

## VII. SPECIFICATION

### A. SPECIFICATION

#### Unpigmented Polypropylene Piping— (PolyPure) General Grade

##### PART 1 GENERAL

###### 1.1 Summary

Furnish a complete high purity unpigmented PP piping system to include pipe, fittings, anchors, 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 2837-85	ASTM D 4101
DVS 2207-11	

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

PolyPure  
Unpigmented Polypropylene

###### 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, ½" through 4" (20-110mm). Pressure rating for pipe and fittings, unless otherwise noted, shall be 150 psi (10 bar) for all SDR11 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: Deionized Water

###### 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 Unpigmented PP 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 experience in HP 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 packaging for shipment.

**B.** Deliver all PolyPure fittings to arrive on-site single bagged in boxes layered with bubble packing to prevent damage.

**C.** Store products on elevated platforms in a dry location with protection from the environment.

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

###### 1.9 Warranty

Warranty period is one year after date of substantial completion.

###### 1.10 Extra Material

Turn over to owner at end of construction necessary welding equipment as suggested by manufacturer for repair, additions and maintenance of PolyPure piping system.

All pipes shall meet the requirements of Section 1.4.

## 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 Chemline Plastics Ltd., Thornhill, Ontario, (905)889-7890. 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 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.

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

### 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:

Dimension	Ra	Rt
OD 20 – 40 mm	≤ 1.5µm	≤ 6µm
OD 50 – 110 mm	≤ 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 (qty dependent). The following chart designates quantities of pipe per PE bag:

Size inches	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
3"	90	One
4"	110	One

#### C. Pressure Rating

### 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 secondary machining all fittings shall be cleaned for a minimum of 1 hour in an automated Hot DI rinse. The DI Rinse water shall be 70°C with resistivity above 18MΩ and TOC ≥10PPB.

#### B. Packaging

All fittings are to be packaged in a class 100 cleanroom immediately after the cleaning process. 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, butt fusion instrumentation fittings, instrumentation donuts, etc. Specialty fittings shall be machined or molded of the same PP resin as the pipe and fittings.

#### 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

#### Type 342 Spigot Diaphragm Valves:

1/2"-2" (20mm –63mm) shall be the type 342 of the PURAD system. The Valves shall have a PolyPure body and a diaphragm of PTFE with EPDM backing or EPDM. Valves will be spigot single body design. Top Works must include integral lockout device on the handle and position indicator.

#### 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 integral lockout device on the handle and position indicator.

#### Flanged Diaphragm Valves:

3"-4" (90mm –110mm) shall be type 14 single PP body design with flanges molded as part of the body. Diaphragm shall be PTFE with EPDM backing or EPDM. Top Works must include integral lockout device on the handle and position indicator.

**Type 343 Reduced Dead Leg Valve:**

1/2" x 1/2" through 2" x 2" (20mm x 20mm through 63mm x 63mm) 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 150 psi 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. (Consult Factory for Availability of Molded T-343)

**Flow Meters:**

All Vortex Meters shall be made of PolyPure and free of all seal materials. Supplier shall be capable of supplying all sizes 1/2" - 3" (20mm - 90mm).

All Vortex Meters shall be wet bench calibrated and supplied with Calibration Records from the manufacturer.

**Check Valves:**

All sizes class 150, ball type Proline PP with FPM or EPDM seat and seals. 150 PSI at 73.4°F for sizes 1/2" through 4".

**Pressure Rating--Valves**

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

**2.6 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. 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. 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 Teflon coating.

**C. Non-Contact Butt-Fusion**

Proper equipment selection should be based on installation requirements and line sizes. Tool shall be either semi automatic (UF2000 style) or fully automatic (SP series).

**UF2000 Style:**

Tool shall be made available in 1/2"- 2" (20mm - 63mm) and 2 1/2" - 10" (75mm - 250mm) size ranges. Tools shall possess electronic planer and non-contact heating element. To avoid improper welded joints, tools will utilize and measure the welding pressures to join material and not mechanical stops. All IR fusion equipment shall possess a minimum of the following capabilities:

1. Computer Control of the welding process.
2. Ability to store welding data internally on computer memory - up to 1000 welds.
3. Full alignment capabilities (vertical and horizontal)
4. All metal components coated to prevent any particle generation from metals.
5. Ability to download all data to a personal computer.

IR equipment shall also have the capability of following options incorporated into the tool for special demands:

1. Protective hood over welding area up to 2" (63mm)
2. Nitrogen Purge of the welding area.
3. Automatic Nitrogen purge of the pipeline.
4. Security Card Entry
5. Printer Labels for each weld automatically.

**SP Series:**

Tool shall be made available in 1/2" - 4" (20mm - 110mm) and 2 1/2" - 10" (75mm - 250mm) size ranges. Tools shall possess electronic planar and infra 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 PCMCIA cards.
4. Automatic label printouts after each weld.
5. Ability to display and graph weld processes 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 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. Ideal set up is to place welding equipment directly under a filter. In addition 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 2.6. 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.

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 10 PSI. Bring the system up to 100 PSI 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 consider 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.

## Appendix A: Static Leach Out Data

In the international market different test methods for leach out behavior are being used. The different test methods provide different test results, which are not comparable. For better identification and qualification all Agru high purity systems have been tested according to valid international standards.

Static leach tests provide valuable information on a material's purity. Static tests provide a worst case scenario since the test water is stagnant during the entire test. These tests are useful in comparing materials, but do not simulate an actual installation. When comparing this data to other materials, ensure the test methods and result units are identical. Results will vary based on the test method.

#### Measurement Types:

Ion chromatography (IC) According to SEMI draft doc. 2840 (rev 05/14/98)

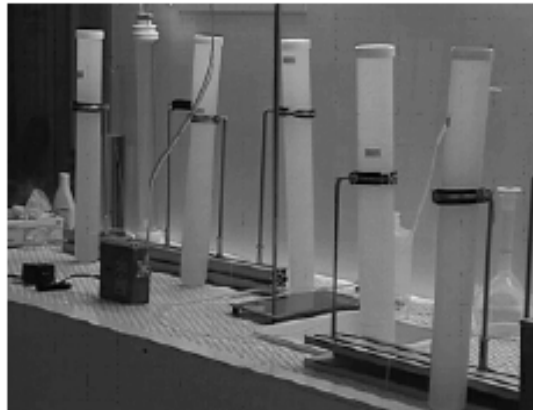
Total organic carbon Analyses (TOC) According to SEMI2840B STD (7d;850C)

#### Test Procedure:

- Sample preparation in class 10.000 environment
- Test performance in class 1 environment
- Precleaning of the sample with UPW according to SEMASPEC.
- Soak time 7 days
- Anion analyses by IC with suppressed conductivity and preconcentration unit (Release values are notified)
- Transition metals + Cation analyses by IC with suppressed conductivity and postcolumn derivation with PAR. (Release values are notified)
- TOC analyses by TAC-502P system



Analytical Equipment



Test Samples

**Static Leach Out Test Results:**  
**Temperature 20°C**

	clean PVC		PPr		ECTFE		PVDF-HP		SEMI Spec.
	small	big	small	big	small	big	small	big	
	Ø 20 – 90	Ø 110 – 250	Ø 20 – 90	Ø 110 – 250	Ø 20 – 90	Ø 110 – 250	Ø 20 – 90	Ø 110 – 250	
Sulphate	2621.0	10545.0	< 7.5	< 27.0	49	11	112	98	300
Chloride	5687	21659	3.3	0.9	915.0	1292.0	751.0	709.0	3000
Nitrite	< 4.7	141.0	< 1.4	< 4.9	< 19.0	18.0	< 8.2	< 11.0	100
Bromide	< 5.0	< 8.2	< 4.5	< 16.0	< 15.0	10.0	< 8.2	< 12.0	100
Nitrate	< 12.0	66.0	< 4.5	< 16.0	69.0	35.0	< 8.2	< 11.0	100
Phosphate	12000.0	4180.0	< 3.7	< 13.0	220.0	95.0	239.0	174.0	300
Fluoride	< 5.0	< 8.2	< 1.5	< 5.3	5296.0	10707.0	53485.0	111359.0	60000
Oxalate	302.0	532.0	< 7.5	< 27.0	8.6	255.0	288.0	221.0	no spec.
Lithium	< 6.2	< 4.8	4.0	6.6	< 1.3	< 2.2	9.2	< 15.0	2
Sodium	78.0	36.0	13.0	30.0	< 1.1	31.0	< 3.1	37.0	15
Ammonium	82.0	223.0	1813	3213	119.0	102.0	< 4.1	< 14.0	1000
Potassium	< 41.0	50.0	56.8	91.0	< 1.5	8.4	7.6	< 21.0	15
Magnesium	50.0	116.0	31.0	61.0	4.3	< 2.2	< 4.1	< 15.0	5
Calcium	1661.0	1452.0	22.0	64.0	11.0	19.0	12.0	< 14.0	30
Iron	7.90	27.00	0.00	1.00	1.80	81.00	9.40	17.00	5
Copper	< 0.70	< 4.10	1.50	< 0.40	< 0.70	41.00	< 0.60	6.10	15
Nickel	12.00	43.00	0.10	0.50	0.20	50.00	< 0.30	< 0.84	1
Zinc	42.00	139.00	5.80	8.40	13.00	1174	< 1.70	< 0.85	10
Cobalt	< 0.60	< 4.10	< 0.10	< 0.30	< 0.20	< 0.20	< 0.20	< 0.56	no spec.
Manganese	< 2.50	< 8.20	< 0.30	< 1.10	< 0.20	< 0.20	< 0.80	< 1.64	5
TOC	53.096	198.815	34.762	117.342	55.136	55.822	27.872	73.336	60