it all at the end of the job.
3. You may have as many passes as you want, however do not use less than 3 star pattern passes and the optional 2 chase (1 clockwise and 1 counter-clockwise).

RELAXATION:

1. Some of the joint relaxation is due to cross-talk in the bolts. Multiple passes, repetition, friction control and good craftsmanship can compensate for this.
2. Another form of relaxation takes place after initial tightening. This is when the majority of thread yielding and gasket creep occurs. The joint is responding to all of the forces that have been applied. Deal with this by repeating the chase patterns before start up (Usually within 24 hours of equipment start up).
3. The most critical form of relaxation takes place during pressurization start up and operation. Additional loads due to temperature and media are introduced. Everything changes but we have built in enough safety factor and control to do the job.
4. Hot torquing is generally not recommended. If hot bolting is required consult fastener, gasket and flange vendor before applying additional loads (be prepared to discuss the application, pressure, temperature and final torque applied to fasteners).

Gasket Cutting

Conventional methods should be used when cutting gasket materials; for example, ring cutting machine, water-jet cutting machine, steel rule -dies, or a TP-tool. The use of grinders, "dull razors", or hammers is strongly opposed. For more information regarding the conventional cutting methods contact your local gasket supplier.

The ability of a gasket material to make and maintain a seal depends not only on the quality of the gasket material, but also on medium being sealed, the flange design, the amount of pressure applied to the gasket by the bolts and how the gasket is assembled into the flanges and tightened.

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Segmented Gaskets

Segmented gaskets are often necessary due to either the limited manufactured size of the sheet or to minimize waste generated with centers. Large gaskets are often made in sections and joined with beveled cuts (fig. 1). This procedure requires extra skiving and gluing operations and it is difficult to obtain a smooth, even joint without steps or transverse grooves that can create leak paths. The glue and layered materials can also affect the overall thickness and compressibility at the joined area which may result in uneven loading.

The best solution is to die cut the joint with a dove tail (fig. 2) or puzzle pattern (fig. 3). Under compression, the material flows together to create a tight, longer lasting seal. If properly done, this procedure does not necessarily require an additional applied sealant which can have adverse effects on the gasket material.

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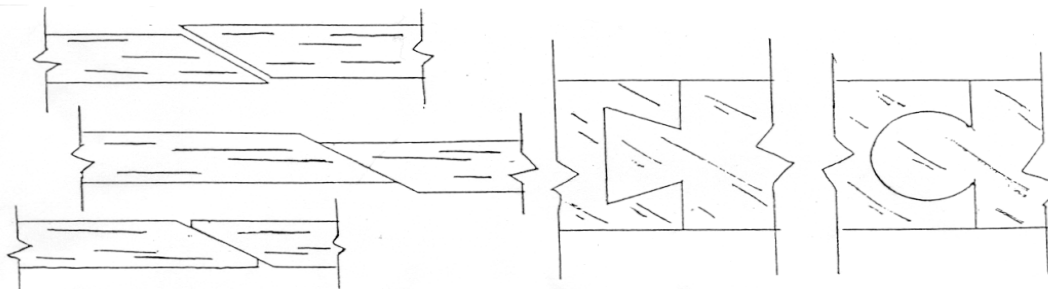


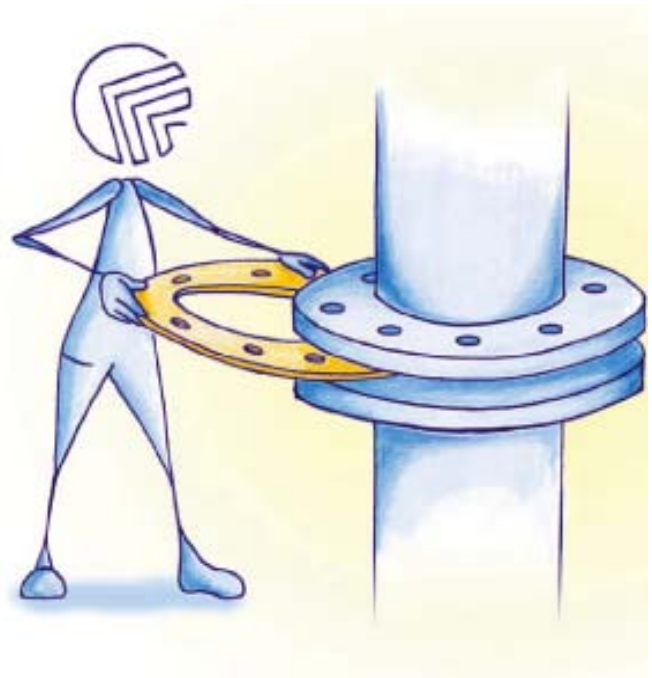
Fig. 1

Fig. 2

Fig. 3

Gasket Dimensions for ANSI Flanges

RING GASKETS FOR 150 LB. CLASS ANSI PIPE FLANGE			RING GASKETS FOR 300 LB. CLASS ANSI PIPE FLANGE		
Nominal Pipe Size	Gasket I.D.	Gasket O.D.	Nominal Pipe Size	Gasket I.D.	Gasket O.D.
1/2"	27/32"	1-7/8"	1/2"	27/32"	2-1/8"
3/4"	1-1/16"	2-1/4"	3/4"	1-1/16"	2-5/8"
1"	1-5/16"	2-5/8"	1"	1-5/16"	2-7/8"
1-1/4"	1-21/32"	3"	1-1/4"	1-21/32"	3-1/4"
1-1/2"	1-29/32"	3-3/8"	1-1/2"	1-29/32"	3-3/4"
2"	2-3/8"	4-1/8"	2"	2-3/8"	4-3/8"
2-1/2"	2-7/8"	4-7/8"	2-1/2"	2-7/8"	5-1/8"
3"	3-1/2"	5-3/8"	3"	3-1/2"	5-7/8"
3-1/2"	4"	6-3/8"	3-1/2"	4"	6-1/2"
4"	4-1/2"	6-7/8"	4"	4-1/2"	7-1/8"
5"	5-9/16"	7-3/4"	5"	5-9/16"	8-1/2"
6"	6-5/8"	8-3/4"	6"	6-5/8"	9-7/8"
8"	8-5/8"	11"	8"	8-5/8"	12-1/8"
10"	10-3/4"	13-3/8"	10"	10-3/4"	14-1/4"
12"	12-3/4"	16-1/8"	12"	12-3/4"	16-5/8"



Gasket Installation Instructions

■ Before you begin

Tools Needed

Specific tools are required for cleaning and tensioning the bolts. Always use standard safety equipment and follow good safety practices. The following tools are required for removal of the old gasket and installation of the new gasket:

- Calibrated torque wrench or hydraulic tensioner
- Brass wire brush
- Personal safety equipment
- Lubricants for the bolts (if specified)

Clean and Examine

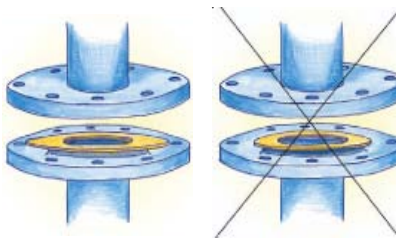
Clean and examine the flange surfaces. Make sure all foreign material and debris from the flange surfaces, fasteners (bolts or studs), nuts and washers are removed. Use a brass wire brush in the direction of the grooves to clean the flange surfaces.



Examine the flange surfaces, fasteners (bolts or studs), nuts and washers to ensure they are free from any serious defects. Replace any components if found to be defective. If in doubt, seek advice.

■ Gasket Dimensions

Ensure the gasket is the correct size.



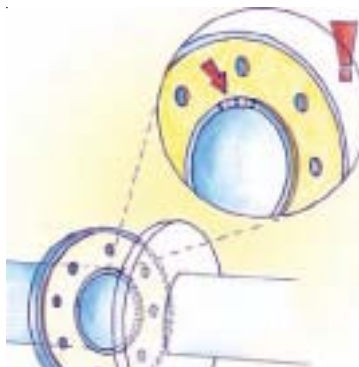
Bolt Holes

Cut the bolt holes slightly larger than the bolts to simplify the centralization of the gasket.



Inner Diameter

The inner diameter of the gasket should not be smaller than the inner diameter of the flange.



Storage and Handling

The gasket should be stored horizontally to avoid tensions and warping. Ideal storage conditions are in a clean area (ideally in a plastic bag) at <math><75^{\circ}\text{F}</math>, 50 - 60% humidity, and out of direct light.

All types of gaskets should be handled with care. Carry gaskets carefully, ideally in some form of protective cover.

Protect the surfaces and do not bend or write on the gasket.



■ Bolts, Nuts, and Washers

Be sure to install the bolts that are designed for the flange and suitable for the given operating temperatures. Ensure that there is no corrosion on the bolts as this can effect the function of the bolt. Never re-use bolts.

Use a nut which has a specified proof lead 20% greater than the ultimate strength of the fastener. Use standard threads, rather than fine, and use the correct lubricant.

Use the same material for the washers and the nuts. Use washers to bridge slotted or oversized holes, even interface forces between joint components, and/or reduce problems of fatigue by spreading the load placed by the fastener on the joint.

■ Flange Conditions

Align the flange faces and bolt holes and report all irregularities.



■ Gasket Installation

Assure the gasket is the specified size and material and ensure that it is free of defects. Carefully insert the gasket between the dry flanges. Make sure the gasket is centered between the flanges. Do not use joint compounds or release agents on the gasket or seating surfaces unless specified by the gasket manufacturer as this can lead to reduced surface friction.



Lubrication of Bolts

Uniformly apply lubricant to the bolt and the nut threads as well as to the face of the nut to reduce friction with tightening. Do not contaminate the gasket or the flange surfaces with lubricant. Be sure that the recommended service temperature of the lubricant is within the process service temperature limited.



Bring the flanges together ensuring the gasket is not pinched or damaged.

Bolt Tightening

The required torque value can be calculated with KLINGER® expert gasket selection software.

Always use the proper tools such as calibrated torque wrench. Make 5 passes in a crisscross pattern to the required torque as follows:

1. Tighten all nuts initially by hand
2. Torque each nut to approximately 30% of the required torque
3. Torque each nut to approximately 60% of the required torque
4. Torque each nut to full torque.
5. Apply at least one final torque to all nuts in a clockwise direction until all torque is uniform.

Large-diameter flanges may require additional tightening passes.



Retightening

CAUTION--If retightening is considered necessary, this should only be done at ambient temperature and atmospheric pressure before or during the first start-up.

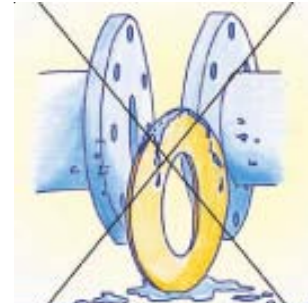
Never retighten compressed fiber gaskets at higher operating temperatures and longer operating times.

Retorque fasteners exposed to aggressive thermal cycling once the joint is again at ambient temperature and atmospheric pressure.



Re-use of Gaskets

For safety reasons never re-use a gasket.



**KLINGER® expert
Powerful Sealing
Calculation**

Call Thermoseal today at
800-990-SEAL
to get your free copy

Use of Gasket Adhesives

In some instances it is necessary to apply an adhesive to gasket materials. This may be necessary for installation purposes, segmenting large gasket diameters, laminating or for OEM applications. If necessary, Thermoseal recommends either a neoprene contact adhesive or a chlorine free epoxy adhesive. Care should be taken in selecting an adhesive that is compatible with the temperature and media which the gasket will be exposed to. The amount of adhesive should be minimized.

Thermoseal does not recommend the use of silicone or permatex-based products because of negative effects on the gasket materials. These and other compounds may also effect friction between the joint causing excess creep and premature failure.

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Silicone

Silicone is not added in the manufacture of KLINGERSIL® compressed gasket materials, KLINGERTop-chem® PTFE gasket materials, Thermoseal® soft-chem® expanded PTFE gasket materials, or SEALEX® joint sealant.

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Class I or Class II Ozone Depleting Substances

No component of Class I or Class II ozone depleting substances per the U.S. Clean Air Act Amendment of 1990 is used in the manufacture of any Thermoseal Inc. product.

Further, we presently have no reason to believe that our suppliers use any component of Class I or Class II ozone depleting substances in the manufacture of their products.

For product safety information, warranty and damage limitations, refer to the Material Safety Data Sheet (MSDS).