PolyPure® High Purity Natural Polypropylene (PPn) Piping

PART 1: GENERAL

1.1 Summary

Furnish a complete high purity natural PP piping system to include pipe, fittings, specialty fittings and valves.

1.2 References

The following standards apply to products used within this section.

ASTM D 1598	ASTM D 1599
ASTM D 2122	ASTM D 2657
ASTM D 2837	ASTM D 4101
DVS 2207-11	ISO 15494 & DIN 8077

The system design shall meet the requirements of ASME/ANSI B31.3 for design criteria where temperature and pressure fall within the limits of the code.

1.3 Definitions

Natural polypropylene: Unpigmented random copolymer polypropylene, also referred to as PPn.
PolyPure®: Asahi/America's natural polypropylene piping high purity system.

1.4 System Description and Pressure Rating

System shall be a PolyPure® system made of uniform pipe and fitting resin. System pressure ratings shall be based on continuous use of 50 years. PolyPure® pipe and fittings shall be based on a Standard Dimensional Ratio (SDR) of 11, 1/2" through 4" (20-110mm). Pressure rating for pipe and fittings, unless otherwise noted, shall be 150psi (10 bar) for all SDR 11 material.

1.5 System Performance Requirements

System performance requirements shall handle the following:

Operating Pressure:	(TBD by Engineer/Project Owner)
Operating Temp:	(TBD by Engineer/Project Owner)
Test Pressure:	(TBD by Engineer/Project Owner)
Media:	(TBD by Engineer/Project Owner)

1.6 Submittals

Submit the following:

A. Product data for the system specified; relative to materials, dimensions of individual components, profiles and finishes.

B. Product certificates signed by manufacturer of PolyPure® PPn piping product, stating compliance to stated requirements.

C. Welder certificates, certifying that welders comply with the installation procedures as outlined by ASTM D-2657 & DVS 2207-11. All required training should be scheduled and completed at job start-up.

D. Qualification of firms supplying PolyPure®: Firms must have a minimum of five years of experience in design, installation and operation of thermoplastic high-purity piping systems.

1.7 Quality Assurance

Obtain components from a single source having responsibility and accountability to answer and resolve problems regarding proper installation, compatibility, performance, and acceptance.

1.8 Delivery, Storage, and Handling

A. Deliver all PolyPure® pipe to arrive on-site inside protected polyethylene static free, non-tear bags for cleanroom applications. See Section 2.3.B for pipe quantities per bag.

B. Deliver all PolyPure® fittings to arrive on-site single bagged in boxes layered with bubble packing or expanding Styrofoam to

prevent damage.

C. Store products on elevated platforms in a dry location with protection from the environment. Failure to protect pipe from damage during the project may result in longer start up times, pressure failures or premature breakage.

D. Lift, support and transport PolyPure® piping per manufacturers' recommendations.

1.9 Warranty

Warranty period is one year after date of substantial completion for job installations lasting no longer than one year. Asahi/America is not responsible for failures due to installation error or neglect.

PART 2: PRODUCTS

2.1 Manufacturers

Subject to compliance with requirements products which may be incorporated in the work include: The PolyPure® system as supplied by Asahi/America, Inc. of Lawrence, Massachusetts, 800-343-3618. Produced by Alois Gruber GmbH AGRU of Bad Hall, Austria.

2.2 Material

Pipe, valves and fittings shall be made from natural unpigmented random copolymer polypropylene (PPR). The resin shall meet or exceed the requirements outlined for a random copolymer resin according to ASTM D 4101-96a and DIN 16774. MFI shall be 0.30 g/10min per 230/2.16 according to ASTM D 792. Resin is approved for contact with foodstuff as per the FDA CFR, Title 21 (2001) 177.1520, and shall be certified as USP Class VI compliant.

In addition, manufacturer shall test all lots to ensure the melt flow index is within allowable range.

Traceability of all molded and extruded components must be molded into or otherwise printed on the outside of the piping component.

2.3 Pipe

A. Production

All pipe shall be produced on a dedicated extruder completely within a dedicated clean area. Surface finish smoothness is as follows:

Dim (mm)	Dim (inch)	Ra	Rt
OD 20 – 40	1/2 - 1-1/4	≤ 1.5µm	≤ 6µm
OD 50 – 110	1-1/2 - 4	≤ 0.8µm	≤ 3µm

B. Packaging

All pipes shall have ends sealed with PE bags and then capped. Pipe shall be sleeved in full length PE bag (quantity dependent). The following chart designates quantities of pipe per PE bag. Minimum purchase of bundled quantity is required to maintain packaging.

Size (inch)	Size (mm)	Quantity Per Tube
1/2	20	Five
3/4	25	Four
1	32	Three
1-/4	40	One
1-1/2	50	One
2	63	One
3	90	One
4	110	One

C. Pressure Rating

All pipes shall meet the requirements of Section 1.4.

2.4 Fittings

A. Production

All standard fittings through 4" (110mm) shall be injection molded. All fittings are to be molded with equipment in a clean environment. After any secondary, all fittings shall be cleaned for a minimum of one hour in a hot UPW cleaning system. The DI rinse water shall be 70° C with resistivity above 18MΩ and TOC ≤10PPB.

B. Packaging

All molded fittings are to be packaged in a class 100 cleanroom immediately after the cleaning process. All machined fittings are to be packaged in a class 1000 cleanroom. Fittings are to be single bagged in PE/Nylon composite bags. Bags are to be silicone free and anti-static.

C. Specialty Fittings

Specialty fittings are to include restraint fittings, instrumentation fittings, sanitary connections, etc. Specialty fittings shall be machined or molded of a compatible resin to the PolyPure® pipe and fittings and shall be packaged according to the requirements of section 2.4.B.

D. Pressure Rating

All fittings, unless otherwise noted, shall meet the requirements of Section 1.4.

2.5 Valves

All valves shall be produced in the same manner as high purity fittings.

A. Type-342 Spigot Diaphragm Valves:
1/2" - 2" (20mm - 63mm) shall be Type-342 of the PolyPure® system. The valves shall be molded using a compatible resin with options for EPDM backed PTFE or EPDM diaphragms. Valve bodies are to be unibody, molded design with a full 150psi rating at 70º F. All metal nuts and bolts must be capped or covered to reduce metal exposure. Top works must include integral lockout device on the handle and position indicator.

B. Type-342 Flanged Diaphragm Valves:
1/2" - 2" (20mm - 63mm) shall be Type-342 with stub end and backing ring IR welded onto both sides. Top works must include locking device on the handle and position indicator.

C. Type-343 Zero Dead Leg Valve:
1/2" x 1/2" - 2" x 1" (20mm x 20mm - 63mm x 32mm) reduced dead leg (zero dead leg) valves shall be Type-343 style from the PolyPure® system. Valves shall be made of PolyPure® resin. Valve bodies are to be unibody, molded design with a full 150psi rating at 70º F. All metal nuts and bolts must be capped or covered to reduce metal exposure. Top works must include integral lockout device on the handle and position indicator.

D. Ball Valves:
1/2" - 2" (20mm - 63mm) PolyPure® ball valves shall be made with natural polypropylene resin. O-rings are to be FKM standard. Ball valves shall be offered in spigot, socket or female NPT.

E. Flanged Ball Valves:
1/2" - 2" (20mm - 63mm) valves shall consist of PolyPure® backing rings and stub ends welded to spigot ball valves (above).

F. Flow Meters:
Available in polysulphone (PSU) and polyamide (PA) M123 and M335 flow meters shall be supplied with spigot ends suitable for high purity welding. Flow ranges available up to 135 gallons-per-minute with custom ranges available.

G. Check Valves:
1/2" - 4" (20mm - 110mm) valves shall be made from pigmented PP with EPDM or FKM end connections. Stainless steel springs or PTFE-coated springs shall be available for on-site installation.

H. V182 Pressure Reducing Valves:
1/2" - 2" (20mm - 63mm) pressure reducing valves shall be made from PPn from a compatible resin. A PTFE or EPDM diaphragm will isolate all internal metal components. Pressure regulating valve is pressure rated to 150psi. Available with spigot ends. V82 regulating valves shall have an integral gauge guard and gauge for inline adjustments of the valve.

I. V186 Pressure Retaining Valves:
1/2" - 2" (20mm - 63mm) back pressure valves shall be made from compatible PPn resin, available with PTFE or EPDM diaphragm and spigot ends. V86 back pressure valves are adjustable under pressure and pressure rated to 150psi.

J. Faucets:
All faucets to be fabricated and provide constant flow, zero static operation.

K. Pressure Rating – Valves:
Pressure rating of valves shall be per manufacturer's recommendations based on materials, valve type and size.

2.6 Pipe/Valve Hangers and Supports

A. Support Spacing
Design pipe supports and anchors in accordance with Asahi/America's recommended support spacing for SDR 11 polypropylene pipe. See Section 4.3 for recommended support spacing for PolyPure® piping systems.

B. Supports and Hangers
Use Asahi/America's recommended support types per document "Asahi/America Engineering Design Guide". Metallic supports and clamps shall not come directly into contact with plastic piping systems.

2.7 Joining Equipment
PolyPure® installation shall be performed by factory certified and trained installers in accordance with manufacturer's ISO procedures, ASTM D 2657 and DVS 2207-15. Date of certification or re-certification shall not exceed two years from the beginning of project. Acceptable joining techniques are detailed below. Methods listed first are more likely to introduce contaminates, while those listed last minimize process contamination.

A. Socket Fusion
Proper equipment selection should be based on pipe size and site conditions. Socket fusion tools shall be available in two styles: one portable style capable of welding 1/2" - 2" (20mm - 63mm) and a bench style capable of welding 3/4" - 4" (25mm - 110mm). Heating elements are to be electronically controlled for accurate welding temperatures. Tools should also incorporate male and female heater inserts with PTFE coating.

B. Butt Fusion
Proper equipment selection should be based on pipe size and site conditions. Butt fusion equipment should be designed and tested to provide reliable welds. All equipment should utilize electronically controlled heating elements for accurate welding temperatures. Tools should also incorporate planing units to face ends prior to heating. Butt fusion equipment supplied shall weld joints based on force or pressure and not mechanical stops.

C. SP Series Infrared Welding Equipment:
Tool shall be made available in 1/2" - 4" (20 - 110mm) or 1/2" - 2" (20 - 63mm). Tool shall possess electronic planer and infra-heating element. Welding equipment should measure the welding pressures to join material and automatically adjust for accuracy. Mechanical stops are not acceptable for high purity welding. To avoid improper welded joints, tool shall automatically operate clamps and control joining force. Tool shall possess the following features:

1. Computer control and automatic fusion.
2. Touch screen for tool operation and parameter selection.
3. Restricted access through use of bar code user cards.
4. Automatic label printouts after each weld, selectable from 0 to 3 identical labels.
5. Ability to display and graph weld processes as it is proceeding.
6. Memory storage of welds
7. Magnetic clamps to reduce change out time from one size to another.
8. Vertical and horizontal adjustment for pipe alignment.

D. SP 110-B Beadless Welding Equipment:
Tool shall be made available in 1/2" - 4" (20 - 110mm). Tool shall possess electric planer and individual sized clam-shell heaters. Welding equipment should measure the welding pressures to join material and automatically adjust for accuracy. Mechanical stops are not acceptable for high purity welding. To avoid improper welded joints, tool shall automatically operate clamps and control joining force. Tool shall possess the following features:

1. Computer control and automatic fusion.

2. Touch screen for tool operation and parameter selection.
3. Restricted access through use of bar code user cards.
4. Automatic label printouts after each weld, selectable from 0 to 3 identical labels.
5. Ability to display and graph weld processes as it is proceeding.
6. Memory storage of welds
7. Magnetic clamps to reduce change out time from one size to another.
8. Vertical and horizontal adjustment for pipe alignment.

PART 3: EXECUTION

3.1 Installation

A. Facilities

Subassembly and fabrication work should be conducted in a separate, temporary clean room located within the building. Cleanroom should be equipped with the following to provide a clean installation:

1. Provide laminar flow HEPA filters in room ceiling to reach a level of class 10,000.
2. The quantity of filters should be determined by providing a minimum of 60 room air changes per hour.
3. Nitrogen should be available for purging the pipelines with a positive pressure if the assemblies expand beyond the bounds of the room.

B. Tools

All fusion tools utilized are to be dedicated for clean build only, and should be kept separate. Special attention should be given to the fusion tools to prevent the possibility of contaminating a weld. The contractor shall lease or purchase all necessary welding equipment from the manufacturer. At the end of the installation, any necessary equipment needed on-site should be sold to the owner. Contractor is responsible for proper maintenance and care of the fusion tools during construction.

C. Certification

Installers shall be pre-qualified as per section 2.7. Manufacturer shall provide on-site training in the assembly and installation of the PolyPure® piping system as needed.

3.2 Testing

A. Inspection

Prior to pressure testing, the system shall be examined for the following items:

1. Pipe shall be completed per drawing layout with all pipe and valve supports in place.
2. Pipe, valves, and equipment shall be supported as specified, without any concentrated loads on the system.
3. Pipe shall be in good conditions, void of any cracks, gouges or deformation.
4. Pipe flanges shall be properly aligned. All flange bolts should be checked for correct torques.
5. All diaphragm valve bonnet bolts shall be checked for correct torques.
6. All joints should be reviewed for appropriate welding technique:

Butt: To have two beads, 360° around the joint.

Socket: To have two beads on the end of the fitting and on the outside of the pipe in contact.

Non-Contact: Identity labels shall identify weld certification by the print “welding parameters OK”. Joints should have two beads 360° around the joint.

Beadless: Identity labels shall identify weld certification by the print “WELD.P OK”. There should be clear joining between the two spigots. Any voids, burns or gaps shall be re welded.

Manufacturer to supply inspection procedures beyond the above recommendations. If any deficiencies appear, the quality control manager shall provide directions for repair.

B. Pressure Test

1. Test fluid should be deionized water, with quality level set by quality control engineer. In all cases, test must be done hydrostatically. Air test is not allowed

2. Filling the system: Open all valves and vents to purge the system of air. Slowly inject the water into the system, making sure that

air does not become trapped in the system.

3. Begin pressurizing the system in increments of 10psi. Bring the system up to 100psi and hold. Allow system to hold pressure for a minimum of two hours and up to a recommended 12 hours. Check pressure gauge after one hour. Due to natural creep effects on plastic piping the pressure will have decreased. If drop is less than 10% pump the pressure back up. At this time the system may be fully pressurized to desired test pressure.

4. If after one hour the pressure has decreased more than 10%, test is considered a failure. Note the 10% value may need to be greater for larger systems, or systems experiencing significant thermal changes.

5. Test is to be witnessed by quality control engineer and certified by the contractor.

3.3 Cleaning of PolyPure® Piping System

System shall be cleaned at completion of project according to requirements set by owner.

Part 4: Appendices

Disclaimer: This information is provided for convenience. For additional information, please consult Asahi/America's engineering design guide or contact our engineering staff at 781-321-5409.

4.1 Material Properties

Table 1 - Material Properties PolyPure® PP

	Properties	Condition	Standard	Units	PP
Physical	Density	23° C (73.4° F)	ISO 1183	g/cm^3	0.91
	Melt Flow Rate	230°C/5 kg 190°C/5 kg	ISO 1133	g/10min	1.25 0.5
Mechanical Properties	Tensile stress at yield	50 mm/min	ISO 527	MPa	25
	Elongation at yield	50 mm/min	ISO 527	%	12
	Elongation at break	50 mm/min	ISO 527	%	>300
	Impact strength unnotched	23° C (73.4° F)	ISO 179/1eU	kJ/m^2	no break
		0° C (32° F)			no break
		-20° C (-4° F)			40
	Impact strength notched	23° C (73.4° F)	ISO 179/1eA	kJ/m^2	20
		0° C (32° F)			3.5
		-20° C (-4° F)			2
	Ball indentation hardness according to Rockwell		ISO 2039-1	MPa	45
	Flexural strength (3.5% flexural stress)		ISO 178	MPa	20
	Modulus of elasticity		ISO 527	MPa	900
Thermal Properties	Vicat-Softening point	VST/B/50	ISO 306	°C °F	65 149
	Heat deflection temperature	HDT/B	ISO 75	°C °F	70 158
	Linear thermal expansion coefficient		DIN 53752	K^{-1} x 10^{-4}	1.5
	Thermal conductivity	20° C (68° F)	DIN 52612	W/(m x K)	0.24
	Flammability		UL94 DIN 4102		94-HB B2
Electrical Properties	Specific volume resistance		VDE 0303	Ω x cm	>10^{16}
	Specific surface resistance		VDE 0303	Ω	>10^{13}
	Dielectric constant	1 MHz	DIN 53483		2.3
	Dielectric strength		VDE 0303	kV/mm	70
General	Physiologically nontoxic		EEC 90/128		Yes
	FDA				Yes
	USP Class VI				Yes
	UV Resistance				No
	Color	PP-Pure®			Grey RAL 7032
		PolyPure®			Natural

4.2 Pressure Rating

Permissible operating pressure for PolyPure® piping systems based on years of operation and temperature. These tables are for water, a safety correction factor shall be applied for chemical service. Consult Asahi/America engineering staff for chemical recommendation. Additionally, a system reduction factor of 0.8 shall be used for influences such as welding, joints, flange, and bending loads for aboveground installations and 1.0 should be used for below ground installation.

Table 2 - Permissible Operating Pressures for PolyPure® PP (psi)

Temperature		1 Year	5 Years	10 Years	25 Years	50 Years	100 Years
° C	° F	PP 150 SDR11	PP 150 SDR11	PP 150 SDR11	PP 150 SDR11	PP 150 SDR11	PP 150 SDR11
10	50	306	289	281	271	265	258
20	68	261	245	239	231	225	219
30	86	222	209	203	196	190	-
40	104	189	176	171	164	160	-
50	122	160	148	144	138	135	-
60	140	135	125	120	116	112	-
70	158	113	104	102	87	74	-
80	176	94	84	71	57	-	-
90	194	78	55	46	-	-	-
95	203	67	45	-	-	-	-

4.3 Support Spacing

Table 3 - PolyPure® PP Support Spacing (feet)

Pipe Size		68° F/ 20° C	86° F/ 30° C	104° F/ 40° C	122° F/ 50° C	140° F/ 60° C	158° F/ 70° C	176° F/ 80° C
mm	inch							
20	1/2	1.7	1.7	1.6	1.5	1.5	1.4	1.4
25	3/4	2.0	1.9	1.8	1.8	1.7	1.7	1.6
32	1	2.3	2.3	2.2	2.2	2.1	2.0	1.8
40	1-1/4	2.7	2.6	2.6	2.5	2.3	2.3	2.2
50	1-1/2	3.1	3.0	3.0	2.8	2.7	2.6	2.5
63	2	3.6	3.5	3.4	3.3	3.2	3.1	3.0
75	2-1/2	3.8	3.7	3.6	3.4	3.3	3.2	3.1
90	3	4.1	3.9	3.8	3.7	3.6	3.4	3.3
110	4	4.6	4.4	4.3	4.2	3.9	3.7	3.4

For gases and fluids with different densities, the conversion factors shown below should be used.

$$L = L_A * f_1$$

f_1 – conversion factor (See Table 4)
L – new support distance [mm]
L_A – permissible support distance (See table 3)

Table 4 - External Support Spacing Correction Factors based on Operating Media Density for PP

Material	SDR	Conversion factor f_1			
		Media density [g/cm^3]			
		Gases	Water	Other Media	
		<0.01	1.00	1.25	1.50
PolyPure®	11	1.30	1.0	0.96	0.92