

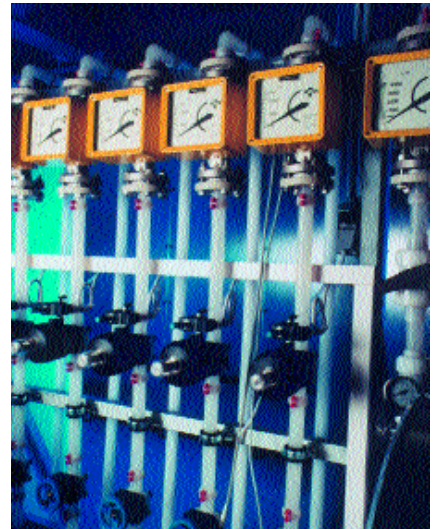
about: high purity

High purity plastic piping systems are manufactured from specially formulated materials and undergo additional processes and packaging so that they meet the requirements of industries transporting ultra-pure water, fine chemicals and foodstuffs.

Plastic systems for high purity applications have evolved from standard grade materials during the past fifteen years. Extensive studies on the leach out behaviour of the plastic raw materials has led to the development of new variants with extremely low-extractable contaminants, especially TOC and trace metals. Strictly controlled manufacturing processes also guarantee a superior product with an extremely smooth internal surface to resist microbiological growth.

These high integrity systems are available in a selection of materials to meet a range of budgets. Installation methods vary from solvent cement welding to computer controlled infra-red non-contact fusion welding with full weld traceability. The choices available suit a wide range of applications, including:-

- Pure water distribution
- Dialysis and other medical units
- Fine chemical handling
- Food and drinks processing
- Biotechnology processes



Manufacturing high purity systems

The process begins with the special grades of thermoplastic materials that have been developed for this application. Using only virgin compounds, product traceability begins at this point, with all batches being completely traceable back to raw material.

Pipe and fittings production takes place under strictly controlled conditions. Optimizing processing conditions and providing smooth internal surfaces greatly reduce the potential for extractable and particle contaminants.

Harvel LXT® piping, and PURAD® PP-Pure and Polypure piping are produced on designated extrusion and injection moulding equipment, with particular reference to stringent controls to enhance product quality. Products are immediately packaged in sealed bags so that they reach the point of installation without the risk of any contamination.

PURAD® PVDF UHP piping is manufactured in a class 100/1000 cleanroom on dedicated production equipment. After manufacturing, all UHP fittings and valves are cleaned in an automatic process carried out in a class 100 environment. As with other high purity systems, UHP products are immediately packaged so that no contamination can occur on route to the job site.

Detailed manufacturing records are kept and all high purity systems can be supplied with certificates of conformity including quality control records.



Harvel LXT®

Ideal for the semiconductor, electronic, biotechnology, healthcare, university, and laboratory industries, Harvel LXT® low-extractable piping is made from an innovative clean PVC compound that offers a number of advantages:

- Extremely low extractable containments, particularly trace metals and Total Oxidizable Carbon (TOC)
- Fast reliable installation with simple inexpensive joining methods
- Speciality one-step fast setting solvent cement joining system rinses up quickly
- Unique blue translucent material allows visual joint integrity inspection
- Ultra-smooth interior pipe surface minimizes the potential for bacterial growth and particle generation
- Rigid Schedule 80 dimensions for pressure service requires fewer supports than flexible plastic systems

Harvel LXT® material also meets the toxicological requirements of NSF International Standard 61 as being safe for use in potable water applications, and also complies with the provisions of Title 21 of the United States FDA Code of Federal Regulations as being safe for the use in food contact applications.

Physical Properties

LXT® Physical Properties	Value	Test Method
Cell Classification	12343	ASTM D1784
Specific Gravity	1.327 (g/cu.Cm @ 73°F)	ASTM D792
Tensile Strength, @ yield	463 bar (6720 psi)	ASTM D638
Tensile Modulus of Elasticity	26,497 bar (384,200 psi)	ASTM D638
Flexural Strength, @ yield	786 bar (11,400 psi)	ASTM D790
Flexural Modulus of Elasticity	26,069 bar (378,000 psi)	ASTM D790
Izod Impact (avg 2 complete breaks) (avg 3 partial & 2 complete breaks)	1.3 ft-lbs /inch 10.9 ft-lbs /inch	ASTM D256
Coefficient of Linear Expansion	3.89×10^{-5} in/in°F	ASTM D696
Compressive Strength	602 bar (8732 psi)	ASTM D695
Heat Distortion Temperature	67°C (152°F)	ASTM D648
Hardness, Shore D	82.2±3	ASTM D2240
Maximum Temperature Use	60°C (140°F)	

Although the extractable contaminants of Harvel LXT® are much lower than common PVC piping, Harvel LXT® has physical properties very similar to those of conventional PVC systems. As a result, Harvel LXT® products exhibit the well-known physical characteristics and other benefits of conventional PVC piping, such as good chemical and corrosion resistance, low thermal conductivity, high strength-to-weight ration, good impact resistance, and ease of installation.

Joining

The Harvel LXT® system utilizes a one-step solvent cementing system specifically formulated for use with this product (Harvel LXT® One-Step Cement). Unlike conventional PVC solvent cements, this system contains fewer contaminants and cures quickly, reducing the potential for TOC contamination. Joining is accomplished quickly and efficiently utilizing inexpensive tools, thereby greatly reducing installation costs.

LXT® Leach Out Values		
Element	DL (Detection Limit) ppb	Harvel LXT®
TOC	5	59
Flouride	2	*
Chloride	0.25	2.33
Aluminum	0.05	0.30
Barium	0.01	0.04
Calcium	3	7
Magnesium	0.02	0.81
Sodium	0.06	0.83
Tin	0.02	0.93
Zinc	0.06	0.49

* = Below Detection Limit

Leach out behaviour

Static leach out tests provide valuable information on the purity of a material, providing the worst case scenario since the test water is stagnant during the test.

- All samples pre-rinsed identically with UPW prior to test
- Independent Laboratory Extractable Analysis (Balazs Analytical Laboratory)
- Seven-Day Static Leach @ ambient temperature
- 450mL 18.2 megohm ultra-pure water
- 120-square-inch wet surface contact area
- Based on 1" diameter pipe without solvent-cemented joint
- Concentration units expressed as ug/L of Leachate (ppb)

Pressure ratings for Harvel LXT® system

Harvel LXT® piping is produced to Schedule 80 dimensions in strict accordance with ASTM D1785. Harvel LXT® fittings are produced to Schedule 80 dimensions per ASTM D2467. The maximum operating pressure is expressed at an operating temperature of 20°C. Under higher temperature conditions the maximum operating pressure will reduce.

Pipe Size	Max. Operating Pressure	Working Temperature °C	Pressure De-Rating Factor
1/2"	29 Bar	20	1.00
3/4"	23 Bar	30	0.80
1"	22 Bar	40	0.58
1 1/4"	18 Bar	50	0.39
1 1/2"	17 Bar	60	0.22
2"	14 Bar		
3"	13 Bar		
4"	11 Bar		
6"	10 Bar		

about: high purity

Polypure® Natural Polypropylene Piping System

Polypure is manufactured from a natural random copolymer polypropylene (PPR) offering superior mechanical properties compared to homopolymer polypropylene (PPH). The low crystallinity of the material also makes the fusion welded joints more reliable. The material also offers low leach out characteristics and superior quality.

Polypure is ideal for applications:

- in pure water distribution
- handling chemicals from DSP- and CPM-systems in the semiconductor industry
- handling process fluids in biotechnology
- in food and drinks processing

Installation

The Polypure system is assembled using infra red non-contact butt fusion (IR) or conventional butt fusion methods. Both methods provide superior mechanical properties that exceed the mechanical strength of



socket fusion. However the preferred method is infra red non-contact butt fusion (IR) which produces reduced weld bead sizes for cleaner system operation. IR fusion also gives high repeatability of the welding process and complete traceability for each welded joint.

UV resistance

Polypure is not UV resistant and therefore if installed in an exposed situation it should be insulated or given a suitable protection layer such as AGRUCOAT.

Pressure ratings for Polypure

Although Polypure is capable of operating at working temperatures up to 95°C, at high temperatures discolouration of the material occurs (although this has no effect on the mechanical, thermal and/or electrical properties). It is therefore recommended that the maximum operating temperature is 50°C.

Temperature	Pressure Rating (bar): Polypure		
	10 years	25 years	50 years
10°C/50°F	15.5	14.9	14.5
20°C/68°F	13.2	12.8	12.4
30°C/86°F	11.1	10.7	10.4
40°C/104°F	9.4	9.1	8.8
50°C/122°F	7.9	7.6	7.4
60°C/140°F	6.6	6.4	6.2
70°C/158°F	5.6	4.7	4.0
80°C/176°F	3.8	3.0	-
95°C/203°F	2.0	-	-



PP-Pure High Purity Grade Polypropylene Piping System

PP-Pure is manufactured from grey random copolymer polypropylene (PPR) offering superior mechanical properties compared to homopolymer polypropylene (PPH). It provides the same ease of welding and jointing reliability as polypure due to the low crystallinity of the material. PP-Pure also offers low leach out characteristics and superior surface quality.

PP-Pure is available in a wider range of diameters than Polypure (up to 315mm) and is ideal for applications:

- in ultra-pure water distribution for less critical applications than PVDF

Installation

The PP-Pure system is assembled using infra red non-contact butt fusion (IR) or conventional butt fusion methods. Both methods provide superior mechanical properties that exceed the mechanical strength of socket fusion. However the preferred method is infra red non-contact butt fusion (IR) which produces reduced weld bead sizes for cleaner system operation. IR fusion also gives high repeatability of the welding process and complete traceability for each welded joint.

UV resistance

PP-Pure is not UV resistant and therefore if installed in an exposed situation it should be insulated or given a suitable protection layer such as AGRUCOAT.

Packaging

PP-Pure pipes are manufactured, cleaned and immediately double bagged and capped in a class 10,000 environment. PP-Pure fittings and valves are 100% inspected and then cleaned/rinsed with UPW water. In a class 100 room, the products are purged with dry air and double bagged in silicon free antistatic packaging.

Pressure ratings for PP-Pure

PP-Pure is capable of operating at working temperatures up to 95°C in accordance with the following pressures:

Temperature	Pressure Rating (bar): PP-Pure		
	10 years	25 years	50 years
10°C/50°F	19.3	18.7	18.2
20°C/68°F	16.4	16.0	15.5
30°C/86°F	13.9	13.4	13.1
40°C/104°F	11.8	11.3	11.0
50°C/122°F	9.9	9.6	9.3
60°C/140°F	8.3	8.0	7.7
70°C/158°F	7.0	6.1	5.1
80°C/176°F	4.8	3.8	-
95°C/203°F	2.6	-	-

PVDF UHP Ultra High Purity Grade Piping System

PVDF UHP is an extremely pure polymer, containing no stabilizers or additives. It is particularly suitable for ultra-pure water systems in the semi-conductor industry and is chemically inert and resistant to virtually all media. PVDF UHP is UV resistant and therefore may be installed in an exposed situation if required

It has high mechanical strength and very good chemical resistance, even at high temperatures. It has extremely low flammability: Class V0 according to UL 94. It is also safe for use in continuous contact with food stuffs in accordance with FDA regulations.

Installation

PVDF UHP is assembled using infra red non-contact butt fusion (IR) or high purity fusion (HPF) electro-fusion methods.

Packaging

PVDF UHP pipes are manufactured and immediately double bagged and capped in a class 100 environment. Fittings and valves are 100% inspected and then cleaned/rinsed with UPW water. In a class 100 clean room, the products are purged with dry air and double bagged in silicon free antistatic packaging.

Pressure ratings for PVDF UHP

PVDF UHP is capable of operating at working temperatures up to 120°C in accordance with the following working pressures:

	Pressure Rating (bar): PVDF UHP SDR33/PN10					
	20°C	40°C	60°C	80°C	95°C	120°C
10 years	11.0	9.1	7.1	5.4	4.1	1.5
25 years	10.9	9.0	7.0	5.3	3.3	1.3
50 years	10.8	8.8	6.9	5.2	2.9	-
	Pressure Rating (bar): PVDF UHP SDR21/PN16					
	20°C	40°C	60°C	80°C	95°C	120°C
10 years	17.3	14.3	11.1	8.4	6.4	2.4
25 years	17.1	14.1	11.0	8.3	5.3	2.0
50 years	17.0	13.9	10.8	8.2	4.5	-

Leach out behaviour

The following are the results of static leach out tests on PVDF UHP pipe at 85°C for 7 days in accordance with SEMI guidelines:

	PVDF-UHP	SEMI spec
Fluoride	7732	60000
Chloride	78,0	3000
Nitrite	< 9,1	100
Bromide	< 5,5	100
Nitrate	< 18,7	100
Phosphate	74,2	300
Sulphate	11,4	300
Lithium	0,9	2
Sodium	6,8	15
Potassium	3,8	15
Magnesium	2,5	5
Calcium	19,5	30
Iron	1,1	5
Copper	0,7	15
Nickel	0,2	1
Zinc	3,1	10
Manganese	0,5	5
Aluminum	2,0	10
Barium	< 0,3	15
Boron	< 0,7	10
Chromium	< 0,7	1
Lead	< 0,3	1
Strontium	< 0,3	0,5
TOC	8975	60000

Physical properties of Polypure, PP-Pure and PVDF UHP

	Properties	Standards	Units	PVDF UHP	P-Pure/Polypure
Mechanical properties	Density at 23°C	ISO 1183	g/cm ³	1.78	0.91
	Melt flow rate MFR at 230°C/5kg	ISO 1133	g/10 min	6-24	1.25
	Tensile stress at yield	ISO 527	MPa	50	25
	Elongation at yield	ISO 527	%	9	12
	Elongation at break	ISO 527	%	80	> 300
	Impact strength unnotched at +23°C	ISO 179	kJ/m ²	124	no break
	Impact strength notched at +23°C	ISO 179	kJ/m ²	11	25
	Ball indentation hardness acc. Rockwell	ISO 2039-1	MPa	80	45
	Flexural strength	ISO 178	MPa	80	20
	Modulus of elasticity	ISO 527	MPa	2000	900
Thermal properties	Vicat softening point VST/B/50	ISO 306	°C	140	65
	Heat deflection temperature HDT/B	ISO 75	°C	145	70
	Linear coefficient of thermal expansion	DIN 53752	K ⁻¹ x 10 ⁻⁴	1.2	1.6
	Thermal conductivity at +20°C	DIN 52612	w/(mxk)	0.13	0.24
	Flammability	UL94		V-0	94-HB
Electrical properties	Volume resistance	VDE 0303	OHM cm	> 10 ¹³	> 10 ¹⁶
	Surface resistance	VDE 0303	OHM	> 10 ¹²	> 10 ¹³
	Relative dielectric constant at 1 MHz	DIN 53483	-	7.25	2.3
	Dielectric strength	VDE 0303	kV/mm	22	70
	Physiologically non-toxic	EEC 90/128	-	Yes	Yes
	FDA	-	-	Yes	Yes
	UV stable	-	-	Yes	Yes
	Colour	-	-	natural	1)

1) Polypure: natural
PP-Pure: grey, RAL 7032