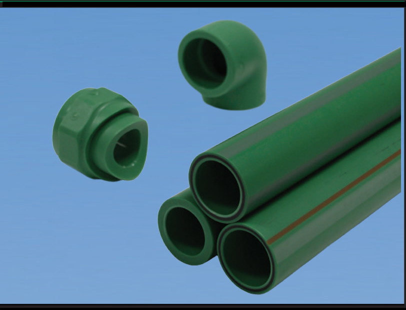
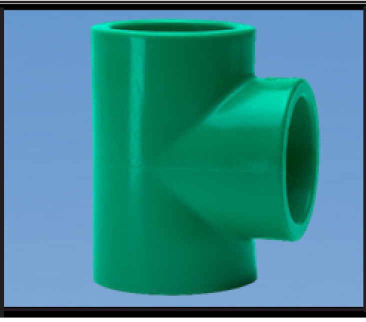
Asahitec™

PP-RCT Plumbing and HVAC Piping Systems

Engineering Design Guide





Pipe • Fittings • Valves

Another Corrosion Problem Solved.™

Climatec™ Watertec™

ASAHI/AMERICA®
Your Experts in Plastics™

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ASAHITEC™ ENGINEERING DESIGN GUIDE

ASAHI/AMERICA, INC.
Lawrence, Massachusetts

Disclaimer

Asahi/America, Inc. provides this guide to assist engineers in the design of systems, installers in the installation and owners in the operation. This guide is designed to provide the best possible recommendations known at the time of printing. Each and every type of piping system is different and no one recommendation can cover all conditions. This guide is made available to assist in the design and installation, but in no way should be construed as a written recommendation on any system. Each system should be individually designed and installed based on the responsibility and decisions of the purchaser. This guide is not a substitute for contacting Asahi/America for specific recommendations on a system. In addition, Asahi/America is not responsible for items not appearing in the guide or recommendations that may have changed after the printing of this guide. It is recommended in each case to consult Asahi/America for specific recommendations on each system.

ABOUT THE COMPANY

Asahi/America pioneered the market for thermoplastic valves in the United States and Latin America during a time when there was no viable alternative to metal for piping systems. Asahi/America began by promoting valves from a company known as Asahi Yukizai Corporation, and piping through AGRU GmbH in Austria and Bänninger Kunststoff-Produkte GmbH in Germany. Through distributor and end user education and acceptance, the use of thermoplastics has grown. Asahi/America now manufactures and distributes a full selection of corrosion resistant thermoplastic fluid flow solutions including valves, actuators, single, double, and triple wall piping systems, wet process solutions and specialty components through a network of over 600 distributors throughout the US and Latin America.

Asahi/America is a diversified ISO9001:2018 certified manufacturer and supplier of corrosion resistant fluid flow products. Headquartered in Lawrence, Massachusetts, where we operate a 200,000-square-foot manufacturing and warehouse facility, Asahi/America supports all of our products with a comprehensive selection of in-depth technical documents and product catalogs. To access any of Asahi/America's technical documentation, testing information, or product catalogs, visit the company's web site at www.asahi-america.com or contact Customer Service at 1-800-343-3618.

What makes Asahi/America special is our ability to provide solutions for corrosive or high purity fluid handling systems individualized to meet virtually any customer's need. The Asahi/America technical staff is able to provide superior knowledge of products, applications and installations. Asahi/America is poised to support your next project with the assistance of our large distribution network.

Another Corrosion Problem Solved.™

INTRODUCTION

Contents

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Plastics in Fluid Handling

Plastic piping systems are offered in a wide assortment of materials and sizes. Each material has unique and specific mechanical properties. These diverse properties allow plastic to become the preferred system for many applications that range from the transport of aggressive chemicals to the distribution of ultra pure water. Because each material has its own unique properties, understanding them becomes vital to the successful design, installation and operation of a system. Asahi/America is proud to present this design guide to assist design engineers and system installers with the proper engineering, layout and installation of plastic systems. Asahi/America is a pioneer in the manufacture and distribution of plastic systems in the United States. Since the 1970s, we have dedicated ourselves to assisting our customers in achieving the maximum benefits plastic systems offer. Designing a system made of thermoplastic materials differs considerably from that of metallic materials. No one understands this as well as Asahi/America's sales and technical staff. Our trained staff is available to assist with all aspects of plastic piping systems. The information contained herein is designed to minimize the efforts of engineers, designers, contractors, and research professionals in sizing and selecting all aspects of fluid systems.

The Plastic Benefit

For pipe, fittings and valves, thermoplastic materials offer superior corrosion resistance, light weight, simple installation, and the potential for cost saving.

Corrosion Resistance

Plastics are non-conductive and are therefore immune to galvanic or electrolytic erosion. Because plastics are corrosion resistant, pipe can be buried in acidic, alkaline, wet or dry soils without requiring a protective coating. In addition, cathodic protection devices are not required.

Chemical Compatibility

Impervious to many chemicals, thermoplastics are gaining an ever increasing acceptance and preference in a large variety of applications. Additionally, the variety of materials available allow a wide range of chemical solutions to be handled successfully with plastic piping.

Thermal Conductance

All plastic piping materials have low thermal conductance properties. This feature results in more uniform temperatures when transporting fluids in plastic than in metal piping. Low thermal conductivity of the plastic piping wall may eliminate or greatly reduce the need for pipe insulation to control sweating.

Low Friction Loss

Because the interior surface of plastic piping is generally very smooth, less power may be required to transmit fluids compared to other piping systems. Furthermore, the excellent corrosion resistance of plastics means that the low friction loss characteristic will not change over time.

Long-term Performance

Due to the relative chemical inertness and the minimal effects of internal and external corrosion, there is very little change in plastic piping's physical characteristics over time. Examinations of pipe samples taken from some systems have shown no measurable degradation after decades of use. In most cases, Asahi/America pipe systems are designed for 50 years of service.

Light Weight

Many plastic piping systems are about one-sixth the weight of steel piping. This lends to lower costs in many ways: lower freight charges, less manpower, simpler hoisting and rigging equipment, etc. This characteristic has allowed unique, cost-effective installation procedures in several applications.

Variety of Joining Methods

Asahitec™ has several different joining methods. The following list incorporates some of the most common:

- Socket fusion
- Butt fusion
- Electrofusion
- Flanges

The various joining methods allow plastic piping to be easily adapted to most field conditions.

Nontoxic

Plastic piping systems have been approved for potable water applications, and certain systems are recognized by the FDA as appropriate material to be in contact with food stuff. As evidence, all plastic potable water piping materials and products are tested and listed for compliance to NSF/ANSI Standard 61. All ASTM and AWWA standards for plastic pressure piping that could be used for potable water contain a provision whereby the regulatory authority or user can require product

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that has been tested and found to be in conformance with NSF/ANSI Standard 61–Drinking Water System Components–Health Effects. When plastic pipe or fittings are NSF/ANSI Standard 14 listed, and have the NSF-pw (potable water) mark, they also meet the NSF/ANSI Standard 61 requirements. The NSF-pw mark certifies to installers, users, and regulators that the product meets the requirements of NSF/ANSI Standard 14 for performance and the NSF/ANSI Standard 61 for health effects.

Biological Resistance

To date, there are no documented reports of any fungi, bacteria, or termite attacks on any plastic piping system. In fact, because of its inertness, plastic piping is the preferred material in deionized and other high purity water applications.

Abrasion Resistance

Certain plastic piping materials provide excellent service in handling slurries such as fly ash, bottom ash, and other abrasive solutions. The material toughness and the smooth inner bore of plastic piping make it ideal for applications where abrasion resistance is needed.

Low Maintenance

A properly designed and installed plastic piping system requires very little maintenance because there is no rust, pitting, or scaling to contend with. The interior and exterior piping surfaces are not subject to galvanic corrosion or electrolysis. In buried applications, the plastic piping is not generally affected by chemically aggressive soil.

PP-RCT

PP-RCT is an advancement in polypropylene polymers and has a wide range of benefits for commercial plumbing systems. It has a more complex crystalline structure that provides greater pressure capabilities at higher temperatures than conventional PP materials. When utilized in a piping system, these enhanced mechanical properties make it suitable for higher temperature applications such as boiler and hot water systems. They also create lighter and thinner piping while maintaining the necessary system pressure ratings. PP-RCT can also be extruded in a multilayer pipe with a Fibercore™ middle layer. This core reduces the impact of thermal expansion on the piping system.

Features and Benefits

- Good resistance to chemicals
- Weather-resistant
- Excellent processing capability

Asahitec™

- Socket fusion 20-125mm (1/2”- 5”)
- Molded butt fusion from 160-500mm (6” – 20”)
- NSF/ANSI 61/14 certified for potable water applications
- ASTM F2389

Molded fittings up to 20”

- Provides full pressure rating over fabricated fittings
- Cost effective vs fabricated fittings
- Save space with a smaller footprint

Wide range of valves

- Ball, butterfly, diaphragm and more
- Complemented with reliable actuation packages

Applications

- Potable Water
- Commercial Hot Water
- HVAC – Hot Water and Chilled Water
- Hydronics
- Buried and Above Ground Water Pipes
- Sports Stadiums and Arenas
- Commercial Buildings
- Residential Buildings
- Institutional Buildings
- Schools and Universities
- Government Buildings
- Hospitals
- Hotels and Apartments

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PP-RCT vs Steel Pipe

Weight

- Steel pipe weight is approximately 3.5 times greater than PP-RCT pipe.
- Large and complex PP-RCT spools can be welded in the shop to minimize field welds, and still be manageable to install.
- Less weight equates to more economical shipping and handling costs.
- PP-RCT requires less labor and equipment to install, thus it is a less expensive and safer system to install.
- PP-RCT reduces the need for heavy duty hangers and supports.

Joining

- Steel pipes require a welding rod and open flame or arc to create the weld.
- PP-RCT welds require no welding rod – the welds are homogeneous.
- There are no “heat affected zones” in thermoplastic fusion.
- PP-RCT welds require no special post-treatment such as passivation.
- PP-RCT butt and socket fusion welds are as strong or stronger than the pipe.
- PP-RCT welds require less labor to produce a proper weld.
- Asahitec™ fusion welding training provided by authorized personnel, on site or in a classroom setting.
- Fusion welding generates no weld slag or noxious fumes.

Flow/Rates and Head Loss

- The H-W flow factor for PP-RCT pipes is higher than that of steel.

Corrosion

- PP-RCT pipes for water applications do not corrode – like steel pipe can.
- Corroding metallic pipes can introduce particles into the water system thus adversely effecting other system components such as pumps, valves, faucets and radiators.
- Corrosion of metallic pipes creates higher operating energy costs over time and reduces the life expectancy of the system.
- Corrosion of metallic pipes can adversely affect the taste and quality of the water and increase health concerns.

Asahitec™ Fibercore™ Technology

Both Climatec™ and Watertec™ pipes are manufactured with patented Fibercore™ technology. Fibercore™(PP-F) pipes consist of three co-extruded layers that make one homogeneous pipe. The middle layer consists of mixed short fiberglass strands and PP-RCT, which is isolated by solid layers of PP-RCT on the inside and outside to create an Asahitec™ pipe. The middle Fibercore™ layer reduces the expansion and contraction by up to 75 percent. This can reduce the installation cost by minimizing expansion loops and quantity of supports required in above ground systems. While the fittings do not have Fibercore™, fittings weld directly to all of Asahi’s PP-RCT fittings and valves.

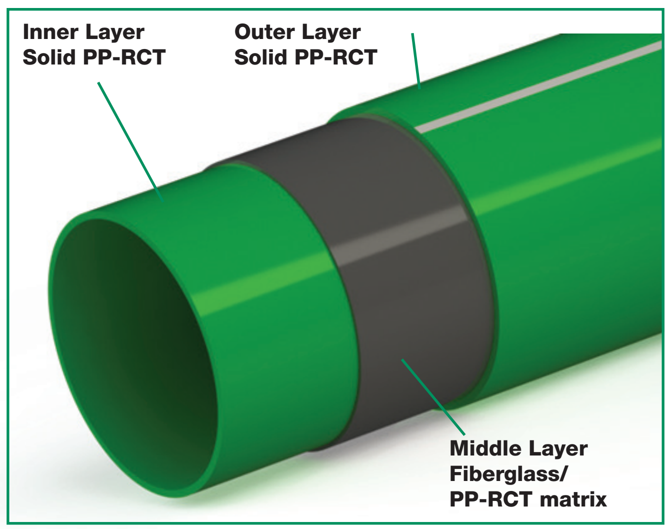

Figure A-1. Fibercore™

Certifications, Approvals and Standards

- ISO 15874 – Plastic piping systems for hot and cold water installations – Polypropylene (PP)
- ASTM F2389 – Standard Specification for Pressure-rated Polypropylene Piping Systems
- Referenced by: IPC, IMC, UPC, and UMC
- ASTM F2023 – Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water
- CSA B137.11 – Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
- DIN 8077 – Polypropylene (PP) Dimensions
- DIN 8078 – Polypropylene (PP) pipes – General quality requirements and testing
- NSF/ANSI 61 – Drinking Water System Components – Health Effects
- NSF/ANSI 14 – Plastic Piping System Components and Related Material
- Installation Requirement Standards
- AMSE/ ANSI B31 – Pressure Piping Code (B31.1, B31.3, B31.9)
- DVS 2207 – Welding of Thermoplastic Materials
- DVS 2008 – Welding Machines and Devices for Thermoplastics

LEED Credit

Leadership in Energy and Environmental Design (LEED) is changing the way we think about how buildings are constructed, maintained and operated.

Our new PP-RCT piping systems fall in line with LEED's guidelines and are considered environmentally friendly, as well as energy efficient.

An Asahitec™ system is one of the most environmentally friendly and cost-effective piping systems. Polypropylene is inherently not susceptible to corrosion, scaling and abrasion, which gives Asahitec™ a projected operating life of 100 years in some cases. With a superior internal smoothness and higher velocity limits when compared to other piping systems, PP-RCT pipes will have a greater flow. This gives you a reduction in the overall power consumption of your pumps. This savings will directly lower a building's operating cost and its environmental impact. Through these characteristics, an Asahitec™ piping system can be implemented in a variety of building systems while contributing to multiple LEED credits. It can contribute to the "Energy and Atmosphere" credit by switching to a more efficient hydronic system compared to a forced air system. Extra credits can be earned when a solar collector or geothermal systems are added. The "Indoor Environmental Quality" credit coupled with a hydronic system can simplify the number of sensors needed at delivery points in a forced air system, while being able to provide thermal comfort to individual occupants or multi-occupant spaces without discomforting drafts. Asahitec™ can contribute to the "Sustainable Sites" credit through rainwater collection systems and recycled water systems. Being chemically inert, Asahitec™ is resistant to almost all acids, alkalies and organic solvents, and being freeze tolerant it makes the perfect pipe for direct burial in an application like this.

Short Specification

Plumbing (hot and cold water) and HVAC piping systems shall be polypropylene pipe and fittings made of PP-RCT resin and certified by NSF International to 14-pw potable water. Material shall comply with NSF/ANSI 61 covering health effects requirements when tested at temperatures up to and including commercial hot water (180° F). Product shall be certified to the Universal Plumbing and Mechanical Codes UPC and UMC, ASTM F 2389 and 2023 or CSA B137.11. Pipe shall be extruded with Fibercore™ middle layer technology to limit thermal expansion. Pipe shall be identified by green color with grey stripes and/or one red stripe. Fittings shall be molded only in green color; socket fusion style in sizes 1/2" – 5" and butt fusion style in sizes 6" – 24". SDR ratings may span 7.4, 9, 11 and 17 sizes, depending upon system pressure/temperature requirements. All pipe and fittings shall be Asahitec™, Climatec™ or Watertec™ as corresponding to required SDR sizing, available from Asahi/America, Inc. of Lawrence, Massachusetts.

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ENGINEERING AND DESIGN CRITERIA

Contents

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Introduction

This section of the guide is to assist in the engineering and theory of a thermoplastic pipe system. Asahi/America provides the theory and the data on the design within this section. When designing a pipe system, all of the topics in this section should be considered. The complexity of your system will dictate how detailed the engineering needs to be. For safety reasons, it is important to consider all topics. While thermoplastics provide many advantages in terms of weight, cleanliness, ease of joining, corrosion resistance, and long life, they do require different considerations than metal pipe and valves. Like any product on the market, thermoplastic has its advantages and its limitations. Use the engineering data in this design guide for optimal results in a thermoplastic piping system.

Familiarize yourself with the following material properties of PP-RCT. Note the significant difference in Fibercore's™ coefficient of expansion.

	Property	Standard	Unit	PP-RCT	Fibercore™
Mechanical Properties	Specific density at 23°C	ISO 1183	g/cm3	0.905	-
	MFR 190/5	ISO 1133	g/10min	0.5	-
	MFR 230/2.16	-	-	0.24 - 0.36	-
	MFI range	ISO1872/1873	-	T003	-
	Tensile stress at yield	ISO 527	MPa	25	-
	Elongation at break	ISO 527	%	>300	-
	Flexural strength (3.5% flexural stress)	ISO 178	MPa	23	-
	Modulus of elasticity	ISO 527	MPa	900	-
Thermal Properties	Linear coefficient of thermal expansion	DIN 53752	K-1 x 10-4	1.5	0.57
	Thermal conductivity at 20°C	DIN 52612	W/(m x K)	0.24	-
	Specific heat at 20°C	-	kJ/kg K	2.0	-
Electrical Properties	Specific volume resistance	VDE 0303	OHM cm	-	-
	Specific surface resistance	VDE 0303	OHM	>1013	-
	Relative dielectric constant at 1 MHz	DIN 53483	-	2.3	-
Other Properties	Physiologically non-toxic	EEC 90/128	-	Yes	-
	FDA	-	-	Yes	-
	UV stabilized	-	-	No	-
	Color	-	-	RAL 6024	-

Table B1. PP-RCT/PP-F Material Properties

Design Basis

Inside Diameter and Wall Thickness

The ID of a pipe can be based on various standards. The two common standards for determining the ID or wall thickness of a pipe are a schedule rating and a standard dimensional ratio (SDR).

Normally, metal pipes and PVC pipes are sized according to schedule ratings. A common schedule rating for PVC is Schedule 40 or 80. The higher the number, the higher the pressure rating. In schedule systems, no matter what the material, the wall thickness will always be the same for the nominal diameter. For example, a Schedule 40 PVC pipe will have the same wall thickness as a Schedule 40 PVDF or PP pipe.

The pressure ratings will be significantly different based on diameter of pipe and the material mechanical properties. Schedule ratings offer the convenience of tradition and dimensional consistency. However, it is not a practical rating system for plastic pipe with various material properties. The conclusion is that schedule ratings ignore material properties and, in many cases, waste excess material and cost just to meet the required wall thickness of the standard.

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A more precise system in use is the standard dimensional ratio (SDR). This is a ratio between the OD of the pipe and the wall thickness. SDR is simply the outside diameter of the pipe divided by the wall thickness. All polypropylene pipes supplied by Asahi/America are produced according to ISO 4065 standards, which outline a universal wall thickness table. The SDR system allows for the same pressure ratings for all pipes within that SDR. From the standard, the following equation for determining wall thickness is derived..

SDR = OD/s , OD = Outside diameter (mm), s = wall thickness (mm)

The SDR class, operating temperature, and service life of the pipe are factors in determining the hoop stress of the pipe under a given set of conditions. Using Figure B1, we can input this value into Equation B1 to find the max operating pressure for a given temperature and expected life span.

$$P_{max} = \frac{20*\sigma\_v}{(SDR-1)*C_{min}} \quad \text{(B1)}$$

P_{max} = Max Operating Pressure (bar)
σ_v = Reference Strength (N/(mm^2) (also referred to as hoop stress)
SDR = Standard Dimensional Ratio
C_{min} = Minimum Safety Factor

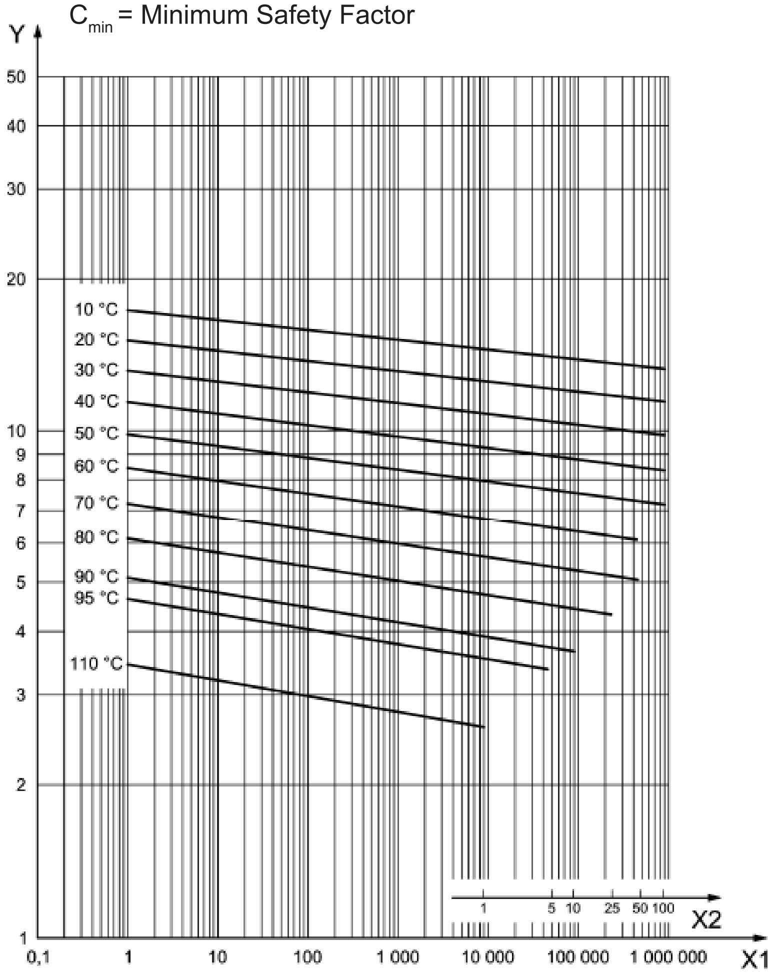

Figure B1. Creep curves for expected strength of PP-RCT

The reference strength is a composite graph called a creep curve. This graph is based off of experimental and mathematical formulas. Above is the creep curve (ISO 15874- 2: 2013) for PP-RCT. *The Y axis is the hoop stress in N/mm^2. The X1 axis is the time to failure in hours. The X2 axis is the time to failure in years.*

B

Temp. (°F)	Operating Years	PP-RCT (psig)			
		7.4	9	11	17
68	10	436	347	276	174
	25	429	341	270	170
	50	423	335	267	168
	100	418	331	262	165
86	10	377	299	238	149
	25	370	293	233	146
	50	364	289	229	145
	100	360	286	226	142
104	10	323	257	204	128
	25	316	251	200	126
	50	312	248	197	123
	100	307	244	193	122
122	10	276	219	174	109
	25	270	213	170	107
	50	265	210	167	104
	100	261	207	164	103
140	10	232	184	146	93
	25	228	184	146	93
	50	223	177	141	88
158	10	196	155	123	77
	25	190	151	120	75
	50	187	148	117	74
176	10	165	131	104	65
	25	162	129	102	64
203	1	129	103	81	51
	5	123	97	77	48

Table B2. PP-RCT Operating Parameters

*Safety factor of 1.25 used

Per ASTM F2389 Miner's rule SDR 11 (PP-RCT) pipe at a continuous temperature of 158°F(70°C) or below, with 90 days per year at 180°F(82°C) for an operating period of 25 years has a pressure rating of 100 psig.

Additional specific Allowable Operating Pressure at different temperature conditions see chart in Appendix.

For temperatures below 68°F (20°C) and down to 23°F (-5°C), the pressure chart for 68°F (20°C) can be used. Limiting impacts and vibrations to the pipe becomes significantly more important as the temperature and wall thickness of the pipe decrease. PP-RCT's creep curve (DIN-8078) has a low-end temperature of 50°F (10°C). However, through experience and testing we have extended uninsulated Asahitec's™ low temperature limit down to 23°F (-5°C).

Please contact Asahi/America's engineering department for design considerations when the application is outside of the pressure/temperature chart. It is important to verify that the material is suitable for use and that the piping system will be capable of withstanding the chemicals under the concurrent pressure and temperature and other loads under which it will operate. Chemical resistance is dependent on a number of specific factors that include more than the concentration of the chemicals and the temperatures that will be handled. Other factors include, but are not limited to, the concurrent temperature, pressure, and other internal and external loads imposed on the system. The duration of application (i.e. continuous vs intermittent), steady vs cyclic loading, consideration of other chemicals that may be mixed together with the chemical under question, and the design codes to which the system is being implemented (e.g. ANSI/ASME). While these charts may serve as a general guideline for the determination of resistance, it is recommended to contact the factory for further guidance for any chemical application of Asahitec™. The final determination will be the responsibility of the engineer in charge of the project or other representative of the owner.

Asahitec™ has a high temperature resistance making it suitable for a wider range of applications. PP is generally suitable up to a maximum temperature of 203°F, while high density polyethylene (HDPE) is rated to a maximum operating temperature of 140°F. HDPE (class and resin dependent) is a ductile material, which makes it preferable for lower temperature applications.

Asahi/America has a very detailed corrosion resistance database available for these specific products, which includes over 600 corrosive solutions at a variety of concentrations and operating temperatures. Asahi/America maintains databases of all its chemical projects. Chemical verifications conducted by resin manufacturers are also kept on file for reference. When using water treatment control additives, consult Asahi/America for a written recommendation on the specific application. To receive a documented recommendation, submit the chemical concentration, temperature and operating pressure to Asahi/America engineering department. A

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Precautionary Note:
Mixed use applications in recirculating **domestic hot water systems** may contain copper components that are used in hot water heaters, distribution headers, plumbing connections, and other equipment. Careful design is important and proper installation in accordance to the Copper Development Association - CDA Publication A4015-14/16 "*The Copper Tube Handbook,*" will eliminate conditions that could cause copper erosion and corrosion, which can have negative effects on thermoplastic piping systems. Further information can be found in the Plastic Pipe Institute's Technical Note-TN57;
PPI TN-57/2018: Proper Integration of Copper Tubing and Components with PP-R Piping Materials for Plumbing Applications
https://plasticpipe.org/pdf/tn-57.pdf
Note: Hydronic and other hot water heating systems are typically not affected by copper erosion due to the lower flow velocities, lower dissolved oxygen, and oxidant levels. The presence of oxidants and oxygen in extreme hot water is typically found only in domestic (potable) water applications.

CHEMICAL RESISTANCE CHECK REQUEST FORM
PIPING SYSTEMS

Attention: **Engineered Products Division** (asahitec@asahi-america.com)

Requester's Information

B

Company Name:____

Address:____

____

____

Phone:____

Fax:____

Contact Name:____

Project Information

End User Name:____

Project Name:____

Contact:____

Address:____

____

____

Phone:____

Chemical Information

Chemical(s) and Concentration:_______________________________

Operating Temperature:_______________________________

Operating Pressure:_______________________________

Flow Rates:_______________________________

UV Exposure:_______________________________

Comments: (Please note any other information that may assist in material selection)

____

____

____

____

Figure B2. Chemical Resistance Check Request Form

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SYSTEM OPERATING CHARACTERISTICS

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C

Fluid Dynamics

Sizing a thermoplastic piping system is not much different than a metal piping system. Systems transporting compressible fluids and non-compressible fluids are sized very differently and have different concerns. Asahitec™ piping is specifically designed for hot and cold water applications, so only non-compressible fluid flow will be summarized.

Pipe diameter is a critical factor in properly designing the Asahitec™ pipe system. It is generally recommended that the flow velocity in Asahitec™ piping systems not exceed 8 fps for clean water. This promotes efficient pumping, control of noise generation, and dampens the effects of water hammer on the piping system. Pump suction piping velocity is usually recommended to be less than 5 fps. Higher velocities are also possible, contact Asahi/America engineering for assistance.

Once pipe sizes have been determined for the system, the following equations can be used to determine the system pressure drop and to select pump motor horsepower. When determining frictional pressure loss across a system, it is recommended that a 20percent safety factor be used to account for fitting pressure drop elimination, non-smooth welds and manufacturing tolerances.

Darcy Method

h_f = Friction loss from flow in the pipe/fittings (ft)
L = Length of pipe and/or equivalent length of pipe fitting (ft)
D = Inside diameter of pipe (ft)
V = Average flow velocity within pipe (ft/s)
g = 32.174, gravitational constant (ft/s^2)
f = Friction factor

The Darcy-Weisbach equation can be used to determine the friction loss for Asahitec™ piping systems. It can be used to determine the system's friction loss across pipe, fittings, and valves.

$$h_l = f\frac{L}{D}\frac{V^2}{2g}$$

All the variables in the Darcy equation can be easily acquired, but for the friction factor one must first calculate the Reynolds number. The Reynolds number is dimensionless and is used to determine if the flow is laminar or turbulent.

RE = 7745.8 (Vd/*v*)

Re = Reynold number
d_i = Inside diameter of pipe (inch)
V = velocity (ft/s)
g = 32.174 (ft/s^2)
v = kinematic viscosity (centistokes)

The Reynolds number allows the friction factor to be determined. Depending on how large or small the Reynolds number will determine which equation should be used to calculate the friction factor. For Reynolds numbers <2000, the flow condition is considered to be a laminar flow condition. For a laminar flow condition use the following equation to calculate the friction factor.

$$f = \frac{64}{Re}$$

For Reynolds numbers >4000, the flow condition is considered to be a turbulent flow condition. For turbulent flow conditions the Colebrook equation is used to calculate the friction factor.

Colebrook Equation

$$\frac{1}{\sqrt{f}} = -2 \cdot log_{10}\left(\frac{\epsilon}{3.7D} + \frac{2.51}{Re\sqrt{f}}\right)$$

A Moody Diagram can be used to determine the friction factor as well. It can be used to determine the friction factor in laminar flow conditions, transitional flow conditions, or turbulent flow conditions. To use the Moody Diagram, first calculate the Reynolds number and a relative roughness number. Use these numbers with a Moody Diagram to determine the friction factor. An equation for relative roughness is shown below.

$$Relative\ Roughness = \frac{\epsilon}{D}$$

ϵ = 2.2966E-05, Absolute roughness of polypropylene pipe (ft)

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Friction Head Loss Across Pipe

Measure the developed length of pipe (the length of pipe in the system containing the same pipe diameter and same average flow velocity). Insert this length along with the average flow velocity and pipe diameter into the Darcy-Weisbach equation to calculate the frictional head loss of the pipe. Where L= L (developed length).

$$h_p = f \cdot \frac{L}{D} \cdot \frac{V^2}{2 \cdot g}$$

$$h_p = head\ loss\ through\ pipe\ only\ (ft)$$

Friction Head Loss Across a Fitting

Head loss in fittings is frequently expressed as the equivalent length of pipe that is added to the straight run of pipe. This approach has sufficient accuracy for many applications. A table for equivalent length of pipe is in the Appendix (Figure AP-24). Select the fitting's equivalent pipe length from the fitting table and use this length in the Darcy-Weisbach equation to determine the frictional head loss across the fitting. Where Le=L (fitting equivalent length).

$$h_f = f \cdot \frac{Le}{D} \cdot \frac{V^2}{2 \cdot g}$$

$$h_f = head\ loss\ through\ fittings\ only\ (ft)$$

If the pipe and fitting have identical sizes and flow, the equivalent length of the fitting and the developed length of the pipe can be summed together as a combined equivalent length, which can be used to determine the frictional head loss across the combined length of pipe. Where L= L (developed length) + L (fitting equivalent length).

$$h_t = f \cdot \frac{L}{D} \cdot \frac{V^2}{2 \cdot g}$$

$$ht = hp + hf$$

$$h_t = head\ loss\ through\ pipe\ and\ fittings\ \ (ft)$$

Frictional Head Loss Across a Valve

The flow coefficient or Cv of a valve is defined as the number of gallons of water at 60°F that flows through the valve creating a pressure drop of 1 psi across the valve. To determine the pressure drop across the valve, insert the density of the chemical flowing through the valve, the volumetric flow rate, and the manufacturer's flow coefficient. SG = specific gravity (density of the fluid/density of water at 68ºF.

$$\Delta P = SG\left(\frac{Q}{Cv}\right)^2$$

$$Hv = \Delta P\left(\frac{2.31}{SG}\right)$$

hv = head loss through valves (ft)

P is in psi and Q is in GPM

Hazen-Williams Method

The Hazen-Williams equation is applicable to water pipes under conditions of full turbulent flow. It provides a sound conservative design basis for plastic pipe sizing.

The variables for the equation are:

D = Inside diameter of pipe (inch)

Q = Volumetric pipe flow (gpm)

C = Flow coefficient

Hf = Friction head (ft of water/100 ft of pipe)

$$H_F = 0.2083 \cdot \left(\frac{100}{C}\right)^{1.85} \cdot \frac{Q^{1.85}}{D^{4.8655}}$$

C = 150 for polypropylene pipe
C = 100 for carbon steel (standard design factor)

To determine the pressure loss in psi/100 ft of pipe
H_F = 0.4335H_F

Asahi/America has already calculated the pressure drop in our pipe systems at most flow rates using the Hazen-Williams method. These tables are in the appendix starting at Table AP-3.

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C

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PIPE SUPPORT AND THERMAL EXPANSION

Contents

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D

Support Spanning for Asahitec™ Pipe Types

The permissible support distances of thermoplastic pipes are determined by the SDR of the pipe and the operating temperature of the media. A thicker walled pipe and a lower temperature system will both contribute to a longer support spacing distance, while thin walled pipes and high operating temperatures will result in shorter hanger spacing. Below are the maximum hanger spacing distances for Asahitec™ pipe. This includes loose point (LP) guides and locating point or fixed point (FP) supports. Thermal growth needs to be evaluated to determine LP and FP supports location. See details in this section below. Note that the hanger distances will differ if the pipe has Fibercore™.

If the system is exposed to thermal cycling the placement of hangers, guides (LP), and anchors (FP) is critical. In these cases, the hanger locations should be identified by the system engineer and laid out to allow for expansion and contraction of the pipe over its life of operation.

Support spacing for SDR-7.4 Solid Wall (inches)

Size	68°F	86°F	104°F	122°F	140°F	158°F	176°F
1/2”	29	27	25	24	23	22	21
3/4”	33	31	29	28	26	26	24
1”	39	36	34	33	31	30	29
1-1/4”	44	42	39	38	36	35	33
1-1/2”	49	46	44	43	41	40	38
2”	55	52	50	48	46	45	44
2-1/2”	60	57	54	53	51	50	48
3”	65	63	60	58	56	54	52
4”	72	69	66	64	61	60	58
5”	82	78	74	72	69	68	65

Table D1. PP-RCT Support Spacing

Support spacing for SDR-11 Solid Wall (inches)

Size	68°F	86°F	104°F	122°F	140°F
1/2”	25	24	22	21	20
3/4”	29	27	26	24	23
1”	34	32	30	29	27
1-1/4”	39	37	35	33	31
1-1/2”	44	43	40	38	36
2”	50	48	45	44	42
2-1/2”	54	52	49	48	46
3”	59	57	54	52	50
4”	66	63	60	58	56
5”	74	71	67	65	63
6”	88	84	80	78	74
8”	98	94	89	87	83
10”	110	105	100	97	93
12”	123	118	112	109	105
14”	131	125	119	115	111
16”	139	133	126	122	118
18”	147	141	134	130	125
20”	155	148	141	137	132

Table D2. PP-RCT Support Spacing

Support Spacing for Fibercore™ Table (inches)

Size	SDR	68°F	86°F	104°F	122°F	140°F	158°F	176°F
1/2"	7.4	28	26	24	23	22	21	20
3/4"	7.4	32	30	28	27	26	25	24
1"	9	35	33	31	30	29	28	26
1-1/4"	9	41	39	36	35	33	32	30
	11	39	37	35	33	31	30	29
1-1/2"	9	46	44	42	40	38	37	35
	11	44	43	40	38	36	35	33
2"	9	52	49	47	46	44	43	41
	11	50	48	45	44	42	41	39
2-1/2"	9	56	54	51	50	48	46	45
	11	54	52	49	48	46	45	43
3"	9	62	59	56	54	52	51	49
	11	59	57	54	52	50	49	48
4"	9	68	65	62	60	58	56	54
	11	66	63	60	58	56	54	52
5"	9	77	74	70	68	65	64	61
	11	74	71	67	65	63	61	59
6"	11	88	84	80	78	74	73	70
	17	81	77	74	71	68	65	63
8"	11	98	94	89	87	84	81	78
	17	90	86	82	80	77	75	72
10"	11	110	105	100	97	93	91	88
	17	101	96	92	89	85	83	81
12"	11	123	118	112	109	105	102	98
	17	113	108	103	100	96	94	91
14"	11	131	125	119	115	111	108	104
	17	120	115	109	106	102	100	96
16"	11	139	133	126	122	118	115	111
	17	128	122	116	113	108	106	102
18"	11	147	141	134	130	125	122	118
	17	135	130	123	119	115	112	108
20"	11	155	133	141	137	132	129	124
	17	143	136	130	126	121	118	114

Table D3. Support Spacing for Fibercore™ Pipe

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Pipe Support Types for Asahitec™

When selecting hangers for a system, it is important to avoid using a hanger that will place a pinpoint load on the pipe when tightened. For example, a U-bolt hanger is not recommended for thermoplastic piping. If metal clamps are specified for the project, they should be inspected for rough edges that could damage the pipe. Ideally, if a metal clamp is being used, an elastomeric material should be used in between the pipe and the clamp.

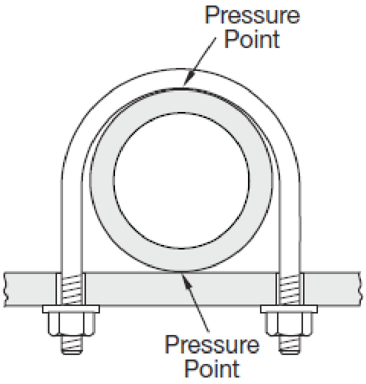


Figure D-1. NOT RECOMMENDED

U-bolt on PP-RCT

Hangers that secure the pipe 360 degrees around the pipe are preferred. It is recommended to use plastic pipe clips that hold the circumference of the pipe and prevent pinpoint stress. Pipe clips should be used as secure supports and guides only. Do not tighten down hard on the wall of the pipe as the pipe must be able to move through the support. Continuous support may also be used. Metal clamps that contact the pipe are not recommended.

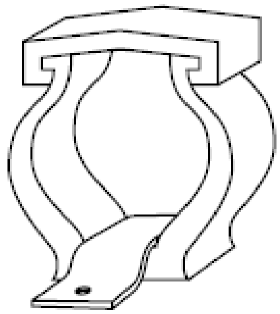
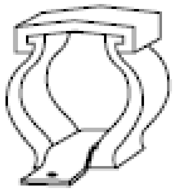


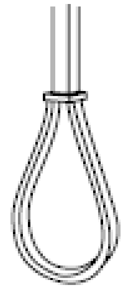
Figure D-2. Recommended clamp

If a clamp will be used as an anchor and it will be exposed to high end loads, a more heavy duty clamp may be required, as well as a special anchoring setup. In these cases, it is advised to either consult a mechanical engineer with experience in pipe stress analysis or receive detailed recommendations from the clamp manufacturer.

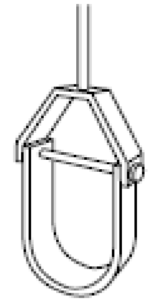
To handle expansion and contraction, a restrained system that limits the movement of the pipe is preferred over the use of loops and offsets. Restraint fittings should be used to protect fittings from excessive movement and to reduce the amount of movement between restraints.



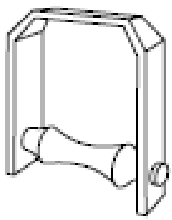
All Thermoplastic Hanger
(recommended for plastic pipe)
Available from Asahi/America



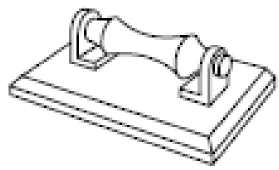
Adjustable Solid Ring
(swivel type)



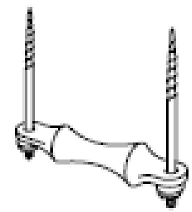
Clevis Hanger



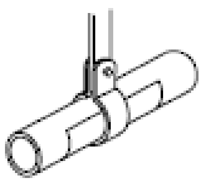
Roller Hanger



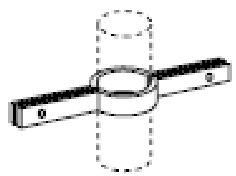
Pipe Roller and Plate



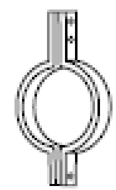
Single Pipe Roller



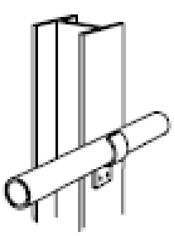
Band Hanger with
Protective Sleeve



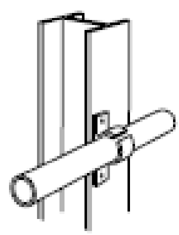
Riser Clamp



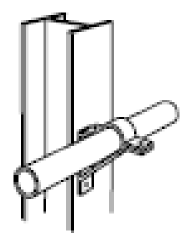
Double-Bolt Clamp



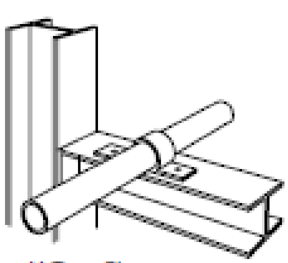
Vertical Clamp



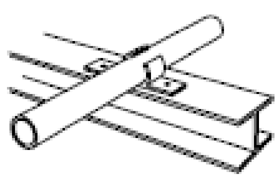
Vertical Pipe Clip



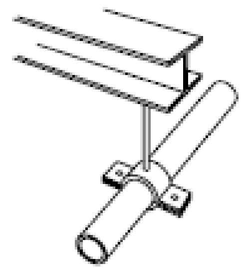
Vertical Offset Clamp



U-Type Clamp



Horizontal Pipe Clip



Suspended Ring Clamp

Figure D-3. Typical plastic piping supports

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Thermal Expansion and Contraction

Based on operating criteria, thermal expansion must be considered. For systems maintained at consistent temperatures, compensation for thermal effects may not be required. It is, however, important to review all aspects such as the operating environment. Is it outdoors where it will be exposed to changing weather? Is the system spiked with a high temperature cleaning solution? Will the system run at a significantly higher temperature than the installation temperature? The occurrence of any thermal change in a plastic system will cause the material to expand or contract. As an example of the effect, Asahitec™ solid wall will grow roughly one inch for every 100 linear feet and 10 degrees F ΔT, while Fibercore™ will grow less than a 1/4" under the same conditions. Thermoplastic systems can be used in hot applications and applications where the temperature is cyclical, but they require analysis of the thermal expansion effects. In most cases, the use of expansion loops, offsets and proper hanging techniques are all that is required to ensure a proper design.

Hot media also reduces the rigidity of thermoplastic piping, which, in turn, decreases the support spacing between pipe hangers. In smaller dimensions, it is recommended to use continuous support made of some type of channel or split plastic pipe.

Finally, the use of hangers as guides and anchors becomes important. As the design proceeds, certain hangers should be used as guides to allow the pipe to move back and forth in line, while other anchoring locations should be used to direct the expansion into the compensating device. The anchors and hangers should be designed to withstand the end load generated by the thermal expansion. Figure D-4 is an example of an anchor type restraint fitting that is available from Asahi/America.

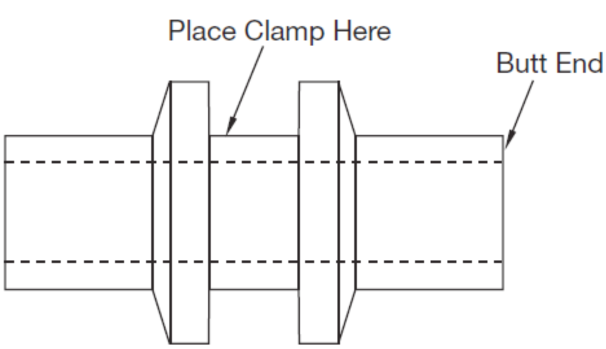

Figure D-4. Restraint fitting

For expansion calculation tools, please visit our website at:

www.asahi-america.com/resource-center/online-tools/expansion-calculator

Below is an example from the online calculator.

Expansion Calculator

Length of Run (L)	100	Feet
Pipe Material	PP Fibercore	
Install Temp	50	°F
Operating Temp	180	°F
Outside Diameter	90mm (3")	
SDR	11	
Change in Length (ΔL)	3.0	in
Min. Straight Length (L_s)	50	in

The change in length that the pipe will experience dictates how long the bending arms are and where to anchor them.

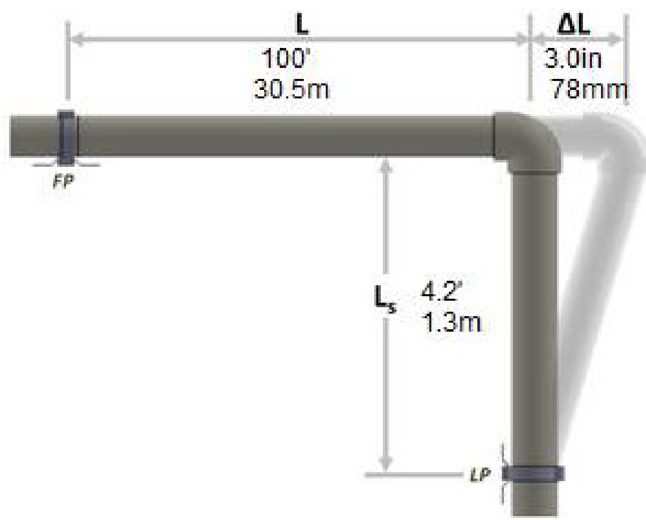

Figure D-5. Expansion Calculator Example

D

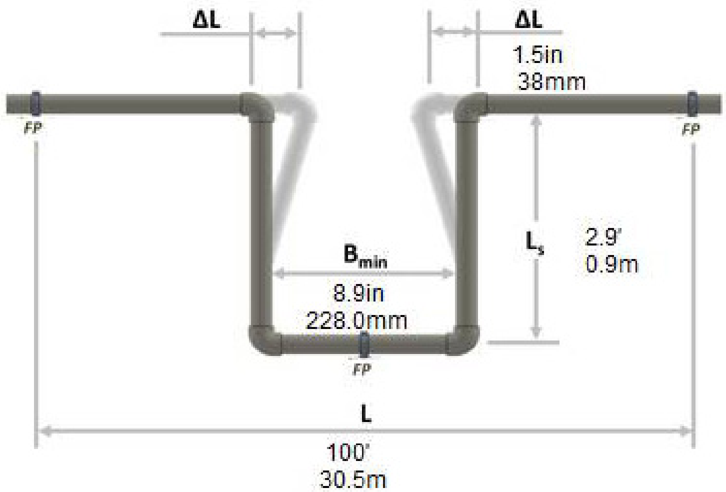

Figure D-6. Alternate Support for Thermal Growth

Burial Practices for Asahitec™ Piping

Similar to pipe clips and supports, when burying Asahitec™, it should be protected from point loads like rocks in the ground. The most common solution is to dig an extra wide trench and backfill it with sand to protect the pipe against any point loads.

If an application requires Asahitec™ piping to be buried, please contact Asahi/ America for recommend burial practices.

If Asahitec™ piping is being buried for freeze protection or other design requirements, please contact Asahi/America.

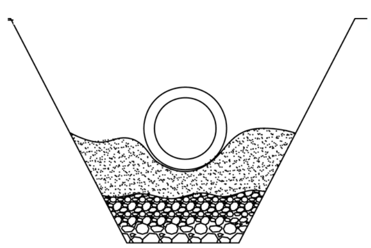

Figure D-7. Typical Plastic Pipe Preparation

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THERMODYNAMIC FACTORS

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HEAT GAIN & HEAT LOSS

Thermal insulation is installed on most piping systems that operate outside of ambient conditions. It not only saves energy and money for the owner, but it protects workers, attenuates noise, and protects against freezing. The following calculations will provide you with information on how to determine the most cost effective solution when deciding on how to insulate a piping system.

Piping insulation's main use is to limit heat loss from the fluid in a hot system, or limit the heat gain of the fluid in a chilled system. Heat flows in the direction of the temperature gradient and does so by conduction, convection or radiation.

The equation below is for conductive heat transfer through a flat slab.

$$q = \frac{kA(T_1 - T_2)}{x}$$

q = heat loss or heat gain (BTU/hr)

k = thermal conductivity (BTU-in/hr-ft^2-F)

A = area (ft^2)

x = thickness (inches)

This simple equation when applied to pipes, changes slightly due to the thickness not being flat. In this case the cylindrical geometry is mathematically shown by the equivalent thickness, as shown in the denominator of the below equation.

$$q = \frac{kA(T_1 - T_2)}{r_2 ln\left({}^{r_2}/_{r_1}\right)}$$

r_1 = radius of inner surface (in.)

r_2 = radius of outer surface (in.)

Conduction happens through both the pipe and the insulation, and since they have different thermal conductivities, they need to be calculated separately. The conduction of the fluid and the pipe is denoted by h_c = inside film coefficient (BTU/hr-ft^2-F), while the convection on the outside surface is h_c = outside convective film coefficient (BTU/hr-ft^2-F).

$$q = \frac{2\pi L(T_i - T_o)}{\left(\frac{1}{r_1 h_i}\right) + \left(\frac{ln\left({}^{r_2}/_{r_1}\right)}{k_{pipe}}\right) + \left(\frac{1}{r_3 h_c}\right)}$$

R-Values

Bare Asahitec™ pipe material is considered to have excellent insulation characteristics with its low thermal conductivity value. Competing metal pipe such as copper, steel, and stainless steel are all considered poor insulators. Comparing the heat loss/gain charts of bare Asahitec™ pipe to the heat loss/gain chart of metal pipe it is easy to see the thermal advantages which Asahitec™ pipe provides. With a 50°F temperature difference across the pipe, the heat loss/gain of the metal pipe is much greater than that of Asahitec™.

There are two terms used to describe the heat loss within a pipe, K-Factor and R-Value. The K-Factor is also known as thermal conductivity. The thermal conductivity of a material is based on the number of BTUs per hour that pass through a one-inch-thick by one-square-foot section of material, with a 1°F temperature difference between the two surfaces. The lower the K-Factor, the more suitable the material is for insulation.

K-Factor	
Material	**(BTU/hr-ft-°F)**
Pipe Insulation	0.021
PP-RCT	0.139
Steel	31
Copper	227

Table E1. PP-RCT K-Factor

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R-Value is a measure of the ability of a material to retard heat flow rather than transmit heat. The higher the R-Value, the better the insulator. For cylindrical pipe geometry equivalent thickness, use the equation shown below to determine the equivalent thickness since the outer surface area of insulation is proportionately greater than the inner surface area. The equivalent thickness is the insulation thickness of a flat surface which would equal the heat flux at the outer surface, of a cylindrical geometry. The relationship between R-Value and K-Factor for pipe insulation is in the equation shown below. Table E-2 displays the R-Values for Asahitec™ pipe at 68°F.

$$R - value = \frac{Thickness\ (inches)}{k - factor(BTU \cdot inch/\ (hr \cdot ft^2 \cdot {}^\circ F)}$$

$$R - value\ (cylindrical) = \frac{Equivalent\ Thickness\ (inches)}{k - factor(BTU \cdot inch/\ (hr \cdot ft^2 \cdot {}^\circ F)}$$

$$Equivalent\ Thickness = r_2 \cdot ln\left(\frac{r_2}{r_1}\right)$$

$$k = \frac{1}{R}$$

To convert BTU/hr-ft-F to BTU-inch/hr-ft^2-F multiply by 12 in/ft

Size	SDR 7.4	SDR 9	SDR 11	SDR 17
1/2" (20mm)	0.078	0.062	-	-
3/4" (25mm)	0.097	0.075	-	-
1" (32mm)	0.122	0.097	0.076	-
1-1/4" (40mm)	0.152	0.121	0.097	-
1-1/2" (50mm)	0.191	0.150	0.120	-
2" (63mm)	0.238	0.191	0.152	-
2-1/2" (75mm)	0.285	0.225	0.178	-
3" (90mm)	0.341	0.271	0.215	-
4" (110mm)	0.418	0.330	0.262	-
5" (125mm)	0.474	0.376	0.298	-
6" (160mm)	-	-	0.382	0.240
8" (200mm)	-	-	0.476	0.300
10" (250mm)	-	-	0.594	0.373
12" (315mm)	-	-	0.748	0.472
14" (355mm)	-	-	0.842	0.535
16" (400mm)	-	-	0.949	0.598
18" (450mm)	-	-	1.070	0.674
20" (500mm)	-	-	1.187	0.749

Table E2. PP-RCT R-Values

Insulation

There is a definite thermal efficiency advantage associated with using Asahitec™ pipe to that of using metallic. The charts in the appendix display both the heat gain and loss in different conditions, as well as with or without insulation. When calculating the thermal gain/ loss, the radiation and inner pipe heat film resistance is usually not included.

Keep in mind that local codes will usually dictate the insulation thickness depending on the type of system and operating temperature of the system.

E

Calculated/Determined Values

R_{Pipe} = Thermal resistance of pipe wall (hr ft F/BTU)

R_{Ins} = Thermal resistance of pipe insulation (hr ft F/BTU)

R_O = Thermal resistance of outer air (hr F/BTU)

R_{Total} = Total thermal resistance of pipe and pipe insulation (hr ft F/BTU)

$$R_{pipe} = \frac{\ln(r_o/r_i)}{2\pi k_{pipe}}$$

$$R_{ins} = \frac{\ln(r_o/r_i)}{2\pi k_{ins}}$$

$$R_o = \frac{1}{2\pi r_o h_{oL}}$$

$$R_{Total} = R_{pipe} + R_{ins} + R_o$$

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INSTALLATION

Contents

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The following information is a reference guide for welding and installation methods.

Please refer to the appropriate DVS standards and welding tool O&M manuals for complete instructions.

Transportation and Storage

Prevent impacts to the pipe ends. Prevent excessive loads. Prevent improper stacking.

A solid flat and level base for the pipes must be provided in order to avoid deformation of the pipes while in transport or storage. If the pipes are stacked to excessive heights, it can lead to ovalization or bowing of the pipes.

Asahitec™ pipes may be stored outside at any temperature if protected from UV light. It is preferable to store pipes inside whenever possible. The pipes are shipped in black protective polyethylene bags. However, the protective bags may become ripped or torn during shipping and sections of the pipe may become exposed. When storing outside, the pipes should be inspected to ensure that they are thoroughly covered and protected from the effects of UV light. Maximum outdoor storage time is 30 days if removed from the factory-supplied UV-protective bags, or for portions of pipe that are exposed due to rips or tears in the bags.

Outdoor Installation

UV radiation has an effect on polymeric plastic products. Protect pipes against weathering and UV radiation to prevent damage. In applications where the installed pipe will be exposed to UV radiation (such as rooftop or other outdoor applications), it is recommended that standard Asahitec™ piping be provided with UV protection. The piping can be protected by a number of methods including priming with plastic primer spray and painting. The piping can also be protected by use of protective tapes or covered with insulation or insulation jacketing.

At temperatures below 32°F (0°C), the piping has less ductility and it is more susceptible to damage by impact (especially against pipe ends), excessive loads, crushing or bending. Handle pipes with care at low temperatures.

Socket Welding

Overview

The Asahitec™ system is joined by socket fusion. Use Type “A” heater bushings in conjunction with a suitable hand-held heater plate or socket fusion bench tool. After the correct welding temperature has been reached, the joining can proceed. The pipe and fitting faucet diameters, as well as the respective heated bush diameters, are matched to build up the necessary pressure during the joining process.

Asahitec™ pipe does not need to be scraped before socket welding. The pipe may be beveled for easier insertion, especially on larger diameters.

Push the pipe and fitting quickly and axially up to the stop of the mandrel and the marked insertion depth respectively and keep them fast without twisting. The heating of the joint faces is done according to the table in Table F2 (page F-4). At the end of the heating period pull the pipe and the fitting from the heating element of the suitable polywelder and join them immediately axially aligned and without twisting. Mind the correct insertion depth (Table F1, page F-3). Do not expose the welded joint to mechanical stress before the expiration of the cooling period (see Table 2, page F-4).

Figure F-1. Measure and cut pipe with suitable pipe cutters to the correct length. Pipe must be squared 90 degrees.

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SOCKET WELDING

Size	Pipe	Depth (In.)
20	1/2”	0.57”
25	3/4”	0.63”
32	1”	0.71”
40	1-1/4	0.81”
50	1-1/2”	0.93”
63	2	1.08”
75	2-1/2”	1.18”
90	3”	1.30”
110	4”	1.46”
125	5”	1.57”

Table F1. PP-RCT Insertion Depth

Figure F-2. Mark the weld insertion depth on the pipe.

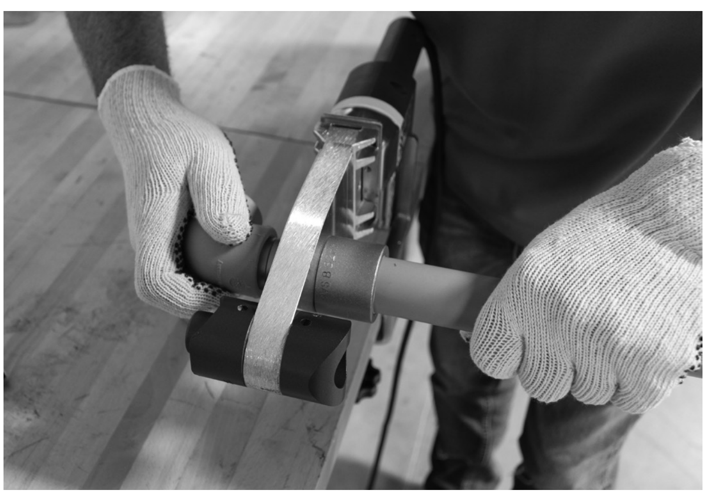

Figure F-3. Push the pipe end and the fitting onto the heating element of the hand socket welder in the axial direction. Heat pipe and fitting simultaneously.

The pipe and the fitting are to be removed from the hand socket welder.

Figure F-4. Join fitting and pipe in the axial direction. During joining do not twist the pipe or fitting.

Figures F-A, F-B, and F-C show the three welding process stages.

A - Welding preparation

B - Heat soak

C - Welded joint

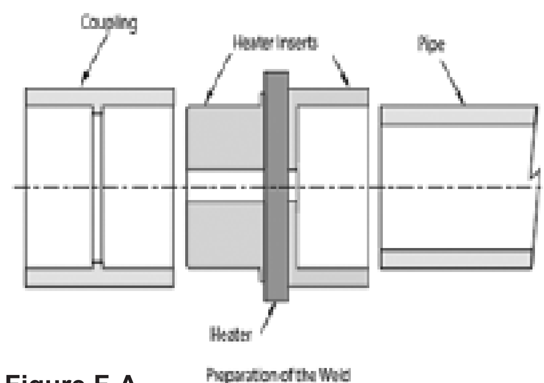

Figure F-A.

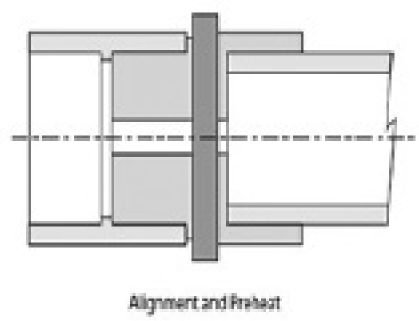

Figure F-B.

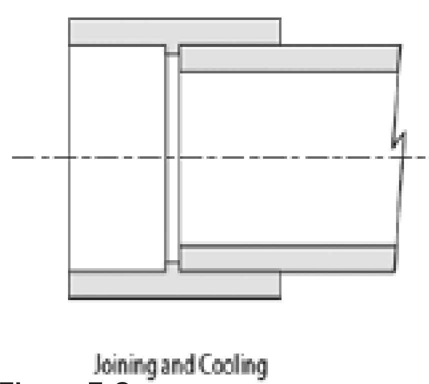

Figure F-C.

F

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Size	Pipe	Heat Soak Time (Sec)	Changeover (Sec)	Cooling (Min)
20	1/2”	5	4	2
25	3/4”	7		
32	1”	8	6	4
40	1-1/4”	12		
50	1-1/2”	18		
63	2”	24	8	6
75	2-1/2”	30		
90	3”	40	10	8
110	4”	50		
125	5”	60		

Table F2. Standard values for socket fusion

Notes:

1. Fusion temperature is 500 ± 15°F (260 ± 10°C)

2. Use Asahitec™ depth gauge for marking correct insertion depth.

3. These values are for room temperature of 68°F (20°C). If room temperature is <41°F (5°C) please contact Asahi/America for new values.

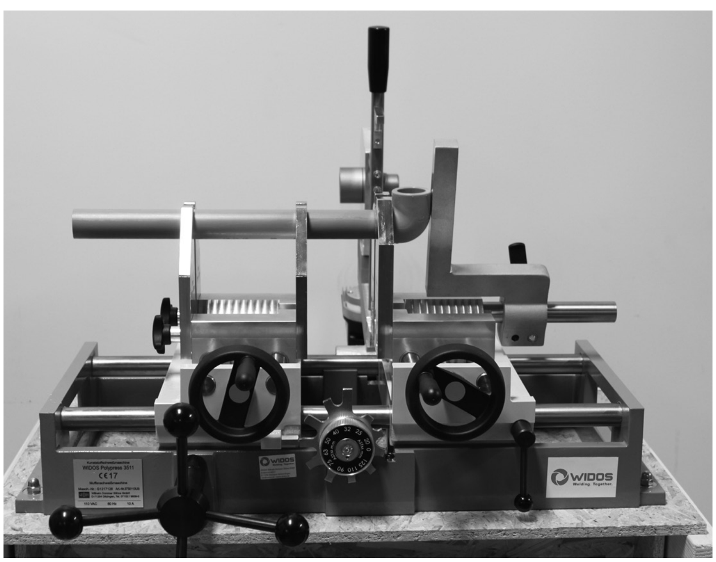

Figure F-5. Benchtop Socket Welding Machine

Set the heating element in the holder. Mount the suitable welding tools (bushing and mandrel) and install the clamping jaws.

Pipes are measured and cut with suitable pipe cutters to the required length. Cutting should be perpendicular to the pipe axis.

Figure F-6. Place and adjust the fitting in the clamping jaw and adjust the stop to hold the fitting.

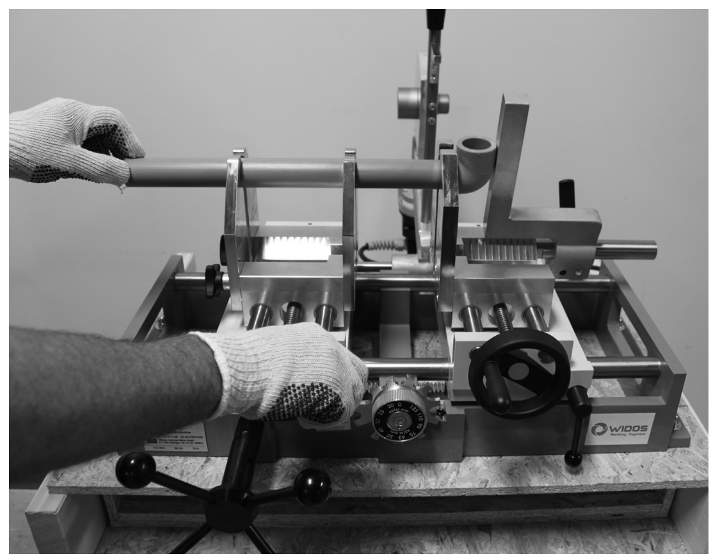

Figure F-7. Lay the pipe axially to the fitting and position it so that it is situated flush to the fitting.

F

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Welding:

Switch on the socket welding machine. The temperature control lamp goes off after reaching the operating temperature (500°F). Temperature tolerance ± 15°F. The first welding should take place within five minutes after the welding temperature has been reached. Split apart the machine slides and close down the heating element. Slowly move the machine slides by turning the hand wheel. Align the heating element so that the pipe and the fitting fit properly into the welding tools. Clean pipe and fitting with 99% isopropyl alcohol. Move the slides with steady forward motion until the stop has been reached. The heating timer of the joint surfaces starts only after the stop has been reached. After completion of the heating time the slides will be split and the heating unit must be brought into a rest position as fast as possible. Move the machine slides with the hand wheel with a steady forward motion up to the stroke end so that the precise jointing depth between the pipe and the fitting is reached. The welded joint may be removed from the clamping jaws only after cooling down. Unscrew the clamping jaw with the handle lock and take off the welded unit.

Figure F-8. Move the machine slides with the handle lock to set the heating element into the center between pipe and fitting.

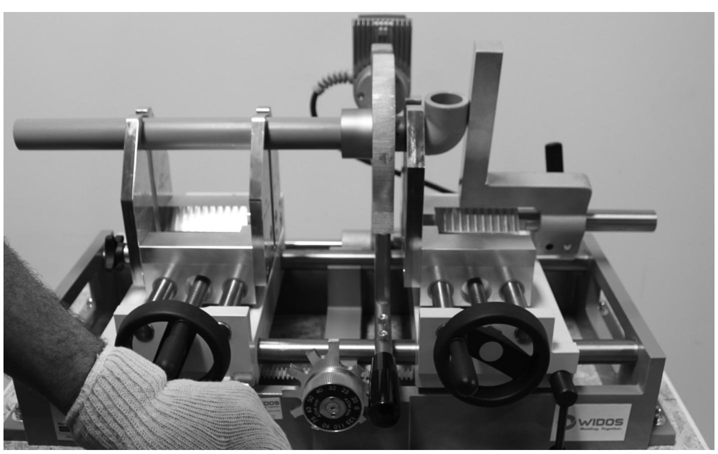

Figure F-9. Move the machine slides with the handle lock, warm up the pipe and the fitting in the welding tools.

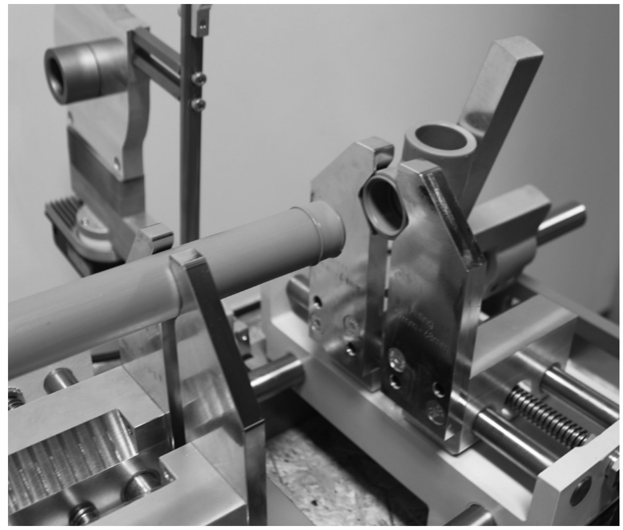

Figure F-10. Move the machine slides with the handle lock and remove the heating element.

After the warming time, weld the pipe and the fitting.

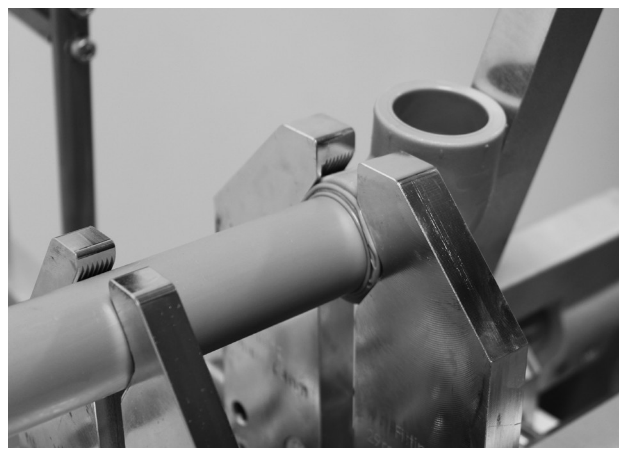

Figure F-11. Move the machine slides up to the stoke end.

Butt Welding

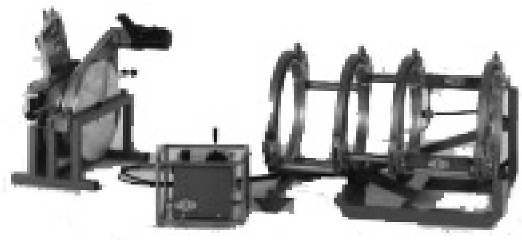

Figure F-12. Trench Butt Welding Machine

Preparation

Cut the pipes with a suitable sawing machine to the required length.

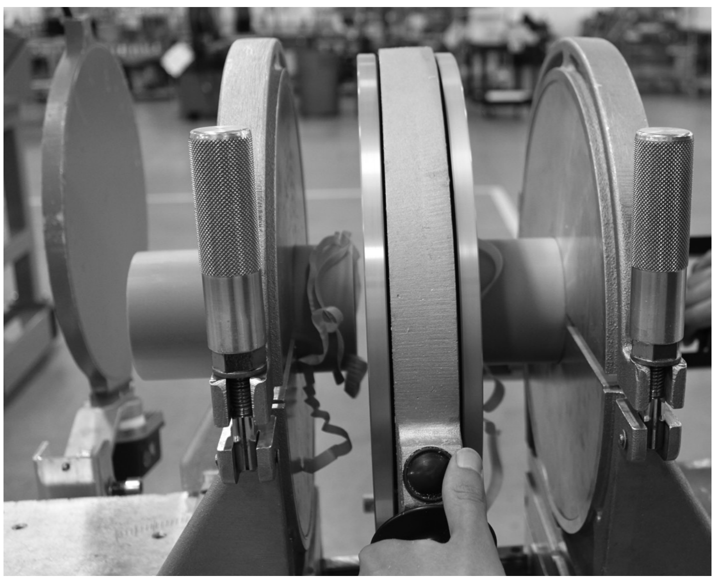

Figure F-13. The spigots of the fittings have to be planed with a planing tool. Ensure that the spigots of the fittings are always planed before every weld.

Welding Procedure:

During butt welding, the areas to be joined are pushed into the heating element at a specified force until the specified bead height is reached. Continue heating up to the welding temperature with reduced pressure (14.5 ±1.5psi) for a prescribed time then, after removing the heating element, join the pieces with merging pressure. Please see welding tool O&M manual for specific welding parameters.

Figure F-14. During butt welding with heating elements, the areas to be joined are heated up to the welding temperature and brought together by prescribed pressure after the heat element has been removed. Heating temperature 410°F (±18°F).

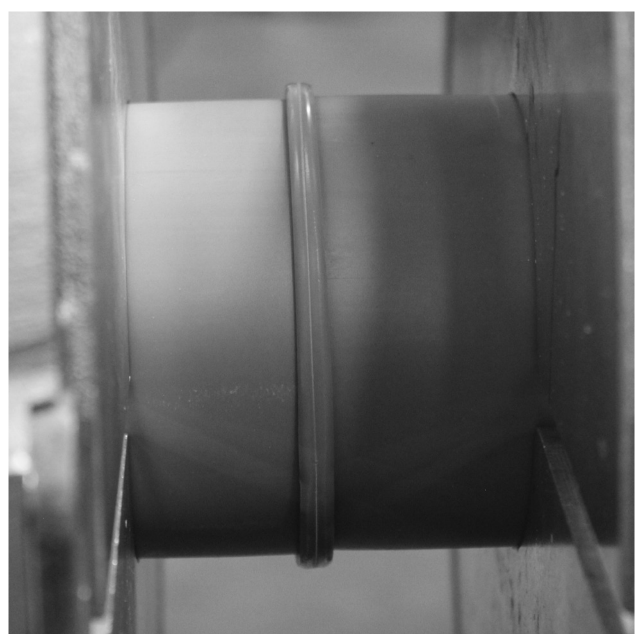

Figure F-15. Check to see that a uniform double bead has been formed and rolled over; this indicates a successful welding.

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Saddle Welding

Additional extension of existing pipe systems:

Direct connection of existing pipe to a utility line. Alternative to T-pieces.

Welding Preparations:

Heat up the heating unit to 500°F.

Check the preset temperature prior to the welding process.

Temperature tolerance (±15°F).

The welding elements must be clean and should be cleaned prior to every welding process.

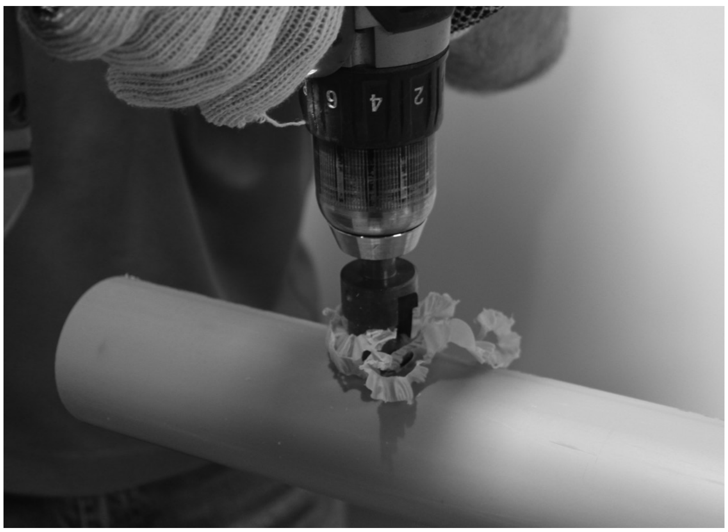

Figure F-16. To drill through the pipe wall, an electric drill and correctly sized drill big, supplied by Asahi/America, are required.

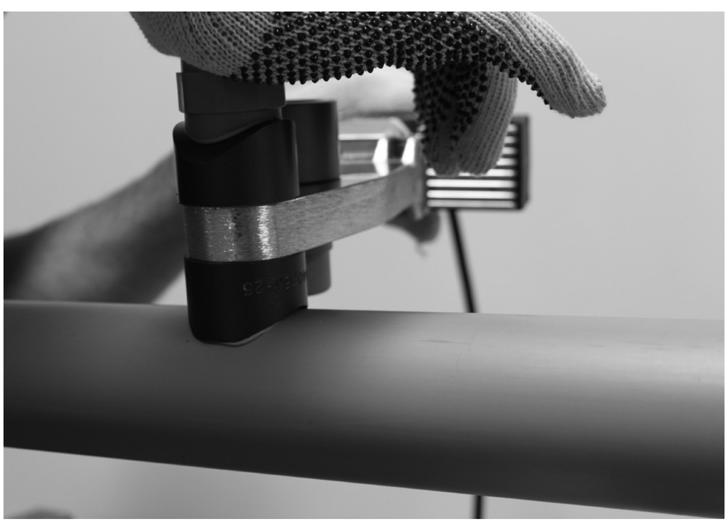

Figure F-17. Insert the male tool bushing into the drilled hole while pushing the fitting spigot into the female tool bushing. The heating time for all dimensions is about 30 seconds.

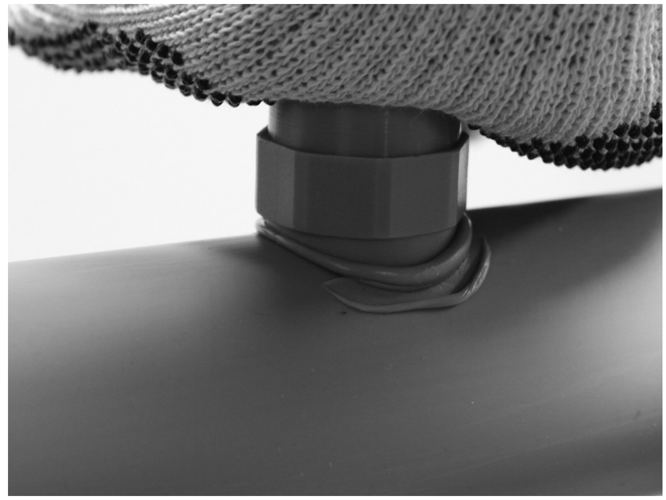

Figure F-18. Push the connecting piece of the welding saddle quickly into the heated bore hole. Push the fitting for about 15 seconds onto the pipe. After a cooling time of about 10 minutes the fused joint can be operated under pressure. The appropriate branch connections will be assembled through socket fusion welding or by using female or male adapters with the welding saddle.

Electrofusion Welding

Figure F-19.

Cut the PP-RCT pipe ends rectangularly to the pipe axis with a suitable pipe cutter. Remove in chips the outer surface oxide layer with a suitable scraper and purify with non-fuzzing, absorbent paper and purifying agent (e.g. alcohol).

Both pieces of pipe must be supported and restrained against movement or external forces. If the pipe is out of round (especially important on larger sizes), a suitable rounding tool will need to be used.

Figure F-17. Remove the outside oxide layer using a scraper. For dimensions larger than 3” (90mm), we recommend using a peeling tool similar to the one shown above for removing the outside oxide layer. Clean the joint surfaces with a purifying agent (e.g. alcohol) and mark the bushing depth.

Mounting of the Electrofusion Welding Sockets.

Mark the socket depth on the pipe. After finishing all preparatory work, take the electrofusion socket out of its packaging - do not touch the inner surfaces of the socket - then push the socket slowly onto the pipe to the marked position.

Figure F-18. Push in the electrofusion socket up to the marked position on the pipe.

Repair Work with the Electrofusion Welding Socket.

Remove the defective pipe by cutting a rectangular section of at least three to four times the socket length to its axis. Fit the new pipe piece into the gap and prepare the ends of the old pipe and new pipe piece as previously described. Unpack two electrofusion sockets and push them completely over the two ends of the new pipe piece. Now fit in the new pipe piece and move the sockets to the marks on the old pipe.

Figure F-19. Align the pipes and the electrofusion socket by using an aligning tool.

Figure F-20. Plug the cables in to the terminals of the electrofusion coupling.

Connecting the Socket Cord

Position the electrofusion welding sockets in a way offering the easiest connection of the cord plugs to the contact leads. Having checked that the required generator voltage is available, switch on the device and plug the cords into the terminals. The electrofusion machine automatically calculates and controls the required welding time and shows the welding indicators after completion. The welding indicator does not indicate the weld quality. Its value may differ depending on the slot width between the electrofusion welding socket and the pipe.

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All parameters of electrofusion are contained in the bar code and show welding time, working voltage and cooling time.

Figure F-21. The welding data can be seen on the bar code label of the socket. The data can also be read by the bar code scanner of the electrofusion machine.

Figure F-22. Start the welding device from the switch.

Cooling Time

Observe the required cooling time.

Pressure Testing

STATEMENT OF USE
The following information is intended to provide a general overview of pressure testing requirements for Asahitec™ PP-RCT piping systems. A pressure test must be performed, documented and submitted to Asahi/America, Inc. in order to receive the available extended warranty. The customer, contractor and design firm should agree upon pressure test criteria applicable to their pipeline and follow all local codes or governing agencies.

SAFETY
- Pneumatic or gas pressure tests are not recommended above 5psi
- Pressure tests should be conducted between 50°F and 90°F
- Before pressure testing, all welded joints must be completely cooled down (one hour after the last welding process)
- If leaks are found in welds during the pressure test, the system should be depressurized and drained prior to fixing

APPARATUS & EQUIPMENT
- Equipment used to isolate sections shall be rated equal or higher than test pressure to be applied
- Air release devices should be located at every high point
- Follow local jurisdictions for supply and disposal of the water test media
- Pressure regulators and gauges must be utilized in order to ensure accuracy and safety
- Pressure gauges should have accuracy better than 1% of full scale

PROCEDURE
SETUP
- It may be necessary to flush the system to remove any debris from installation

INITIAL TEST <5psi Air Test (recommended) five minutes
- Conducting an initial test with compressed air will identify any joints that are not fully fused or threads that are not fully tightened prior to introducing water to the system
- Ability to retain 5psi for five minutes will indicate that no connections remain loose and to continue with the fluid test

PRELIMINARY STATIC TEST (required) 30 minutes
- Fill the system with water at a rate that does not exceed the capacity of the high point vents to release air
- Apply incremental pressure to achieve test requirement of 1.5 times the operating pressure or 150psi, whichever is higher, using a centrifugal pump. Do not exceed the lowest pressure rated component in the system or remove the low pressure rated items during system pressure test
- Apply pressure at the following guide rates:
    - Up through 5” (125mm) at 3% per minute (150psi test pressure = 4.5psi/min)
    - 6” (160mm) through 14” (355mm) at 1% per minute (150psi test pressure = 1.5psi/min)
    - 16” (400mm) and larger at 0.5% per minute (150psi test pressure = 0.75psi/min)
- The pipe system will expand during initial pressurization, which will result in pressure loss. If pressure loss is less than 10psi, continue to next test
- If pressure drops more than 10psi in 30 minutes, stop and repeat the primary static test
- Continued failure indicates leaks exist. Locate the leak and repair the system

PRIMARY STATIC TEST (required) 120 minutes
- Repressurize the system to the test pressure and monitor for 120 minutes
- Pressure loss of more than 5psi is considered a failure

PRIMARY CYCLICAL TEST (required)
- Release the system pressure to 0psi
- Repressurize to test pressure and hold for two minutes. No pressure drop is allowed
- Reduce pressure to 15psi and hold for two minutes. No pressure drop is allowed
- If no pressure drop is witnessed, release the pressure to 0psi and repeat three more times with final intervals of five minutes
- If more than 0.5psi pressure drop occurs, restart from the primary static test

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TESTING

Process Flow Diagram

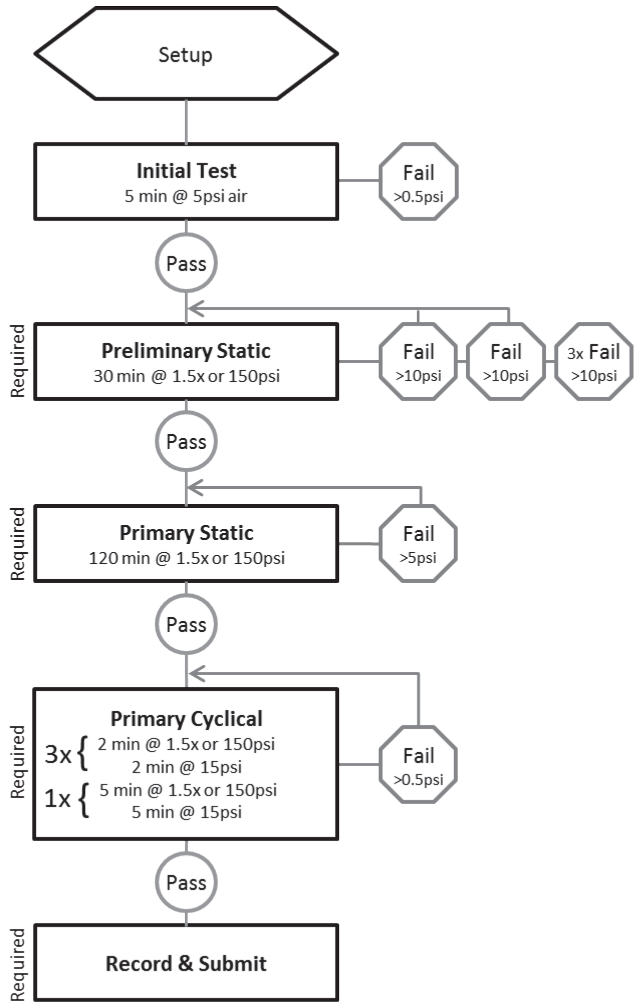

Figure F-23. Process Flow Diagram

Example: System Pressure During Test

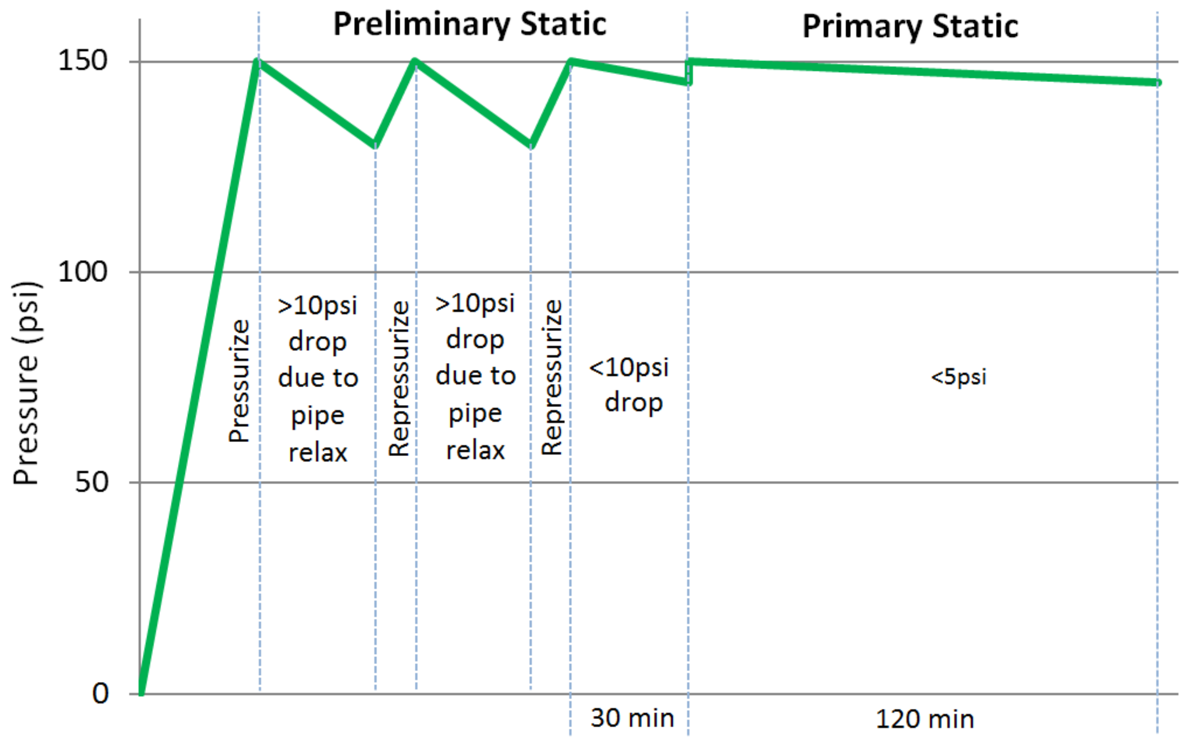

Figure F-24. System Pressure Test

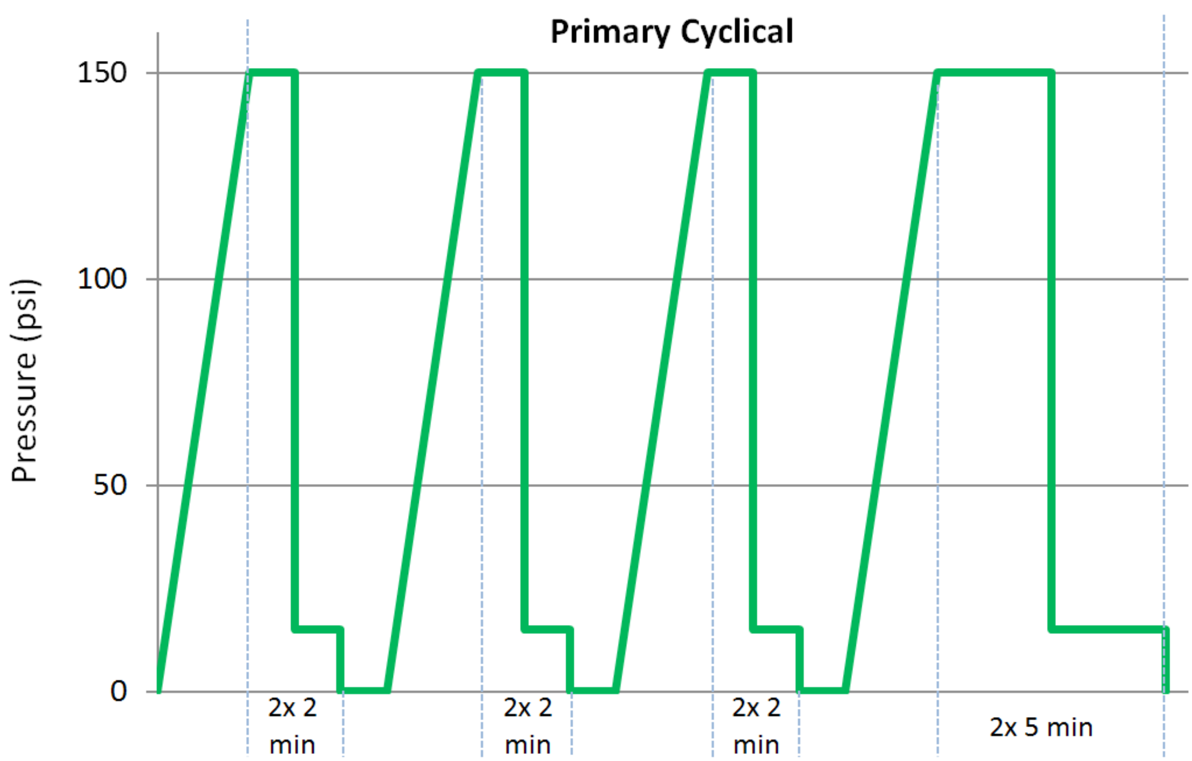

Figure F-25. System Pressure Test

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CHARTS

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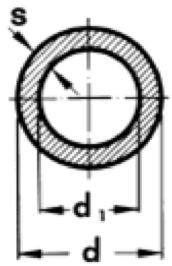

SDR 7.4

Nominal Diameter	d (in)	s (in)	d1 (in)	Weight (lb/ft)
1/2"	0.79	0.11	0.57	0.1
3/4"	0.98	0.14	0.71	0.16
1"	1.26	0.17	0.91	0.25
1-1/4"	1.57	0.22	1.14	0.39
1-1/2"	1.97	0.27	1.43	0.6
2"	2.48	0.34	1.8	0.93
2-1/2"	2.95	0.41	2.14	1.32
3"	3.54	0.48	2.57	1.97
4"	4.33	0.59	3.14	2.93
5"	4.92	0.67	3.57	3.73

Table AP-1. Dimensions 1/2" - 5" SDR 7.4

Limiting impacts and vibrations to the pipe becomes significantly more important as the temperature and wall thickness of the pipe decrease. PP-RCT’s creep curve (DIN 8078) has a low-end temperature of 10°C (50°F). However, through experience and testing we have extended uninsulated Asahitec’s™ low temperature limit down to -5° C (23°F). Please contact Asahi/America’s engineering department for design considerations when the application is outside of the pressure/temperature chart.

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SDR 7.4	1/2"		3/4"		1"		1-1/4"		1-1/2"	
Flow Rate (gpm)	20 mm		25 mm		32 mm		40 mm		50 mm	
	V	P	V	P	V	P	V	P	V	P
0.1	0.1	0.0	0.1	0.0	-	-	-	-	-	-
0.5	0.6	0.4	0.4	0.1	0.2	0.0	0.2	0.0	-	-
1	1.3	1.5	0.8	0.5	0.5	0.2	0.3	0.1	-	-
1.5	1.9	3.3	1.2	1.1	0.7	0.3	0.5	0.1	0.3	0.0
2	2.5	5.5	1.6	1.9	1.0	0.5	0.6	0.2	0.4	0.1
2.5	3.2	8.4	2.0	2.9	1.2	0.8	0.8	0.3	0.5	0.1
3	3.8	11.7	2.4	4.0	1.5	1.2	0.9	0.4	0.6	0.1
3.5	4.4	15.6	2.8	5.3	1.7	1.5	1.1	0.5	0.7	0.2
4	5.1	20.0	3.3	6.8	2.0	2.0	1.3	0.7	0.8	0.2
4.5	5.7	24.8	3.7	8.5	2.2	2.5	1.4	0.8	0.9	0.3
5	6.3	30.2	4.1	10.3	2.4	3.0	1.6	1.0	1.0	0.3
5.5	7.0	36.0	4.5	12.3	2.7	3.6	1.7	1.2	1.1	0.4
6	7.6	42.3	4.9	14.4	2.9	4.2	1.9	1.4	1.2	0.5
6.5	8.2	49.0	5.3	16.7	3.2	4.9	2.0	1.7	1.3	0.6
7	8.9	56.2	5.7	19.2	3.4	5.6	2.2	1.9	1.4	0.6
7.5	9.5	63.9	6.1	21.8	3.7	6.3	2.4	2.2	1.5	0.7
8	10.1	72.0	6.5	24.6	3.9	7.1	2.5	2.4	1.6	0.8
8.5	-	-	6.9	27.5	4.2	8.0	2.7	2.7	1.7	0.9
9	-	-	7.3	30.5	4.4	8.9	2.8	3.0	1.8	1.0
9.5	-	-	7.7	33.7	4.6	9.8	3.0	3.3	1.9	1.1
10	-	-	8.1	37.1	4.9	10.8	3.1	3.7	2.0	1.3
11	-	-	9.0	44.3	5.4	12.9	3.5	4.4	2.2	1.5
12	-	-	9.8	52.0	5.9	15.1	3.8	5.2	2.4	1.8
13	-	-	10.6	60.3	6.4	17.5	4.1	6.0	2.6	2.0
14	-	-	-	-	6.8	20.1	4.4	6.9	2.8	2.3
15	-	-	-	-	7.3	22.8	4.7	7.8	3.0	2.7
16	-	-	-	-	7.8	25.7	5.0	8.8	3.2	3.0
17	-	-	-	-	8.3	28.8	5.3	9.8	3.4	3.3
18	-	-	-	-	8.8	32.0	5.6	10.9	3.6	3.7
19	-	-	-	-	9.3	35.4	6.0	12.1	3.8	4.1
20	-	-	-	-	9.8	38.9	6.3	13.3	4.0	4.5
22	-	-	-	-	10.8	46.4	6.9	15.8	4.4	5.4
24	-	-	-	-	-	-	7.5	18.6	4.8	6.3
26	-	-	-	-	-	-	8.2	21.5	5.2	7.3
28	-	-	-	-	-	-	8.8	24.7	5.6	8.4
30	-	-	-	-	-	-	9.4	28.1	6.0	9.6
32	-	-	-	-	-	-	10.0	31.6	6.4	10.8
34	-	-	-	-	-	-	-	-	6.8	12.0
36	-	-	-	-	-	-	-	-	7.2	13.4
38	-	-	-	-	-	-	-	-	7.6	14.8
40	-	-	-	-	-	-	-	-	8.1	16.3
45	-	-	-	-	-	-	-	-	9.1	20.2
50	-	-	-	-	-	-	-	-	10.1	24.6

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-2. Flow Rate 1/2" - 1-1/2" SDR 7.4

AP

SDR 7.4	2"		2-1/2"		3"		4"		5"	
Flow Rate (gpm)	63 mm		75 mm		90 mm		110 mm		125 mm	
	V	P	V	P	V	P	V	P	V	P
3	0.4	0.0	-	-	-	-	-	-	-	-
4	0.5	0.1	-	-	-	-	-	-	-	-
5	0.6	0.1	0.4	0.0	-	-	-	-	-	-
6	0.8	0.2	0.5	0.1	-	-	-	-	-	-
7	0.9	0.2	0.6	0.1	-	-	-	-	-	-
8	1.0	0.3	0.7	0.1	0.5	0.0	-	-	-	-
9	1.1	0.3	0.8	0.1	0.6	0.1	-	-	-	-
10	1.3	0.4	0.9	0.2	0.6	0.1	-	-	-	-
12	1.5	0.6	1.1	0.2	0.7	0.1	0.5	0.0	-	-
14	1.8	0.7	1.2	0.3	0.9	0.1	0.6	0.1	-	-
16	2.0	1.0	1.4	0.4	1.0	0.2	0.7	0.1	-	-
18	2.3	1.2	1.6	0.5	1.1	0.2	0.7	0.1	0.6	0.0
20	2.5	1.4	1.8	0.6	1.2	0.3	0.8	0.1	0.6	0.1
25	3.1	2.2	2.2	0.9	1.5	0.4	1.0	0.1	0.8	0.1
30	3.8	3.1	2.7	1.3	1.8	0.5	1.2	0.2	1.0	0.1
35	4.4	4.1	3.1	1.8	2.2	0.7	1.4	0.3	1.1	0.1
40	5.0	5.2	3.6	2.3	2.5	0.9	1.7	0.4	1.3	0.2
45	5.7	6.5	4.0	2.8	2.8	1.1	1.9	0.4	1.4	0.2
50	6.3	7.9	4.5	3.4	3.1	1.4	2.1	0.5	1.6	0.3
55	6.9	9.4	4.9	4.1	3.4	1.7	2.3	0.6	1.8	0.3
60	7.5	11.0	5.3	4.8	3.7	1.9	2.5	0.7	1.9	0.4
65	8.2	12.8	5.8	5.5	4.0	2.3	2.7	0.9	2.1	0.5
70	8.8	14.6	6.2	6.4	4.3	2.6	2.9	1.0	2.2	0.5
75	9.4	16.6	6.7	7.2	4.6	2.9	3.1	1.1	2.4	0.6
80	10.1	18.7	7.1	8.1	4.9	3.3	3.3	1.3	2.6	0.7
85	-	-	7.6	9.1	5.2	3.7	3.5	1.4	2.7	0.8
90	-	-	8.0	10.1	5.5	4.1	3.7	1.6	2.9	0.8
95	-	-	8.5	11.2	5.8	4.6	3.9	1.7	3.0	0.9
100	-	-	8.9	12.3	6.2	5.0	4.1	1.9	3.2	1.0
110	-	-	9.8	14.7	6.8	6.0	4.5	2.3	3.5	1.2
120	-	-	10.7	17.2	7.4	7.0	5.0	2.7	3.8	1.4
130	-	-	-	-	8.0	8.2	5.4	3.1	4.2	1.7
140	-	-	-	-	8.6	9.3	5.8	3.6	4.5	1.9
150	-	-	-	-	9.2	10.6	6.2	4.0	4.8	2.2
160	-	-	-	-	9.9	12.0	6.6	4.6	5.1	2.4
180	-	-	-	-	11.1	14.9	7.4	5.7	5.8	3.0
200	-	-	-	-	-	-	8.3	6.9	6.4	3.7
220	-	-	-	-	-	-	9.1	8.2	7.0	4.4
240	-	-	-	-	-	-	9.9	9.6	7.7	5.2
260	-	-	-	-	-	-	10.8	11.2	8.3	6.0
280	-	-	-	-	-	-	-	-	8.9	6.9
300	-	-	-	-	-	-	-	-	9.6	7.8
320	-	-	-	-	-	-	-	-	10.2	8.8

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-3. Flow Rate 2" - 5" SDR 7.4

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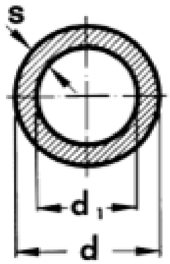

SDR 9

Nominal Diameter	d (in)	s (in)	d1 (in)	Weight (lb/ft)
1/2"	0.79	0.091	0.605	0.09
3/4"	0.98	0.110	0.764	0.14
1"	1.26	0.141	0.978	0.23
1-1/4"	1.57	0.177	1.221	0.34
1-1/2"	1.97	0.22	1.529	0.5
2"	2.48	0.279	1.922	0.84
2-1/2"	2.95	0.33	2.293	1.14
3"	3.54	0.397	2.749	1.65
4"	4.33	0.484	3.363	2.45
5"	4.92	0.551	3.819	3.01

Table AP-4. Dimensions 1/2" - 5" SDR 9

Limiting impacts and vibrations to the pipe becomes significantly more important as the temperature and wall thickness of the pipe decrease. PP-RCT's creep curve (DIN 8078) has a low-end temperature of 10°C (50°F). However, through experience and testing we have extended uninsulated Asahitec's™ low temperature limit down to -5° C (23°F). Please contact Asahi/America's engineering department for design considerations when the application is outside of the pressure/temperature chart.

SDR 9	1/2" 20 mm		3/4" 25 mm		1" 32 mm		1-1/4" 40 mm		1-1/2" 50 mm	
Flow Rate (gpm)	V	P	V	P	V	P	V	P	V	P
0.1	0.1	0.0	0.1	0.0	-	-	-	-	-	-
0.5	0.6	0.3	0.3	0.1	0.2	0.0	-	-	-	-
1	1.1	1.1	0.7	0.4	0.4	0.1	0.3	0.0	-	-
1.5	1.7	2.4	1.0	0.8	0.6	0.2	0.4	0.1	-	-
2	2.2	4.0	1.4	1.3	0.9	0.4	0.5	0.1	0.3	0.0
2.5	2.8	6.1	1.7	2.0	1.1	0.6	0.7	0.2	0.4	0.1
3	3.3	8.6	2.1	2.8	1.3	0.8	0.8	0.3	0.5	0.1
3.5	3.9	11.4	2.4	3.7	1.5	1.1	1.0	0.4	0.6	0.1
4	4.5	14.6	2.8	4.7	1.7	1.4	1.1	0.5	0.7	0.2
4.5	5.0	18.1	3.1	5.9	1.9	1.8	1.2	0.6	0.8	0.2
5	5.6	22.0	3.5	7.1	2.1	2.2	1.4	0.7	0.9	0.2
5.5	6.1	26.3	3.8	8.5	2.3	2.6	1.5	0.9	1.0	0.3
6	6.7	30.9	4.2	10.0	2.6	3.0	1.6	1.0	1.0	0.3
6.5	7.2	35.8	4.5	11.6	2.8	3.5	1.8	1.2	1.1	0.4
7	7.8	41.1	4.9	13.3	3.0	4.0	1.9	1.4	1.2	0.5
7.5	8.4	46.7	5.2	15.1	3.2	4.6	2.1	1.6	1.3	0.5
8	8.9	52.6	5.6	17.0	3.4	5.1	2.2	1.8	1.4	0.6
8.5	9.5	58.8	5.9	19.0	3.6	5.7	2.3	2.0	1.5	0.7
9	10.0	65.4	6.3	21.1	3.8	6.4	2.5	2.2	1.6	0.7
9.5	-	-	6.6	23.3	4.1	7.1	2.6	2.4	1.7	0.8
10	-	-	7.0	25.7	4.3	7.8	2.7	2.6	1.7	0.9
11	-	-	7.7	30.6	4.7	9.3	3.0	3.2	1.9	1.1
12	-	-	8.4	35.9	5.1	10.9	3.3	3.7	2.1	1.2
13	-	-	9.1	41.7	5.6	12.6	3.6	4.3	2.3	1.4
14	-	-	9.8	47.8	6.0	14.5	3.8	4.9	2.4	1.7
15	-	-	10.5	54.3	6.4	16.4	4.1	5.6	2.6	1.9
16	-	-	-	-	6.8	18.5	4.4	6.3	2.8	2.1
17	-	-	-	-	7.3	20.7	4.7	7.1	3.0	2.4
18	-	-	-	-	7.7	23.0	4.9	7.9	3.1	2.6
19	-	-	-	-	8.1	25.5	5.2	8.7	3.3	2.9
20	-	-	-	-	8.5	28.0	5.5	9.5	3.5	3.2
22	-	-	-	-	9.4	33.4	6.0	11.4	3.8	3.8
24	-	-	-	-	10.3	39.2	6.6	13.4	4.2	4.5
26	-	-	-	-	-	-	7.1	15.5	4.5	5.2
28	-	-	-	-	-	-	7.7	17.8	4.9	6.0
30	-	-	-	-	-	-	8.2	20.2	5.2	6.8
35	-	-	-	-	-	-	9.6	26.9	6.1	9.0
40	-	-	-	-	-	-	11.0	34.4	7.0	11.6
45	-	-	-	-	-	-	-	-	7.9	14.4
50	-	-	-	-	-	-	-	-	8.7	17.5
55	-	-	-	-	-	-	-	-	9.6	20.8
60	-	-	-	-	-	-	-	-	10.5	24.5
65	-	-	-	-	-	-	-	-	11.4	28.4

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-5. Flow Rate 1/2" - 1-1/2" SDR 9

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PRESSURE RATING

SDR 9	2"		2-1/2"		3"		4"		5"	
Flow Rate (gpm)	63 mm		75 mm		90 mm		110 mm		125 mm	
	V	P	V	P	V	P	V	P	V	P
2	0.2	0.0	-	-	-	-	-	-	-	-
4	0.4	0.1	-	-	-	-	-	-	-	-
6	0.7	0.1	0.5	0.0	-	-	-	-	-	-
8	0.9	0.2	0.6	0.1	0.4	0.0	-	-	-	-
10	1.1	0.3	0.8	0.1	0.5	0.1	-	-	-	-
12	1.3	0.4	0.9	0.2	0.6	0.1	-	-	-	-
14	1.5	0.5	1.1	0.2	0.8	0.1	-	-	-	-
16	1.8	0.7	1.2	0.3	0.9	0.1	0.6	0.0	-	-
18	2.0	0.9	1.4	0.4	1.0	0.2	0.7	0.1	-	-
20	2.2	1.1	1.6	0.4	1.1	0.2	0.7	0.1	0.6	0.0
25	2.8	1.6	1.9	0.7	1.4	0.3	0.9	0.1	0.7	0.1
30	3.3	2.2	2.3	1.0	1.6	0.4	1.1	0.1	0.8	0.1
35	3.9	3.0	2.7	1.3	1.9	0.5	1.3	0.2	1.0	0.1
40	4.4	3.8	3.1	1.6	2.2	0.7	1.4	0.3	1.1	0.1
45	5.0	4.7	3.5	2.0	2.4	0.8	1.6	0.3	1.3	0.2
50	5.5	5.7	3.9	2.4	2.7	1.0	1.8	0.4	1.4	0.2
55	6.1	6.9	4.3	2.9	3.0	1.2	2.0	0.5	1.5	0.2
60	6.6	8.1	4.7	3.4	3.2	1.4	2.2	0.5	1.7	0.3
65	7.2	9.3	5.0	4.0	3.5	1.6	2.3	0.6	1.8	0.3
70	7.7	10.7	5.4	4.6	3.8	1.9	2.5	0.7	2.0	0.4
75	8.3	12.2	5.8	5.2	4.1	2.1	2.7	0.8	2.1	0.4
80	8.8	13.7	6.2	5.8	4.3	2.4	2.9	0.9	2.2	0.5
85	9.4	15.3	6.6	6.5	4.6	2.7	3.1	1.0	2.4	0.5
90	9.9	17.1	7.0	7.3	4.9	3.0	3.3	1.1	2.5	0.6
95	10.5	18.8	7.4	8.0	5.1	3.3	3.4	1.3	2.7	0.7
100	-	-	7.8	8.8	5.4	3.7	3.6	1.4	2.8	0.7
110	-	-	8.5	10.5	5.9	4.4	4.0	1.6	3.1	0.9
120	-	-	9.3	12.3	6.5	5.1	4.3	1.9	3.4	1.0
130	-	-	10.1	14.3	7.0	5.9	4.7	2.2	3.6	1.2
140	-	-	-	-	7.6	6.8	5.1	2.6	3.9	1.4
150	-	-	-	-	8.1	7.7	5.4	2.9	4.2	1.6
160	-	-	-	-	8.6	8.7	5.8	3.3	4.5	1.8
180	-	-	-	-	9.7	10.8	6.5	4.1	5.0	2.2
200	-	-	-	-	10.8	13.2	7.2	5.0	5.6	2.7
220	-	-	-	-	-	-	7.9	5.9	6.2	3.2
240	-	-	-	-	-	-	8.7	6.9	6.7	3.7
260	-	-	-	-	-	-	9.4	8.1	7.3	4.3
280	-	-	-	-	-	-	10.1	9.2	7.8	5.0
300	-	-	-	-	-	-	-	-	8.4	5.7
320	-	-	-	-	-	-	-	-	9.0	6.4
340	-	-	-	-	-	-	-	-	9.5	7.1
360	-	-	-	-	-	-	-	-	10.1	7.9
380	-	-	-	-	-	-	-	-	10.6	8.8

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-6. Flow Rate 2"- 5" SDR 9

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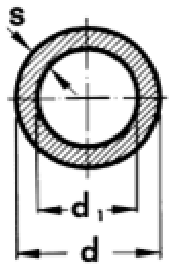

SDR 11

Nominal Diameter	d (in)	s (in)	d1 (in)	Weight (lb/ft)
1"	1.26	0.11	1.03	0.19
1-1/4"	1.59	0.15	1.28	0.28
1-1/2"	1.97	0.18	1.61	0.43
2"	2.48	0.23	2.02	0.94
2-1/2"	2.95	0.27	2.42	0.97
3"	3.54	0.32	2.9	1.36
4"	4.33	0.39	3.54	2.07
5"	4.92	0.45	4.02	2.63
6"	6.30	0.57	5.15	4.54
8"	7.87	0.72	6.44	7.15
10"	9.84	0.89	8.06	10.86
12"	12.40	1.13	10.15	17.06
14"	13.98	1.27	11.44	24.54
16"	15.75	1.43	12.89	27.28
18"	17.72	1.61	14.5	38.51
20"	19.59	1.79	16.11	43.57

Table AP-7. Dimensions 1" - 20" SDR 11

Limiting impacts and vibrations to the pipe becomes significantly more important as the temperature and wall thickness of the pipe decrease. PP-RCT's creep curve (DIN 8078) has a low-end temperature of 10°C (50°F). However, through experience and testing we have extended uninsulated Asahitec's™ low temperature limit down to -5° C (23°F). Please contact Asahi/America's engineering department for design considerations when the application is outside of the pressure/temperature chart.

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SDR 11	1"		1-1/4"		1-1/2"		2"		2-1/2"	
Flow Rate (gpm)	32 mm		40 mm		50 mm		63 mm		75 mm	
	V	P	V	P	V	P	V	P	V	P
0.5	0.2	0.0	-	-	-	-	-	-	-	-
1	0.4	0.1	0.2	0.0	-	-	-	-	-	-
1.5	0.6	0.2	0.4	0.1	-	-	-	-	-	-
2	0.8	0.3	0.5	0.1	0.3	0.0	-	-	-	-
2.5	1.0	0.5	0.6	0.2	0.4	0.1	-	-	-	-
3	1.2	0.6	0.7	0.2	0.5	0.1	-	-	-	-
3.5	1.3	0.9	0.9	0.3	0.6	0.1	-	-	-	-
4	1.5	1.1	1.0	0.4	0.6	0.1	0.4	0.0	-	-
4.5	1.7	1.4	1.1	0.5	0.7	0.2	0.4	0.1	-	-
5	1.9	1.7	1.2	0.6	0.8	0.2	0.5	0.1	-	-
6	2.3	2.3	1.5	0.8	0.9	0.3	0.6	0.1	-	-
7	2.7	3.1	1.7	1.1	1.1	0.4	0.7	0.1	0.5	0.0
8	3.1	4.0	2.0	1.4	1.3	0.5	0.8	0.2	0.6	0.1
9	3.5	4.9	2.2	1.7	1.4	0.6	0.9	0.2	0.6	0.1
10	3.8	6.0	2.5	2.1	1.6	0.7	1.0	0.2	0.7	0.1
11	4.2	7.1	2.7	2.5	1.7	0.8	1.1	0.3	0.8	0.1
12	4.6	8.4	3.0	2.9	1.9	1.0	1.2	0.3	0.8	0.1
13	5.0	9.7	3.2	3.4	2.1	1.1	1.3	0.4	0.9	0.2
14	5.4	11.2	3.5	3.9	2.2	1.3	1.4	0.4	1.0	0.2
16	6.1	14.3	4.0	5.0	2.5	1.7	1.6	0.5	1.1	0.2
18	6.9	17.8	4.5	6.2	2.8	2.1	1.8	0.7	1.3	0.3
20	7.7	21.6	5.0	7.5	3.2	2.5	2.0	0.8	1.4	0.3
22	8.4	25.7	5.5	9.0	3.5	3.0	2.2	1.0	1.5	0.4
24	9.2	30.2	6.0	10.5	3.8	3.5	2.4	1.2	1.7	0.5
26	10.0	35.0	6.5	12.2	4.1	4.1	2.6	1.3	1.8	0.6
28	-	-	6.9	14.0	4.4	4.7	2.8	1.5	2.0	0.6
30	-	-	7.4	15.9	4.7	5.3	3.0	1.7	2.1	0.7
35	-	-	8.7	21.1	5.5	7.1	3.5	2.3	2.4	1.0
40	-	-	9.9	27.0	6.3	9.1	4.0	3.0	2.8	1.3
45	-	-	11.2	33.6	7.1	11.3	4.5	3.7	3.1	1.6
50	-	-	-	-	7.9	13.7	5.0	4.5	3.5	1.9
55	-	-	-	-	8.7	16.4	5.5	5.3	3.8	2.3
60	-	-	-	-	9.5	19.2	6.0	6.3	4.2	2.7
65	-	-	-	-	10.3	22.3	6.5	7.3	4.5	3.1
70	-	-	-	-	-	-	7.0	8.3	4.9	3.5
80	-	-	-	-	-	-	8.0	10.7	5.6	4.5
90	-	-	-	-	-	-	9.0	13.3	6.3	5.6
100	-	-	-	-	-	-	10.0	16.1	7.0	6.8
110	-	-	-	-	-	-	-	-	7.7	8.1
120	-	-	-	-	-	-	-	-	8.4	9.6
130	-	-	-	-	-	-	-	-	9.1	11.1
140	-	-	-	-	-	-	-	-	9.8	12.7
150	-	-	-	-	-	-	-	-	10.5	14.5

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-8. Flow Rate 1" - 2-1/2" SDR 11

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SDR 11	3"		4"		5"		6"		8"	
Flow Rate (gpm)	90 mm		110 mm		125 mm		160 mm		200 mm	
	V	P	V	P	V	P	V	P	V	P
10	0.5	0.0	-	-	-	-	-	-	-	-
15	0.7	0.1	0.5	0.0	-	-	-	-	-	-
20	1.0	0.1	0.7	0.1	-	-	-	-	-	-
25	1.2	0.2	0.8	0.1	0.6	0.0	-	-	-	-
30	1.5	0.3	1.0	0.1	0.8	0.1	-	-	-	-
35	1.7	0.4	1.1	0.2	0.9	0.1	-	-	-	-
40	1.9	0.5	1.3	0.2	1.0	0.1	-	-	-	-
45	2.2	0.6	1.5	0.2	1.1	0.1	-	-	-	-
50	2.4	0.8	1.6	0.3	1.3	0.2	0.8	0.0	-	-
60	2.9	1.1	2.0	0.4	1.5	0.2	0.9	0.1	-	-
70	3.4	1.5	2.3	0.6	1.8	0.3	1.1	0.1	-	-
80	3.9	1.9	2.6	0.7	2.0	0.4	1.2	0.1	-	-
90	4.4	2.3	2.9	0.9	2.3	0.5	1.4	0.1	0.9	0.0
100	4.9	2.8	3.3	1.1	2.5	0.6	1.5	0.2	1.0	0.1
120	5.8	4.0	3.9	1.5	3.0	0.8	1.8	0.2	1.2	0.1
130	6.3	4.6	4.2	1.7	3.3	0.9	2.0	0.3	1.3	0.1
140	6.8	5.3	4.6	2.0	3.5	1.1	2.2	0.3	1.4	0.1
150	7.3	6.0	4.9	2.3	3.8	1.2	2.3	0.4	1.5	0.1
160	7.8	6.8	5.2	2.5	4.0	1.4	2.5	0.4	1.6	0.1
180	8.8	8.4	5.9	3.2	4.5	1.7	2.8	0.5	1.8	0.2
200	9.7	10.2	6.5	3.9	5.0	2.1	3.1	0.6	2.0	0.2
220	10.7	12.2	7.2	4.6	5.6	2.5	3.4	0.7	2.2	0.3
240	-	-	7.8	5.4	6.1	2.9	3.7	0.9	2.4	0.3
260	-	-	8.5	6.3	6.6	3.4	4.0	1.0	2.6	0.3
280	-	-	9.1	7.2	7.1	3.9	4.3	1.2	2.8	0.4
300	-	-	9.8	8.2	7.6	4.4	4.6	1.3	3.0	0.4
325	-	-	10.6	9.5	8.2	5.1	5.0	1.5	3.2	0.5
350	-	-	-	-	8.8	5.9	5.4	1.8	3.4	0.6
375	-	-	-	-	9.5	6.6	5.8	2.0	3.7	0.7
400	-	-	-	-	10.1	7.5	6.2	2.3	3.9	0.8
450	-	-	-	-	-	-	6.9	2.8	4.4	1.0
500	-	-	-	-	-	-	7.7	3.4	4.9	1.2
550	-	-	-	-	-	-	8.5	4.1	5.4	1.4
600	-	-	-	-	-	-	9.2	4.8	5.9	1.6
650	-	-	-	-	-	-	10.0	5.6	6.4	1.9
700	-	-	-	-	-	-	-	-	6.9	2.2
750	-	-	-	-	-	-	-	-	7.4	2.4
800	-	-	-	-	-	-	-	-	7.9	2.8
850	-	-	-	-	-	-	-	-	8.4	3.1
900	-	-	-	-	-	-	-	-	8.9	3.4
950	-	-	-	-	-	-	-	-	9.4	3.8
1000	-	-	-	-	-	-	-	-	9.8	4.2
1050	-	-	-	-	-	-	-	-	10.3	4.6

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-9. Flow Rate 3"- 8" SDR 11

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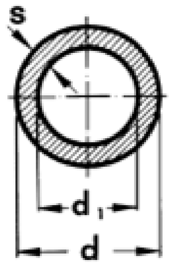
SDR 11	10"		12"		14"		16"		18"	
Flow Rate (gpm)	250 mm		315 mm		355 mm		400 mm		450 mm	
	V	P	V	P	V	P	V	P	V	P
150	0.9	0.0	-	-	-	-	-	-	-	-
200	1.3	0.1	-	-	-	-	-	-	-	-
250	1.6	0.1	-	-	-	-	-	-	-	-
300	1.9	0.2	1.2	0.0	-	-	-	-	-	-
350	2.2	0.2	1.4	0.1	-	-	-	-	-	-
400	2.5	0.3	1.6	0.1	1.2	0.0	-	-	-	-
450	2.8	0.3	1.8	0.1	1.4	0.1	-	-	-	-
500	3.1	0.4	2.0	0.1	1.6	0.1	-	-	-	-
550	3.5	0.5	2.2	0.2	1.7	0.1	1.4	0.0	-	-
600	3.8	0.5	2.4	0.2	1.9	0.1	1.5	0.1	-	-
700	4.4	0.7	2.8	0.2	2.2	0.1	1.7	0.1	1.4	0.0
800	5.0	0.9	3.2	0.3	2.5	0.2	2.0	0.1	1.6	0.1
900	5.7	1.2	3.6	0.4	2.8	0.2	2.2	0.1	1.7	0.1
1000	6.3	1.4	4.0	0.5	3.1	0.3	2.5	0.1	1.9	0.1
1100	6.9	1.7	4.4	0.5	3.4	0.3	2.7	0.2	2.1	0.1
1200	7.6	2.0	4.8	0.6	3.7	0.4	2.9	0.2	2.3	0.1
1300	8.2	2.3	5.2	0.7	4.1	0.4	3.2	0.2	2.5	0.1
1400	8.8	2.6	5.6	0.9	4.4	0.5	3.4	0.3	2.7	0.2
1500	9.4	3.0	5.9	1.0	4.7	0.5	3.7	0.3	2.9	0.2
1600	10.1	3.4	6.3	1.1	5.0	0.6	3.9	0.3	3.1	0.2
1700	-	-	6.7	1.2	5.3	0.7	4.2	0.4	3.3	0.2
1800	-	-	7.1	1.4	5.6	0.8	4.4	0.4	3.5	0.2
1900	-	-	7.5	1.5	5.9	0.8	4.7	0.5	3.7	0.3
2000	-	-	7.9	1.7	6.2	0.9	4.9	0.5	3.9	0.3
2100	-	-	8.3	1.8	6.6	1.0	5.2	0.6	4.1	0.3
2200	-	-	8.7	2.0	6.9	1.1	5.4	0.6	4.3	0.4
2300	-	-	9.1	2.1	7.2	1.2	5.7	0.7	4.5	0.4
2400	-	-	9.5	2.3	7.5	1.3	5.9	0.7	4.7	0.4
2500	-	-	9.9	2.5	7.8	1.4	6.1	0.8	4.9	0.4
2600	-	-	10.3	2.7	8.1	1.5	6.4	0.8	5.1	0.5
2700	-	-	-	-	8.4	1.6	6.6	0.9	5.2	0.5
2800	-	-	-	-	8.7	1.7	6.9	1.0	5.4	0.5
2900	-	-	-	-	9.0	1.8	7.1	1.0	5.6	0.6
3000	-	-	-	-	9.4	2.0	7.4	1.1	5.8	0.6
3250	-	-	-	-	10.1	2.3	8.0	1.3	6.3	0.7
3500	-	-	-	-	-	-	8.6	1.5	6.8	0.8
3750	-	-	-	-	-	-	9.2	1.7	7.3	0.9
4000	-	-	-	-	-	-	9.8	1.9	7.8	1.1
4250	-	-	-	-	-	-	10.4	2.1	8.3	1.2
4500	-	-	-	-	-	-	-	-	8.7	1.3
4750	-	-	-	-	-	-	-	-	9.2	1.5
5000	-	-	-	-	-	-	-	-	9.7	1.6
5250	-	-	-	-	-	-	-	-	10.2	1.8

** PLEASE CONSULT FACTORY FOR 20" AND 24" DATA

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-10. Flow Rate 10" - 18" SDR 11



SDR 17

Nominal Diameter	d (in)	s (in)	d1 (in)	Weight (lb/ft)
6"	6.30	0.37	5.55	4.54
8"	7.87	0.47	6.94	7.15
10"	9.84	0.58	8.68	10.86
12"	12.40	0.74	10.93	17.06
14"	13.98	0.83	12.31	24.54
16"	15.75	0.93	13.88	27.28
18"	17.72	1.05	15.61	38.51
20"	19.69	1.17	17.35	43.57

Table AP-11. Dimensions 6" - 20" SDR 17

Limiting impacts and vibrations to the pipe becomes significantly more important as the temperature and wall thickness of the pipe decrease. PP-RCT's creep curve (DIN 8078) has a low-end temperature of 10°C (50°F). However, through experience and testing we have extended uninsulated Asahitec's™ low temperature limit down to -5° C (23°F). Please contact Asahi/America's engineering department for design considerations when the application is outside of the pressure/temperature chart.

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SDR 17	6"		8"		10"		12"		14"	
Flow Rate (gpm)	160 mm		200 mm		250 mm		315 mm		355 mm	
	V	P	V	P	V	P	V	P	V	P
50	0.7	0.0	-	-	-	-	-	-	-	-
75	1.0	0.1	-	-	-	-	-	-	-	-
100	1.3	0.1	0.8	0.0	-	-	-	-	-	-
125	1.7	0.2	1.1	0.1	-	-	-	-	-	-
150	2.0	0.3	1.3	0.1	-	-	-	-	-	-
175	2.3	0.3	1.5	0.1	-	-	-	-	-	-
200	2.7	0.4	1.7	0.1	1.1	0.0	-	-	-	-
250	3.3	0.7	2.1	0.2	1.4	0.1	-	-	-	-
300	4.0	0.9	2.5	0.3	1.6	0.1	-	-	-	-
350	4.6	1.2	3.0	0.4	1.9	0.1	1.2	0.0	-	-
400	5.3	1.6	3.4	0.5	2.2	0.2	1.4	0.1	-	-
450	6.0	2.0	3.8	0.7	2.4	0.2	1.5	0.1	-	-
500	6.6	2.4	4.2	0.8	2.7	0.3	1.7	0.1	1.3	0.0
550	7.3	2.8	4.7	1.0	3.0	0.3	1.9	0.1	1.5	0.1
600	8.0	3.3	5.1	1.1	3.3	0.4	2.1	0.1	1.6	0.1
650	8.6	3.9	5.5	1.3	3.5	0.4	2.2	0.1	1.8	0.1
700	9.3	4.4	5.9	1.5	3.8	0.5	2.4	0.2	1.9	0.1
750	9.9	5.0	6.4	1.7	4.1	0.6	2.6	0.2	2.0	0.1
800	10.6	5.7	6.8	1.9	4.3	0.6	2.7	0.2	2.2	0.1
850	-	-	7.2	2.2	4.6	0.7	2.9	0.2	2.3	0.1
900	-	-	7.6	2.4	4.9	0.8	3.1	0.3	2.4	0.1
950	-	-	8.1	2.6	5.2	0.9	3.2	0.3	2.6	0.2
1000	-	-	8.5	2.9	5.4	1.0	3.4	0.3	2.7	0.2
1100	-	-	9.3	3.5	6.0	1.2	3.8	0.4	3.0	0.2
1200	-	-	10.2	4.1	6.5	1.4	4.1	0.4	3.2	0.3
1300	-	-	-	-	7.1	1.6	4.4	0.5	3.5	0.3
1400	-	-	-	-	7.6	1.8	4.8	0.6	3.8	0.3
1500	-	-	-	-	8.1	2.1	5.1	0.7	4.0	0.4
1600	-	-	-	-	8.7	2.3	5.5	0.8	4.3	0.4
1700	-	-	-	-	9.2	2.6	5.8	0.9	4.6	0.5
1800	-	-	-	-	9.8	2.9	6.2	1.0	4.9	0.5
1900	-	-	-	-	10.3	3.2	6.5	1.1	5.1	0.6
2000	-	-	-	-	-	-	6.8	1.2	5.4	0.6
2100	-	-	-	-	-	-	7.2	1.3	5.7	0.7
2200	-	-	-	-	-	-	7.5	1.4	5.9	0.8
2300	-	-	-	-	-	-	7.9	1.5	6.2	0.8
2400	-	-	-	-	-	-	8.2	1.6	6.5	0.9
2500	-	-	-	-	-	-	8.5	1.7	6.7	1.0
2750	-	-	-	-	-	-	9.4	2.1	7.4	1.2
3000	-	-	-	-	-	-	10.3	2.4	8.1	1.4
3250	-	-	-	-	-	-	-	-	8.8	1.6
3500	-	-	-	-	-	-	-	-	9.4	1.8
3750	-	-	-	-	-	-	-	-	10.1	2.1

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-12. Flow Rate 6" - 14" SDR 17

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SDR 17	16"		18"		20"	
Flow Rate (gpm)	400 mm		450 mm		500 mm	
	V	P	V	P	V	P
650	1.4	0.0	-	-	-	-
700	1.5	0.1	-	-	-	-
750	1.6	0.1	-	-	-	-
800	1.7	0.1	-	-	-	-
850	1.8	0.1	-	-	-	-
900	1.9	0.1	1.5	0.0	-	-
950	2.0	0.1	1.6	0.1	-	-
1000	2.1	0.1	1.7	0.1	-	-
1100	2.3	0.1	1.8	0.1	-	-
1200	2.5	0.1	2.0	0.1	1.6	0.0
1300	2.8	0.2	2.2	0.1	1.8	0.1
1400	3.0	0.2	2.3	0.1	1.9	0.1
1500	3.2	0.2	2.5	0.1	2.0	0.1
1600	3.4	0.2	2.7	0.1	2.2	0.1
1700	3.6	0.3	2.8	0.2	2.3	0.1
1800	3.8	0.3	3.0	0.2	2.4	0.1
1900	4.0	0.3	3.2	0.2	2.6	0.1
2000	4.2	0.4	3.4	0.2	2.7	0.1
2100	4.5	0.4	3.5	0.2	2.9	0.1
2200	4.7	0.4	3.7	0.2	3.0	0.1
2300	4.9	0.5	3.9	0.3	3.1	0.2
2400	5.1	0.5	4.0	0.3	3.3	0.2
2500	5.3	0.5	4.2	0.3	3.4	0.2
2750	5.8	0.7	4.6	0.4	3.7	0.2
3000	6.4	0.8	5.0	0.4	4.1	0.3
3250	6.9	0.9	5.4	0.5	4.4	0.3
3500	7.4	1.0	5.9	0.6	4.8	0.3
3750	7.9	1.2	6.3	0.7	5.1	0.4
4000	8.5	1.3	6.7	0.7	5.4	0.4
4250	9.0	1.5	7.1	0.8	5.8	0.5
4500	9.5	1.6	7.5	0.9	6.1	0.6
4750	10.1	1.8	8.0	1.0	6.4	0.6
5000	-	-	8.4	1.1	6.8	0.7
5250	-	-	8.8	1.2	7.1	0.7
5500	-	-	9.2	1.3	7.5	0.8
5750	-	-	9.6	1.4	7.8	0.9
6000	-	-	10.1	1.6	8.1	0.9
6250	-	-	-	-	8.5	1.0
6500	-	-	-	-	8.8	1.1
6750	-	-	-	-	9.2	1.2
7000	-	-	-	-	9.5	1.2
7250	-	-	-	-	9.8	1.3
7500	-	-	-	-	10.2	1.4

** PLEASE CONSULT FACTORY FOR 20" AND 24" DATA

V=Velocity (ft/s^2) P=Pressure Loss (ft of head/100ft)

Table AP-12. Flow Rate 16" - 20" SDR 17

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Equivalent Loss in Fitting Chart

Table AP-14. Equivalent Lengths for Asahitec™ Fittings (friction loss in equivalent length of pipe)

Size Nominal	90° Elbow	45° Elbow	Tee	Concentric Reduction=D_2/D_1*			Concentric Reduction=D_1/D_2**		
				1/4	1/2	3/4	1/4	1/2	3/4
1/2"	1.50	0.80	3.25	-	-	-	4.00	2.00	1.33
3/4"	2.00	1.00	4.00	-	-	-	1.50	1.00	-
1"	2.75	1.25	6.00	-	1.00	0.60	2.00	1.50	0.50
1-1/4"	3.50	1.70	8.00	-	-	-	3.00	1.75	-
1-1/2"	4.25	2.00	9.00	-	1.50	-	-	2.20	-
2"	5.50	2.50	12.00	2.50	2.00	1.20	4.00	2.50	1.00
2-1/2"	7.00	3.00	14.00	-	2.50	-	6.00	3.50	-
3"	8.00	3.80	17.00	4.00	3.00	-	7.00	-	-
4"	11.00	5.00	21.00	5.00	4.00	2.50	8.00	5.00	2.00
6"	16.00	7.50	34.00	7.00	6.00	-	12.00	7.00	-
8"	20.00	10.00	44.00	10.00	8.00	4.00	-	10.00	4.00
10"	25.00	12.50	55.00	12.50	10.00	6.00	-	12.50	-
12"	32.00	15.00	58.00	15.00	12.00	7.00	-	-	-
14"	25.00	12.00	80.00	-	-	-	-	-	7.00
16"	30.00	15.00	90.00	20.00	16.00	9.00	-	-	-
18"	32.50	16.00	100.00	-	-	-	-	-	-
20"	35.00	17.00	110.00	-	-	-	-	-	-
24"	40.00	20.00	140.00	-	-	-	-	-	-

*D2 = larger diameter portion, which is shown in size column

**D1 = smaller diameter portion, which is shown in size column

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Table AP-14. Asahitec™ PP-RCT Pipe Heat Loss in Watts per Linear Foot

n.i.t.	ΔT	Nominal Diameter of Pipe in Inches																
		0.375	0.5	0.75	1	1.25	1.5	2	2.5	3	4	6	8	10	12	14	16	18
0.5	50	1.99	2.28	2.65	3.17	3.73	4.37	5.17	5.88	6.75	7.84	10.26	12.01	13.94	16.14	17.36	18.61	19.85
	75	2.98	3.42	3.97	4.76	5.6	6.55	7.76	8.82	10.12	11.76	15.39	18.02	20.91	24.22	26.05	27.91	29.78
	100	3.97	4.56	5.3	6.34	7.47	8.74	10.35	11.77	13.5	15.68	20.52	24.02	27.88	32.29	34.73	37.22	39.71
	125	4.97	5.7	6.62	7.93	9.33	10.92	12.94	14.71	16.87	19.59	25.66	30.03	34.85	40.37	43.42	46.52	49.64
	150	5.96	6.84	7.94	9.52	11.2	13.11	15.53	17.65	20.25	23.51	30.79	36.04	41.82	48.44	52.1	55.93	59.57
1	50	1.37	1.54	1.75	2.05	2.36	2.73	3.19	3.61	4.12	4.77	6.3	7.44	8.77	10.37	11.29	12.26	13.28
	75	2.06	2.32	2.63	3.07	3.55	4.09	4.79	5.41	6.17	7.16	9.44	11.17	13.16	15.56	16.94	18.4	19.92
	100	2.74	3.09	3.5	4.09	4.73	5.46	6.39	7.21	8.23	9.54	12.59	14.89	17.55	20.75	22.59	24.53	26.56
	125	3.43	3.86	4.38	5.12	5.91	6.82	7.98	9.01	10.29	11.93	15.74	18.61	21.94	25.93	28.24	30.66	33.2
	150	4.12	4.63	5.26	6.14	7.09	8.19	9.58	10.82	12.35	14.32	18.89	22.33	26.33	31.12	33.88	36.8	39.84
1.5	50	1.13	1.26	1.41	1.62	1.85	2.11	2.44	2.74	3.1	3.58	4.69	5.54	6.55	7.78	8.5	9.28	10.1
	75	1.7	1.89	2.12	2.44	2.78	3.17	3.67	4.11	4.66	5.37	7.03	8.31	9.82	11.67	12.75	13.91	15.15
	100	2.27	2.52	2.83	3.25	3.7	4.23	4.89	5.48	6.21	7.15	9.38	11.08	13.09	15.56	17	18.55	20.2
	125	2.84	3.15	3.53	4.06	4.63	5.28	6.11	6.85	7.76	8.94	11.72	13.85	16.36	19.45	21.25	23.19	25.25
	150	3.4	3.78	4.24	4.87	5.56	6.34	7.33	8.22	9.31	10.73	14.07	16.62	19.64	23.34	25.51	27.83	30.3
2	50	1	1.11	1.23	1.4	1.58	1.78	2.04	2.28	2.56	2.94	3.81	4.49	5.3	6.3	6.89	7.54	8.22
	75	1.5	1.66	1.84	2.1	2.37	2.68	3.07	3.42	3.85	4.4	5.72	6.74	7.95	9.45	10.34	11.3	12.33
	100	2.01	2.21	2.46	2.79	3.15	3.57	4.09	4.55	5.13	5.87	7.63	8.98	10.6	12.6	13.79	15.07	16.44
	125	2.51	2.76	3.07	3.49	3.94	4.46	5.11	5.69	6.41	7.34	9.54	11.23	13.25	15.75	17.24	18.84	20.55
	150	3.01	3.32	3.68	4.19	4.73	5.35	6.13	6.83	7.69	8.81	11.44	13.48	15.9	18.9	20.68	22.61	24.67
2.5	50	0.92	1.01	1.11	1.25	1.4	1.58	1.79	1.99	2.22	2.53	3.26	3.83	4.5	5.35	5.85	6.39	6.98
	75	1.38	1.51	1.66	1.88	2.1	2.36	2.69	2.98	3.34	3.8	4.89	5.74	6.75	8.02	8.77	9.59	10.47
	100	1.83	2.01	2.22	2.5	2.81	3.15	3.59	3.97	4.45	5.07	6.53	7.65	9.01	10.69	11.7	12.79	13.96
	125	2.29	2.51	2.77	3.13	3.51	3.94	4.48	4.97	5.56	6.33	8.16	9.57	11.26	13.36	14.62	15.99	17.46
	150	2.75	3.02	3.33	3.76	4.21	4.73	5.38	5.96	6.67	7.6	9.79	11.48	13.51	16.04	17.54	19.18	20.95
3	50	0.86	0.93	1.03	1.15	1.28	1.43	1.62	1.79	1.99	2.25	2.88	3.37	3.95	4.68	5.11	5.59	6.1
	75	1.28	1.4	1.54	1.72	1.92	2.15	2.43	2.68	2.99	3.38	4.32	5.05	5.92	7.01	7.67	8.38	9.15
	100	1.71	1.87	2.05	2.3	2.56	2.86	3.24	3.57	3.98	4.51	5.76	6.73	7.89	9.35	10.22	11.18	12.2
	125	2.14	2.33	2.56	2.88	3.2	3.58	4.05	4.47	4.98	5.64	7.2	8.41	9.87	11.69	12.78	13.97	15.2
	150	2.57	2.8	3.08	3.45	3.85	4.29	4.86	5.36	5.97	6.76	8.64	10.1	11.84	14.03	15.34	16.76	18.31
4	50	0.77	0.84	0.91	1.01	1.12	1.24	1.39	1.52	1.69	1.89	2.38	2.76	3.22	3.8	4.14	4.52	4.93
	75	1.16	1.26	1.37	1.52	1.68	1.86	2.09	2.29	2.53	2.84	3.58	4.15	4.83	5.7	6.21	6.78	7.4
	100	1.55	1.67	1.83	2.03	2.24	2.48	2.78	3.05	3.37	3.79	4.77	5.53	6.45	7.6	8.29	9.04	9.87
	125	1.93	2.09	2.28	2.54	2.8	3.1	3.48	3.81	4.21	4.73	5.96	6.91	8.06	9.49	10.36	11.3	12.33
	150	2.32	2.51	2.74	3.04	3.36	3.72	4.17	4.57	5.06	5.68	7.15	8.29	9.67	11.39	12.43	13.57	14.8

n.i.t. = nominal insulation thickness of foamed elastomer in inches; ΔT = temperature difference between cold fluid and desired maintenance in °F; body of table is in watts per linear foot of pipe. Values are for moving air at 20 mph velocity, assuming no outer cladding.

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HEAT GAIN

Table AP-15. Heat Gain Values for Asahitec™ PP-RCT in Still Air Conditions

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 0.5", O.D. = 0.79"						Pipe Size = 0.75", O.D. = 0.98"						Pipe Size = 1", O.D. = 1.26"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	15.8	42.3	14.4	41.5	12.9	41	19.5	42.5	17.7	41.9	15.9	41.3	24.7	43.2	22.5	42.4	20.2	41.7
0.125	35	11.7	63.1	10.7	60.4	9.6	58	14	62.8	12.7	60.4	11.4	57.9	17.2	62.8	15.7	60.2	14.1	57.7
0.25	35	9.5	72.4	8.7	68.9	7.8	65.6	11.2	71.9	10.2	68.5	9.2	65.2	13.6	71.6	12.3	68.3	11.1	64.9
0.375	35	8.2	77.3	7.4	73.5	6.7	69.6	9.5	76.9	8.6	73.1	7.8	69.2	11.4	76.5	10.4	72.6	9.3	69
0.5	35	7.3	80.3	6.6	76.2	5.9	72.1	8.4	79.9	7.6	75.8	6.9	71.7	10	79.4	9.1	75.4	8.2	71.3
0.625	35	6.6	82.3	6	78	5.4	73.7	7.6	81.9	6.9	77.6	6.2	73.4	8.9	81.5	8.1	77.3	7.3	73.1
0.75	35	6.1	83.6	5.5	79.3	5	74.8	6.9	83.4	6.3	78.9	5.7	74.5	8.2	82.9	7.4	78.6	6.7	74.2
1	35	5.4	85.4	4.9	80.8	4.4	76.2	6.1	85.1	5.5	80.6	6	76	7.1	84.8	6.4	80.3	5.8	75.8
1.25	35	4.9	86.4	4.4	81.8	4	77.1	5.5	86.2	5	81.6	4.5	76.9	6.3	86	5.7	81.4	5.2	76.7
1.5	35	4.5	87.2	4.1	82.4	3.7	77.7	5	87	4.6	82.2	4.1	77.5	5.8	86.7	5.3	82	4.7	77.4
2	35	4	88	3.6	83.2	3.3	78.4	4.4	87.9	4	83.1	3.6	78.3	5	87.7	4.6	82.9	4.1	78.1
2.5	35	3.7	88.5	3.3	83.6	3	78.8	4	88.4	3.7	83.5	3.3	78.7	4.6	88.2	4.1	83.4	3.7	78.6
0	40	14.4	46.5	12.9	46	11.5	45.2	17.7	46.9	15.9	46.3	14.2	45.4	22.5	47.4	20.2	46.7	18	45.9
0.125	40	10.7	65.4	9.6	63	8.5	60.5	12.7	65.4	11.4	62.9	10.2	60.2	15.7	65.2	14.1	62.7	12.5	60.2
0.25	40	8.7	73.9	7.8	70.6	6.9	67.2	10.2	73.5	9.2	70.2	8.1	66.9	12.3	73.3	11.1	69.9	9.9	66.6
0.375	40	7.4	78.5	6.7	74.6	5.9	70.9	8.6	78.1	7.8	74.2	6.9	70.5	10.4	77.6	9.3	74	8.3	70.1
0.5	40	6.6	81.2	5.9	77.1	5.3	72.9	7.6	80.8	6.9	76.7	6.1	72.6	9.1	80.4	8.2	76.3	7.2	72.4
0.625	40	6	83	5.4	78.7	4.8	74.4	6.9	82.6	6.2	78.4	5.5	74.1	8.1	82.3	7.3	78.1	6.5	73.8
0.75	40	5.5	84.3	5	79.8	4.4	75.4	6.3	83.9	5.7	79.5	5.1	75.1	7.4	83.6	6.7	79.2	5.9	74.9
1	40	4.9	85.8	4.4	81.2	3.9	76.7	5.5	85.6	5	81	4.4	76.5	6.4	85.3	5.8	80.8	5.1	76.3
1.25	40	4.4	86.8	4	82.1	3.5	77.5	5	86.6	4.5	81.9	4	77.3	5.7	86.4	5.2	81.7	4.6	77.1
1.5	40	4.1	87.4	3.7	82.7	3.3	77.9	4.6	87.2	4.1	82.5	3.7	77.8	5.3	87	4.7	82.4	4.2	77.6
2	40	3.6	88.2	3.3	83.4	2.9	78.6	4	88.1	3.6	83.3	3.2	78.5	4.6	87.9	4.1	83.1	3.7	78.3
2.5	40	3.3	88.6	3	83.8	2.7	78.9	3.7	88.5	3.3	83.7	2.9	78.8	4.1	88.4	3.7	83.6	3.3	78.7
0	45	12.9	51	11.5	50.2	10.1	49.5	15.9	51.3	14.2	50.4	12.4	49.8	20.2	51.7	18	50.9	15.7	50.3
0.125	45	9.6	68	8.5	65.5	7.5	62.8	11.4	67.9	10.2	65.2	8.9	62.7	14.1	67.7	12.5	65.2	11	62.6
0.25	45	7.8	75.6	6.9	72.2	6.1	68.7	9.2	75.2	8.1	71.9	7.1	68.5	11.1	74.9	9.9	71.6	8.6	68.3
0.375	45	6.7	79.6	5.9	75.9	5.2	71.9	7.8	79.2	6.9	75.5	6	71.7	9.3	79	8.3	75.1	7.3	71.3
0.5	45	5.9	82.1	5.3	77.9	4.6	73.9	6.9	81.7	6.1	77.6	5.3	73.6	8.2	81.3	7.2	77.4	6.3	73.3
0.625	45	5.4	83.7	4.8	79.4	4.2	75.1	6.2	83.4	5.5	79.1	4.8	74.9	7.3	83.1	6.5	78.8	5.7	74.6
0.75	45	5	84.8	4.4	80.4	3.9	75.9	5.7	84.5	5.1	80.1	4.4	75.8	6.7	84.2	5.9	79.9	5.2	75.5
1	45	4.4	86.2	3.9	81.7	3.4	77.1	5	86	4.4	81.5	3.9	76.9	5.8	85.8	5.1	81.3	4.5	76.7
1.25	45	4	87.1	3.5	82.5	3.1	77.8	4.5	86.9	4	82.3	3.5	77.6	5.2	86.7	4.6	82.1	4	77.5
1.5	45	3.7	87.7	3.3	82.9	2.9	78.2	4.1	87.5	3.7	82.8	3.2	78.1	4.7	87.4	4.2	82.6	3.7	77.9
2	45	3.3	88.4	2.9	83.6	2.6	78.7	3.6	88.3	3.2	83.5	2.8	78.7	4.1	88.1	3.7	83.3	3.2	78.5
2.5	45	3	88.8	2.7	83.9	2.3	79.1	3.3	88.7	2.9	83.8	2.6	79	3.7	88.6	3.3	83.7	2.9	78.9
0	50	11.5	55.2	10.1	54.5	8.6	54	14.2	55.4	12.4	54.8	10.6	54.2	18	55.9	15.7	55.3	13.5	54.4
0.125	50	8.5	70.5	7.5	67.8	6.4	65.3	10.2	70.2	8.9	67.7	7.6	65.2	12.5	70.2	11	67.6	9.4	65.1
0.25	50	6.9	77.2	6.1	73.7	5.2	70.4	8.1	76.9	7.1	73.5	6.1	70.2	9.9	76.6	8.6	73.3	7.4	70
0.375	50	5.9	80.9	5.2	76.9	4.5	73	6.9	80.5	6	76.7	5.2	72.8	8.3	80.1	7.3	76.3	6.2	72.6
0.5	50	5.3	82.9	4.6	78.9	4	74.7	6.1	82.6	5.3	78.6	4.6	74.5	7.2	82.4	6.3	78.3	5.4	74.3
0.625	50	4.8	84.4	4.2	80.1	3.6	75.8	5.5	84.1	4.8	79.9	4.1	75.6	6.5	83.8	5.7	79.6	4.9	75.3
0.75	50	4.4	85.4	3.9	80.9	3.3	76.6	5.1	85.1	4.4	80.8	3.8	76.3	5.9	84.9	5.2	80.5	4.5	76.1
1	50	3.9	86.7	3.4	82.1	2.9	77.5	4.4	86.5	3.9	81.9	3.3	77.4	5.1	86.3	4.5	81.7	3.9	77.1
1.25	50	3.5	87.5	3.1	82.8	2.7	78	4	87.3	3.5	82.6	3	77.9	4.6	87.1	4	82.5	3.4	77.8
1.5	50	3.3	87.9	2.9	83.2	2.5	78.4	3.7	87.8	3.2	83.1	2.8	78.3	4.2	87.6	3.7	82.9	3.2	78.2
2	50	2.9	88.6	2.6	83.7	2.2	78.9	3.2	88.5	2.8	83.7	2.4	78.8	3.7	88.3	3.2	83.5	2.8	78.7
2.5	50	2.7	88.9	2.3	84.1	2	79.2	2.9	88.8	2.6	84	2.2	79.1	3.3	88.7	2.9	83.9	2.5	79
0	55	10.1	59.5	8.6	59	7.2	58.2	12.4	59.8	10.6	59.2	8.9	58.3	15.7	60.3	13.5	59.4	11.2	58.8
0.125	55	7.5	72.8	6.4	70.3	5.3	67.8	8.9	72.7	7.6	70.2	6.4	67.6	11	72.6	9.4	70.1	7.8	67.7
0.25	55	6.1	78.7	5.2	75.4	4.3	72	7.1	78.5	6.1	75.2	5.1	71.8	8.6	78.3	7.4	75	6.2	71.6
0.375	55	5.2	81.9	4.5	78	3.7	74.3	6	81.7	5.2	77.8	4.3	74.1	7.3	81.3	6.2	77.6	5.2	73.8
0.5	55	4.6	83.9	4	79.7	3.3	75.6	5.3	83.6	4.6	79.5	3.8	75.4	6.3	83.3	5.4	79.3	4.5	75.2
0.625	55	4.2	85.1	3.6	80.8	3	76.5	4.8	84.9	4.1	80.6	3.4	76.4	5.7	84.6	4.9	80.3	4.1	76.1
0.75	55	3.9	85.9	3.3	81.6	2.8	77.1	4.4	85.8	3.8	81.3	3.2	76.9	5.2	85.5	4.5	81.1	3.7	76.8
1	55	3.4	87.1	2.9	82.5	2.4	77.9	3.9	86.9	3.3	82.4	2.8	77.8	4.5	86.7	3.9	82.1	3.2	77.7
1.25	55	3.1	87.8	2.7	83	2.2	78.4	3.5	87.6	3	82.9	2.5	78.3	4	87.5	3.4	82.8	2.9	78.2
1.5	55	2.9	88.2	2.5	83.4	2.1	78.7	3.2	88.1	2.8	83.3	2.3	78.6	3.7	87.9	3.2	83.2	2.6	78.5
2	55	2.6	88.7	2.2	83.9	1.8	79.1	2.8	88.7	2.4	83.8	2	79	3.2	88.5	2.8	83.7	2.3	79
2.5	55	2.3	89.1	2	84.2	1.7	79.3	2.6	89	2.2	84.1	1.8	79.3	2.9	88.9	2.5	84	2.1	79.2

Fluid Temp = temperature of the chilled water (F).

Table AP-15. Heat Gain Values for Asahitec™ PP-RCT in Still Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 1.25", O.D. = 1.58"						Pipe Size = 1.50", O.D. = 1.97"						Pipe Size = 2", O.D. = 2.48"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	30.1	44.5	27.4	43.6	24.6	42.8	35.8	46.6	32.6	45.5	29.3	44.5	42.8	48.8	38.9	47.6	35	46.3
0.125	35	20.7	63	18.8	60.5	16.9	58	24.5	63.7	22.3	61	20.1	58.4	29.3	64.4	26.6	61.7	24	59
0.25	35	16.1	71.5	14.7	68.1	13.2	64.8	19	71.6	17.3	68.3	15.6	64.9	22.7	71.8	20.6	68.5	18.6	65.1
0.375	35	13.5	76.2	12.2	72.5	11	68.7	15.8	76.1	14.4	72.4	12.9	68.7	18.8	76.1	17.1	72.4	15.4	68.6
0.5	35	11.7	79.2	10.6	75.2	9.6	71.1	13.6	79.1	12.4	75	11.2	71	16.1	79	14.7	74.9	13.2	70.9
0.625	35	10.4	81.2	9.5	77	8.5	72.8	12.1	81	11	76.8	9.9	72.7	14.3	80.8	13	76.7	11.7	72.5
0.75	35	9.5	82.6	8.6	78.3	7.7	74	11	82.4	10	78.1	9	73.8	12.9	82.3	11.7	78	10.5	73.7
1	35	8.1	84.6	7.4	80.1	6.6	75.6	9.4	84.3	8.5	79.9	7.7	75.4	10.9	84.2	9.9	79.7	8.9	75.3
1.25	35	7.2	85.8	6.6	81.1	5.9	76.5	8.3	85.6	7.5	81	6.8	76.4	9.6	85.4	8.7	80.8	7.8	76.3
1.5	35	6.6	86.6	6	81.9	5.4	77.2	7.5	86.4	6.8	81.7	6.1	77.1	8.6	86.3	7.9	81.6	7.1	76.9
2	35	5.7	87.6	5.2	82.8	4.7	78	6.4	87.4	5.8	82.7	5.3	77.9	7.3	87.3	6.7	82.5	6	77.8
2.5	35	5.1	88.1	4.6	83.3	4.2	78.5	5.7	88	5.2	83.2	4.7	78.4	6.5	87.9	5.9	83.1	5.3	78.3
0	40	27.4	48.6	24.6	47.8	21.9	46.9	32.6	50.5	29.3	49.5	26.1	48.4	38.9	52.6	35	51.3	31.1	50.1
0.125	40	18.8	65.5	16.9	63	15	60.4	22.3	66	20.1	63.4	17.8	60.9	26.6	66.7	24	64	21.3	61.4
0.25	40	14.7	73.1	13.2	69.8	11.7	66.6	17.3	73.3	15.6	69.9	13.8	66.7	20.6	73.5	18.6	70.1	16.5	66.8
0.375	40	12.2	77.5	11	73.7	9.8	70	14.4	77.4	12.9	73.7	11.5	69.9	17.1	77.4	15.4	73.6	13.6	69.9
0.5	40	10.6	80.2	9.6	76.1	8.5	72.1	12.4	80	11.2	76	9.9	72	14.7	79.9	13.2	75.9	11.7	72
0.625	40	9.5	82	8.5	77.8	7.6	73.6	11	81.8	9.9	77.7	8.8	73.5	13	81.7	11.7	77.5	10.4	73.3
0.75	40	8.6	83.3	7.7	79	6.9	74.7	10	83.1	9	78.8	8	74.5	11.7	83	10.5	78.7	9.4	74.4
1	40	7.4	85.1	6.6	80.6	5.9	76.1	8.5	84.9	7.7	80.4	6.8	75.9	9.9	84.7	8.9	80.3	7.9	75.8
1.25	40	6.6	86.1	5.9	81.5	5.3	76.9	7.5	86	6.8	81.4	6	76.8	8.7	85.8	7.8	81.3	7	76.6
1.5	40	6	86.9	5.4	82.2	4.8	77.5	6.8	86.7	6.1	82.1	5.4	77.4	7.9	86.6	7.1	81.9	6.3	77.3
2	40	5.2	87.8	4.7	83	4.1	78.2	5.8	87.7	5.3	82.9	4.7	78.1	6.7	87.5	6	82.8	5.3	78
2.5	40	4.6	88.3	4.2	83.5	3.7	78.7	5.2	88.2	4.7	83.4	4.2	78.6	5.9	88.1	5.3	83.3	4.7	78.5
0	45	24.6	52.8	21.9	51.9	19.2	51	29.3	54.5	26.1	53.4	22.8	52.4	35	56.3	31.1	55.1	27.2	53.8
0.125	45	16.9	68	15	65.4	13.2	62.8	20.1	68.4	17.8	65.9	15.6	63.2	24	69	21.3	66.4	18.6	63.7
0.25	45	13.2	74.8	11.7	71.6	10.3	68.2	15.6	74.9	13.8	71.7	12.1	68.3	18.6	75.1	16.5	71.8	14.4	68.5
0.375	45	11	78.7	9.8	75	8.6	71.2	12.9	78.7	11.5	74.9	10	71.2	15.4	78.6	13.6	74.9	11.9	71.2
0.5	45	9.6	81.1	8.5	77.1	7.4	73.2	11.2	81	9.9	77	8.7	73	13.2	80.9	11.7	77	10.3	72.9
0.625	45	8.5	82.8	7.6	78.6	6.6	74.4	9.9	82.7	8.8	78.5	7.7	74.3	11.7	82.5	10.4	78.3	9.1	74.2
0.75	45	7.7	84	6.9	79.7	6	75.3	9	83.8	8	79.5	7	75.2	10.5	83.7	9.4	79.4	8.2	75.1
1	45	6.6	85.6	5.9	81.1	5.2	76.5	7.7	85.4	6.8	80.9	6	76.4	8.9	85.3	7.9	80.8	6.9	76.3
1.25	45	5.9	86.5	5.3	81.9	4.6	77.3	6.8	86.4	6	81.8	5.3	77.2	7.8	86.3	7	81.6	6.1	77.1
1.5	45	5.4	87.2	4.8	82.5	4.2	77.8	6.1	87.1	5.4	82.4	4.8	77.7	7.1	86.9	6.3	82.3	5.5	77.6
2	45	4.7	88	4.1	83.2	3.6	78.5	5.3	87.9	4.7	83.1	4.1	78.4	6	87.8	5.3	83	4.7	78.3
2.5	45	4.2	88.5	3.7	83.7	3.2	78.8	4.7	88.4	4.2	83.6	3.6	78.8	5.3	88.3	4.7	83.5	4.1	78.7
0	50	21.9	56.9	19.2	56	16.4	55.2	26.1	58.4	22.8	57.4	19.5	56.4	31.1	60.1	27.2	58.8	23.3	57.6
0.125	50	15	70.4	13.2	67.8	11.3	65.3	17.8	70.9	15.6	68.2	13.4	65.6	21.3	71.4	18.6	68.7	16	66
0.25	50	11.7	76.6	10.3	73.2	8.8	69.9	13.8	76.7	12.1	73.3	10.4	69.9	16.5	76.8	14.4	73.5	12.4	70.1
0.375	so	9.8	80	8.6	76.2	7.3	72.5	11.5	79.9	10	76.2	8.6	72.5	13.6	79.9	11.9	76.2	10.2	72.5
0.5	50	8.5	82.1	7.4	78.2	6.4	74.1	9.9	82	8.7	78	7.4	74.1	11.7	82	10.3	77.9	8.8	74
0.625	50	7.6	83.6	6.6	79.4	5.7	75.2	8.8	83.5	7.7	79.3	6.6	75.1	10.4	83.3	9.1	79.2	7.8	75
0.75	50	6.9	84.7	6	80.3	5.2	76	8	84.5	7	80.2	6	75.9	9.4	84.4	8.2	80.1	7	75.8
1	50	5.9	86.1	5.2	81.5	4.4	77.1	6.8	85.9	6	81.4	5.1	76.9	7.9	85.8	6.9	81.3	6	76.8
1.25	50	5.3	86.9	4.6	82.3	3.9	77.7	6	86.8	5.3	82.2	4.5	77.6	7	86.6	6.1	82.1	5.2	77.5
1.5	50	4.8	87.5	4.2	82.8	3.6	78.1	5.4	87.4	4.8	82.7	4.1	78	6.3	87.3	5.5	82.6	4.7	78
2	50	4.1	88.2	3.6	83.5	3.1	78.7	4.7	88.1	4.1	83.4	3.5	78.6	5.3	88	4.7	83.3	4	78.5
2.5	50	3.7	88.7	3.2	83.8	2.8	79	4.2	88.6	3.6	83.8	3.1	78.9	4.7	88.5	4.1	83.7	3.5	78.9
0	55	19.2	61	16.4	60.2	13.7	59.3	22.8	62.4	19.5	61.4	16.3	60.2	27.2	63.8	23.3	62.6	19.4	61.3
0.125	55	13.2	72.8	11.3	70.3	9.4	67.7	15.6	73.2	13.4	70.6	11.1	68.1	18.6	73.7	16	71	13.3	68.4
0.25	55	10.3	78.2	8.8	74.9	7.3	71.6	12.1	78.3	10.4	74.9	8.7	71.6	14.4	78.5	12.4	75.1	10.3	71.7
0.375	55	8.6	81.2	7.3	77.5	6.1	73.7	10	81.2	8.6	77.5	7.2	73.7	11.9	81.2	10.2	77.5	8.5	73.7
0.5	55	7.4	83.2	6.4	79.1	5.3	75.1	8.7	83	7.4	79.1	6.2	75	10.3	82.9	8.8	79	7.3	75
0.625	55	6.6	84.4	5.7	80.2	4.7	76	7.7	84.3	6.6	80.1	5.5	75.9	9.1	84.2	7.8	80	6.5	75.8
0.75	55	6	85.3	5.2	81	4.3	76.7	7	85.2	6	80.9	5	76.6	8.2	85.1	7	80.8	5.9	76.5
1	55	5.2	86.5	4.4	82.1	3.7	77.5	6	86.4	5.1	81.9	4.3	77.4	6.9	86.3	6	81.8	5	77.3
1.25	55	4.6	87.3	3.9	82.7	3	78.1	5.3	87.2	4.5	82.6	3.8	78	6.1	87.1	5.2	82.5	4.4	77.9
1.5	55	4.2	87.8	3.6	83.1	3	78.4	4.8	87.7	4.1	83	3.4	78.4	5.5	87.6	4.7	83	3.9	78.3
2	55	3.6	88.5	3.1	83.7	2.6	78.9	4.1	88.4	3.5	83.6	2.9	78.8	4.7	88.3	4	83.5	3.3	78.8
2.5	55	3.2	88.8	2.8	84	2.3	79.2	3.6	88.8	3.1	83.9	2.6	79.1	4.1	88.7	3.5	83.9	3	79

Fluid Temp = temperature of the chilled water (F).

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Table AP-15. Heat Gain Values for Asahitec™ PP-RCT in Still Air Conditions

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 3.0", O.D. = 3.54"						Pipe Size = 4.0", O.D. = 4.33"						Pipe Size = 6.0", O.D. = 6.29"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	55.3	52.7	50.2	51.1	45.2	49.5	63.1	55.2	57.4	53.4	51.7	51.5	78.5	60.2	71.3	57.9	64.2	55.6
0.125	35	38.4	65.8	34.9	63	31.4	60.2	44.4	66.9	40.4	63.9	36.3	61.1	57.2	69.1	52	66	46.8	62.9
0.25	35	29.8	72.4	27.1	69	24.4	65.6	34.7	72.8	31.5	69.4	28.4	66	45.3	74.1	41.2	70.5	37.1	67
0.375	35	24.6	76.3	22.4	72.5	20.1	68.8	28.7	76.5	26	72.8	23.4	69	37.7	77.2	34.3	73.4	30.9	69.5
0.5	35	21.1	78.9	19.2	74.9	17.3	70.9	24.6	79	22.3	75	20.1	71	32.5	79.4	29.5	75.3	26.6	71.3
0.625	35	18.6	80.7	16.9	76.6	15.2	72.4	21.6	80.8	19.7	76.6	17.7	72.4	28.6	80.9	26	76.8	23.4	72.6
0.75	35	16.7	82.1	15.2	77.8	13.7	73.5	19.4	82.1	17.6	77.8	15.9	73.5	25.7	82.1	23.4	77.8	21	73.6
1	35	14	84	12.8	79.5	11.5	75	16.3	83.9	14.8	79.4	13.3	75	21.5	83.8	19.5	79.4	17.6	74.9
1.25	35	12.2	65.2	11.1	80.6	10	76	14.1	85.1	12.8	80.5	11.6	75.9	18.6	84.9	16.9	80.4	15.2	75.9
1.5	35	10.9	86	9.9	81.4	9	76.7	12.6	85.9	11.4	81.3	10.3	76.6	16.5	85.8	15	81.1	13.5	76.5
2	35	9.2	67.1	8.4	82.3	7.5	77.6	10.5	87	9.6	82.2	8.6	77.5	13.6	86.8	12.4	82.1	11.2	77.4
2.5	35	8.1	87.7	7.3	83	6.6	78.2	9.2	87.6	8.3	82.9	7.5	78.1	11.8	87.5	10.7	82.7	9.6	78
0	40	50.2	56.1	45.2	54.5	40.2	52.9	57.4	58.4	51.7	56.5	45.9	54.7	71.3	62.9	64.2	60.6	57.1	58.3
0.125	40	34.9	68	31.4	65.2	27.9	62.4	40.4	68.9	36.3	66.1	32.3	63.2	52	71	46.8	67.9	41.6	64.8
0.25	40	27.1	74	24.4	70.6	21.7	67.2	31.5	74.4	28.4	71	25.2	67.5	41.2	75.5	37.1	72	32.9	68.4
0.375	40	22.4	77.5	20.1	73.8	17.9	70	26	77.8	23.4	74	20.8	70.2	34.3	78.4	30.9	74.5	27.4	70.7
0.5	40	19.2	79.9	17.3	75.9	15.3	72	22.3	80	20.1	76	17.9	72	29.5	80.3	26.6	76.3	23.6	72.3
0.625	40	16.9	81.6	15.2	77.4	13.5	73.3	19.7	81.6	17.7	77.4	15.7	73.3	26	81.8	23.4	77.6	20.8	73.4
0.75	40	15.2	82.8	13.7	78.5	12.1	74.3	17.6	82.8	15.9	78.5	14.1	74.2	23.4	82.8	21	78.6	18.7	74.3
1	40	12.8	84.5	11.5	80	10.2	75.6	14.8	84.4	13.3	80	11.8	75.5	19.5	84.4	17.6	79.9	15.6	75.5
1.25	40	11.1	85.6	10	81	8.9	76.5	12.8	85.5	11.6	80.9	10.3	76.4	16.9	85.4	15.2	80.9	13.5	76.3
1.5	40	9.9	86.4	9	81.7	8	77.1	11.4	86.3	10.3	81.6	9.2	77	15	86.1	13.5	81.5	12	76.9
2	40	8.4	87.3	7.5	82.6	6.7	77.9	9.6	87.2	8.6	82.5	7.6	77.8	12.4	87.1	11.2	82.4	9.9	77.7
2.5	40	7.3	88	6.6	83.2	5.9	78.4	8.3	87.9	7.5	83.1	6.7	78.3	10.7	87.7	9.6	83	8.6	78.2
0	45	45.2	59.5	40.2	57.9	35.2	56.3	51.7	61.5	45.9	59.7	40.2	57.8	64.2	65.6	57.1	63.3	49.9	61.1
0.125	45	31.4	70.2	27.9	67.4	24.4	64.6	36.3	71.1	32.3	68.2	28.3	65.2	46.8	72.9	41.6	69.8	36.4	66.7
0.25	45	24.4	75.6	21.7	72.2	19	68.8	28.4	76	25.2	72.5	22.1	69.1	37.1	77	32.9	73.4	28.8	69.9
0.375	45	20.1	78.8	17.9	75	15.7	71.3	23.4	79	20.8	75.2	18.2	71.4	30.9	79.5	27.4	75.7	24	71.9
0.5	45	17.3	80.9	15.3	77	13.4	73	20.1	81	17.9	77	15.6	73	26.6	81.3	23.6	77.3	20.7	73.2
0.625	45	15.2	82.4	13.5	78.3	11.8	74.1	17.7	82.4	15.7	78.3	13.8	74.1	23.4	82.6	20.8	78.4	18.2	74.2
0.75	45	13.7	83.5	12.1	79.3	10.6	75	15.9	83.5	14.1	79.2	12.4	74.9	21	83.6	18.7	79.3	16.3	75
1	45	11.5	85	10.2	80.6	8.9	76.2	13.3	85	11.8	80.5	10.3	76.1	17.6	84.9	15.6	80.5	13.7	76.1
1.25	45	10	86	8.9	81.5	7.8	76.9	11.6	85.9	10.3	81.4	9	76.9	15.2	85.9	13.5	81.3	11.8	76.8
1.5	45	9	86.7	8	82.1	7	77.4	10.3	86.6	9.2	82	8	77.4	13.5	86.5	12	81.9	10.5	77.3
2	45	7.5	87.6	6.7	82.9	5.8	78.2	8.6	87.5	7.6	82.8	6.7	78.1	11.2	87.4	9.9	82.7	8.7	78
2.5	45	6.6	88.2	5.9	83.4	5.1	78.6	7.5	88.1	6.7	83.3	5.8	78.5	9.6	88	8.6	83.2	7.5	78.4
0	50	40.2	62.9	35.2	61.3	30.1	59.7	45.9	64.7	40.2	62.8	34.4	61	57.1	68.3	49.9	66.1	42.8	63.8
0.125	50	27.9	72.4	24.4	69.6	20.9	66.8	32.3	73.2	28.3	70.2	24.2	67.4	41.6	74.8	36.4	71.7	31.2	68.6
0.25	50	21.7	77.2	19	73.8	16.3	70.4	25.2	77.5	22.1	74.1	18.9	70.7	32.9	78.4	28.8	74.9	24.7	71.3
0.375	so	I7.9	80	15.7	76.3	13.4	72.5	20.8	80.2	18.2	76.4	15.6	72.7	27.4	80.7	24	76.9	20.6	73
0.5	50	15.3	82	13.4	78	11.5	74	17.9	82	15.6	78	13.4	74	23.6	82.3	20.7	78.2	17.7	74.2
0.625	50	13.5	83.3	11.8	79.1	10.1	75	15.7	83.3	13.8	79.1	11.8	75	20.8	83.4	18.2	79.2	15.6	75.1
0.75	50	12.1	84.3	10.6	80	9.1	75.7	14.1	84.2	12.4	79.9	10.6	75.7	18.7	84.3	16.3	80	14	75.7
1	50	10.2	85.6	8.9	81.2	7.7	76.7	11.8	85.5	10.3	81.1	8.9	76.6	15.6	85.5	13.7	81.1	11.7	76.6
1.25	50	8.9	86.5	7.8	81.9	6.7	77.4	10.3	86.4	9	81.9	7.7	77.3	13.5	86.3	11.8	81.8	10.1	77.3
1.5	50	8	87.1	7	82.4	6	77.8	9.2	87	8	82.4	6.9	77.8	12	86.9	10.5	82.3	9	77.7
2	50	6.7	87.9	5.8	83.2	5	78.4	7.6	87.8	6.7	83.1	5.7	78.4	9.9	87.7	8.7	83	7.4	78.3
2.5	50	5.9	88.4	5.1	83.6	4.4	78.8	6.7	88.3	5.8	83.5	5	78.7	8.6	88.2	7.5	83.4	6.4	78.6
0	55	35.2	66.3	30.1	64.7	25.1	63.1	40.2	67.8	34.4	66	28.7	64.2	49.9	71.1	42.8	68.8	35.7	66.5
0.125	55	24.4	74.6	20.9	71.8	17.4	69	28.3	75.2	24.2	72.4	20.2	69.5	36.4	76.7	31.2	73.6	26	70.5
0.25	55	19	78.8	16.3	75.4	13.5	72	22.1	79.1	18.9	75.7	15.8	72.2	28.8	79.9	24.7	76.3	20.6	72.8
0.375	55	15.7	81.3	13.4	77.5	11.2	73.8	18.2	81.4	15.6	77.7	13	73.9	24	81.9	20.6	78	17.2	74.2
0.5	55	13.4	83	11.5	79	9.6	75	15.6	83	13.4	79	11.2	75	20.7	83.2	17.7	79.2	14.8	75.2
0.625	55	11.8	84.1	10.1	80	8.5	75.8	13.8	84.1	11.8	80	9.8	75.8	18.2	84.2	15.6	80.1	13	75.9
0.75	55	10.6	85	9.1	80.7	7.6	76.4	12.4	84.9	10.6	80.7	8.8	76.4	16.3	85	14	80.7	11.7	76.4
1	55	8.9	86.2	7.7	81.7	6.4	77.2	10.3	86.1	8.9	81.6	7.4	77.2	13.7	86.1	11.7	81.6	9.8	77.2
1.25	55	7.8	86.9	6.7	82.4	5.6	77.8	9	86.9	7.7	82.3	6.4	77.8	11.8	86.8	10.1	82.3	8.4	77.7
1.5	55	7	87.4	6	82.8	5	78.2	8	87.4	6.9	82.8	5.7	78.1	10.5	87.3	9	82.7	7.5	78.1
2	55	5.8	88.2	5	83.4	4.2	78.7	6.7	88.1	5.7	83.4	4.8	78.6	8.7	88	7.4	83.3	6.2	78.6
2.5	55	5.1	88.6	1	4.4	83.8	3.7	79	1	5.1	83.7	14.2	78.9	17.5	88.4	16.4	83.6	15.4	78.9

Fluid Temp = temperature of the chilled water (F).

Table AP-15. Heat Gain Values for Asahitec™ PP-RCT in Still Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 8", O.D. = 7.87"						Pipe Size = 10", O.D. = 9.84"						Pipe Size = 12", O.D. = 12.4"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	88.2	63.2	80.2	60.7	72.2	58.1	97.6	66.3	88.8	63.5	79.9	60.6	107.3	69.3	97.5	66.2	87.8	63.1
0.125	35	65.8	70.7	59.9	67.4	53.9	64.2	74.8	72.3	68	68.9	61.2	65.5	84.6	74	76.9	70.5	69.2	66.9
0.25	35	52.8	74.9	48	71.3	43.2	67.7	61	75.9	55.4	72.2	49.9	68.5	70.1	77	63.7	73.2	57.3	69.4
0.375	35	44.3	77.7	40.3	73.8	36.3	69.9	51.6	78.4	46.9	74.4	42.2	70.5	60	79.1	54.5	75.1	49.1	71.1
0.5	35	38.3	79.7	34.8	75.6	31.4	71.5	44.9	80.1	40.8	76	36.7	71.9	52.5	80.6	47.8	76.5	43	72.3
0.625	35	33.9	81.1	30.8	76.9	27.7	72.7	39.8	81.4	36.2	77.2	32.6	73	46.8	81.8	42.6	77.5	38.3	73.3
0.75	35	30.4	82.3	27.6	78	24.9	73.7	35.8	82.5	32.6	78.1	29.3	73.8	42.3	82.7	38.5	78.4	34.6	74.1
1	35	25.4	83.9	23.1	79.4	20.8	75	30	84	27.3	79.5	24.6	75	35.6	84.1	32.4	79.6	29.1	75.2
1.25	35	22	84.9	20	80.4	18	75.9	26	85	23.6	80.4	21.3	75.9	30.9	85	28.1	80.5	25.3	75.9
1.5	35	19.5	85.7	17.7	81.1	15.9	76.5	23	85.7	20.9	81.1	18.8	76.5	27.4	85.8	24.9	81.1	22.4	76.5
2	35	16	86.8	14.6	82.1	13.1	77.4	18.9	86.7	17.2	82	15.5	77.3	22.5	86.7	20.5	82	18.4	77.3
2.5	35	13.8	87.4	12.5	82.7	11.3	77.9	16.2	87.4	14.8	82.6	13.3	77.9	19.3	87.4	17.5	82.6	15.8	77.8
0	40	80.2	65.7	72.2	63.1	64.2	60.5	88.8	68.5	79.9	65.6	71	62.8	97.5	71.2	87.8	68.1	78	65
0.125	40	59.9	72.4	53.9	69.2	47.9	65.9	68	73.9	61.2	70.5	54.4	67.1	76.9	75.5	69.2	71.9	61.5	68.4
0.25	40	48	76.3	43.2	72.7	38.4	69	55.4	77.2	49.9	73.5	44.3	69.8	63.7	78.2	57.3	74.4	51	70.6
0.375	40	40.3	78.8	36.3	74.9	32.2	71.1	46.9	79.4	42.2	75.5	37.5	71.5	54.5	80.1	49.1	76.1	43.6	72.1
0.5	40	34.8	80.6	31.4	76.5	27.9	72.5	40.8	81	36.7	76.9	32.6	72.8	47.8	81.5	43	77.3	38.2	73.2
0.625	40	30.8	81.9	27.7	77.7	24.6	73.6	36.2	82.2	32.6	78	28.9	73.8	42.6	82.5	38.3	78.3	34.1	74
0.75	40	27.6	83	24.9	78.7	22.1	74.4	32.6	83.1	29.3	78.8	26.1	74.5	38.5	83.4	34.6	79.1	30.8	74.7
1	40	23.1	84.4	20.8	80	18.5	75.5	27.3	84.5	24.6	80	21.8	75.6	32.4	84.6	29.1	80.2	25.9	75.7
1.25	40	20	85.4	18	80.9	16	76.3	23.6	85.4	21.3	80.9	18.9	76.3	28.1	85.5	25.3	80.9	22.5	76.4
1.5	40	17.7	86.1	15.9	81.5	14.2	76.9	20.9	86.1	18.8	81.5	16.7	76.9	24.9	86.1	22.4	81.5	19.9	76.9
2	40	14.6	87.1	13.1	82.4	11.7	77.6	17.2	87	15.5	82.3	13.8	77.6	20.5	87	18.4	82.3	16.4	77.6
2.5	40	12.5	87.7	11.3	82.9	10	78.1	14.8	87.6	13.3	82.9	11.8	78.1	17.5	87.6	15.8	82.8	14	78.1
0	45	72.2	68.1	64.2	65.5	56.1	63	79.9	70.6	71	67.8	62.1	64.9	87.8	73.1	78	70	68.3	66.9
0.125	45	53.9	74.2	47.9	70.9	41.9	67.7	61.2	75.5	54.4	72.1	47.6	68.7	69.2	76.9	61.5	73.4	53.8	69.8
0.25	45	43.2	77.7	38.4	74	33.6	70.4	49.9	78.5	44.3	74.8	38.8	71	57.3	79.4	51	75.6	44.6	71.7
0.375	45	36.3	79.9	32.2	76.1	28.2	72.2	42.2	80.5	37.5	76.5	32.8	72.6	49.1	81.1	43.6	77.1	38.2	73.1
0.5	45	31.4	81.5	27.9	77.5	24.4	73.4	36.7	81.9	32.6	77.8	28.6	73.7	43	82.3	38.2	78.2	33.4	74
0.625	45	27.7	82.7	24.6	78.6	21.5	74.4	32.6	83	28.9	78.8	25.3	74.6	38.3	83.3	34.1	79	29.8	74.8
0.75	45	24.9	83.7	22.1	79.4	19.3	75.1	29.3	83.8	26.1	79.5	22.8	75.2	34.6	84.1	30.8	79.7	26.9	75.4
1	45	20.8	85	18.5	80.5	16.2	76.1	24.6	85	21.8	80.6	19.1	76.1	29.1	85.2	25.9	80.7	22.7	76.2
1.25	45	18	85.9	16	81.3	14	76.8	21.3	85.9	18.9	81.3	16.5	76.8	25.3	85.9	22.5	81.4	19.7	76.8
1.5	45	15.9	86.5	14.2	81.9	12.4	77.3	18.8	86.5	16.7	81.9	14.7	77.3	22.4	86.5	19.9	81.9	17.4	77.3
2	45	13.1	87.4	11.7	82.6	10.2	77.9	15.5	87.3	13.8	82.6	12	77.9	18.4	87.3	16.4	82.6	14.3	77.9
2.5	45	11.3	87.9	10	83.1	8.8	78.4	13.3	87.9	11.8	83.1	10.3	78.3	15.8	87.8	14	83.1	12.3	78.3
0	50	64.2	70.5	56.1	68	48.1	65.4	71	72.8	62.1	69.9	53.3	67.1	78	75	68.3	71.9	58.5	68.7
0.125	50	47.9	75.9	41.9	72.7	35.9	69.4	54.4	77.1	47.6	73.7	40.8	70.3	61.5	78.4	53.8	74.8	46.1	71.3
0.25	50	38.4	79	33.6	75.4	28.8	71.8	44.3	79.8	38.8	76	33.3	72.3	51	80.6	44.6	76.7	38.2	72.9
0.375	50	32.2	81.1	28.2	77.2	24.2	73.3	37.5	81.5	32.8	77.6	28.1	73.7	43.6	82.1	38.2	78.1	32.7	74.1
0.5	50	27.9	82.5	24.4	78.4	20.9	74.4	32.6	82.8	28.6	78.7	24.5	74.6	38.2	83.2	33.4	79	28.7	74.9
0.625	50	24.6	83.6	21.5	79.4	18.5	75.2	28.9	83.8	25.3	79.6	21.7	75.3	34.1	84	29.8	79.8	25.5	75.5
0.75	50	22.1	84.4	19.3	80.1	16.6	75.8	26.1	84.5	22.8	80.2	19.5	75.9	30.8	84.7	26.9	80.4	23.1	76
1	50	18.5	85.5	16.2	81.1	13.9	76.6	21.8	85.6	19.1	81.1	16.4	76.7	25.9	85.7	22.7	81.2	19.4	76.8
1.25	50	16	86.3	14	81.8	12	77.2	18.9	86.3	16.5	81.8	14.2	77.3	22.5	86.4	19.7	81.8	16.9	77.3
1.5	50	14.2	86.9	12.4	82.3	10.6	77.7	16.7	86.9	14.7	82.3	12.6	77.7	19.9	86.9	17.4	82.3	14.9	77.7
2	50	11.7	87.6	10.2	82.9	8.8	78.2	13.8	87.6	12	82.9	10.3	78.2	16.4	87.6	14.3	82.9	12.3	78.2
2.5	50	10	88.1	8.8	83.4	7.5	78.6	11.8	88.1	10.3	83.3	8.9	78.6	14	88.1	12.3	83.3	10.5	78.6
0	55	56.1	73	48.1	70.4	40.1	67.8	62.1	74.9	53.3	72.1	44.4	69.2	68.3	76.9	58.5	73.7	48.8	70.6
0.125	55	41.9	77.7	35.9	74.4	29.9	71.2	47.6	78.7	40.8	75.3	34	72	53.8	79.8	46.1	76.3	38.5	72.7
0.25	55	33.6	80.4	28.8	76.8	24	73.2	38.8	81	33.3	77.3	27.7	73.6	44.6	81.7	38.2	77.9	31.9	74.1
0.375	55	28.2	82.2	24.2	78.3	20.1	74.4	32.8	82.6	28.1	78.7	23.5	74.7	38.2	83.1	32.7	79.1	27.3	75
0.5	55	24.4	83.4	20.9	79.4	17.4	75.3	28.6	83.7	24.5	79.6	20.4	75.5	33.4	84	28.7	79.9	23.9	75.7
0.625	55	21.5	84.4	18.5	80.2	15.4	76	25.3	84.6	21.7	80.3	18.1	76.1	29.8	84.8	25.5	80.5	21.3	76.3
0.75	55	19.3	85.1	16.6	80.8	13.8	76.5	22.8	85.2	19.5	80.9	16.3	76.6	26.9	85.4	23.1	81	19.2	76.7
1	55	16.2	86.1	13.9	81.6	11.6	77.2	19.1	86.1	16.4	81.7	13.7	77.2	22.7	86.2	19.4	81.8	16.2	77.3
1.25	55	14	86.8	12	82.2	10	77.7	16.5	86.8	14.2	82.3	11.8	77.7	19.7	86.8	16.9	82.3	14	77.8
1.5	55	12.4	87.3	10.6	82.7	8.9	78	14.7	87.3	12.6	82.7	10.5	78	17.4	87.3	14.9	82.7	12.5	78.1
2	55	10.2	87.9	8.8	83.2	7.3	78.5	12	87.9	10.3	83.2	8.6	78.5	14.3	87.9	12.3	83.2	10.2	78.5
2.5	155	8.8	88.4	7.5	83.6	6.3	78.8	10.3	88.3	18.9	83.6	7.4	78.81	12.3	88.31	10.5	83.6	8.8	78.8

Fluid Temp = temperature of the chilled water (F).

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Table AP-15. Heat Gain Values for Asahitec™ PP-RCT in Still Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 14", O.D. = 13.98"						Pipe Size = 16", O.D. = 15.75"						Pipe Size = 18", O.D. = 17.72"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	112.1	70.9	101.9	67.6	91.8	64.3	116.7	72.3	106.1	68.9	95.5	65.5	120.9	73.7	109.9	70.2	98.9	66.7
0.125	35	89.7	75	81.6	71.3	73.4	67.7	94.8	75.9	86.2	72.1	77.5	68.4	99.6	76.8	90.6	73	81.5	69.2
0.25	35	75	77.6	68.2	73.8	61.4	69.9	80	78.2	72.7	74.3	65.4	70.4	84.9	78.9	77.2	74.9	69.5	70.9
0.375	35	64.6	79.5	58.7	75.5	52.9	71.4	69.3	80	63	75.9	56.7	71.8	74.1	80.4	67.3	76.3	60.6	72.2
0.5	35	56.8	80.9	51.7	76.8	46.5	72.6	61.3	81.3	55.7	77.1	50.1	72.9	65.8	81.6	59.8	77.4	53.8	73.1
0.625	35	50.8	82	46.2	77.8	41.6	73.5	55	82.3	50	78	45	73.7	59.3	82.5	53.9	78.2	48.5	73.9
0.75	35	46	82.9	41.8	78.6	37.7	74.2	49.9	83.1	46.4	78.7	40.9	74.3	54	83.3	49.1	78.9	44.2	74.5
1	35	38.9	84.2	35.3	79.7	31.8	75.2	42.3	84.3	38.5	79.8	34.6	75.3	45.9	84.4	41.8	79.9	37.6	75.4
1.25	35	33.8	85.1	30.7	80.6	27.6	76	36.8	85.2	33.5	80.6	30.1	76.1	40.1	85.3	36.5	80.7	32.8	76.1
1.5	35	30	85.8	27.2	81.2	24.5	76.6	32.7	85.8	29.8	81.2	26.8	76.6	35.7	85.9	32.4	81.3	29.2	76.6
2	35	24.6	86.7	22.4	82	20.2	77.3	26.9	86.7	24.5	82	22	77.3	29.4	86.8	26.7	82.1	24.1	77.4
2.5	35	21.1	87.3	19.2	82.6	17.3	77.8	23.1	87.3	21	82.6	18.9	77.8	25.2	87.4	22.9	82.6	20.6	77.8
0	40	101.9	72.6	91.8	69.3	81.6	66.1	106.1	73.9	95.5	70.5	84.9	67.1	109.9	75.2	98.9	71.7	88	68.1
0.125	40	81.6	76.3	73.4	72.7	65.3	69	86.2	77.1	77.5	73.4	68.9	69.7	90.6	78	81.5	74.2	72.5	70.4
0.25	40	66.2	78.8	61.4	74.9	54.6	71	72.7	79.3	65.4	75.4	58.2	71.4	77.2	79.9	69.5	75.9	61.7	71.9
0.375	40	58.7	80.5	52.9	76.4	47	72.4	63	80.9	56.7	76.8	50.4	72.7	67.3	81.3	60.6	77.2	53.9	73
0.5	40	51.7	81.8	46.5	77.6	41.3	73.4	55.7	82.1	50.1	77.9	44.6	73.6	59.8	82.4	53.8	78.1	47.9	73.9
0.625	40	46.2	82.8	41.6	78.5	37	74.2	50	83	45	78.7	40	74.4	53.9	83.2	48.5	78.9	43.1	74.6
0.75	40	41.8	83.6	37.7	79.2	33.5	74.8	45.4	83.7	40.9	79.3	36.3	75	49.1	83.9	44.2	79.5	39.3	75.1
1	40	35.3	84.7	31.8	80.2	28.3	75.8	38.5	84.8	34.6	80.3	30.8	75.9	41.8	84.9	37.6	80.4	33.4	76
1.25	40	30.7	85.6	27.6	81	24.6	76.4	33.5	85.6	30.1	81.1	26.8	76.5	36.5	85.7	32.8	81.1	29.2	76.6
1.5	40	27.2	86.2	24.5	81.6	21.8	76.9	29.8	86.2	26.8	81.6	23.8	77	32.4	86.3	29.2	81.6	25.9	77
2	40	22.4	87	20.2	82.3	17.9	77.6	24.5	87	22	82.3	19.6	77.6	26.7	87.1	24.1	82.4	21.4	77.6
2.5	40	19.2	87.6	17.3	82.8	15.3	78.1	21	87.6	18.9	82.8	16.8	78.1	22.9	87.6	20.6	82.8	18.3	78.1
0	45	91.8	74.3	81.6	71.1	71.4	67.8	95.5	75.5	84.9	72.1	74.3	68.7	98.9	76.7	88	73.1	77	69.6
0.125	45	73.4	77.7	65.3	74	57.1	70.4	77.5	78.4	68.9	74.7	60.3	71	81.5	79.2	72.5	75.4	63.4	71.6
0.25	45	61.4	79.9	54.6	76	47.7	72.1	65.4	80.4	58.2	76.4	50.9	72.5	69.5	80.9	61.7	76.9	54	72.9
0.375	45	52.9	81.4	47	77.4	41.1	73.3	56.7	81.8	50.4	77.7	44.1	73.6	60.6	82.2	53.9	78	47.1	73.9
0.5	45	46.5	82.6	41.3	78.4	36.2	74.2	50.1	82.9	44.6	78.6	39	74.4	53.8	83.1	47.9	78.9	41.9	74.7
0.625	45	41.6	83.5	37	79.2	32.3	74.9	45	83.7	40	79.4	35	75.1	48.5	83.9	43.1	79.6	37.7	75.3
0.75	45	37.7	84.2	33.5	79.8	29.3	75.5	40.9	84.3	36.3	80	31.8	75.6	44.2	84.5	39.3	80.1	34.3	75.7
1	45	31.8	85.2	28.3	80.8	24.7	76.3	34.6	85.3	30.8	80.9	26.9	76.4	37.6	85.4	33.4	81	29.2	76.5
1.25	45	27.6	86	24.6	81.4	21.5	76.9	30.1	86.1	26.8	81.5	23.4	76.9	32.8	86.1	29.2	81.6	25.5	77
1.5	45	24.5	86.6	21.8	81.9	19.1	77.3	26.8	86.6	23.8	82	20.8	77.4	29.2	86.6	25.9	82	22.7	77.4
2	45	20.2	87.3	17.9	82.6	15.7	77.9	22	87.3	19.6	82.6	17.1	77.9	24.1	87.4	21.4	82.6	18.7	77.9
2.5	45	17.3	87.8	15.3	83.1	13.4	78.3	18.9	87.8	16.8	83.1	14.7	78.3	20.6	87.8	18.3	83.1	16	78.3
0	50	81.6	76.1	71.4	72.8	61.2	69.5	84.9	77.1	74.3	73.7	63.7	70.3	88	78.1	77	74.6	66	71.1
0.125	50	65.3	79	57.1	75.4	49	71.8	68.9	79.7	60.3	76	51.7	72.3	72.5	80.4	63.4	76.6	54.3	72.8
0.25	50	54.6	81	47.7	77.1	40.9	73.3	58.2	81.4	50.9	77.5	43.6	73.6	61.7	81.9	54	77.9	46.3	73.9
0.375	50	47	82.4	41.1	78.3	35.2	74.3	50.4	82.7	44.1	78.6	37.8	74.5	53.9	83	47.1	78.9	40.4	74.8
0.5	50	41.3	83.4	36.2	79.2	31	75.1	44.6	83.6	39	79.4	33.4	75.2	47.9	83.9	41.9	79.7	35.9	75.4
0.625	50	37	84.2	32.3	79.9	27.7	75.7	40	84.4	35	80.1	30	75.8	43.1	84.6	37.7	80.3	32.3	75.9
0.75	50	33.5	84.8	29.3	80.5	25.1	76.1	36.3	85	31.8	80.6	27.2	76.2	39.3	85.1	34.3	80.7	29.4	76.3
1	50	28.3	85.8	24.7	81.3	21.2	76.8	30.8	85.9	26.9	81.4	23.1	76.9	33.4	86	29.2	81.5	25.1	77
1.25	50	24.6	86.4	21.5	81.9	18.4	77.3	26.8	86.5	23.4	81.9	20.1	77.4	29.2	86.6	25.5	82	21.9	77.4
1.5	50	21.8	86.9	19.1	82.3	16.3	77.7	23.8	87	20.8	82.4	17.9	77.7	25.9	87	22.7	82.4	19.5	77.8
2	50	17.9	87.6	15.7	82.9	13.4	78.2	19.6	87.6	17.1	82.9	14.7	78.2	21.4	87.6	18.7	82.9	16	78.2
2.5	50	15.3	88.1	13.4	83.3	11.5	78.6	16.8	88.1	14.7	83.3	12.6	78.6	18.3	88.1	16	83.3	13.7	78.6
0	55	71.4	77.8	61.2	74.5	51	71.3	74.3	78.7	63.7	75.3	53.1	72	77	79.6	66	76.1	55	72.6
0.125	55	57.1	80.4	49	76.8	40.8	73.2	60.3	81	51.7	77.3	43.1	73.6	63.4	81.6	54.3	77.8	45.3	74
0.25	55	47.7	82.1	40.9	78.3	34.1	74.4	50.9	82.5	43.6	78.6	36.4	74.7	54	82.9	46.3	78.9	38.6	74.9
0.375	55	41.1	83.3	35.2	79.3	29.4	75.2	44.1	83.6	37.8	79.5	31.5	75.4	47.1	83.9	40.4	79.8	33.7	75.6
0.5	55	36.2	84.2	31	80.1	25.8	75.9	39	84.4	33.4	80.2	27.9	76	41.9	84.7	35.9	80.4	29.9	76.2
0.625	55	32.3	84.9	27.7	80.7	23.1	76.4	35	85.1	30	80.8	25	76.5	37.7	85.3	32.3	80.9	26.9	76.6
0.75	55	29.3	85.5	25.1	81.1	20.9	76.8	31.8	85.6	27.2	81.2	22.7	76.9	34.3	85.7	29.4	81.3	24.5	77
1	55	24.7	86.3	21.2	81.8	17.7	77.4	26.9	86.4	23.1	81.9	19.2	77.4	29.2	86.5	25.1	82	20.9	77.5
1.25	55	21.5	86.9	18.4	82.3	15.4	77.8	23.4	86.9	20.1	82.4	16.7	77.8	25.5	87	21.9	82.4	18.2	77.9
1.5	55	19.1	87.3	16.3	82.7	13.6	78.1	20.8	87.4	17.9	82.7	14.9	78.1	22.7	87.4	19.5	82.8	16.2	78.1
2	55	15.7	87.9	13.4	83.2	11.2	78.5	17.1	87.9	14.7	83.2	12.2	78.5	18.7	87.9	16	83.2	13.4	78.5
2.5	155	13.4	88.3	11.5	83.6	9.6	78.8	14.7	88.3	12.6	83.6	10.5	78.8	16.1	88.3	13.7	83.6	11.5	78.8

Fluid Temp = temperature of the chilled water (F).

Table AP-16. Heat Gain Values for Asahitec™ PP-RCT in Moving Air Conditions

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 0.5", O.D. = 0.79"						Pipe Size = 0.75", O.D. = 0.98"						Pipe Size = 1", O.D. = 1.26					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	43.7	54.8	39.7	53	35.7	51.2	53	55.6	48.2	53.7	43.4	51.8	65.8	56.8	59.9	54.7	53.9	52.8
0.125	35	18.3	78.8	16.6	74.8	14.9	70.9	21.9	78.7	19.9	74.7	17.9	70.7	27.1	78.6	24.6	74.6	22.1	70.7
0.25	35	12.5	83.8	11.3	79.4	10.2	75	14.7	83.7	13.4	79.2	12.1	74.8	18	83.5	16.4	79.1	14.7	74.7
0.375	35	9.8	85.9	8.9	81.3	8.1	76.7	11.5	85.8	10.5	81.1	9.4	76.5	13.9	85.6	12.7	81	11.4	76.4
0.5	35	8.3	87	7.6	82.3	6.8	77.6	9.7	86.9	8.8	82.2	7.9	77.5	11.6	86.7	10.5	82	9.5	77.3
0.625	35	7.4	87.7	6.7	82.9	6	78.1	8.5	87.6	7.7	82.8	6.9	78	10.1	87.4	9.2	82.7	8.2	77.9
0.75	35	6.7	88.1	6.1	83.3	5.4	78.5	7.6	88	6.9	83.2	6.2	78.4	9	87.9	8.2	83.1	7.4	78.3
1	35	5.7	88.7	5.2	83.8	4.7	78.9	6.5	88.6	5.9	83.7	5.3	78.9	7.6	88.5	6.9	83.7	6.2	78.8
1.25	35	5.1	89	4.7	84.1	4.2	79.2	5.8	88.9	5.2	84	4.7	79.1	6.7	88.9	6.1	84	5.5	79.1
1.5	35	4.7	89.2	4.3	84.3	3.8	79.4	5.3	89.2	4.8	84.2	4.3	79.3	6	89.1	5.5	84.2	4.9	79.3
2	35	4.1	89.5	3.7	84.5	3.4	79.5	4.6	89.4	4.2	84.5	3.7	79.5	5.2	89.4	4.7	84.4	4.3	79.5
2.5	35	3.8	89.6	3.4	84.6	3.1	79.7	4.1	89.6	3.8	84.6	3.4	79.6	4.7	89.5	4.2	84.6	3.8	79.6
0	40	39.7	58	35.7	56.2	31.8	54.4	48.2	58.7	43.4	56.8	38.6	54.9	59.9	59.7	53.9	57.8	47.9	55.8
0.125	40	16.6	79.8	14.9	75.9	13.3	71.9	19.9	79.7	17.9	75.7	15.9	71.8	24.6	79.6	22.1	75.7	19.7	71.7
0.25	40	11.3	84.4	10.2	80	9.1	75.5	13.4	84.2	12.1	79.8	10.7	75.4	16.4	84.1	14.7	79.7	13.1	75.3
0.375	40	8.9	86.3	8.1	81.7	7.2	77	10.5	86.1	9.4	81.5	8.4	76.9	12.7	86	11.4	81.4	10.1	76.8
0.5	40	7.6	87.3	6.8	82.6	6.1	77.8	8.8	87.2	7.9	82.5	7	77.7	10.5	87	9.5	82.3	8.4	77.6
0.625	40	6.7	87.9	6	83.1	5.4	78.3	7.7	87.8	6.9	83	6.2	78.2	9.2	87.7	8.2	82.9	7.3	78.1
0.75	40	6.1	88.3	5.4	83.5	4.8	78.7	6.9	88.2	6.2	83.4	5.5	78.6	8.2	88.1	7.4	83.3	6.5	78.5
1	40	5.2	88.8	4.7	83.9	4.2	79	5.9	88.7	5.3	83.9	4.7	79	6.9	88.7	6.2	83.8	5.5	78.9
1.25	40	4.7	89.1	4.2	84.2	3.7	79.3	5.2	89	4.7	84.1	4.2	79.2	6.1	89	5.5	84.1	4.9	79.2
1.5	40	4.3	89.3	3.8	84.4	3.4	79.4	4.8	89.2	4.3	84.3	3.8	79.4	5.5	89.2	4.9	84.3	4.4	79.3
2	40	3.7	89.5	3.4	84.5	3	79.6	4.2	89.5	3.7	84.5	3.3	79.6	4.7	89.4	4.3	84.5	3.8	79.5
2.5	40	3.4	89.6	3.1	84.7	2.7	79.7	3.8	89.6	3.4	84.6	3	79.7	4.2	89.6	3.8	84.6	3.4	79.7
0	45	35.7	61.2	31.8	59.4	27.8	57.6	43.4	61.8	38.6	59.9	33.7	58.1	53.9	62.8	47.9	60.8	41.9	58.8
0.125	45	14.9	80.9	13.3	76.9	11.6	72.9	17.9	80.7	15.9	76.8	13.9	72.8	22.1	80.7	19.7	76.7	17.2	72.7
0.25	45	10.2	85	9.1	80.5	7.9	76.1	12.1	84.8	10.7	80.4	9.4	76	14.7	84.7	13.1	80.3	11.5	75.8
0.375	45	8.1	86.7	7.2	82	6.3	77.4	9.4	86.5	8.4	81.9	7.3	77.3	11.4	86.4	10.1	81.8	8.9	77.2
0.5	45	6.8	87.6	6.1	82.8	5.3	78.1	7.9	87.5	7	82.7	6.2	78	9.5	87.3	8.4	82.6	7.4	77.9
0.625	45	6	88.1	5.4	83.3	4.7	78.5	6.9	88	6.2	83.2	5.4	78.5	8.2	87.9	7.3	83.1	6.4	78.4
0.75	45	5.4	88.5	4.8	83.7	4.2	78.8	6.2	88.4	5.5	83.6	4.9	78.7	7.4	88.3	6.5	83.5	5.7	78.7
1	45	4.7	88.9	4.2	84	3.6	79.2	5.3	88.9	4.7	84	4.1	79.1	6.2	88.8	5.5	83.9	4.8	79.1
1.25	45	4.2	89.2	3.7	84.3	3.3	79.4	4.7	89.1	4.2	84.2	3.7	79.3	5.5	89.1	4.9	84.2	4.3	79.3
1.5	45	3.8	89.4	3.4	84.4	3	79.5	4.3	89.3	3.8	84.4	3.3	79.5	4.9	89.3	4.4	84.3	3.8	79.4
2	45	3.4	89.5	3	84.6	2.6	79.7	3.7	89.5	3.3	84.6	2.9	79.6	4.3	89.5	3.8	84.5	3.3	79.6
2.5	45	3.1	89.7	2.7	84.7	2.4	79.7	3.4	89.6	3	84.7	2.6	79.7	3.8	89.6	3.4	84.7	3	79.7
0	50	31.8	64.4	27.8	62.6	23.8	60.8	38.6	64.9	33.7	63.1	28.9	61.2	47.9	65.8	41.9	63.8	35.9	61.9
0.125	50	13.3	81.9	11.6	77.9	10	73.9	15.9	81.8	13.9	77.8	11.9	73.8	19.7	81.7	17.2	77.7	14.8	73.8
0.25	50	9.1	85.5	7.9	81.1	6.8	76.6	10.7	85.4	9.4	81	8	76.6	13.1	85.3	11.5	80.8	9.8	76.5
0.375	50	7.2	87	6.3	82.4	5.4	77.8	8.4	86.9	7.3	82.3	6.3	77.7	10.1	86.8	8.9	82.2	7.6	77.6
0.5	50	6.1	87.8	5.3	83.1	4.5	78.4	7	87.7	6.2	83	5.3	78.3	8.4	87.6	7.4	82.9	6.3	78.2
0.625	50	5.4	88.3	4.7	83.5	4	78.8	6.2	88.2	5.4	83.5	4.6	78.7	7.3	88.1	6.4	83.4	5.5	78.6
0.75	50	4.8	88.7	4.2	83.8	3.6	79	5.5	88.6	4.9	83.7	4.2	78.9	6.5	88.5	5.7	83.7	4.9	78.9
1	50	4.2	89	3.6	84.2	3.1	79.3	4.7	89	4.1	84.1	3.5	79.3	5.5	88.9	4.8	84.1	4.1	79.2
1.25	50	3.7	89.3	3.3	84.4	2.8	79.5	4.2	89.2	3.7	84.3	3.1	79.4	4.9	89.2	4.3	84.3	3.6	79.4
1.5	50	3.4	89.4	3	84.5	2.6	79.6	3.8	89.4	3.3	84.5	2.9	79.5	4.4	89.3	3.8	84.4	3.3	79.5
2	50	3	89.6	2.6	84.7	2.2	79.7	3.3	89.6	2.9	84.6	2.5	79.7	3.8	89.5	3.3	84.6	2.8	79.7
2.5	50	2.7	89.7	2.4	84.7	2	79.8	3	89.7	2.6	84.7	2.3	79.8	3.4	89.7	3	84.7	2.5	79.7
0	55	27.8	67.6	23.8	65.8	19.8	64	33.7	68.1	28.9	66.2	24.1	64.3	41.9	66.8	35.9	66.9	29.9	64.9
0.125	55	11.6	82.9	10	78.9	8.3	74.9	13.9	82.8	11.9	78.8	9.9	74.9	17.2	82.7	14.8	78.8	12.3	74.8
0.25	55	7.9	86.1	6.8	81.6	5.7	77.2	9.4	86	8	81.6	6.7	77.1	11.5	85.8	9.8	81.5	8.2	77
0.375	55	6.3	87.4	5.4	82.8	4.5	78.1	7.3	87.3	6.3	82.7	5.2	78.1	8.9	87.2	7.6	82.6	6.3	78
0.5	55	5.3	88.1	4.5	83.4	3.8	78.6	6.2	88	5.3	83.3	4.4	78.6	7.4	87.9	6.3	83.2	5.3	78.5
0.625	55	4.7	88.5	4	83.8	3.3	79	5.4	88.5	4.6	83.7	3.9	78.9	6.4	88.4	5.5	83.6	4.6	78.8
0.75	55	4.2	88.8	3.6	84	3	79.2	4.9	88.7	4.2	83.9	3.5	79.1	5.7	88.7	4.9	83.9	4.1	79.1
1	55	3.6	89.2	3.1	84.3	2.6	79.4	4.1	89.1	3.5	84.3	3	79.4	4.8	89.1	4.1	84.2	3.4	79.3
1.25	55	3.3	89.4	2.8	84.5	2.3	79.6	3.7	89.3	3.1	84.4	2.6	79.5	4.3	89.3	3.6	84.4	3	79.5
1.5	55	3	89.5	2.6	84.6	2.1	79.6	3.3	89.5	2.9	84.5	2.4	79.6	3.8	89.4	3.3	84.5	2.7	79.6
2	55	2.6	89.7	2.2	84.7	1.9	79.7	2.9	89.6	2.5	84.7	2.1	79.7	3.3	89.6	2.8	84.7	2.4	79.7
2.5	55	2.4	89.7	2	84.8	1.7	79.8	2.6	89.7	2.3	84.8	1.9	79.8	3	89.7	2.5	84.7	2.1	79.8

Fluid Temp = temperature of the chilled water (F).

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HEAT GAIN

Table AP-16. Heat Gain Values for Asahitec™ PP-RCT in Moving Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 1.25", O.D. = 1.58"						Pipe Size = 1.50", O.D. = 1.97"						Pipe Size = 2", O.D. = 2.48"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	76.6	59.1	69.6	57	62.6	54.8	85.1	62.5	77.4	60	69.6	57.5	94.8	65.7	86.2	62.9	77.6	60.1
0.125	35	32.3	78.8	29.4	74.8	26.4	70.8	37.8	79.2	34.4	75.1	30.9	71.1	44.5	79.6	40.5	75.6	36.4	71.5
0.25	35	21.4	83.5	19.5	79	17.5	74.6	25.2	83.5	22.9	79.1	20.6	74.7	30	83.6	27.2	79.2	24.5	74.8
0.375	35	16.5	85.5	15	80.9	13.5	76.3	19.4	85.5	17.6	80.9	15.8	76.3	23	85.5	20.9	80.9	18.8	76.3
0.5	35	13.6	86.6	12.4	81.9	11.2	77.2	16	86.6	14.5	81.9	13.1	77.2	18.9	86.5	17.2	81.9	15.5	77.2
0.625	35	11.8	87.3	10.7	82.6	9.7	77.8	13.8	87.3	12.5	82.5	11.3	77.8	16.3	87.2	14.8	82.5	13.3	77.7
0.75	35	10.5	87.8	9.5	83	8.6	78.2	12.2	87.8	11.1	83	10	78.2	14.4	87.7	13.1	82.9	11.8	78.1
1	35	8.8	88.4	8	83.6	7.2	78.7	10.1	88.4	9.2	83.5	8.3	78.7	11.8	88.3	10.8	83.5	9.7	78.6
1.25	35	7.7	88.8	7	83.9	6.3	79	8.8	88.7	8	83.9	7.2	79	10.2	88.7	9.3	83.8	8.4	78.9
1.5	35	6.9	89	6.3	84.1	5.6	79.2	7.9	89	7.1	84.1	6.4	79.2	9.1	88.9	8.3	84	7.4	79.1
2	35	5.9	89.3	5.3	84.4	4.8	79.5	6.6	89.3	6	84.4	5.4	79.4	7.6	89.3	6.9	84.3	6.2	79.4
2.5	35	5.2	89.5	4.8	84.5	4.3	79.6	5.9	89.5	5.3	84.5	4.8	79.6	6.7	89.4	6.1	84.5	5.5	79.5
0	40	69.6	62	62.6	59.8	55.7	57.6	77.4	65	69.6	62.5	61.9	60	86.2	67.9	77.6	65.1	69	62.3
0.125	40	29.4	79.8	26.4	75.8	23.5	71.8	34.4	80.1	30.9	76.1	27.5	72.1	40.5	80.6	36.4	76.5	32.4	72.4
0.25	40	19.5	84	17.5	79.6	15.6	75.2	22.9	84.1	20.6	79.7	18.3	75.3	27.2	84.2	24.5	79.8	21.8	75.3
0.375	40	15	85.9	13.5	81.3	12	76.7	17.6	85.9	15.8	81.3	14.1	76.7	20.9	85.9	18.8	81.3	16.7	76.7
0.5	40	12.4	86.9	11.2	82.2	9.9	77.6	14.5	86.9	13.1	82.2	11.6	77.5	17.2	86.9	15.5	82.2	13.8	77.5
0.625	40	10.7	87.6	9.7	82.8	8.6	78.1	12.5	87.5	11.3	82.8	10	78	14.8	87.5	13.3	82.7	11.8	78
0.75	40	9.5	88	8.6	83.2	7.6	78.4	11.1	88	10	83.2	8.9	78.4	13.1	87.9	11.8	83.1	10.4	78.3
1	40	8	88.6	7.2	83.7	6.4	78.9	9.2	88.5	8.3	83.7	7.4	78.8	10.8	88.5	9.7	83.6	8.6	78.8
1.25	40	7	88.9	6.3	84	5.6	79.1	8	88.9	7.2	84	6.4	79.1	9.3	88.8	8.4	83.9	7.4	79.1
1.5	40	6.3	89.1	5.6	84.2	5	79.3	7.1	89.1	6.4	84.2	5.7	79.3	8.3	89	7.4	84.1	6.6	79.2
2	40	5.3	89.4	4.8	84.5	4.3	79.5	6	89.4	5.4	84.4	4.8	79.5	6.9	89.3	6.2	84.4	5.5	79.5
2.5	40	4.8	89.5	4.3	84.6	3.8	79.6	5.3	89.5	4.8	84.6	4.3	79.6	6.1	89.5	5.5	84.5	4.9	79.6
0	45	62.6	64.8	55.7	62.6	48.7	60.4	69.6	67.5	61.9	65	54.2	62.5	77.6	70.1	69	67.3	60.3	64.5
0.125	45	26.4	80.8	23.5	76.8	20.6	72.8	30.9	81.1	27.5	77.1	24.1	73.1	36.4	81.5	32.4	77.4	28.3	73.4
0.25	45	17.5	84.6	15.6	80.2	13.6	75.8	20.6	84.7	18.3	80.3	16	75.9	24.5	84.8	21.8	80.3	19.1	75.9
0.375	45	13.5	86.3	12	81.7	10.5	77.1	15.8	86.3	14.1	81.7	12.3	77.1	18.8	86.3	16.7	81.7	14.6	77.1
0.5	45	11.2	87.2	9.9	82.6	8.7	77.9	13.1	87.2	11.6	82.5	10.2	77.8	15.5	87.2	13.8	82.5	12.1	77.8
0.625	45	9.7	87.8	8.6	83.1	7.5	78.3	11.3	87.8	10	83	8.8	78.3	13.3	87.7	11.8	83	10.4	78.2
0.75	45	8.6	88.2	7.6	83.4	6.7	78.6	10	88.2	8.9	83.4	7.8	78.6	11.8	88.1	10.4	83.3	9.1	78.5
1	45	7.2	88.7	6.4	83.9	5.6	79	8.3	88.7	7.4	83.8	6.4	79	9.7	88.6	8.6	83.8	7.5	78.9
1.25	45	6.3	89	5.6	84.1	4.9	79.2	7.2	89	6.4	84.1	5.6	79.2	8.4	88.9	7.4	84.1	6.5	79.2
1.5	45	5.6	89.2	5	84.3	4.4	79.4	6.4	89.2	5.7	84.3	5	79.4	7.4	89.1	6.6	84.2	5.8	79.3
2	45	4.8	89.5	4.3	84.5	3.7	79.6	5.4	89.4	4.8	84.5	4.2	79.6	6.2	89.4	5.5	84.5	4.9	79.5
2.5	45	4.3	89.6	3.8	84.6	3.3	79.7	4.8	89.6	4.3	84.6	3.7	79.7	5.5	89.5	4.9	84.6	4.3	79.6
0	50	55.7	67.6	48.7	65.4	41.8	63.2	61.9	70	54.2	67.5	46.4	65	69	72.3	60.3	69.5	51.7	66.7
0.125	50	23.5	81.8	20.6	77.8	17.6	73.9	27.5	82.1	24.1	78.1	20.6	74.1	32.4	82.4	28.3	78.4	24.3	74.3
0.25	50	15.6	85.2	13.6	80.8	11.7	76.4	18.3	85.3	16	80.9	13.8	76.4	21.8	85.3	19.1	80.9	16.3	76.5
0.375	50	12	86.7	10.5	82.1	9	77.5	14.1	86.7	12.3	82.1	10.6	77.5	16.7	86.7	14.6	82.1	12.6	77.5
0.5	50	9.9	87.6	8.7	82.9	7.4	78.2	11.6	87.5	10.2	82.8	8.7	78.1	13.8	87.5	12.1	82.8	10.3	78.1
0.625	50	8.6	88.1	7.5	83.3	6.4	78.6	10	88	8.8	83.3	7.5	78.5	11.8	88	10.4	83.2	8.9	78.5
0.75	50	7.6	88.4	6.7	83.6	5.7	78.8	8.9	88.4	7.8	83.6	6.7	78.8	10.4	88.3	9.1	83.5	7.8	78.8
1	50	6.4	88.9	5.6	84	4.8	79.1	7.4	88.8	6.4	84	5.5	79.1	8.6	88.8	7.5	83.9	6.5	79.1
1.25	50	5.6	89.1	4.9	84.2	4.2	79.3	6.4	89.1	5.6	84.2	4.8	79.3	7.4	89.1	6.5	84.2	5.6	79.3
1.5	50	5	89.3	4.4	84.4	3.8	79.5	5.7	89.3	5	84.4	4.3	79.4	6.6	89.2	5.8	84.3	5	79.4
2	50	4.3	89.5	3.7	84.6	3.2	79.6	4.8	89.5	4.2	84.6	3.6	79.6	5.5	89.5	4.9	84.5	4.2	79.6
2.5	50	3.8	89.6	3.3	84.7	2.9	79.7	4.3	89.6	3.7	84.7	3.2	79.7	4.9	89.6	4.3	84.6	3.7	79.7
0	55	48.7	70.4	41.8	68.2	34.8	66	54.2	72.5	46.4	70	38.7	67.5	60.3	74.5	51.7	71.7	43.1	68.9
0.125	55	20.6	82.8	17.6	78.9	14.7	74.9	24.1	83.1	20.6	79.1	17.2	75.1	28.3	83.4	24.3	79.3	20.2	75.3
0.25	55	13.6	85.8	11.7	81.4	9.7	77	16	85.9	13.8	81.4	11.5	77	19.1	85.9	16.3	81.5	13.6	77.1
0.375	55	10.5	87.1	9	82.5	7.5	78	12.3	87.1	10.6	82.5	8.8	77.9	14.6	87.1	12.6	82.5	10.5	77.9
0.5	55	8.7	87.9	7.4	83.2	6.2	78.5	10.2	87.8	8.7	83.1	7.3	78.4	12.1	87.8	10.3	83.1	8.6	78.4
0.625	55	7.5	88.3	6.4	83.6	5.4	78.8	8.8	88.3	7.5	83.5	6.3	78.8	10.4	88.2	8.9	83.5	7.4	78.7
0.75	55	6.7	88.6	5.7	83.8	4.8	79	7.8	88.6	6.7	83.8	5.5	79	9.1	88.5	7.8	83.8	6.5	79
1	55	5.6	89	4.8	84.1	4	79.3	6.4	89	5.5	84.1	4.6	79.3	7.5	88.9	6.5	84.1	5.4	79.2
1.25	55	4.9	89.2	4.2	84.3	3.5	79.5	5.6	89.2	4.8	84.3	4	79.4	6.5	89.2	5.6	84.3	4.6	79.4
1.5	55	4.4	89.4	3.8	84.5	3.1	79.6	5	89.4	4.3	84.4	3.6	79.5	5.8	89.3	5	84.4	4.1	79.5
2	55	3.7	89.6	3.2	84.6	2.7	79.7	4.2	89.6	3.6	84.6	3	79.7	4.9	89.5	4.2	84.6	3.5	79.7
2.5	55	3.3	89.7	2.9	84.7	2.4	79.8	3.7	89.71	3.2	84.7	2.7	79.8	4.3	89.6	3.7	84.7	3	79.7

Fluid Temp = temperature of the chilled water (F).

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Table AP-16. Heat Gain Values for Asahitec™ PP-RCT in Moving Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 3.0", O.D. = 3.54"						Pipe Size = 4.0", O.D. = 4.33"						Pipe Size = 6.0", O.D. = 6.29"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	109.9	70.2	99.9	67	89.9	63.8	117.8	72.7	107.1	69.3	96.4	65.8	130.2	76.8	118.3	73	106.5	69.2
0.125	35	56.6	80.5	51.5	76.3	46.3	72.2	64.3	81.1	58.4	76.9	52.6	72.7	79.2	82.3	72	78	64.8	73.7
0.25	35	38.9	83.9	35.4	79.4	31.9	75	44.9	84.1	40.8	79.6	36.7	75.2	57.5	84.6	52.3	80.1	47.1	75.6
0.375	35	30.1	85.5	27.3	80.9	24.6	76.3	34.9	85.6	31.7	81	28.6	76.4	45.5	85.9	41.4	81.3	37.2	76.6
0.5	35	24.8	86.5	22.5	81.8	20.3	77.2	28.8	86.6	26.2	81.9	23.6	77.2	37.9	86.7	34.4	82	31	77.3
0.625	35	21.2	87.2	19.3	82.4	17.4	77.7	24.7	87.2	22.4	82.4	20.2	77.7	32.6	87.2	29.6	82.5	26.7	77.7
0.75	35	18.7	87.6	17	82.9	15.3	78.1	21.7	87.6	19.7	82.8	17.8	78.1	28.7	87.7	26.1	82.9	23.5	78.1
1	35	15.3	88.2	13.9	83.4	12.5	78.6	17.7	88.2	16.1	83.4	14.5	78.5	23.4	88.2	21.3	83.4	19.1	78.5
1.25	35	13.1	88.6	11.9	83.7	10.7	78.9	15.1	88.6	13.7	83.7	12.4	78.8	19.9	88.6	18.1	83.7	16.3	78.8
1.5	35	11.6	88.9	10.5	84	9.5	79.1	13.3	88.8	12.1	83.9	10.9	79.1	17.5	88.8	15.9	83.9	14.3	79
2	35	9.6	89.2	8.7	84.3	7.8	79.3	10.9	89.2	10	84.2	9	79.3	14.2	89.1	12.9	84.2	11.6	79.3
2.5	35	8.3	89.4	7.5	84.4	6.8	79.5	9.5	89.4	8.6	84.4	7.7	79.5	12.2	89.3	11.1	84.4	10	79.4
0	40	99.9	72	89.9	68.8	79.9	65.6	107.1	74.3	96.4	70.8	85.7	67.4	118.3	78	106.5	74.2	94.7	70.4
0.125	40	51.5	81.3	46.3	77.2	41.2	73.1	58.4	81.9	52.6	77.7	46.7	73.5	72	83	64.8	78.7	57.6	74.4
0.25	40	35.4	84.4	31.9	80	28.3	75.5	40.8	84.6	36.7	80.2	32.7	75.7	52.3	85.1	47.1	80.6	41.8	76.1
0.375	40	27.3	85.9	24.6	81.3	21.9	76.8	31.7	86	28.6	81.4	25.4	76.8	41.4	86.3	37.2	81.6	33.1	77
0.5	40	22.5	86.8	20.3	82.2	18	77.5	26.2	86.9	23.6	82.2	21	77.5	34.4	87	31	82.3	27.5	77.6
0.625	40	19.3	87.4	17.4	82.7	15.4	78	22.4	87.4	20.2	82.7	18	77.9	29.6	87.5	26.7	82.7	23.7	78
0.75	40	17	87.9	15.3	83.1	13.6	78.3	19.7	87.8	17.8	83.1	15.8	78.3	26.1	87.9	23.5	83.1	20.9	78.3
1	40	13.9	88.4	12.5	83.6	11.1	78.7	16.1	88.4	14.5	83.5	12.9	78.7	21.3	88.4	19.1	83.5	17	78.7
1.25	40	11.9	88.7	10.7	83.9	9.5	79	13.7	88.7	12.4	83.8	11	79	18.1	88.7	16.3	83.8	14.5	78.9
1.5	40	10.5	89	9.5	84.1	8.4	79.2	12.1	88.9	10.9	84.1	9.7	79.2	15.9	88.9	14.3	84	12.7	79.1
2	40	8.7	89.3	7.8	84.3	7	79.4	10	89.2	9	84.3	8	79.4	12.9	89.2	11.6	84.3	10.3	79.4
2.5	40	7.5	89.4	6.8	84.5	6	79.6	8.6	89.4	7.7	84.5	6.9	79.5	11.1	69.4	10	84.4	8.9	79.5
0	45	89.9	73.8	79.9	70.6	69.9	67.4	96.4	75.8	85.7	72.4	75	69	106.5	79.2	94.7	75.4	82.8	71.6
0.125	45	46.3	82.2	41.2	78.1	36	74	52.6	82.7	46.7	78.5	40.9	74.3	64.8	83.7	57.6	79.4	50.4	75.1
0.25	45	31.9	85	28.3	80.5	24.8	76.1	36.7	85.2	32.7	80.7	28.6	76.2	47.1	85.6	41.8	81.1	36.6	76.6
0.375	45	24.6	86.3	21.9	81.8	19.1	77.2	28.6	86.4	25.4	81.8	22.2	77.2	37.2	86.6	33.1	82	29	77.4
0.5	45	20.3	87.2	18	82.5	15.8	77.8	23.6	87.2	21	82.5	18.3	77.8	31	87.3	27.5	82.6	24.1	77.9
0.625	45	17.4	87.7	15.4	83	13.5	78.2	20.2	87.7	18	82.9	15.7	78.2	26.7	87.7	23.7	83	20.7	78.3
0.75	45	15.3	88.1	13.6	83.3	11.9	78.5	17.8	88.1	15.8	83.3	13.8	78.5	23.5	88.1	20.9	83.3	18.3	78.5
1	45	12.5	88.6	11.1	83.7	9.7	78.9	14.5	88.5	12.9	83.7	11.3	78.9	19.1	88.5	17	83.7	14.9	78.9
1.25	45	10.7	88.9	9.5	84	8.3	79.1	12.4	88.8	11	84	9.6	79.1	16.3	88.8	14.5	83.9	12.7	79.1
1.5	45	9.5	89.1	8.4	84.2	7.4	79.3	10.9	89.1	9.7	84.2	8.5	79.3	14.3	89	12.7	84.1	11.1	79.2
2	45	7.8	89.3	7	84.4	6.1	79.5	9	89.3	8	84.4	7	79.5	11.6	89.3	10.3	84.4	9.1	79.4
2.5	45	6.8	89.5	6	84.6	5.3	79.6	7.7	89.5	6.9	84.5	6	79.6	10	89.4	8.9	84.5	7.8	79.6
0	50	79.9	75.6	69.9	72.4	59.9	69.2	85.7	77.4	75	74.6	4.3	70.5	94.7	80.4	82.8	76.6	71	72.8
0.125	50	41.2	83.1	36	79	30.9	74.8	46.7	83.5	40.9	79.3	35.1	75.1	57.6	84.4	50.4	80.1	43.2	75.8
0.25	50	28.3	85.5	24.8	81.1	21.2	76.7	32.7	85.7	28.6	81.2	24.5	76.8	41.8	86.1	36.6	81.6	31.4	77.1
0.375	50	21.9	86.8	19.1	82.2	16.4	77.6	25.4	86.8	22.2	82.2	19	77.6	33.1	87	29	82.4	24.8	77.8
0.5	50	18	87.5	15.8	82.8	13.5	78.1	21	87.5	18.3	82.8	15.7	78.1	27.5	87.6	24.1	82.9	20.7	78.2
0.625	50	15.4	88	13.5	83.2	11.6	78.5	18	87.9	15.7	83.2	13.5	78.5	23.7	88	20.7	83.3	17.8	78.5
0.75	50	13.6	88.3	11.9	83.5	10.2	78.7	15.8	88.3	13.8	83.5	11.8	78.7	20.9	88.3	18.3	83.5	15.7	78.7
1	50	11.1	88.7	9.7	83.9	8.3	79	12.9	88.7	11.3	83.9	9.7	79	17	88.7	14.9	83.9	12.8	79
1.25	50	9.5	89	8.3	84.1	7.1	79.3	11	89	9.6	84.1	8.2	79.2	14.5	88.9	12.7	84.1	10.9	79.2
1.5	50	8.4	89.2	7.4	84.3	6.3	79.4	9.7	89.2	8.5	84.3	7.3	79.4	12.7	89.1	11.1	84.2	9.5	79.3
2	50	7	89.4	6.1	84.5	5.2	79.6	8	89.4	7	84.5	6	79.5	10.3	89.4	9.1	84.4	7.8	79.5
2.5	50	6	89.6	5.3	84.6	4.5	79.7	6.9	89.5	6	84.6	5.2	79.6	8.9	89.5	7.8	84.6	6.6	79.6
0	55	69.9	77.4	59.9	74.2	49.9	71	75	79	64.3	75.5	53.6	72.1	82.8	81.6	71	77.8	59.2	74
0.125	55	36	84	30.9	79.8	25.7	75.7	40.9	84.3	35.1	80.1	29.2	75.9	50.4	85.1	43.2	80.8	36	76.5
0.25	55	24.8	86.1	21.2	81.7	17.7	7.2	28.6	86.2	24.5	81.8	20.4	77.3	36.6	86.6	31.4	82.1	26.1	77.6
0.375	55	19.1	87.2	16.4	82.6	13.7	78	22.2	87.2	19	82.6	15.9	78	29	87.4	24.8	82.8	20.7	78.1
0.5	55	15.8	87.8	13.5	83.1	11.3	78.4	18.3	87.8	15.7	83.1	13.1	78.4	24.1	87.9	20.7	83.2	17.2	78.5
0.625	55	13.5	88.2	11.6	83.5	9.6	78.7	15.7	88.2	13.5	83.5	11.2	78.7	20.7	88.3	17.8	83.5	14.8	78.8
0.75	55	11.9	88.5	10.2	83.7	8.5	78.9	13.8	88.5	11.8	83.7	9.9	78.9	18.3	88.5	15.7	83.7	13	78.9
1	55	9.7	88.9	8.3	84	6.9	79.2	11.3	88.9	9.7	84	8	79.2	14.9	88.9	12.8	84	10.6	79.2
1.25	55	8.3	89.1	7.1	84.3	5.9	79.4	9.6	89.1	8.2	84.2	6.9	79.4	12.7	89.1	10.9	84.2	9.1	79.3
1.5	55	7.4	89.3	6.3	84.4	5.3	79.5	8.5	89.3	7.3	84.4	6.1	79.5	11.1	89.2	9.5	84.3	7.9	79.5
2	55	6.1	89.5	5.2	84.6	4.3	79.6	7	89.5	6	84.5	5	79.6	9.1	89.4	7.8	84.5	6.5	79.6
2.5	55	5.3	89.6	4.5	84.7	3.8	79.7	6	89.6	5.2	84.6	4.3	79.7	7.8	89.6	6.6	84.6	5.5	79.7

Fluid Temp = temperature of the chilled water (F).

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Table AP-16. Heat Gain Values for Asahitec™ PP-RCT in Moving Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 8", O.D. = 7.87"						Pipe Size = 10", O.D. = 9.84"						Pipe Size = 12", O.D. = 12.4"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	137.1	78.9	124.7	74.9	112.2	70.9	142.7	80.8	129.7	76.6	116.7	72.4	148	82.4	134.6	78.1	121.1	73.8
0.125	35	88.7	83	80.7	78.7	72.6	74.3	98	83.8	89.1	79.4	80.2	74.9	107.5	84.6	97.7	80.1	87.9	75.6
0.25	35	66.1	85	60.1	80.4	54.1	75.9	75	85.4	68.2	80.8	61.4	76.2	84.7	85.8	77	81.2	69.3	76.6
0.375	35	53	86.1	48.2	81.4	43.4	76.8	61.1	86.3	55.5	81.7	50	77	70.1	86.6	63.8	81.9	57.4	77.2
0.5	35	44.4	86.8	40.4	82.1	36.3	77.4	51.7	87	47	82.2	42.3	77.5	60	87.1	54.6	82.4	49.1	77.7
0.625	35	38.4	87.3	34.9	82.6	31.4	77.8	44.9	87.4	40.8	82.7	36.8	77.9	52.6	87.5	47.8	82.8	43	78
0.75	35	33.9	87.7	30.8	82.9	27.7	78.1	39.8	87.8	36.2	83	32.6	78.2	46.9	87.9	42.6	83	38.3	78.2
1	35	27.7	88.2	25.2	83.4	22.7	78.5	32.7	88.2	29.7	83.4	26.7	78.6	38.7	88.3	35.2	83.4	31.6	78.6
1.25	35	23.6	88.6	21.4	83.7	19.3	78.8	27.9	88.6	25.3	83.7	22.8	78.8	33.1	88.6	30.1	83.7	27.1	78.8
1.5	35	20.7	88.8	18.8	83.9	16.9	79	24.4	88.8	22.2	83.9	20	79	29	88.8	26.4	83.9	23.8	79
2	35	16.8	89.1	15.2	84.2	13.7	79.3	19.8	89.1	18	84.2	16.2	79.3	23.5	89.1	21.4	84.2	19.3	79.3
2.5	35	14.3	89.3	13	84.4	11.7	79.4	16.8	89.3	15.3	84.3	13.8	79.4	20	89.3	18.2	84.3	16.3	79.4
0	40	124.7	79.9	112.2	75.9	99.7	71.9	129.7	81.6	116.7	77.4	103.8	73.3	134.6	83.1	121.1	78.8	107.7	74.5
0.125	40	80.7	83.7	72.6	79.3	64.5	74.9	89.1	84.4	80.2	79.9	71.3	75.5	97.7	85.1	87.9	80.6	78.2	76.1
0.25	40	60.1	85.4	54.1	80.9	48.1	76.3	68.2	85.8	61.4	81.2	54.6	76.6	77	86.2	69.3	81.6	61.6	77
0.375	40	48.2	86.4	43.4	81.8	38.5	77.2	55.5	86.7	50	82	44.4	77.3	63.8	86.9	57.4	82.2	51	77.5
0.5	40	40.4	87.1	36.3	82.4	32.3	77.7	47	87.2	42.3	82.5	37.6	77.8	54.6	87.4	49.1	82.7	43.7	77.9
0.625	40	34.9	87.6	31.4	82.8	27.9	78.1	40.8	87.7	36.8	82.9	32.7	78.1	47.8	87.8	43	83	38.2	78.2
0.75	40	30.8	87.9	27.7	83.1	24.7	78.3	36.2	88	32.6	83.2	29	78.4	42.6	88	38.3	83.2	34.1	78.4
1	40	25.2	88.4	22.7	83.5	20.1	78.7	29.7	88.4	26.7	83.6	23.8	78.7	35.2	88.4	31.6	83.6	28.1	78.8
1.25	40	21.4	88.7	19.3	83.8	17.1	79	25.3	88.7	22.8	83.8	20.3	79	30.1	88.7	27.1	83.8	24.1	79
1.5	40	18.8	88.9	16.9	84	15	79.1	22.2	88.9	20	84	17.8	79.1	26.4	88.9	23.8	84	21.1	79.1
2	40	15.2	89.2	13.7	84.3	12.2	79.3	18	89.2	16.2	84.3	14.4	79.3	21.4	89.2	19.3	84.3	17.1	79.3
2.5	40	13	89.4	11.7	84.4	10.4	79.5	15.3	89.3	13.8	84.4	12.2	79.5	18.2	89.3	16.3	84.4	14.5	79.5
0	45	112.2	80.9	99.7	76.9	87.3	72.9	116.7	82.4	103.8	78.3	90.8	74.1	121.1	83.8	107.7	79.5	94.2	75.2
0.125	45	72.6	84.3	64.5	79.9	56.5	75.6	80.2	84.9	71.3	80.5	62.4	76.1	87.9	85.6	78.2	81.1	68.4	76.6
0.25	45	54.1	85.9	48.1	81.3	42.1	76.8	61.4	86.2	54.6	81.6	47.8	77.1	69.3	86.6	61.6	82	53.9	77.3
0.375	45	43.4	86.8	38.5	82.2	33.7	77.5	50	87	44.4	82.3	38.9	77.7	57.4	87.2	51	82.5	44.6	77.8
0.5	45	36.3	87.4	32.3	82.7	28.3	78	42.3	87.5	37.6	82.8	32.9	78.1	49.1	87.7	43.7	82.9	38.2	78.2
0.625	45	31.4	87.8	27.9	83.1	24.4	78.3	36.8	87.9	32.7	83.1	28.6	78.4	43	88	38.2	83.2	33.5	78.4
0.75	45	27.7	88.1	24.7	83.3	21.6	78.5	32.6	88.2	29	83.4	25.4	78.6	38.3	88.2	34.1	83.4	29.8	78.6
1	45	22.7	88.5	20.1	83.7	17.6	78.9	26.7	88.6	23.8	83.7	20.8	78.9	31.6	88.6	28.1	83.8	24.6	78.9
1.25	45	19.3	88.8	17.1	84	15	79.1	22.8	88.8	20.3	84	17.7	79.1	27.1	88.8	24.1	84	21.1	79.1
1.5	45	16.9	89	15	84.1	13.1	79.2	20	89	17.8	84.1	15.5	79.2	23.8	89	21.1	84.1	18.5	79.2
2	45	13.7	89.3	12.2	84.3	10.7	79.4	16.2	89.3	14.4	84.3	12.6	79.4	19.3	89.3	17.1	84.3	15	79.4
2.5	45	11.7	89.4	10.4	84.5	9.1	79.5	13.8	89.4	12.2	84.5	10.7	79.5	16.3	89.4	14.5	84.5	12.7	79.5
0	50	99.7	81.9	87.3	77.9	74.8	73.9	103.8	83.3	90.8	79.1	77.8	75	107.7	84.5	94.2	80.2	80.7	75.9
0.125	50	64.5	84.9	56.5	80.6	48.4	76.2	71.3	85.5	62.4	81.1	53.4	76.6	78.2	86.1	68.4	81.6	58.6	77.1
0.25	50	48.1	86.3	42.1	81.8	36.1	77.3	54.6	86.6	47.8	82.1	40.9	77.5	61.6	87	53.9	82.3	46.2	77.7
0.375	50	38.5	87.2	33.7	82.5	28.9	77.9	44.4	87.3	38.9	82.7	33.3	78	51	87.5	44.6	82.8	38.3	78.1
0.5	50	32.3	87.7	28.3	83	24.2	78.3	37.6	87.8	32.9	83.1	28.2	78.3	43.7	87.9	38.2	83.2	32.7	78.4
0.625	50	27.9	88.1	24.4	83.3	20.9	78.5	32.7	88.1	28.6	83.4	24.5	78.6	38.2	88.2	33.5	83.4	28.7	78.7
0.75	50	24.7	88.3	21.6	83.5	18.5	78.7	29	88.4	25.4	83.6	21.7	78.8	34.1	88.4	29.8	83.6	25.6	78.8
1	50	20.1	88.7	17.6	83.9	15.1	79	23.8	88.7	20.8	83.9	17.8	79	28.1	88.8	24.6	83.9	21.1	79.1
1.25	50	17.1	89	15	84.1	12.9	79.2	20.3	89	17.7	84.1	15.2	79.2	24.1	89	21.1	84.1	18	79.2
1.5	50	15	89.1	13.1	84.2	11.3	79.3	17.8	89.1	15.5	84.2	13.3	79.3	21.1	89.1	18.5	84.2	15.8	79.3
2	50	12.2	89.3	10.7	84.4	9.1	79.5	14.4	89.3	12.6	84.4	10.8	79.5	17.1	89.3	15	84.4	12.8	79.5
2.5	50	10.4	89.5	9.1	84.5	7.8	79.6	12.2	89.5	10.7	84.5	9.2	79.6	14.5	89.5	12.7	84.5	10.9	79.6
0	55	87.3	82.9	74.8	78.9	62.3	75	90.8	84.1	77.8	80	64.9	75.8	94.2	85.2	80.7	80.9	67.3	76.5
0.125	55	56.5	85.6	48.4	81.2	40.3	76.8	62.4	86.1	53.4	81.6	44.5	77.2	68.4	86.6	58.6	82.1	48.9	77.5
0.25	55	42.1	86.8	36.1	82.3	30.1	77.7	47.8	87.1	40.9	82.5	34.1	77.9	53.9	87.3	46.2	82.7	38.5	78.1
0.375	55	33.7	87.5	28.9	82.9	24.1	78.2	38.9	87.7	33.3	83	27.8	78.3	44.6	87.8	38.3	83.1	31.9	78.5
0.5	55	28.3	88	24.2	83.3	20.2	78.6	32.9	88.1	28.2	83.3	23.5	78.6	38.2	88.2	32.7	83.4	27.3	78.7
0.625	55	24.4	88.3	20.9	83.5	17.4	78.8	28.6	88.4	24.5	83.6	20.4	78.8	33.5	88.4	28.7	83.7	23.9	78.9
0.75	55	21.6	88.5	18.5	83.7	15.4	79	25.4	88.6	21.7	83.8	18.1	79	29.8	88.6	25.6	83.8	21.3	79
1	55	17.6	88.9	15.1	84	12.6	79.2	20.8	88.9	17.8	84	14.9	79.2	24.6	88.9	21.1	84.1	17.6	79.2
1.25	55	15	89.1	12.9	84.2	10.7	79.3	17.7	89.1	15.2	84.2	12.7	79.3	21.1	89.1	18	84.2	15	79.4
1.5	55	13.1	89.2	11.3	84.3	9.4	79.4	15.5	89.2	13.3	84.3	11.1	79.4	18.5	89.2	15.8	84.3	13.2	79.5
2	55	10.7	89.4	9.1	84.5	7.6	79.6	12.6	89.4	10.8	84.5	9	79.6	15	89.4	12.8	94.5	10.7	79.6
2.5	55	9.1	89.5	7.8	84.6	6.5	79.7	10.7	89.5	9.2	84.6	7.6	79.7	12.7	89.5	10.9	84.6	9.1	79.7

Fluid Temp = temperature of the chilled water (F).

Table AP-16. Heat Gain Values for Asahitec™ PP-RCT in Moving Air Conditions (Continued)

Nominal Insulation Thickness (inches)	Fluid Temp (F)	Pipe Size = 14", O.D. = 13.98"						Pipe Size = 16", O.D. = 15.75"						Pipe Size = 18", O.D. = 17.72"					
		Ambient Temperature (F)						Ambient Temperature (F)						Ambient Temperature (F)					
		90		85		80		90		85		80		90		85		80	
		Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp	Heat Gain	Surface Temp
0	35	150.6	83.1	136.9	78.8	123.2	74.4	152.7	83.8	138.9	79.4	125	74.9	154.5	84.4	140.5	80	126.4	75.5
0.125	35	112.3	85	102.1	80.4	91.9	75.9	116.8	85.4	106.2	80.8	95.6	76.2	121	85.7	110	81.1	99	76.5
0.25	35	89.8	86.1	81.7	81.4	73.5	76.8	94.8	86.3	86.2	81.6	77.6	77	99.7	86.5	90.6	81.8	81.5	77.2
0.375	35	75.1	86.8	68.3	82	61.4	77.3	80	86.9	72.7	82.2	65.5	77.5	84.9	87.1	77.2	82.3	69.5	77.6
0.5	35	64.6	87.3	58.8	82.5	52.9	77.8	69.3	87.4	63	82.6	56.7	77.8	74.1	87.5	67.3	82.7	60.6	77.9
0.625	35	56	87.6	51.7	82.8	46.5	78.1	61.3	87.7	55.7	82.9	50.1	78.1	65.8	87.8	59.8	83	53.8	78.2
0.75	35	50.8	87.9	46.2	83.1	41.6	78.3	55	88	50	83.2	45	78.3	59.3	88	53.9	83.2	48.5	78.4
1	35	42.1	88.3	38.3	83.5	34.5	78.6	45.8	88.4	41.6	83.5	37.5	78.7	49.6	88.4	45.1	83.5	40.6	78.7
1.25	35	36.1	88.6	32.9	83.7	29.6	78.9	39.4	88.6	35.8	83.8	32.2	78.9	42.8	88.7	38.9	83.8	35	78.9
1.5	35	31.7	88.8	28.9	83.9	26	79	34.7	88.8	31.5	83.9	28.4	79	37.7	88.8	34.3	83.9	30.9	79.1
2	35	25.8	89.1	23.4	84.2	21.1	79.3	28.2	89.1	25.6	84.2	23	79.3	30.7	89.1	27.9	84.2	25.2	79.3
2.5	35	21.9	89.3	19.9	84.3	17.9	79.4	23.9	89.3	21.7	84.3	19.6	79.4	26.1	89.3	23.7	84.3	21.4	79.4
0	40	136.9	83.8	123.2	79.4	109.5	75	138.9	84.4	125	79.9	111.1	75.5	140.5	85	126.4	80.5	112.4	76
0.125	40	102.1	85.4	91.9	80.9	81.7	76.3	106.2	85.8	95.6	81.2	85	76.6	110	86.1	99	81.5	88	76.9
0.25	40	81.7	86.4	73.5	81.8	65.3	77.1	86.2	86.6	77.6	82	69	77.3	90.6	86.8	81.5	82.2	72.5	77.5
0.375	40	68.3	87	61.4	82.3	54.6	77.6	72.7	87.2	65.5	82.5	58.2	77.8	77.2	87.3	69.5	82.6	61.8	77.9
0.5	40	58.8	87.5	52.9	82.8	47	78	63	87.6	56.7	82.8	50.4	78.1	67.3	87.7	60.6	82.9	53.9	78.2
0.625	40	51.7	87.8	46.5	83.1	41.4	78.3	55.7	87.9	50.1	83.1	44.6	78.3	59.8	88	53.8	83.2	47.9	78.4
0.75	40	46.2	88.1	41.6	83.3	37	78.5	50	88.2	45	83.3	40	78.5	53.9	88.2	48.5	83.4	43.1	78.6
1	40	38.3	88.5	34.5	83.6	30.6	78.8	41.6	88.5	37.5	83.7	33.3	78.8	45.1	88.5	40.6	83.7	36.1	78.8
1.25	40	32.9	88.7	29.6	83.9	26.3	79	35.8	88.8	32.2	83.9	28.6	79	38.9	88.8	35	83.9	31.1	79
1.5	40	28.9	88.9	26	84	23.1	79.1	31.5	88.9	28.4	84	25.2	79.1	34.3	88.9	30.9	94.1	27.5	79.2
2	40	23.4	89.2	21.1	84.3	18.7	79.3	25.6	89.2	23	84.3	20.5	79.3	27.9	89.2	25.2	84.3	22.4	79.3
2.5	40	19.9	89.3	17.9	84.4	15.9	79.5	21.7	89.3	19.6	84.4	17.4	79.5	23.7	89.3	21.4	84.4	19	79.5
0	45	123.2	84.4	109.5	80	95.8	75.6	125	84.9	111.1	80.5	97.2	76.1	126.4	85.5	112.4	81	98.3	76.5
0.125	45	91.9	85.9	81.7	81.3	71.5	76.8	95.6	86.2	85	81.6	74.3	77	99	86.5	88	81.9	77	77.3
0.25	45	73.5	86.8	65.3	82.1	57.2	77.5	77.6	87	69	82.3	60.4	77.6	81.5	87.2	72.5	82.5	63.4	77.8
0.375	45	61.4	87.3	54.6	82.6	47.8	77.9	65.5	87.5	58.2	82.8	50.9	78	69.5	87.6	61.8	82.9	54	78.1
0.5	45	52.9	87.8	47	83	41.1	78.3	56.7	87.8	50.4	83.1	44.1	78.3	60.6	87.9	53.9	83.2	47.1	78.4
0.625	45	46.5	88.1	41.4	83.3	36.2	78.5	50.1	88.1	44.6	83.3	39	78.5	53.8	88.2	47.9	83.4	41.9	78.6
0.75	45	41.6	88.3	37	83.5	32.4	78.7	45	88.3	40	83.5	35	78.7	48.5	88.4	43.1	83.6	37.7	78.8
1	45	34.5	88.6	30.6	83.8	26.8	78.9	37.5	88.7	33.3	83.8	29.1	79	40.6	88.7	36.1	83.8	31.6	79
1.25	45	29.6	88.9	26.3	84	23	79.1	32.2	88.9	28.6	84	25.1	79.1	35	88.9	31.1	84	27.2	79.1
1.5	45	26	89	23.1	84.1	20.2	79.2	28.4	89	25.2	84.1	22.1	79.2	30.9	89.1	27.5	84.2	24	79.3
2	45	21.1	89.3	18.7	84.3	16.4	79.4	23	89.3	20.5	84.3	17.9	79.4	25.2	89.3	22.4	84.3	19.6	79.4
2.5	45	17.9	89.4	15.9	84.5	13.9	79.5	19.6	89.4	17.4	84.5	15.2	79.5	21.4	89.4	19	84.5	16.6	79.5
0	50	109.5	85	95.8	80.6	82.1	76.3	111.1	85.5	97.2	81.1	83.3	76.6	112.4	86	98.3	81.5	84.3	77
0.125	50	81.7	86.3	71.5	81.8	61.3	77.3	85	86.6	74.3	82	63.7	77.5	88	86.9	77	82.3	66	77.7
0.25	50	65.3	87.1	57.2	82.5	49	77.8	69	87.3	60.4	82.6	51.7	78	72.5	87.5	63.4	82.8	54.4	78.1
0.375	50	54.6	87.6	47.8	82.9	41	78.2	58.2	87.8	50.9	83	43.6	78.3	61.8	87.9	54	83.1	46.3	78.4
0.5	50	47	88	41.1	83.3	35.3	78.5	50.4	88.1	44.1	83.3	37.8	78.6	53.9	88.2	47.1	83.4	40.4	78.6
0.625	50	41.4	88.3	36.2	83.5	31	78.7	44.6	88.3	39	83.5	33.4	78.7	47.9	88.4	41.9	83.6	35.9	78.8
0.75	50	37	88.5	32.4	83.7	27.7	78.9	40	88.5	35	83.7	30	78.9	43.1	88.6	37.7	83.8	32.3	78.9
1	50	30.6	88.8	26.8	83.9	23	79.1	33.3	88.8	29.1	84	25	79.1	36.1	88.8	31.6	84	27.1	79.1
1.25	50	26.3	89	23	84.1	19.7	79.2	28.6	89	25.1	84.1	21.5	79.3	31.1	89	27.2	84.1	23.3	79.3
1.5	50	23.1	89.1	20.2	84.2	17.3	79.4	25.2	89.1	22.1	84.2	18.9	79.4	27.5	89.2	24	84.3	20.6	79.4
2	50	18.7	89.3	16.4	84.4	14.1	79.5	20.5	89.3	17.9	84.4	15.4	79.5	22.4	89.3	19.6	84.4	16.8	79.5
2.5	50	15.9	89.5	13.9	84.5	11.9	79.6	17.4	89.5	15.2	84.5	13	79.6	19	89.5	16.6	84.5	14.2	79.6
0	55	95.8	85.6	82.1	81.3	68.5	76.9	97.2	86.1	83.3	81.6	69.4	77.2	98.3	86.5	84.3	82	70.2	77.5
0.125	55	71.5	86.8	61.3	82.3	51	77.7	74.3	87	63.7	82.5	53.1	77.9	77	87.3	66	82.7	55	78.1
0.25	55	57.2	87.5	49	82.8	40.8	78.2	60.4	87.6	51.7	83	43.1	78.3	63.4	87.8	54.4	83.1	45.3	78.4
0.375	55	47.8	87.9	41	83.2	34.1	78.5	50.9	88	43.6	83.3	36.4	78.6	54	88.1	46.3	83.4	38.6	78.7
0.5	55	41.1	88.3	35.3	83.5	29.4	78.8	44.1	88.3	37.8	83.6	31.5	78.8	47.1	88.4	40.4	83.6	33.7	78.9
0.625	55	36.2	88.5	31	83.7	25.8	78.9	39	88.5	33.4	83.7	27.9	79	41.9	88.6	35.9	83.8	29.9	79
0.75	55	32.4	88.7	27.7	83.9	23.1	79.1	35	88.7	30	83.9	25	79.1	37.7	88.8	32.3	83.9	26.9	79.1
1	55	26.8	88.9	23	84.1	19.2	79.2	29.1	89	25	84.1	20.8	79.3	31.6	89	27.1	84.1	22.5	79.3
1.25	55	23	89.1	19.7	84.2	16.4	79.4	25.1	89.1	21.5	84.3	17.9	79.4	27.2	89.1	23.3	84.3	19.5	79.4
1.5	55	20.2	89.2	17.3	84.4	14.4	79.5	22.1	89.2	18.9	84.4	15.8	79.5	24	89.3	20.6	84.4	17.2	79.5
2	55	16.4	89.4	14.1	84.5	11.7	79.6	17.9	89.4	15.4	84.5	12.8	79.6	19.6	89.4	16.8	84.5	14	79.6
2.5	55	13.9	89.5	11.9	84.6	9.9	79.7	15.2	89.51	13	84.6	10.9	79.7	16.6	89.5	14.2	84.6	11.9	79.7

Fluid Temp = temperature of the chilled water (F).

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OPERATING PRESSURES

Table AP-18 Allowed operating pressures for warm and hot water pipelines made of PP-RCT

Time-Temperature collective	Temperature (°F)	Operating period (Years)	PP-RCT		
			Allowed operation pressures - Nominal pressue		
			SDR 7.4 (psi)	SDR 9 (psi)	SDR 11 (psi)
Continuous temperature 158°F including 30 days per year with	167	5	193	152	122
		10	189	149	119
		25	184	146	116
		45	181	144	115
	176	5	177	141	112
		10	174	138	109
		25	170	135	106
		42.5	167	132	104
	185	5	161	128	102
		10	158	126	100
		25	154	122	97
		37.5	152	120	96
	194	5	146	116	93
		10	144	115	90
		25	139	110	88
		35	138	110	87
Continuous temperature 158°F including 60 days per year with	167	5	190	151	119
		10	186	148	117
		25	181	144	115
		45	178	142	113
	176	5	174	138	109
		10	170	135	107
		25	167	132	104
		40	164	131	103
	185	5	158	126	100
		10	151	120	96
		25	151	120	96
		35	149	119	94
	194	5	144	115	90
		10	141	112	88
		25	136	109	86
		30	136	107	86
Continuous temperature 158°F including 90 days per year with	167	5	189	149	119
		10	184	146	116
		25	180	142	113
		45	177	141	112
	176	5	171	136	109
		10	168	133	106
		25	164	131	103
		37.5	162	129	102
	185	5	157	125	99
		10	154	122	96
		25	149	119	94
		32.5	148	117	93
	194	5	142	113	90
		10	139	110	87
		25	135	107	86

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Specifications

22 11 16 DOMESTIC WATER AND HVAC SYSTEM PIPING

GENERAL

SUMMARY

This section includes piping, fittings, valves and specialties within the scope of the project; for potable cold, hot, and hydronic hot and cold water piping systems.

Execute work and provide materials and equipment as shown on the drawings and as specified or indicated in this section of the specifications. All work associated with this section shall be completely coordinated with work of all other trades. Provide a complete and fully functional system.

REFERENCE DOCUMENTS

ASTM F412 – 17a – Standard Terminology Relating to Plastic Piping Systems

ASTM F2389 – 17a – Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

NSF/ANSI 14 – Plastic Piping System Components and Related Materials

ISO 4065 Thermoplastic Pipes – Universal Wall Thickness Table

ISO 9080 – Plastics Piping and Ducting Systems Determination of the Long-Term Hydrostatic Strength of Thermoplastics Materials in Pipe Form by Extrapolation

ISO 15874 – Plastics piping systems for hot and cold water installations – Polypropylene (PP) – Parts 1-4

ISO 4427 – Plastics piping systems – PE pipes and fittings for water supply – Part 3: Fittings

IPC 2012 – International Plumbing Code

DVS-2017 – Technical Codes on Plastics Joining Technologies

DEFINITIONS

Definitions of terms used herein shall have the meaning set forth by ASTM F 2389-17, ASTM F 412-17, and local plumbing codes.

SUBMITTALS

Each product to be used shall be identified by the manufacturer and product number on the material list.

QUALITY ASSURANCE

The manufacturer's product complies with the universal wall thickness tables of ISO 4065, long term hydrostatic strength shall be determined by ISO 9080 standard extrapolation method, and ISO 15874.

Material shall be certified to NSF-14 and ASTM F2389. NSF International shall have the product listed on www.nsf.org.

Special engineered products shall be marked appropriately according NSF-14.

PRODUCTS

PIPE AND PIPING PRODUCTS

Pipe shall be manufactured from a PP-RCT resin meeting the short-term properties and long-term strength requirements of ASTM F2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be made in an extrusion process. Domestic hot water shall contain a fiberglass reinforced middle layer (Fibercore™) to restrict thermal expansion. All pipes shall comply with the rated pressure requirements of ASTM F2389. All pipes shall be certified to NSF-14 and ASTM F2389.

Pipe shall be solid wall Climatec™ or Watertec™, and be provided by Asahi/America. Piping specifications and ordering information are available at www.asahi-america.com.

FITTINGS

Fittings shall be manufactured from a PP-RCT resin meeting the short-term and long-term strength requirements of ASTM F2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be injection molded, except where a molded fitting is unavailable. All fittings shall be certified to ASTM F2389 and NSF-14.

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Fittings of nominal size 5” (125mm) and below shall be of the socket fusion type and have an SDR equal or less than that of the connecting pipe.

Fittings nominal sizes 6” (160mm) and above shall be of the butt fusion type and shall be injection molded, except where a molded fitting is unavailable.

Fabricated fittings, made from pipes, are to have a **pressure derating in accordance to ISO4427-3.**

Segmented bends - For pipe cut angles less than or equal to 7.5° have a derating factor of 1.0. Pipe cut angles greater than 7.5° and less than or equal to 15° have a derating factor of 0.8. No pipe cut angle shall be greater than 15°.

Segmented tees’ pressure rating shall be derated by half.

WARRANTY

Asahi/ America shall warrant pipe and fittings for 10 years to be free of defects in materials or manufacturing.

Warranty shall cover labor and material costs of repairing or replacing the defective material.

Warranty shall be in effect upon the submission of a valid pressure/leak test to Asahi/America.

Visit www.asahi-america.com to acquire the latest warranty.

VALVES

Ball valves, sizes 1/2” – 4”, shall be of true union design with two-way blocking capability. All O-rings shall be EPDM with PTFE seats that shall have an elastomeric backing cushion of the same material as the valve seals. The stem shall have double O-rings and be of blowout-proof design. The valve handle shall double as carrier removal and/or tightening tool. ISO mounting pad shall be integrally molded to valve body for actuation. PP conforming to ASTM D4101 Cell Classification PP0210B67272. For all sizes, pressure rating of 150psi at 70°F. Must carry a three year guarantee, as manufactured by Asahi/ America.

All solid thermoplastic butterfly valves sizes 1-1/2” through 14” shall be of the Type-57P lined body design and bubble-tight seal (meeting or exceeding class VI as defined by American National Standard Institute) with only the liner and disc as wetted parts. The lever handle (size 1-1/2”- 8”) shall have a molded provision for a padlock. Gear operators shall be worm gear design, self-locking Plasgear™. The spherical disc design for higher Cv values shall be of solid, abrasion resistant plastic. Liner shall be molded and formed around the body, functioning as gasket seals with convex ring design on each side of the valve for lower bolt tightening torque and valve body shall have molded body stops and seat relief area to prevent over tightening of mating flanges. Stem shall be of 316 stainless steel, non-wetted, having engagement over the full length of the disc and be locked into valve body by PP stem retainer. Valves shall have a molded ISO bolt pattern on top flange for actuator mount. PP conforming to ASTM D4101 Cell Classification PP0210B67272. Valves shall be rated to 150psi at 70º F, sizes 1-1/2” through 10” and 100psi for sizes 12” and 14”. Butterfly valves shall be wafer style, as manufactured by Asahi/America.

Valves shall be manufactured in accordance with the manufacturer’s specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11. The valves shall contain no rework or recycled thermoplastic materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

SMOKE AND FIRE RATINGS

Where indicated on the drawings that a plenum-rate piping system is required; the pipe wrap and/or insulation shall meet the requirements of ASTM E84 or UL 723. The assembly shall have a flame spread classification of less than 25 and smoke development rating of less than 50.

UV PROTECTION

If piping will be exposed to direct UV light for more than 30 days, it shall be indicated on the drawings and the necessary measures shall be taken. A UV-resistant coating shall be applied or an alternative UV-protection method employed to protect the pipe. Asahi/America recommends a heavy duty, water-based, elastomeric acrylic coating that has a high elasticity (200 percent or greater) to accommodate for the pipes growth and movement, without cracking the paint.

INSULATION

Insulation shall be fibrous glass insulation. A factory-applied fire retardant vapor barrier jacket with a K Factor meeting or exceeding the latest International Energy Conservation Code.

Insulation shall be listed and labeled as having a flame spread index of not more than 25 and a smoke-development index of not more than 50 when tested in accordance with ASTM E84 or UL 723.

Apply insulation after systems have passed testing and the pressure test has been submitted. Remove all foreign matter on pipes and install insulation onto properly cleaned surfaces.

Leaks in vapor barrier or voids in the insulation are not acceptable.

EXECUTION

PIPING SYSTEMS

All drawings (diagrams, plans, and schematics) indicate the general location and arrangement of the piping system. Deviations from the drawings are prohibited, unless the engineer approves and issues a new layout on a coordination drawing.

Installers shall be trained and certified to install the pipe, and do so with the appropriate tools, without any deviation from the manufacturer's recommendations. Contact Asahi/America for certifiable training.

Underground piping shall be installed per manufacturer's instructions and ASTM D2774.

Aboveground piping shall be installed per manufacturer's instructions and ASTM F2389.

The installed system is to be free of sags and bends unless indicated otherwise by a slope. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated.

DELIVERY AND STORAGE

The product shall be delivered in the manufacturer's original packaging.

Inspect the delivered goods and verify that it is a complete delivery. Ensure that all goods are free of defects and are capable to deliver a fully functional system. Promptly notify Asahi/America, within a week of delivery, if there is a situation that adversely affects the installation.

Storage of the product shall be in accordance with Asahi/America's instructions. All pipes shall be supported appropriately. All products shall be kept from extreme temperature swings and be kept out of direct sunlight. At temperatures lower than 32°F, pipes are less flexible and more prone to breakage, therefore, extra care must be taken to prevent impacts, excessive loads, crushing or bending.

Do not install piping or fittings before they have finished cooling or if they have been damaged. Remove all damaged products from the job site immediately.

FUSION WELDING OF JOINTS

All joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance to ASTM F 2389 and the manufacturer's specifications

5" nominal (125mm) and below shall be joined using socket fusion, while pipe and fittings of sizes 6" nominal (160mm) and greater shall be joined using butt fusion.

Pipe joining equipment shall be limited to Asahi/America's recommendations.

PIPING INSTALLATIONS

Installation of hangers supports, guides and anchors shall comply with the applicable plumbing code or as recommended by Asahi/America.

Support vertical piping at each floor penetration as specified in the applicable plumbing code, using the appropriate riser clamps as recommended by Asahi/America.

Seismic-restraint devices must comply with local code for "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Pipe hangers, supports, and installation shall comply with local code for "Hangers and Supports for Plumbing Piping and Equipment."

Bare metal shall not have direct contact with the piping system. Provide clamps and supports that are rubber coated or lined. Ensure that there aren't any sharp surfaces that could potentially damage any part of the piping system.

Provide expansion loops, offsets, guides or other approved expansion and contraction components to absorb all of the stresses the system could experience between anchor points. Refer to www.asahi-america.com for the latest instructions and calculations.

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Improvised pipe support systems are not allowed. All piping support materials shall be new and shall be installed as the manufacturer dictates. Do not over tighten clamps as this can cause pipe deformation and stress cracking.

The piping system shall not have direct contact with the building structure. Necessary measures must be taken to isolate any potential contact.

Fire stopping shall meet ASTM E 814 or ULC S115. Where the pipe passes through a fire stop, the pipe insulation or fire resistive coatings shall be removed and shall meet all other requirements set forth by the firestop manufacturer.

Pipes shall be protected from heat generation of pumps that are larger than 7.5 HP. A temperature relief valve shall be installed and shall be set to 185°F if there is a chance that the pump will operate with no flow.

Heat tracing must be suitable for use with plastic piping and be self-regulating. The surface temperature of the pipes and fittings shall not exceed 158°F.

INSPECTION AND CLEANING

Inspection, cleaning, and testing shall be carried out while the piping system is still fully accessible.

The entire piping system shall be flushed with cold water after the installation is complete. The system shall be inspected and tested in accordance with Asahi/ America's recommendations and shall also meet the requirements of all authorities having jurisdiction.

TESTING

Upon completion of the installation, inspection and cleaning, the piping system shall be tested according to Asahi/ America's recommendation. A hydrostatic pressure test of 1.5 times the design pressure or 150 psi, whichever is higher shall be conducted.

Any leaks that are found will be repaired at the expense of the contractor. The section that failed shall be removed appropriately and replaced with new parts.

Visit www.asahi-america.com for the latest forms and test procedures.

AP

ASAHITEC™ STANDARDS & LISTINGS		
	Standard	**Title**
International Standards	NSF/ANSI-61	Drinking Water System Components - Health Effects
	NSF/ANSI-14	Plastics Piping System Components and Related Material
	ISO 15874	Plastic Piping systems for hot and cold water installations Polypropylene
	DIN EN ISO 9001	Quality Management Systems
	DIN 8077	Polypropylene (PP) - Dimensions
	IPC 2009 Sec. 605	International Plumbing Code
	IMC 2009 Ch.12	International Mechanical Code
	IRC 2009 Ch. 21 & 26	International Residential Code
	UMC 2009 Ch. 12	Uniform Mechanical Code
	UPC Ch. 6	Uniform Plumbing Code
	CSA B137.11	Polypropylene (PP-R) Pipe and Fittings for Pressure Applications
American Standards	ASTM F2389	Standard Specification for Pressure-rated Polypropylene Piping Systems
	ASTM F2023	Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water1
	ASME B31.3	Process Piping Guide
	ASME B31.9	Working Pressure and Temperature Limits
State Regulations	California - CPC 2013	California Plumbing Code
	California - CMC 2013	California Mechanical Code
	City of Los Angeles	Approval
	Massachusetts IMO Part 2	Approval
	State of Wisconsin	Approval

Table AP-17. Standards and Listings

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SOIL LOAD CHART

Size	Soil Modulus (E')			
	200 psi	400 psi	700 psi	1000 psi
2"	749	847	995	1144
2-1/2"	897	1015	1191	1367
3"	1047	1189	1400	1612
4"	1272	1445	1704	1963
6"	1870	2121	2497	2874
8"	2319	2633	3104	3576
10"	2913	3305	3894	4483
12"	3657	4151	4894	4636
14"	4106	4664	5501	6338
16"	4625	5254	6197	7140
18"	5219	4926	6987	8047

Table AP-17. Soil Load

Glossary

Contents

**The following definitions are from ASTM F412 - Standard Terminology Relating to Plastic Piping Systems*

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GLOSSARY

Aging –

(1) The effect on materials of exposure to an environment for an interval of time. (2) The process of exposing materials to an environment for an interval of time.

Allowable Stress –

The maximum force per unit area that may be safely applied to a pipe.

Antioxidant –

Compounding ingredient used to retard deterioration caused by oxidation.

Bead-up Cycle –

Part of the fusion procedure that insures complete contact between the heater surfaces and the pipe ends by applying pressure such as fusion joining pressure to force the pipe ends against the heater surfaces.

Beveled Pipe –

A pipe with an end chamfered to mate or adjust to another surface or to assist in assembly.

Blister –

An imperfection, a rounded elevation of the surface of a plastic, with boundaries that may be more or less sharply defined, somewhat resembling in shape a blister on the human skin.

Brittle Failure –

A pipe failure mode which exhibits no visible (to the naked eye) permanent material deformation (stretching, elongation, or necking down) in the area of the break.

Burst Strength –

The internal pressure required to cause a pipe or fitting to fail.

Chalking –

In plastics, a powdery residue on the surface of a material resulting from degradation or migration of an ingredient, or both.

Chamfered Pipe –

A pipe with a conical surface (angle) made by cutting off the edge around the outside diameter on the end of a pipe.

Coextrusion –

A process whereby two or more heated or unheated plastic material streams forced through one or more shaping orifice(s) become one continuously formed piece.

Collapse –

—(1) Inadvertent densification of cellular material during manufacture resulting from breakdown of cell structure; (2) The buckling of the inner liner of composite piping; (3) The buckling or flattening of a plastic rehabilitation liner; (4) The buckling or crushing of a plastic pipe from external forces, such as earth loads or external hydrostatic load.

Compatible –

(1) A condition wherein components of a plastic piping system or different specific plastic materials, or both, can be joined together for satisfactory joints. (2) In relation to elastomeric seal joints, a condition wherein the elastomer does not adversely affect the pertinent properties of the plastic pipe or fittings, or both, when the sealing gasket is in intimate contact with the plastic for a prolonged period.

Composite Pipe –

Pipe consisting of two or more different materials arranged with specific functional purpose to serve as pipe.

Compound –

A mixture of a polymer with other ingredients such as fillers, stabilizers, catalysts, processing aids, lubricants, modifiers, pigments, or curing agents.

Contamination –

The presence of a substance not intentionally incorporated in a product.

Cool Time at Fusion Pressure –

The minimum duration that fusion pressure is maintained while the joined pipe faces drop in temperature and solidify.

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Crack –

Any narrow opening or fissure in the surface that is visible to the naked eye.

Crater –

A small, shallow surface imperfection.

Crazing –

Apparent fine cracks at or under the surface of a plastic.

Creep –

The time-dependent part of strain resulting from stress, that is dimensional change caused by the application of load over and above the elastic deformation and with respect to time.

Cure –

To change the properties of a polymeric system into a more stable, usable condition by the use of heat, radiation, or reaction with chemical additives.

Deadload –

The static load imposed on the top of the pipe.

Deburred Pipe –

A pipe with the sharp edge and/or cutting remnants removed from the pipe end ID or OD edges

Degradation –

A deleterious change in chemical structure, physical properties, or appearance of a plastic.

Drag Pressure –

The fusion machine's hydraulic pressure required to overcome the static and dynamic resistance to motion of the movable carriage.

Ductile Failure –

A pipe failure mode which exhibits material deformation (stretching, elongation, or necking down) in the area of the break.

Environmental Stress Cracking –

The development of cracks in a material that is subjected to stress or strain in the presence of specific chemicals.

Extrusion –

A process in which heated or unheated plastic is forced through a shaping orifice (a die) in one continuously formed shape as film, sheet, rod, or tubing.

Fabricating –

The manufacture of plastic products from molded parts, rods, tubes, sheeting, extrusions, or other forms by appropriate operations such as punching, cutting, drilling, and tapping including fastening plastic parts together or to other parts by mechanical devices, adhesives, heat sealing, or other means.

Filler –

A relatively inert material added to a plastic to modify its strength, permanence, working properties, or other qualities or to lower costs.

Fish-eye –

Small globular mass that has not blended completely into the surrounding material.

Fitting –

A piping component used to join or terminate sections of pipe or to provide changes of direction or branching in a pipe system.

Fusion Cycle –

The pressure / time sequence, at a defined heater surface temperature for the fusion procedure, beginning with the bead-up cycle and ending when the cooling time is complete.

Frosting –

A light-scattering surface resembling fine crystals.

Fungi Resistance –

The ability of plastic pipe to withstand fungi growth or their metabolic products, or both, under normal conditions of service or laboratory tests simulating such conditions.

GLOSSARY

Fuse –

(1) To convert plastic powder or pellets into a homogeneous mass through heat and pressure; (2) To make a plastic piping joint by heat and pressure.

Fusion Machine Operator –

A trained person qualified to perform fusion joining of plastic pipes and/or fittings based on a fusion procedure.

Fusion Pressure –

For machines with hydraulic pressure capability, this is a calculated number determined by adding the theoretical fusion pressure (psi) and the drag pressure (psi).

Fusion Procedure –

A written document that provides detailed steps for performing fusion joining that has been qualified by testing.

Glass transition –

The reversible change in an amorphous polymer or in amorphous regions of a partially crystalline polymer from (or to) a viscous or rubbery condition to (or from) a hard and relatively brittle one.

Glass Transition Temperature –

The approximate midpoint of the temperature range over which the glass transition takes place.

Gray Water –

The waste water of a system that may be a combination of the liquid and water-carried wastes except human wastes.

Heat Mark –

Extremely shallow depression or groove in the surface of a plastic visible because of a sharply defined rim or a roughened surface.

Heat Soak Cycle –

The period of time in the fusion procedure during which heat is allowed to penetrate into the piping component ends causing them to soften.

Heater Surface Temperature –

The temperature on the surface of the heater where the ends of the piping components make contact.

Homopolymer –

A polymer resulting from polymerization involving a single monomer.

Hoop Stress –

The tensile stress in the wall of the piping product in the circumferential direction due to internal hydrostatic pressure

Hydrostatic Design Basis –

One of a series of established stress values specified in Test Method D2837 for a plastic compound obtained by categorizing the long-term hydrostatic strength determined in accordance with Test Method D2837.

Hydrostatic Design Stress –

The estimated maximum tensile stress the material is capable of withstanding continuously with a high degree of certainty that failure of the pipe will not occur. This stress is circumferential when internal hydrostatic water pressure is applied.

Injection Molding –

The process of forming a material by forcing it, in a fluid state and under pressure, through a runner system (sprue, runner, gate(s)) into the cavity of a closed mold.

Interfacial Pressure –

The amount of force per square inch of pipe end surface area required for heat fusion joining.

Joint –

The location at which two pieces of pipe or a pipe and a fitting are connected together.

Joint, butt-fused –

A joint in which the prepared ends of the joint components are heated and then placed in contact to form the joint.

Joint, flanged –

A mechanical joint using pipe flanges, a gasket, and bolts.

Joint, heat fused –

A joint made using heat and pressure only.

Joint, mechanical –

A connection between piping components employing physical force to develop a seal or produce alignment.

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Joint, saddle-fused –

A joint in which the curved base of the saddle fitting and a corresponding area of the pipe surface are heated and then placed together to form the joint.

Joint, socket-fused –

A joint in which the joining surfaces of the components are heated, and the joint is made by inserting one component into the other.

Joint, threaded –

A mechanical joint that utilizes threaded pipe and fittings.

Melt Index –

The flow rate of material when measured in accordance with Test Method D1238.

Minimum Required Pressure –

One of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve, and so forth) obtained by categorizing the long-term hydrostatic pressure strength in accordance with ISO 9080.

Minimum Required Strength –

One of a series of established stress values for a plastic compound obtained by categorizing the long-term hydrostatic strength determined by hydrostatic testing in accordance with ISO 9080.

Multilayer Pipe –

A pipe constructed of multiple layers that are bonded to each other and in which at least 60% of the wall thickness consists of polymeric material(s).

Necking –

The localized reduction in cross section which may occur in a material under tensile stress.

Non-pressure Pipe –

Pipe designed for gravity-conveyed medium which must resist only intermittent static pressures and does not have a pressure rating.

Out-of-roundness –

The allowed difference between the maximum measured diameter and the minimum measured diameter (stated as an absolute deviation). to stress or strain in the presence of specific chemicals.

Ovality –

$$\frac{(\max measured\ diameter - mininum\ measured\ diam}{average\ measured\ diameter}$$

Overall Length –

The total length of the individual pipeline system, section, or fitting prior to installation.

Pipe Spigot –

Portion of a pipe or fitting which fits into a bell or socket of a preceding pipe or fitting.

Pit –

An imperfection, a small crater in the surface of the plastic, with its width approximately the same order of magnitude as its depth.

Plastic –

A material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

Plasticizer –

A substance incorporated in a material to increase its workability, flexibility, or distensibility.

Plastic Pipe –

A hollow cylinder of a plastic material in which the wall thicknesses are usually small when compared to the diameter and in which the inside and outside walls are essentially concentric.

Polymer –

A substance consisting of molecules characterized by the repetition (neglecting ends, branch junctions, and other minor irregularities).

GLOSSARY

Pressure Design Basis –

One of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve) obtained by categorizing the long-term hydrostatic pressure strength (LTHPS) determined in accordance with an industry test method that uses linear regression analysis.

Pressure Pipe –

One of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve) obtained by categorizing the long-term hydrostatic pressure strength (LTHPS) determined in accordance with an industry test method that uses linear regression analysis.

Pressure Rating (PR) –

The estimated maximum water pressure the pipe is capable of withstanding continuously with a high degree of certainty that failure of the pipe will not occur.

Primer –

An organic solvent or a blend of solvents, which enhances adhesion, applied to plastic pipe and fittings prior to application of solvent cement.

Quick Burst Pressure –

An internal pressure test designed to produce failure of a piping component over a relatively short period of time, usually measured in seconds.

Quick Burst Strength –

The hoop stress resulting from the quick burst pressure.

Quick Burst Test –

An internal pressure test designed to produce failure of a piping component over a relatively short period of time, usually measured in seconds.

Reinforced Plastic –

A plastic with high strength fillers embedded in the composition, resulting in some mechanical properties superior to those of the base resin.

Reprocessed Plastic –

A thermoplastic prepared from usually melt processed scrap or reject parts by a plastics processor, or from non-standard or non-uniform virgin material.

Resin –

A solid or pseudosolid organic material, often of high molecular weight, which exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally.

Rework Plastic –

A plastic from a manufacturer's own production that has been reground or pelletized for reuse by that same manufacturer.

Schedule –

A pipe size system (outside diameters and wall thicknesses) originated by the iron pipe industry.

Service Factor –

A factor which is used to reduce a strength value to obtain an engineering design stress. The factor may vary depending on the service conditions, the hazard, the length of service desired, and the properties of the pipe.

Shrink Mark –

An imperfection, a depression in the surface of a molded material where it has retracted from the mold.

Skin –

A relatively dense layer at the surface of a cellular polymeric material.

Socket –

The portion of a jointing system that is designed to accept a plain-end pipe or spigot-end pipe.

Socket end –

The end portion of a piping component which is designed to accept a plain-end piping component or spigot end piping component.

Specifying Agency –

The individual engineer, firm, or political subdivision charged with and having responsibility for the design of a facility, product, equipment, or material requirements.

Specimen –

A piece or portion of a sample used to make a test.

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Stabilizer –

An ingredient added to a plastic to retard possible degradation.

Standard Dimension Ratio (SDR) –

The average specified diameter of a pipe or tubing divided by the minimum specified wall thickness.

Strain –

The change per unit of length in a linear dimension of a body, that accompanies a stress.

Strength –

The stress required to break, rupture, or cause a failure.

Stress Relaxation –

The decrease in stress, at constant strain, with time.

Theoretical Fusion Pressure –

For hydraulic fusion machines, this is a calculated number determined by taking the pipe end cross-section area and multiplying it by the interfacial pressure and dividing by the total effective piston area of the fusion machine.

Thermoplastic –

a plastic that repeatedly can be softened by heating and hardened by cooling through a temperature range characteristic of the plastic, and that in the softened state can be shaped by flow into articles by molding or extrusion.

Thermoset –

A plastic that, after having been cured by heat or other means, is substantially infusible and insoluble.

Thermosetting –

Capable of being changed into a substantially infusible or insoluble product when cured by heat or other means.

Toe-in –

A small reduction of the outside diameter at the cut end of a length of thermoplastic pipe.

Virgin Plastic –

A plastic material in the form of pellets, granules, powder, floc, or liquid that has not been subjected to use or processing other than that required for its initial manufacture.

Viscosity –

The property of resistance to flow exhibited within the body of a material.

Void –

(1) In a solid plastic, an unfilled space of such size that it scatters radiant energy such as light. (2) A cavity unintentionally formed in a cellular material and substantially larger than the characteristic individual cells.

Vulcanization –

An irreversible process during which a rubber compound, through a change in its chemical structure (for example, cross-linking), becomes less plastic and more resistant to swelling by organic liquids and elastic properties are conferred, improved, or extended over a greater range of temperature

Water Service –

The pipe from the water main or other source of water supply to the building or other point of use or distribution

Weld-mark –

A visible weld line.

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