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PRODUCTS

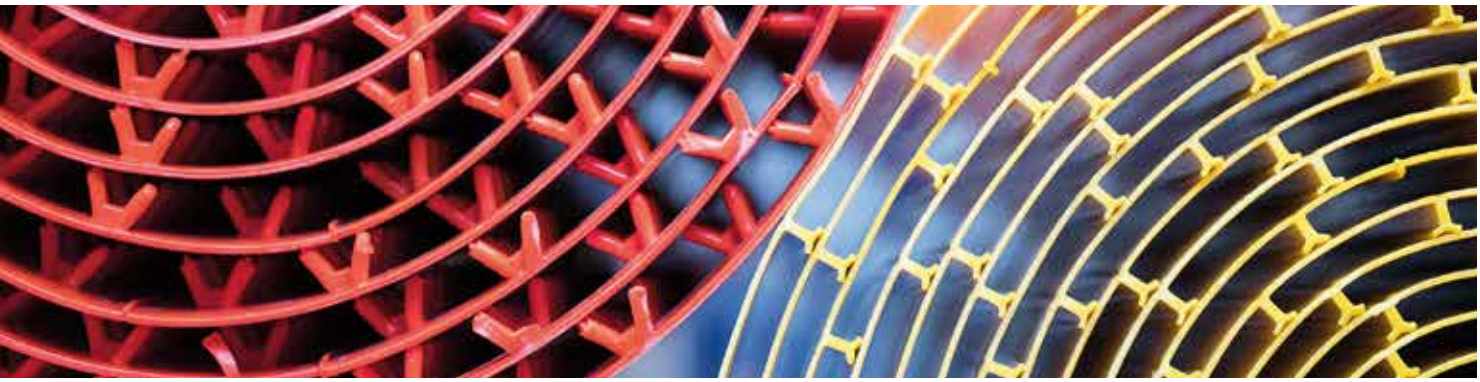
V-Lock & T-Rib Sheet Lining System

PACIFIC POLYMER PRODUCTS CO., LTD.

Polyethylene and Welding Sheet Manufacturer

V-LOCK and T-RIB

DESIGNED FOR CHEMICAL AND PROCESS TANKS, DRY AND WET CAST PIPE, CULVERT, AND TUNNEL



DESCRIPTION

- V-Lock and T-Rib Polyethylene in LLDPE and HDPE grades.
- Resistant to acids, alkaline solutions, Petroleum products, including Fuels and Oil, Ketones and Chlorinated solvents.
- Has excellent abrasion resistance and impermeability.

TYPICAL USE

- PPP's V-Lock and T-Rib liners are produced from the finest raw materials, when required, imported. Our linings are noted for the superior tensile and reaction to Chemical Exposure (See Test report Section).
- The V-Lock and T-Rib Lining and plain sheets, are extruded under great heat and pressure, to ensure a high molecular weight.
- Widely specified for a broad spectrum of Service Roles in Industry.
- V-Lock and T-Rib are the primary choice of Wastewater an Environmental Utilities, were long term protection performance for economic price are required.
- V-Lock and T-Rib are used for Lining Concrete Pipes, of all types, Concrete Tunnels, Sumps, Grit Chambers, Clarifiers, Wet Wells, Manholes and Chambers.
- Wastewater Treatment Linings are simply fabricated into correct sized blankets, placed onto the formworks and Concrete poured, in a manner, that after removal of the formwork, the V's and T's are embedded in the Concrete.

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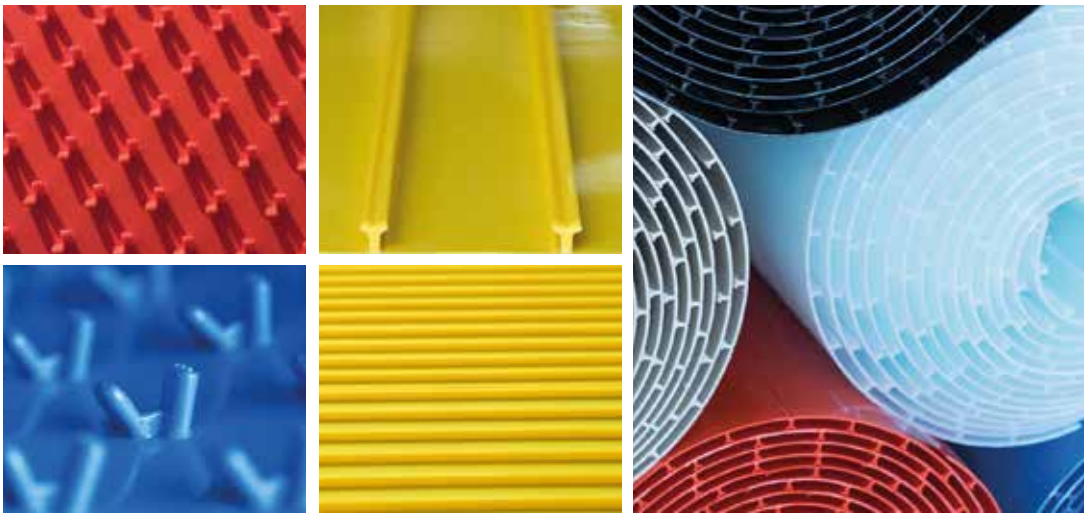
CHEMICAL PROPERTIES

- Acid Resistance PPP's V-Lock and T-Rib for Plain Sheet HDPE or LLDPE linings, have excellent performance in most mineral acids and in specific Organic acids.
- Excellent Resistance to most salts, including copper sulphate, calcium chloride, rock salt and alum.
- Excellent Resistance to Sodium Hydroxide (Dilute) at ambient temperatures.
- PPP's Polyethylene produced with the best resins, can withstand immersion in the following chemicals at the temperatures shown, for a period of one year or more. These materials will discolor in some application, and even swell or harden, however this do not mean, the material has failed, as, left alone, it may well perform for many years.
- Plating solutions, HDPE will withstand continuous immersion at normal conditions and temperature of, up to 55°C

Brass
Bronze
Cadmium
Chromium (all types)
Copper (Cyanide)
Copper (Acid)
Copper (Flouburate)
Gold
Indium
Iron
Lead
Lead Tin Alloys
Nickel (all types)
Palladium
Rhodium
Silver
Tin (all types)
Zinc (Acid)

PHYSICAL DATA

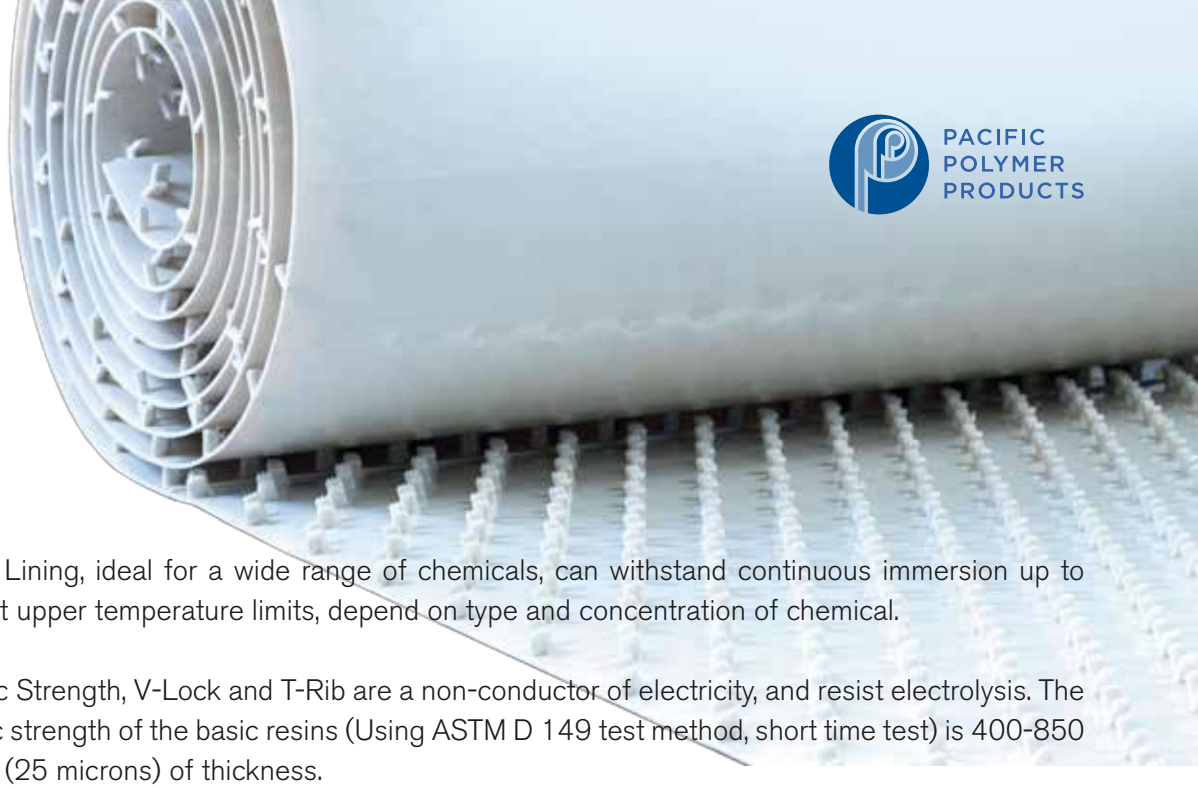


Color: Black and White are standard, other colors can be produced to Customer Specification.
Packing: Standard size Width 1070 mm. can be Butt-welded to transportable width, when Length up to 5,000 mm. is weldable.
Bulk Rolls:
Plain Sheet:
Supplied in rolls: width 1.200 mm. x 50 meter, thickness is 2 mm. (60 m^2)
Supplied in rolls: width 2.000 mm. x 50 meter, thickness is 2 mm. (100 m^2) = 267 kg.
Weld Strips:
Material for extrusion welding:
Shipping Weights of V-Lock and T-Rib:
Weight of different thickness V-Lock and T-Rib:

- 2.0 mm. Thickness = 2.50 - 2.60 kg/m^2
- 2.5 mm. Thickness = 3.00 - 3.10 kg/m^2
- 4.0 mm. Thickness = 4.40 - 4.50 kg/m^2

Typical Properties

- V-Lock and T-Rib are a thermoplastic, and remains flexible within a wide range of temperature, between 40 and 75 °C.
- V-Lock and T-Rib also remain stable throughout a wide band of temperature range, making its user friendly and easy to work with.
- Weld ability, can be welded at any time, during its lifespan.
- Welding methods; Hot-Air – Speed weld
  Hot wedge type
  Extrusion type



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As Tank Lining, ideal for a wide range of chemicals, can withstand continuous immersion up to 71°C, but upper temperature limits, depend on type and concentration of chemical.

Dielectric Strength, V-Lock and T-Rib are a non-conductor of electricity, and resist electrolysis. The dielectric strength of the basic resins (Using ASTM D 149 test method, short time test) is 400-850 volts per (25 microns) of thickness.

Water Absorption Rate, (% change maximum weight) to ASTM D 570 Results are 0.1% over first 24 hours, then the rate drops rapidly.

Water Vapor Transmission Rate, Using ASTM E 96 test method, (38°C and 100% relative humidity) the transmission rate is about 0.020 (per 100 inch^{2}per 24 hours) for 1.5 mm. thickness of sheet.

Gas Transmission Rate, according ASTM D 1434

Hardness, with Shore Durometer reading is 55 Shore at 25°C according ASTM D 2240 test method.

Tensile Strength, of V-Lock Lining / Weld strength, in accordance with ASTM 638 test method, average around 3600 psi (25 N/mm^2) Field Weld all types Shear tests, Parent material, fail before weld.

Elongation of V-Lock and T-Rib sheet 600%.
Abrasion Resistance, according ASTM D 1044 test method.
Wheel CS 17, with loading weight of 1 Kg. weight loss is about 18 mg. per 1000 cycles.

Coefficient of Friction, according ASTM D 1894 test method, static value 0.74, Kinetic value 0.55

- Specific gravity ASTM D 792
- Specific gravity for LLDPE is 0.92
- Specific gravity for HDPE is 0.93 +
- The above values are nominal, and linked to the particular resin used.

Tear Resistance, according ASTM D 1004 Die C test method, thickness 1.82 mm. C, Average 300 N.

Low temperature Brittleness, according ASTM D 746 test method - 94°F.

Modulus of Elasticy, Secant Modulus, expressed in pounds per inch^2, 15.000 psi for HDPE.

V-LOCK and T-RIB
Standard Specification

Description of the V Profile HDPE / PP Liner

The V-Lock sheet liner has two splayed studs, each one 15 mm. in length, and joined by a cross bar in a V arrangement. The double stud unit is formed during the extrusion process and it is integral to the sheet itself. There are 400 such stud units per m^2 to ensure perfect embedment of the liner, in the casted concrete. The angle of splay ensures that the height of each V does not exceed 13 mm. and that the V-Lock Liner can resist great pull-off forces both physical (pull-out of concrete) and Hydraulic (back pressure).

Description of the T-Rib Profile HDPE / PP Liner

The T-Rib sheet liner is another excellent choice for customer. The T-Rib is designed to be easy to bond strongly and completely with concrete. The T-Rib liner is featured with excellent resistance against abrasion and low coefficient of friction so that the T-Rib lining pipe will smoothly flow for waste water.

1. GENERAL

When HDPE V-Lock and T-Rib Liner have been used, the welding strips or patches, shall be made from the same material as the sheets.

- At any time, during the course of a project, during manufacturing or installation, the Engineer may take samples of the sheet or welding strips.
- The manufacturer may make changes in the formulation, after (1) prior notice to the Engineer (2) the manufacturer will meet or exceed physical and chemical resistance according the specifications.

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2. PROPERTIES

The following are main properties of HDPE sheet

Test method:		Requirement.
Elongation at break,	ASTM D 638 / D 882	Exceeds 500%
Tensile Strength,	ASTM D 638 / D412	14.0 Mpa
Low temperature Brittleness,	ASTM D 746	-103°F (-75°C)

All plastic Liner or strips, shall have the following properties, when tested at the temperature of 77 °F (25°C).

Property Initial

Tensile strength	: 2.200 Psi
Elongation at break	: 500%
Shore Durometer	: 1 second 50-60
Weight change under Chemical Exposure	: Not exceeding + or – 1.5%

3. TESTS

112 Day test according (City of L.A. Green Book Section 210- 2.3.3.)
7 Day test according (ASTM D543) this test is shorter period, with higher chemical concentrations.

- **Generals**
  Samples taken from sheets, weld strips, joint strips, shall be tested to determine material properties. Determination of Tensile Strength and Elongation shall be in accordance with ASTM D 638

- **Measurement of initial physical properties**
  Determines the initial values of the Tensile Strength, Weight, Elongation and indentation hardness prior to resistance test.

- **Chemical resistance test**
  Determine the physical properties of the specimens after exposure to chemical solutions. Test specimen shall be conditioned to constant weight at 72°F (24°C) before and after submersion in the following solutions, for a period of 112 Days at 72°F + or – 5 °F (24°C, + or – 3 °C)

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CHEMICAL SOLUTION CONCENTRATION

Chemical Solution	Concentration
Sulphuric Acid	20 %
Sodium Hydroxide	0.5 %
Ammonium Hydroxide	0.5 %
Nitric Acid	0.1 %
Ferric Acid	0.1 %
Soap	0.1 %
Detergent (Linear alkyl benzyl sulfate or LAS)	0.1 %

Bacteriological BOD not less than 700 PPM
Volumetric percentage of concentrated reagents of C.P. grade.

At 28 Days interval, specimen shall be removed from each chemical solution, and tested, if any specimen fails to meet the 112 Day exposure, the material will be subject to rejection.

- **Pull-out Test for studs**
  Liner studs embedded in concrete, shall withstand a Test-pull of 85 Kg. applied perpendicularly to the concrete surface, during one minute, without rupture of the locking extensions or withdrawal from the embedment. This test shall be executed, at a temperature, between 70°F and 80°F (21°C and 27°C).

- **Shop welded joints**
  Shop welded joints, used to fuse individual section of liner together, shall be at least equal to the minimum requirements of the liner for thickness, and shall be tested for Tensile strength.Tensile strength measured across the welded joint, in shear, shall be 90% of the parent material, using a strip, 1 x 5 and the Peel shall be equal to 60% of the Yield strength of the parent material.
  Thermal Wedge Welding is used, to make shop welded joints.In case of Hot-Air fabricated welds, the Shear value is 90% of the Yield strength, and the Peel value is 50% of the Yield strength, all of parent material.
  The test shall be executed, at a temperature, between 70°F and 80°F (21°C and 27°C).

Spark Test
All liner shall be shop tested for holes, with a Spark Tester set between 20.000 and 30.000 volts. Sheets, having holes, shall be shop repaired, prior to shipment, from the manufacturing plant.

4. DETAILS AND DIMENSIONS

Approval of details

Liner sheets and strips, and other accessory pieces, shall be conform the required specifications or Standards.

Thickness of material

The minimum thickness of Sheets and Strips, shall be as follows;

- Sheet 2 to 5 mm.
- Plain sheet 2 to 5 mm.
- Joint strips 2 to 5 mm. Width. 100 - 150 mm.
- Weld strips 2 to 5 mm. Width. 100 - 150 mm.

V-Lock material sizes

Sheets of liner used for Pipes, Tunnels and Structures, shall be sized, to provide the coverage according the plans.

Locking extensions

All liner embedded in concrete shall have Locking Extensions.Locking Studs shall be integrally extruded with the sheets, and the distance between Studs shall be minimum 50 mm. measured from the center of the Cross-Bars, and will have 400 pieces of stud per m^2. The distance on the edges of the sheet, to the studs, shall be not more than 8 mm. Liner, shall be applied and secured to the formwork, (the formwork shall be oiled), Inspected and Approved, by the Engineer, prior to placing the reinforcement, and pouring concrete.

Installer Qualifications

- Applicators, the application of the liner, to the forms, or other surfaces is considered as highly specialized work.
- Personnel performing such installation works, shall be trained, and demonstrate their ability, to the Engineer.
- All test welds, shall be made in the presence of the agency's representative and shall consist of the following;
  Two pieces of liner approximate 40 x 25 cm. and shall be lapped 40 mm. and held in vertical position.
  A welding strip, shall be positioned over the edge of the lap, and welded to both pieces of liner. Each end of the welding strip shall be extended at least 50 mm beyond the liner to provide tabs.

The welded specimen will be tested by the Engineer.



5. CONCRETE OPERATIONS

- Coverage, the circumference coverage shown on the plan for the liner, the minimum limit of coverage is permitted.
- Positioning liner, all liner installed in pipes, shall be positioned in a manner, that the locking studs are parallel to the horizontal axis of the pipe

Depending the production method of Pipes, the liner shall be centered Flush to TOP and BOTTOM to permit overlap welding with welding strip. The minimum distance of V's at both ends, until the edges, shall be not more than 8 mm.

For Constructions, the Manufacturer shall be contacted for installation advice

- Concrete placement, care must be taken when placing concrete against the liner, in order to avoid damages on the liner during vibration of the concrete. It is essential that good dense concrete is produced, to secure the Studs outer vibrations are recommended.
- At removing of the forms, care shall be taken to protect liner from damage. Sharp instruments shall not been used, to remove the formwork.
- After removing of the formwork, the liner shall be cleaned for inspection, according instructions of the Engineer, and prior to shipment to the Client.
- Any handling straps, used in securing the liner in constructions shall be removed, and in case of voids occurred due to enclosed air, during compaction of the concrete, shall be repaired with material approved by the Engineer.

6. FIELD JOINTING AN SPARK TESTING OF LINER

• **General**

No field joint shall be made in liner, until the pipe or structure has been backfilled, and 7 Days have elapsed, after doing testing. Were ground water is encountered, the ground water shall be removed, dewatering stopped for at least 7 Days, and no visible leakage is evident at the joint. Liner at joints shall be free from Mortar and other foreign material, and shall be Clean and Dry before Joints are made.

Hot Joint Compound, shall not be brought in contact with the liner.

• **Installation**

Field joints in liner sheet at Pipe Joints shall be one of the following types;

1. **PPP- 4 Joint** shall consist of a 100 mm. Joint Strip centered over the pipe joint fixed to adjacent liner, Hot-Air welded direct to the liner surface before being sealed with extrusion welds along the Strip.
2. **Type 1.** Shall be made with integral joint flap (Studs shall be removed over 100 mm.) beyond the spigot-end of the pipe. The flap shall overlap, and be Hot-Air welded to the adjacent pipe, followed by securing extrusion welding at the edges.

NB. – Protect pipe flaps from damages.
NB. – Remove all mortar and splash, from flaps and pipe=ends
NB. – All welding tracks shall be cleaned and prepared for welding, with a clean cloth or angle-grinder, before any extrusion welding is made.

Important Checks and Notes for welding operations.

Adequate ventilation shall be maintained to confined spaces, during welding operations.

The welding strips shall be centered over the cleaned surfaces to be joined and fused across the entire width. Incomplete fusion, charred or blistered welds will be rejected.

After repair, the welds shall be re inspected and tested.

Spark-Testing of Liner

All welds, shall be tested with a Spark-Tester, adjusted to the following settings;

Thickness; 1.65 at 20.000 Volts
2.00 at 25.000 Volts
3.00 at 48.000 Volts

- In the event, of “Positive” Test result, revealing an imperfect weld, the point of defect shall be marked, with a color in contrast with the liner.
- Return to all marked defects, on the liner, and remove the offending weld, using an angle=grinder/
- Re-Weld the areas in question and return to re-check weld integrity.

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