PP-Pure® High Purity Polypropylene (PP) Piping Specification

PART 1: GENERAL

1.1 Summary

Furnish a complete high purity pigmented 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	DIN 8077
ASTM D 2122	ASTM D 2657	
ASTM D 2837	ASTM D 4101	
DVS 2207-11	ISO 15494	

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

Polypropylene - PPR grey: Random copolymer polypropylene with pigmentation.
PP-Pure®: Asahi/America's pigmented polypropylene high purity piping system.

1.4 System Description and Pressure Rating

System shall be a PP-Pure® system made of uniform pipe and fitting resin. System pressure ratings shall be based on continuous use of 50 years. PP-Pure® pipe, fittings, and valves shall be based on a Standard Dimensional Ratio (SDR) of 11, 1/2" - 12" (20 - 315mm). Pressure rating for pipe and fittings, unless otherwise noted, shall be rated in accordance with ASTM D2837 and DIN 8077 for hydrostatic design basis. Components are rated to 150psi for all SDR 11 material and 150psi for all applied valves at 68° F.

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 PP-Pure® 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 PP-Pure®: Firms must have a minimum of five years 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 PP-Pure® pipe to arrive on-site double bagged for protection inside polyethylene static-free, non-tear bags for cleanroom applications. See section 2.3.B for quantities per bag.

B. Deliver all PP-Pure® fittings to arrive on-site double bagged in boxes, when possible, 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 PP-Pure® piping per manufacturers' recommendations.

1.9 Warranty

Warranty period is one year after date of substantial completion. 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 PP-Pure® 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 resin produced by one supplier. The resin shall meet or exceed the requirements outlined for a random copolymer resin according to DIN 16774 and ASTM D 4101-96a. MFI shall be 1.25 g/10min per 230/5. Resin must be approved for contact with foodstuff as per the FDA CFR, Title 21 (2001) 177.1520, and shall be certified as USP Class VI.

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. Dimensions and tolerances shall exceed ISO 15494 requirement. Pipe must be in-line stress relieved as it is extruded. Post extrusion annealing is not allowed. Surface finish is as follows:

Size (inch)	Size (mm)	Result
1/2 - 1-1/4	20 - 40	Ra = 39.3μ" (1.0μm)
1-1/2 - 12	50 - 315	Ra = 31.μ" (0.8μm)

B. Packaging

All pipes shall have capped ends. Pipe shall be sleeved in a PE bag and heat-sealed on both sides. Pipe is then packed into a second PE bag and heat sealed on both sides. The following chart designates quantities of pipe per second PE bag:

Size (inch)	Size (mm)	Quantity Per Tube
1/2	20	Five
3/4	25	Four
1	32	Three
1-1/4	40	One
1-1/2	50	One
2	63	One
2-1/2	75	One
3	90	One

4	110	One
6	160	One
8	200	One
9	225	One
10	250	One
12	315	One

C. Pressure Rating
All pipe shall meet the requirements of Section 1.4.

2.4 Fittings
A. Production
All standard fittings 1/2" - 12" (20 - 315mm) shall be injected molded. All fittings are to be molded with equipment in a clean environment. After secondary machining all fittings shall be cleaned for a minimum of one hour in an automated hot DI rinse. The DI rinse water shall be 70° C with resistivity above 18MΩ and TOC ≤10PPB. Dimensions and tolerances shall exceed ISO 15494 requirement and shall be molded with a central injection gate. Surface finish smoothness is as follows:

Size (inch)	Size (mm)	Result
1/2 - 5	20 - 140	Ra = 11.8μ" (0.3μm)
6 - 12	160 - 315	Ra = 19.7μ" (0.5μm)

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 double bagged, purged with clean dry class 100 air or nitrogen in PE/Nylon composite bags. Bags are to be silicone free and anti-static.

C. Specialty Fittings
Specialty fittings are to include restraint fittings, butt fusion instrumentation fittings, sanitary connections, etc. Specialty fittings shall be machined or molded of a compatible resin to the PP-Pure® 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 Valve:
1/2" - 2" (20mm - 63mm) shall be the Type-342 of the PP-Pure® 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 70° 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-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 PP- Pure® system. Valves shall be made of PP-Pure® resin. Valve bodies are to be unibody, molded design with a full 150psi rating at 68° F (20° C). 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.

C. Flanged Diaphragm Valves:
1/2" - 10" (20mm - 250mm) shall be Type-14, Type-15 or Type-G pigmented polypropylene unibody with flanges molded as part of the body. Diaphragm shall be a two-piece style with PTFE and separate EPDM backing. Top works shall include a position indicator and travel stop. Supplied cleaned and double bagged.

D. Butterfly Valves:
1-1/2" - 12" (50mm - 315mm) shall be Type-57P manual gear operated valves with a polypropylene disc and ANSI 150# bolt pattern. Liners shall be available in EPDM or FKM materials. Supplied cleaned and double bagged.

E. Ball Valve:

PP-Pure® ball valves shall be available 1/2" - 2" (20mm - 63mm). O-rings are to be FKM or EPDM. Ball valves shall be offered in spigot ends. Supplied cleaned and double bagged.

F. Ball Check Valves:

1/2" - 4" (20mm - 110mm) shall be polypropylene ball type check with FKM or EPDM seat and seals. Ball check valves shall be offered in spigot ends. Supplied cleaned and double bagged.

G. V182 Pressure Regulating Valve with Gauge Guard:

1/2" - 4" (20mm - 110mm) shall be polypropylene V182 with EPDM/EPDM or PTFE/FKM diaphragms/seals. 1/2" - 1-1/2" (20mm - 50mm) shall be pressure rated to 150psi at 68° F. 2" - 3" (63mm - 90mm) shall be pressure rated to 90psi at 68° F. 4" (110mm) shall be pressure rated to 60psi at 68° F.

H. V186 Back Pressure Regulating Valve:

1/2" - 2-1/2" shall be polypropylene V182 with EPDM/EPDM or PTFE/FKM diaphragms/seals. 1/2" - 1-1/2" shall be pressure rated to 150psi at 68° F. 2" shall be pressure rated to 90psi at 68° F.

I. Flow Meters:

Available in polysulphone (PSU) and polyamide (PA) Frank 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.

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 PP-Pure® 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

PP-Pure® installations shall be performed by factory certified and trained installers in accordance with manufacturer's ISO procedures, ASTM D 2657 and DVS 2207-11. Date of certification or re-certification shall not exceed two years from the beginning of project. Available joining techniques are as follows:

A. 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.

B. Non-Contact Butt Fusion

Proper equipment selection should be based on installation requirements and line sizes. Tool shall be fully automatic (SP series).

SP-S Series:

Tool shall be made available in the following models

SP 110-S	1/2" - 4"	(20mm - 110mm)
SP 250-S	4" - 10"	(110mm -250mm)
SP 315-S	4" - 12"	(110mm - 315mm)

Tools shall possess electronic planer and infrared heating element. Tools will utilize and measure the welding pressures to join material and not mechanical stops. To avoid improper welded joints, tool shall automatically operate clamps and control joining force. Tools 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 barcode or RFID cards.
4. Automatic label printouts after each weld.

5. Ability to display and graph weld processes as weld 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.

C. Beadless Fusion

SP-B Series:
SP 110-B: 1/2" - 4" (20mm - 110mm)

Tools shall possess electronic planer and heating element. To avoid improper welded joints, tool shall automatically operate clamps, heater movement, heater closing and control joining force. Tools shall possess identical features as:

1. Computer control and automatic fusion.
2. Touch screen for tool operation and parameter selection.
3. Restricted access through use of RFID cards.
4. Automatic label printouts after each weld.
5. Ability to display and graph weld processes as weld 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 Piping Assembly

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 PP-Pure® piping system as needed.

D. Installation of Flanged Connections

For each flange connection, only Asahi/America seal clean expanded PTFE (e-PTFE) gaskets should be used. Ensure that each gasket is centered according to manufacturer's recommendation. Apply the recommended backing rings and torques. Ensure correct support of piping in the area of flange connection.

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:

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

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

Manufacturer to supply inspection procedures beyond 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 PP-Pure® 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 of PP-Pure® PP

	Properties	Condition	Standard	Units	PP-R
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 PP-Pure® 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 PP-Pure® PP (psi)

Temperature		1 Year	5 Years	10 Years	25 Years	50 Years	100 Years
° C	° F	PP 150 SDR 11	PP 150 SDR 11	PP 150 SDR 11	PP 150 SDR 11	PP 150 SDR 11	PP 150 SDR 11
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 - PP-Pure® 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
125	4-1/2	4.9	4.8	4.7	4.4	4.2	3.9	3.7
140	5	5.2	5.0	4.9	4.7	4.4	4.2	3.9
160	6	5.5	5.4	5.2	4.9	4.7	4.4	4.2
180	7	5.8	5.7	5.4	5.2	4.9	4.7	4.4
200	8	6.2	5.9	5.7	5.4	5.2	4.9	4.7
225	9	6.5	6.3	6.0	5.8	5.5	5.3	4.9
250	10	6.9	6.6	6.4	6.2	5.9	5.7	5.3
280	11	7.3	7.0	6.8	6.5	6.3	6.0	5.7
315	12	10.3	10.0	9.7	9.4	8.9	8.5	8.0

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/cm³]			
		Gases	Water	Other Media	
		<0.01	1.00	1.25	1.50
PP-Pure®	11	1.30	1.0	0.96	0.92