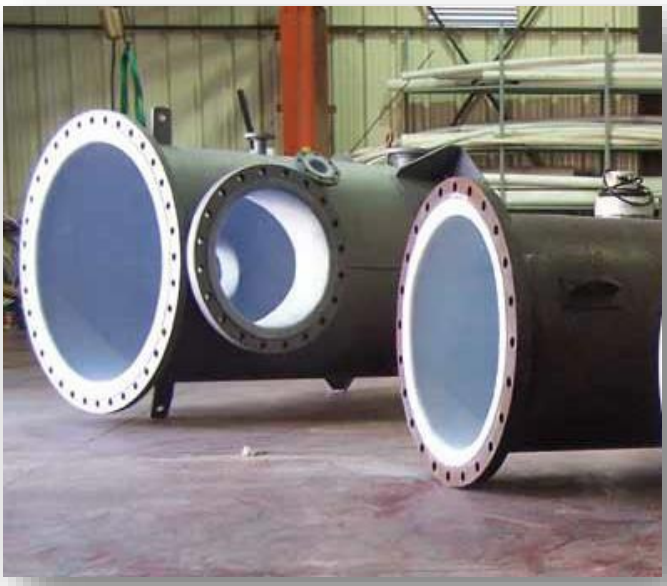
HIGH TECHNOLOGY PRODUCTS AND SERVICES FOR YOUR MOST DEMANDING CORROSIVE CHEMICAL ENVIRONMENTS

CG Thermal fully understands the specialized needs of the markets and customers that we serve, many whom demand custom-designed equipment to meet highly-corrosive process and/or plant conditions. In order to more fully serve our customers, CG Thermal has teamed up with Engiplas to provide a complete line of fluoropolymer lined components to complement our Impervite® graphite and Umax® ceramic heat exchangers. Since the 1970's, Engiplas has been engineering and producing lined columns, vessels, and components for the chemical, bio-diesel, semiconductors, pharmaceutical, and water treatment industries.



PRODUCTS AND CAPABILITIES

Engiplas provides an extensive array of fluoropolymer materials and production techniques along with the "know-how" to choose the most appropriate system for your application. This "know-how" and engineering expertise will help you address your most challenging issues including shape, corrosion resistance, permeation, volume and weight limitations, thermal expansion, piping connections, internals, and code requirements.

fluoropolymer

lined components

Why should you consider fluoropolymer lined equipment?

Along with their superior chemical resistance, fluoropolymers also provide thermal stability, high purity, non-bonding surfaces, and thermal and electrical insulation. Combining the above with metal and rigid structural materials, fluoropolymers provide a cost effective alternative to glass lined and exotic metal construction.

Engiplas and CG Thermal engineers, with their combined experience with corrosion resistant materials, will assist you in overcoming your most difficult application challenges. We offer a complete array of fluoropolymers and processing techniques and can recommend which is most suitable for the given fluid properties, design temperature, design pressure, and shape and dimensional criteria.

Process Columns

Heat Exchanger Components:
- Shells
- Bonnets

Storage and Buffer Tanks

Reactor, Separator, & Agitator Vessels

Scrubbing Towers

PROCESSING TECHNIQUES

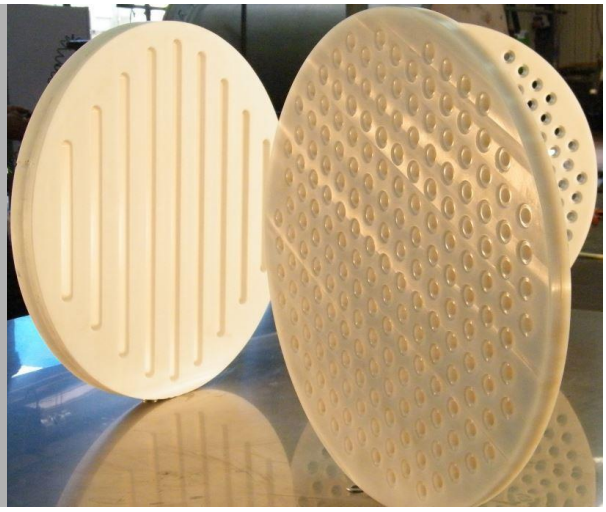
Loose Liners for simple shaped structures with positive pressure conditions. For larger structures, components can be joined with our fluoropolymer welding system.

Bonded Liners for structures with simple or complicated shapes and vacuum or positive pressure conditions.

Rotolining for structures with complicated shapes under vacuum or positive pressure conditions, with no welds or seams. Provides maximum permeation resistance and is field repairable.

Liquid and Powder Coatings for structures with complicated shapes under vacuum or positive pressure conditions, with no welds or seams, where permeability is not a great concern.

quality



QUALITY AND TESTING

The linings we provide are fabricated under the watchful eye of a quality department that tests on a daily basis in a facility that fosters ongoing training. The following are conducted on a daily basis:

spark tests
pressure tests
vacuum tests
density
tensile and elongation
hardness
tolerances test
surface finishes

CERTIFICATIONS AVAILABLE

Quality management in accordance with ISO 9001:2000

Fabrication in accordance to the ASTM, ASME VIII Div 1 and PED 97/23/EC standards for lined piping and vessels.

ASME and CE Marks and third party inspections

ATX 94/9/EC Certificate, for equipment in a potentially explosive atmosphere

engineering

AVAILABLE MATERIALS

Material	Working temperatures (°F)	Chemical Resistance	Comments
PTFE	-148 to 437	Supreme	Suitable for high-purity applications, exceptional non-stick properties, high thermal stability and longest flex life.
PTFE-M	-148 to 437	Supreme	Modified PTFE, suitable for high-purity applications, exceptional non-stick properties, high thermal stability, lower permeation rates and better mechanical properties
PFA	-148 to 437	Supreme	Suitable for high-purity applications, non-stick properties, lower permeation rates, high thermal stability and long flex life.
MFA	-148 to 374	Supreme	Non-stick properties, lower permeation rates, high thermal stability, better surface smoothness
FEP	-148 to 356	Excellent	Exceptional non-stick properties, high thermal stability
ETFE	-58 to 302	Excellent	Lower permeation rates, high thermal stability, outstanding abrasion and tear resistance, better mechanical properties
ECTFE	-58 to 302	Excellent	High thermal stability, outstanding abrasion resistance, better mechanical properties
PVDF	-4 to 230	Very Good	Lower permeation rates, outstanding abrasion resistance, better mechanical properties
PP	14 to 194	Good	Very good abrasion resistance, low cost material
XLPE	14 to 185	Good	Supreme abrasion resistance - the best there is, low cost material
HDPE	14 to 140	Good	Low cost material

VACUUM and PERMEATION

Particular attention must be made to lining components that will operate under a vacuum. Not only does the structure need to stand up to the pressures imposed on it, since vapor is most likely involved, permeation must be addressed and minimized as well.

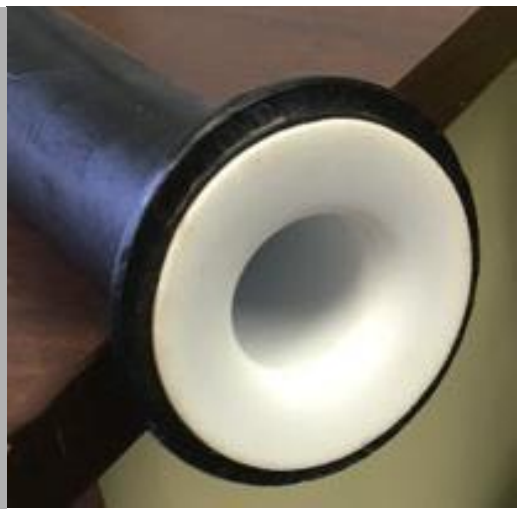
Throughout the past 40 years, Engiplas has experienced overwhelming success in vacuum applications and when permeation has been a concern. After selecting the appropriate material and processing technique, the required wall thickness is determined. If required, liners will be chemically or mechanically bonded to the steel substrate, or mechanical devices to hold the liners in place might be recommended. When permeation is of particular concern, a two layer system may be utilized. This detailed attention to design has resulted in an impressive record of lined products outlasting their anticipated service life under these most rigorous conditions.

DESIGN AND DIMENSIONS

technique	thickness	vessel design	head design	max. dia.	max. length
loose lining	0.078" - 0.39"	flanged cylinder	flat and slight conical	240"	150"
bonded liner	0.078" - 0.39"	closed or flanged	flat, conical, or dished	800"	240"
roto-lined	0.078"-0.5"	closed or flanged	flat, conical, or dished	82"	82"
coated	0.078" max	flanged cylinder	flat, conical, or dished	100"	110"

XLPE/PTFE
HDPE/PTFE

lined pipe



DESIGN FEATURES

Double layer pipe; XLPE or HDPE exterior with PTFE liner

Available in 1” -20” diameter

Maximum design temperature of 266 °F

Coated steel or plastic flanges

No cold flow sealing faces

Superior PTFE grade for extended permeation resistance

Excellent stress crack resistance

Can be cut and assembled on site

Excellent thermal cycling life

No welding

Low weight

Cost effective

No special training

Numerous sealing options

Bending radius of 7 times OD

Pipe OD	max. operating pressure	max. single price length	wall thickness	weight per foot	pair of flanges
1"	300 psig	160 ft	0.17"	0.38 lbs	3.5 lbs
1-1/2"	300 psig	160 ft	0.27"	0.67 lbs	6 lbs
2"	300 psig	80 ft	0.18-0.33"	1.35 lbs	9 lbs
3"	300 psig	60 ft	0.22-0.39"	2.18 lbs	17.5 lbs
4"	220 psig	35 ft	0.27-0.38"	3.28 lbs	24 lbs
6"	150 psig	30 ft	0.38"	5.10 lbs	33 lbs
8"	150 psig	18 ft	0.54"	9.66 lbs	60.5 lbs

MAXIMUM SPAN and CALCULATED DEFLECTION @ 50 PSIG Operating Pressure

	Pipe Rated Pressure							
	150 psig		175 psig		220 psig		300 psig	
Pipe OD	span	deflection	span	deflection	span	deflection	span	deflection
1"	---	---	---	---	---	---	3.25 ft	0.280 in
1.5"	---	---	---	---	---	---	5.0 ft	0.325 in
2"	---	---	5.0 ft	0.381 in	5.0 ft	0.337 in	5.5 ft	0.373 in
3"	7.0 ft	0.333"	7.2 ft	0.330 in	7.5 ft	0.330 in	7.8 ft	0.354 in
4"	9.0 ft	0.311"	9.0 ft	0.239 in	10.0 ft	0.360 in	---	---
6"	13.5 ft	0.328"	---	---	---	---	---	---
8"	18 ft	0.311"	---	---	---	---	---	---

MAXIMUM SPAN and CALCULATED DEFLECTION @ Maximum Rated Pipe Pressure

	Pipe Rated Pressure							
	150 psig		175 psig		220 psig		300 psig	
Pipe OD	span	deflection	span	deflection	span	deflection	span	deflection
1"	---	---	---	---	---	---	2.2 ft	0.154 in
1.5"	---	---	---	---	---	---	4.0 ft	0.325 in
2"	---	---	4.5 ft	0.250 in	5.0 ft	0.359 in	5.4 ft	0.356 in
3"	7.0 ft	0.337"	7.2 ft	0.330 in	7.5 ft	0.338 in	7.6 ft	0.344 in
4"	9.0 ft	0.311"	9.0 ft	0.347 in	10.0 ft	0.390 in	---	---
6"	13.5 ft	0.328"	---	---	---	---	---	---
8"	18 ft	0.311"	---	---	---	---	---	---

Maximum Deflection

y_{max} = 9.525 mm (0.375")

$$y = \frac{5wL^4 + 8w_cL^3}{384EI}$$

w = uniformly distributed weight of pipeline in (N/m)
w_c = concentrated weight on pipeline (N)
L = span length (m)
D = pipe OD (m)
d = pipe ID (m)
E = modulus of elasticity of pipe (N/m^2)
I = moment of inertia of pipe (m^4)

Maximum Allowable Stress

$S_a \leq 22$ MPa (3200 psig) with 1.25 safety factor

$$S_a = \frac{PD_o}{4t_n} + \frac{10000wl^2}{12Z}$$

P = design pressure (MPa)
Do = pipe OD (mm)
tn = wall thickness (mm)
w = pipe weight (N/m)
l = pipe span (m)
Z = section modulus (mm3)