VOLUME V: AQUARISE® POTABLE WATER PIPING SYSTEMS

MECHANICAL TECHNICAL MANUAL SERIES

MECHANICAL SYSTEMS

AquaRISE®

IPEX by aliaxis

We build tough products for tough environments®

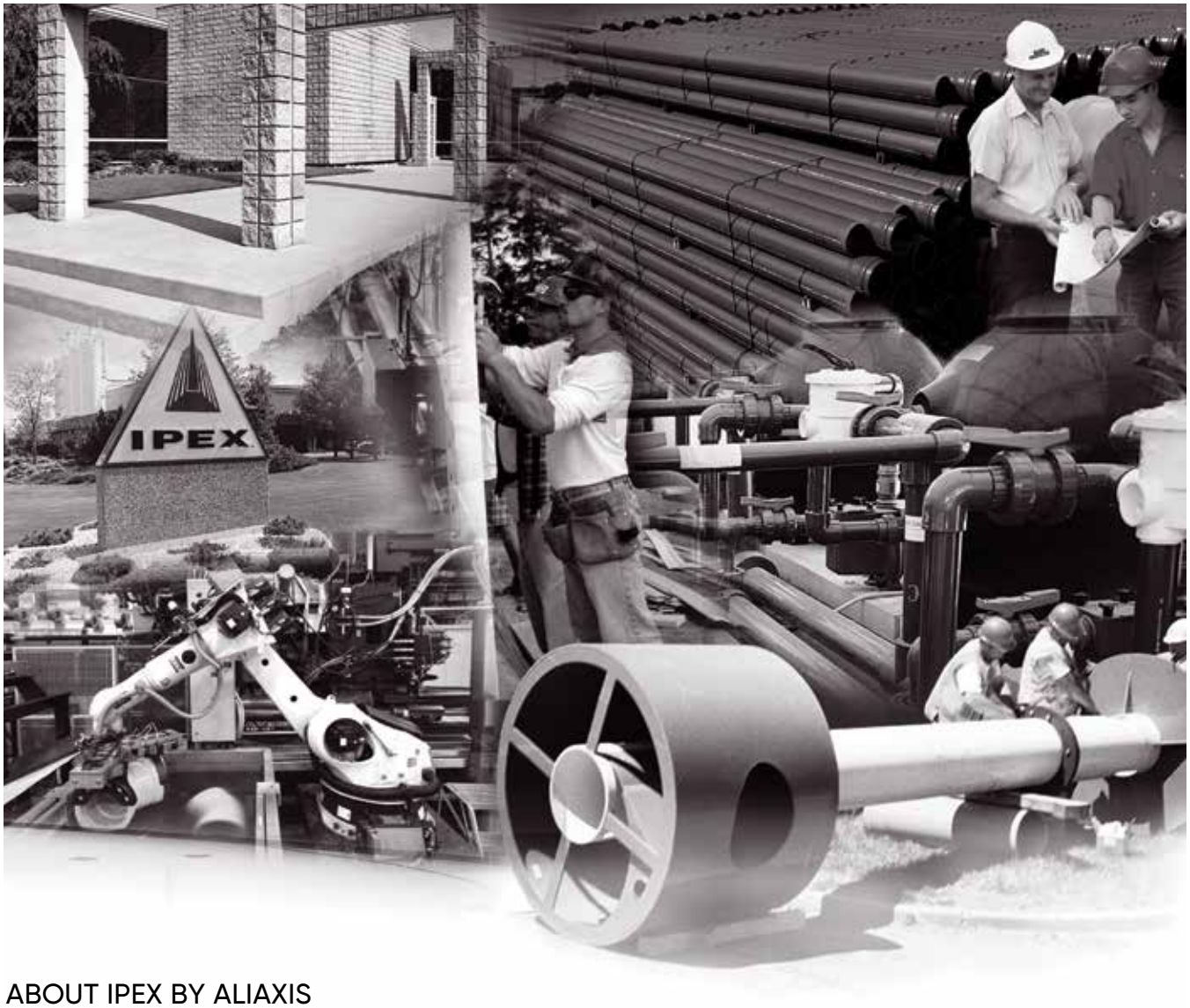
AquaRise® Potable Water Piping Systems

Mechanical Technical Manual Series, Vol. V

IPEX Inc. hereinafter referred to as "IPEX".

LITERATURE & WEBSITE DISCLAIMER

The information contained here within is based on current information and product design at the time of publication and is subject to change without notification. IPEX does not guarantee or warranty the accuracy, suitability for particular applications, or results to be obtained therefrom.



ABOUT IPEX BY ALIAXIS

At IPEX Inc., we have been manufacturing nonmetallic pipe and fittings since 1951. Our products are made available for customers thanks to a network of regional stocking locations throughout North America. We offer a wide variety of systems including complete lines of piping, fittings, valves and custom-fabricated items.

More importantly, we are committed to meeting our customers' needs. As a leader in the plastic piping industry, IPEX continually develops new products, modernizes manufacturing facilities and acquires innovative process technology. In addition, our staff take pride in their work, making available to customers their extensive thermoplastic knowledge and field experience. IPEX personnel are committed to improving the safety, reliability and performance of thermoplastic materials. We are involved in several standards committees and are members of and/or comply with the organizations listed on this page.

If you need additional copies of any instructions, or if you have questions about the safe and proper installation of IPEX products, contact IPEX Toll Free 1-866-473-9462.

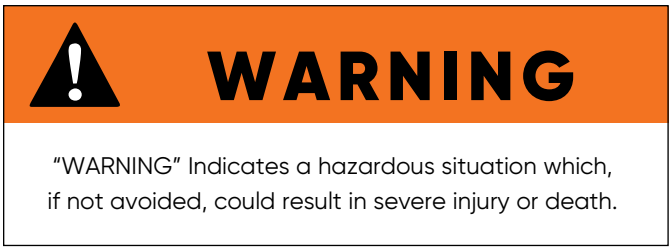
For the most up-to-date information on IPEX products, visit: ipexna.com Always adhere to local jobsite and workplace safety regulations.

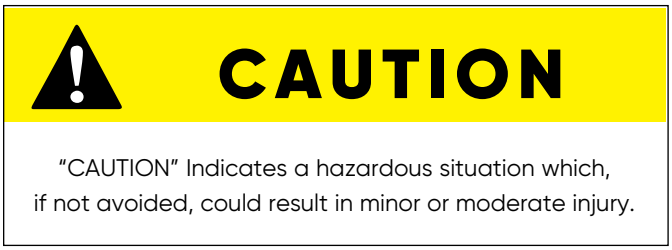
UNDERSTANDING SAFETY ALERT MESSAGES

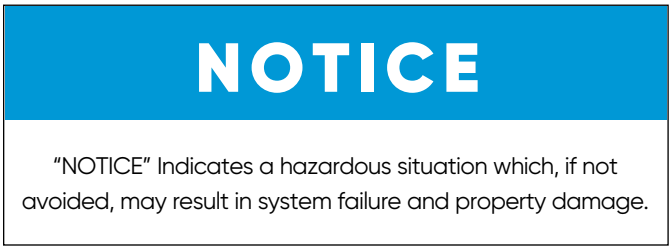
It is important to read and understand this manual. It contains information to help maintain safety and prevent problems. Improper installation or use of AquaRise® can result in personal injury and/or property damage. It is important to be aware of and recognize safety alert messages as they appear in this manual.

The types of safety alert messages are described below.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid personal injury or death.







The use of the word "NOTE" signifies special instructions which are important but are not related to hazards.

WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

AQUARISE SAFETY ALERTS

WARNING

- **NEVER** use compressed air or gas in AquaRise pipe, fittings, and valves
- **NEVER** use or test AquaRise with compressed air or other gases. Do not use air-over-water boosters.

Use of compressed air or gas in AquaRise pipe, fittings, and valves can result in explosive failures and cause severe injury or death.

WARNING

Follow all preparation and installation procedures.

WARNING

Only use SDR 21 pipe in Cold Water AquaRise systems.

DO NOT use SDR 21 pipe in AquaRise Hot Water systems. Using SDR 21 pipe in Hot Water AquaRise systems will void the AquaRise limited warranty.

NOTICE

AGING OF TEMPRITE® TECHNOLOGY

TempRite®* Technology aging can result in changes to physical characteristics such as increased brittleness and the reduction in impact resistance. This is precipitated by prolonged elevated operating temperatures or prolonged exposure to UV light. Refer to SECTION 4 of this Technical Manual for further details.

NOTICE

MAINTENANCE, AGING AND REPAIRS

ALWAYS refer to SECTION 4 of this Technical Manual before commencing any maintenance or repairs on any AquaRise products. Failure to follow instructions may cause cracks or fractures to develop in AquaRise products resulting in property damage and personal injury.

* TempRite® is a registered trademark of Lubrizol Advanced Materials, Inc.

SUPPLEMENTAL INFORMATION - DO'S AND DON'TS

CAUTION

Refer to the contents of this Technical Manual for complete instructions and guidelines.

DO'S

- Read the manufacturer's installation instructions and install product accordingly
- Follow recommended safe work practices
- Use only PTFE (Teflon™) tape to seal threaded connections
- Make certain that gasket lubricants or fire-stop materials are compatible with AquaRise product
- Keep pipe and fittings in original packaging until needed
- If pipe and fittings are stored outdoors, cover with a well-ventilated white tarp
- Follow handling and storage procedures
- Only use tools, on AquaRise pipe and fittings, as described in this manual
- Use only AquaRise primer and solvent cement and follow application instructions
- Use a drop cloth to protect interior finishes
- Cut the pipe ends squarely
- Deburr and bevel the pipe end with a chamfering tool before solvent welding
- Slowly rotate the pipe a quarter turn when inserting pipe in fitting socket when solvent welding
- Avoid puddling of solvent cement in fittings and pipe
- Make certain no solvent cement is on the mating faces of flanges, valves or unions, as well as the threaded portion of adapter fittings
- Ensure excess primer and solvent cement does not run inside pipe, fittings and valves
- Follow AquaRise recommended cure times before pressure testing
- Slowly fill piping system with water and bleed the air from the system before pressure testing
- Use water hammer arrestors
- AquaRise SDR 11 may only be used for hot and cold potable water distribution
- AquaRise SDR 21 may only be used for cold potable water distribution
- Allow for movement due to expansion and contraction

DON'TS

- Don't use petroleum or solvent-based paints, sealants or lubricants
- Don't install adhesive tape, insulated wire, or cable in direct contact with AquaRise product
- Don't use incompatible thread sealants
- Don't use solvent cement that has exceeded its shelf life or has become discolored or jelled
- Don't thread, groove, or drill AquaRise pipe
- Don't allow the primer and or the solvent cement to run inside an AquaRise valve
- Don't use solvent cement near sources of heat or open flame, or when smoking
- Don't pressure test until recommended cure times have elapsed
- Don't pressure test with air
- Don't cut pipe with dull or broken cutting-tool blades
- Don't use ratchet cutters
- Don't use AquaRise product that's been stored unprotected outdoors and is faded in color
- Don't allow threaded rod to come in contact with the pipe, for example, threaded rods used to connect pipe hangers
- DO NOT use SDR 21 pipe in AquaRise HOT WATER Systems

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THE FOLLOWING NOTICE SHOULD BE PRINTED AND POSTED AT THE JOBSITE.

NOTICE

AquaRISE®

Potable Water Piping Systems
SDR 11 Coloured Teal Blue with a Black Print Line for Hot & Cold Water
SDR 21 Coloured Teal Blue with a White Print Line for Cold Water

Please read the following notice before beginning any activity which could come in contact with this system:

AquaRise piping components may be damaged by certain substances and construction practices.

DO NOT stack, support, hang equipment, or hang flexible wire/cable, especially communications cable, or other material on the AquaRise piping system.

ONLY system compatible materials including, but not limited to, solvent cements, caulks and sealants, as noted in the AquaRise Technical Manual, should be used in contact with this system.

DO NOT expose AquaRise products to incompatible substances, such as cutting oils, non-water based paints, packing oils (commonly found in pumps), traditional pipe thread paste and dope, fungicides, termiticides, insecticides, detergents, building caulks, adhesives tape, solder flux, flexible wire/cable (with special consideration for communications cabling),
and non-approved spray foam insulation materials.

DO NOT expose AquaRise products to open flame, solder, and soldering flux.

DO NOT drop, distort, or impact AquaRise products or allow objects to be dropped on them.

DO NOT handle AquaRise products with gloves contaminated with oils (hydrocarbons) or other incompatible materials.

Failure to follow this notice may cause cracks or fractures to develop in AquaRise products resulting in personal injury and property damage due to leaks or flooding. The presence of any visible cracks may require partial or full system replacement. For additional information contact the general contractor or system installer.

FOR ADDITIONAL AQUARISE PRODUCT INFORMATION,
CONTACT "IPEX" AT 866-473-9462 OR VISIT IPEXAQUARISE.COM

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For your convenience, there are additional jobsite notice copies located within the last pages of this manual.

If additional copies of any instructions are needed, or for any questions concerning the safe and proper installation of IPEX products, contact IPEX Toll Free (866) 473-9462
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CONTENTS

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SECTION 1: GENERAL

OVERVIEW

AquaRise®* is a thermoplastic piping system designed for the distribution of potable (drinking) water in combustible or non-combustible buildings. Pipe and fittings are manufactured in sizes 1/2" through 4" diameter using a specially formulated CPVC compound (TempRite® Technology).

This manual provides installers, designers and engineers with guidance to help ensure the proper usage of AquaRise. Readers are encouraged to contact the IPEX Sales Office, or local representative for any further consultation or clarification before using AquaRise to ensure a successful installation.

FEATURES AND BENEFITS

COMPLETE LINE – a matched system of pipe, fittings, valves and solvent cements all offered from a single source. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

FULLY CERTIFIED – AquaRise pipe, fittings and solvent cements are certified to CSA B137.6 and applicable ASTM standards. All components are listed to NSF61 for potable water applications.

WALL THICKNESS - SDR 11 and SDR 21 pipe thicknesses provide uniform pressure rating for all sizes.

SIZE RANGE – offered in IPS nominal pipe sizes 1/2" through 4".

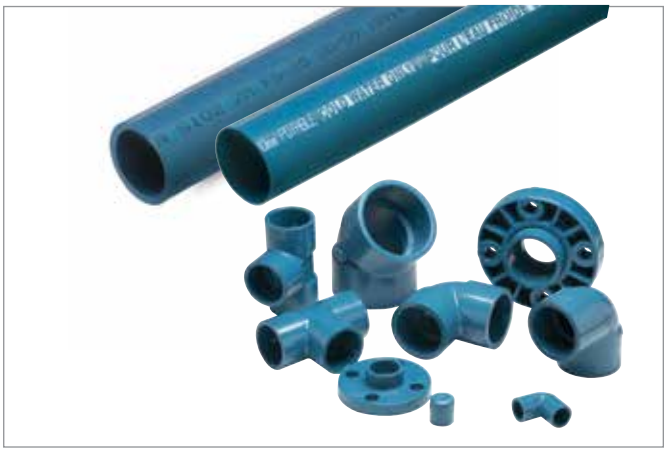
COLOUR CODED – with a Teal Blue colour code for pipe, fittings and valves, AquaRise can be easily identified as a potable water piping system within buildings. SDR 11 Hot & Cold Water pipe is identifiable by black print lines. SDR 21 Cold Water pipe is identifiable by white print lines.

LIGHTWEIGHT – when compared to traditional materials, AquaRise is relatively lightweight offering efficiency in transport, handling and installation.

FLOW CAPACITY – AquaRise pipe and fittings have larger inside diameters than most plastic water pipe systems, resulting in increased flow capacity.

CORROSION RESISTANCE – AquaRise CPVC material is resistant to metallic corrosion.

BURNING CHARACTERISTICS – AquaRise pipe and fittings are listed to ULC S102.2 with Flame Spread Rating and Smoke Developed Classification of not greater than 25 and 50, respectively. This makes AquaRise acceptable for use in High Buildings and Plenums in Canada. Always check with local authorities for approval.



APPLICATIONS

AquaRise may only be used in hot and cold potable water distribution systems including potable water reverse osmosis applications. It may not be used for any other piping applications. Using AquaRise for any application other than hot and cold potable water distribution systems will void the AquaRise Limited Warranty.

Common types of buildings where AquaRise may be used include:

- Apartments / condos / multi-family
- Hotels
- Long-term care facilities
- Retail stores
- Office buildings
- Schools
- Health care facilities
- Industrial plants
- Restaurants
- Indoor sports facilities

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Apartments / condos / multi-family

Indoor sports facilities

Hotels

Long-term care facilities

Health care facilities

Retail stores

Office buildings

Schools

Industrial plants

Restaurants

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MATERIAL DESCRIPTION

AquaRise pipe, fittings and valves are manufactured from TempRite® Technology (CPVC), which is Teal Blue in colour. Bisphenol A (BPA) is not a component of, nor byproduct of, the production of AquaRise compounds, or pipe and fittings. The use of any non-AquaRise CPVC components within an AquaRise system is generally prohibited and must be evaluated and approved by IPEX in writing prior to installation.

PIPE - SDR 11 HOT & COLD WATER

AquaRise pipe is manufactured to Iron Pipe Size Outside Diameter (IPS OD) Standard Dimension Ratio (SDR) 11 dimensions. Pipe is made in 10 ft. lengths and is available in nominal sizes 1/2" – 4". All sizes have the same pressure rating while providing larger inside diameters than most potable water systems.

Below are physical dimensions and weights of SDR 11 AquaRise pipe:

A. Imperial Units

Nom Size (in.)	Avg. OD (in.)	Avg. ID (in.)	Avg. Wall Thickness (in.)	Wt Pipe - Empty (lb/ft)	Wt Pipe - Full of Water (lb/ft)
1/2	0.840	0.679	0.081	0.13	0.76
3/4	1.050	0.847	0.101	0.20	1.18
1	1.315	1.061	0.127	0.32	1.85
1-1/4	1.660	1.340	0.160	0.51	2.95
1-1/2	1.900	1.534	0.183	0.66	3.86
2	2.375	1.917	0.229	1.04	6.04
2-1/2	2.875	2.321	0.277	1.52	8.29
3	3.500	2.826	0.337	2.25	13.12
4	4.500	3.633	0.434	3.87	21.83

B. SI Units

Nom Size (in.)	Avg. OD (mm)	Avg. ID (mm)	Avg. Wall Thickness (mm)	Wt Pipe - Empty (kg/m)	Wt Pipe - Full of Water (kg/m)
12	21.3	17.2	2.06	0.19	1.13
20	26.7	21.5	2.57	0.30	1.76
25	33.4	26.9	3.23	0.48	2.76
32	42.2	34.0	4.06	0.76	4.40
40	48.3	39.0	4.65	0.99	5.76
50	60.3	48.7	5.82	1.55	9.00
65	73.0	56.7	7.04	2.27	12.36
75	88.9	71.8	8.56	3.36	19.56
100	114.3	92.3	11.02	5.77	32.55

PIPE - SDR 21 COLD WATER

AquaRise pipe is manufactured to Iron Pipe Size Outside Diameter (IPS OD) Standard Dimension Ratio (SDR) 21 dimensions. Pipe is made in 10 ft. lengths and is available in nominal sizes 1-1/2" – 4". All sizes have the same pressure rating while providing larger inside diameters than most potable water systems.

Below are physical dimensions and weights of SDR 21 AquaRise pipe:

A. Imperial Units

Nom Size (in.)	Avg. OD (in.)	Avg. ID (in.)	Avg. Wall Thickness (in.)	Wt Pipe - Empty (lb/ft)	Wt Pipe - Full of Water (lb/ft)
1-1/2	1.900	1.700	0.100	0.33	4.75
2	2.375	2.129	0.123	0.52	7.42
2-1/2	2.875	2.581	0.147	0.76	10.88
3	3.500	3.146	0.177	1.13	16.15
4	4.500	4.046	0.227	1.94	26.78

B. SI Units

Nom Size (in.)	Avg. OD (mm)	Avg. ID (mm)	Avg. Wall Thickness (mm)	Wt Pipe - Empty (kg/m)	Wt Pipe - Full of Water (kg/m)
40	48.3	43.18	2.54	0.50	7.07
50	60.3	54.08	3.12	0.78	11.04
65	73.0	65.56	3.73	1.14	16.20
75	88.9	79.91	4.50	1.68	24.05
100	114.3	102.77	5.77	2.89	39.87

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FITTINGS

The AquaRise system offers a wide variety of fittings including Tees, Reducer Tees, Elbows, Couplings, Reducer Bushings, and Flanges. All AquaRise fittings are manufactured to SDR 11 thickness and to strict IPEX tolerances to ensure a proper interference fit between pipe and fittings.

Specialty fittings are also available including Maintenance Couplings, Repair Assemblies and Full-Pressure Flange Kits.

VALVES

AquaRise True Union Ball Valves are available in sizes 1/2" through 4". True union connections allow for easy valve removal and replacement without having to cut the pipe. This valve uses EPDM O-ring seals for performance in potable water where a variety of treatment chemicals may be used. Refer to "System Pressure and Temperature Ratings" for the AquaRise TUBV pressure rating.

AquaRise One-Piece Ball Valves are available in sizes 1/2" - 1". The one-piece valves can withstand the full AquaRise system pressure. These valves feature a spin-welded design, making the valves light and compact. They are the smarter valve option for applications that do not require a serviceable connection or for systems that see higher than normal pressures.

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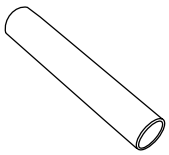
PRODUCT SELECTION GUIDE

The following is a list of pipe, fittings, valves and accessories currently offered.
Refer to System Pressure and Temperature Ratings Section for product specific ratings.

AquaRise SDR 11 (Hot & Cold Water)

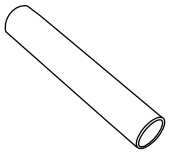
Pipe 10 Ft. Lengths, Plain End



Nominal pipe size (Inches)	Product Code
1/2	119100
3/4	119101
1	119102
1-1/4	119103
1-1/2	119104
2	119105
2-1/2	119106
3	119107
4	119108

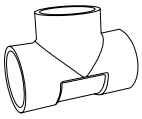
AquaRise SDR 21 (Cold Water)

Pipe 10 Ft. Lengths, Plain End



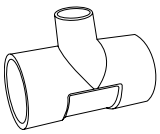
Nominal pipe size (Inches)	Product Code
1-1/2	119120
2	119121
2-1/2	119122
3	119123
4	119124

Tee Soc x Soc x Soc



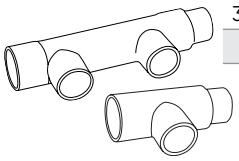
Nominal pipe size (Inches)	Product Code
1/2	359481
3/4	359482
1	359483
1-1/4	359484
1-1/2	359485
2	359486
2-1/2	359487
3	359488
4	359489

Reducer Tee Soc x Soc x Soc



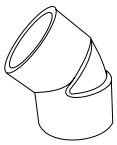
Nominal pipe size (Inches)	Product Code
3/4 x 1/2 x 1/2	359514
3/4 x 1/2 x 3/4	359513
3/4 x 3/4 x 1/2	359492
1 x 1 x 1/2	359493
1 x 1 x 3/4	359494
1-1/4 x 1-1/4 x 1	359495
1-1/2 x 1-1/2 x 1/2	359515
1-1/2 x 1-1/2 x 3/4	359496
1-1/2 x 1-1/2 x 1	359497
2 x 2 x 1/2	359498
2 x 2 x 3/4	359499
2 x 2 x 1	359500
2 x 2 x 1-1/2	359501
2-1/2 x 2-1/2 x 1/2	359503
2-1/2 x 2-1/2 x 3/4	359504
2-1/2 x 2-1/2 x 1	359505
2-1/2 x 2-1/2 x 1-1/4	359506
2-1/2 x 2-1/2 x 2	359507
3 x 3 x 2	359502
4 x 4 x 2	359508
4 x 4 x 3	359509

U Do-It Manifold Soc x Sp x Soc



3/4 x 3/4 x 1/2 x 1/2	359060
3/4 x 3/4 x 1/2	359061

45° Elbow Soc x Soc



1/2	359164
3/4	359165
1	359166
1-1/4	359167
1-1/2	359168
2	359169
2-1/2	359170
3	359171
4	359172

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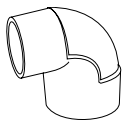
PRODUCT SELECTION GUIDE

90° Elbow Soc x Soc

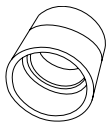
Nominal pipe size (Inches)	Product Code
1/2	359194
3/4	359195
1	359196
1-1/4	359197
1-1/2	359198
2	359199
2-1/2	359200
3	359201
4	359202

90° Street Elbow Soc x Sp



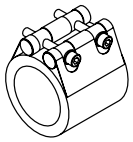
Nominal pipe size (Inches)	Product Code
1/2	359175
3/4	359176
1	359177

Coupling Soc x Soc



Nominal pipe size (Inches)	Product Code
1/2	359132
3/4	359133
1	359134
1-1/4	359135
1-1/2	359136
2	359137
2-1/2	359138
3	359139
4	359140

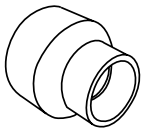
Maintenance Coupling*



Nominal pipe size (Inches)	Product Code
1	359204
1-1/4	359205
1-1/2	359206
2	359207
2-1/2	359208
3	359209
4	359210

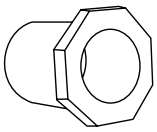
*Torque wrench kits are available through IPEX

Reducer Coupling Soc x Soc



Nominal pipe size (Inches)	Product Code
3/4 x 1/2	359460
1 x 1/2	359461
1 x 3/4	359462
1-1/4 x 1	359463
1-1/2 x 1	359465
1-1/2 x 1-1/4	359466
2 x 1	359467
2 x 1-1/2	359458
3 x 2	359470
4 x 2	359459
4 x 3	359472

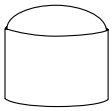
Reducer Bushing Sp x Soc



Nominal pipe size (Inches)	Product Code
3/4 x 1/2	359375
1 x 1/2	359376
1 x 3/4	359377
1-1/4 x 1/2	359378
1-1/4 x 3/4	359379
1-1/4 x 1	359380
1-1/2 x 1/2	359381
1-1/2 x 3/4	359382
1-1/2 x 1	359383
1-1/2 x 1-1/4	359384
2 x 1/2	359385
2 x 3/4	359386
2 x 1	359387
2 x 1-1/4	359388
2 x 1-1/2	359389
2-1/2 x 3/4	359390
2-1/2 x 1	359391
2-1/2 x 2	359392
3 x 1-1/2	359393
3 x 2	359394
3 x 2-1/2	359395
4 x 1-1/4	359428
4 x 1-1/2	359429
4 x 2	359396
4 x 2-1/2	359430
4 x 3	359397

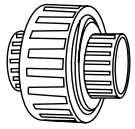
WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

Cap Soc



Nominal pipe size (Inches)	Product Code
1/2	359109
3/4	359110
1	359111
1-1/4	359112
1-1/2	359113
2	359114
2-1/2	359115
3	359116
4	359107

Union Soc x Soc

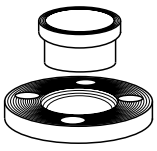


Nominal pipe size (Inches)	Product Code
1/2	359520
3/4	359521
1	359522
1-1/4	359523
1-1/2	359524
2	359525
3	359051
4	359550

Flange Soc Solid Style

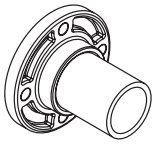
Nominal pipe size (Inches)	Product Code
1/2	359228
3/4	359229
1	359230
1-1/4	359231
1-1/2	359232
2	359233
2-1/2	359234
3	359235
4	359236

Vanstone Flange Soc



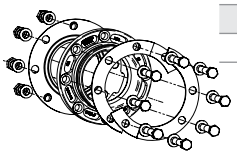
Nominal pipe size (Inches)	Product Code
4	359270

Repair Flange Solid Style Flange x Pipe Stub



Nominal pipe size (Inches)	Product Code
2-1/2	359057
3	359058
4	359059

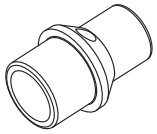
Full Pressure (FP) Flange Kit



Nominal pipe size (Inches)	Product Code
2-1/2	359040
3	359041
4	359043

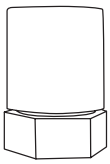
Note: Kit includes one (1) AquaRise socket flange - solid style, gasket and all required hardware.

CPVC Copper Tube Size Adapter (CTS)



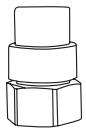
Nominal pipe size (Inches)	Product Code
AquaRise **Spigot** x CTS Spigot	
1/2	359100
3/4	359101
AquaRise **Socket** x CTS Spigot	
1/2	359097
3/4	359098

Female Threaded Adapter Soc x Bronze FNPT



Nominal pipe size (Inches)	Product Code
1/2	359800
3/4	359801
1	359802
1-1/4	359803
1-1/2	359804
2	359805

Female Threaded Adapter Sp x Bronze FNPT



Nominal pipe size (Inches)	Product Code
1/2	359820
3/4	359821
1	359822

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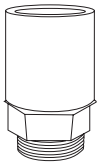
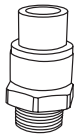
PRODUCT SELECTION GUIDE

Male Threaded Adapter Soc x Bronze MNPT



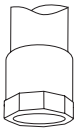
Nominal pipe size (Inches)	Product Code
1/2	359811
3/4	359812
1	359813
1-1/4	359814
1-1/2	359815
2	359816

Male Threaded Adapter Sp x Bronze MNPT



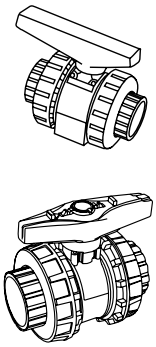
Nominal pipe size (Inches)	Product Code
1/2	359823
3/4	359824
1	359825

Repair Threaded Adapter Sp x Bronze FNPT



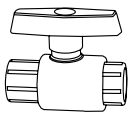
Nominal pipe size (Inches)	Product Code
1	359063
1-1/4	359064
1-1/2	359077
2	359065

True Union Ball Valve Soc x Soc



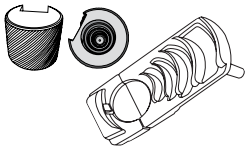
Nominal pipe size (Inches)	Product Code
1/2	359000
3/4	359001
1	359002
1-1/4	359003
1-1/2	359004
2	359005
2-1/2	359102
3	359103
4	359104

One-Piece Ball Valve Soc x Soc



Nominal pipe size (Inches)	Product Code
1/2	359070
3/4	359071
1	359072

Beveling Tools



Nominal pipe size (Inches)	Product Code
1/2, 3/4, 1	359044
1-1/4 to 4	359062

Aquarise One-Step Cement**

Description imperial	Description metric	Product Code
Pint	473 ml	359086
Quart	946 ml	359092
Gallon	3785 ml	359091

**For use on 1/2" to 2"

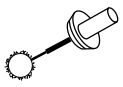
Aquarise Two-Step Cement w/Primer***

Description imperial	Description metric	Product Code
Quart	946 ml	359087
Gallon	3785 ml	359093

***For use on 2-1/2", 3" & 4"

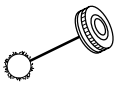
Cement products come complete with Primer as required and extra daubers.

Can-Mate Daubers (with telescoping shaft)



Nominal pipe size (Inches)	Product Code
CM-75 (pipe sizes 1/2" - 1-1/4")	074436
CM-150 (pipe sizes 1-1/2" - 3")	074437

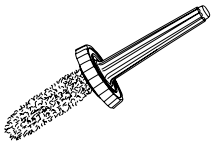
Cap Daubers



Nominal pipe size (Inches)	Product Code
DP 50 (pipe sizes 1/2" - 1")	074455
DP 150 (pipe sizes 1-1/4" - 3")	074421
DQ 50 (pipe sizes 1/2" - 1")	074193
DQ 150 (pipe sizes 1-1/4" - 3")	074422

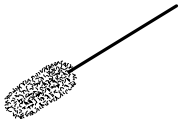
Note: DP fits Pint cans and DQ fits Quart cans

Swab



Nominal pipe size (Inches)	Product Code
4"	074456

AquaRise Super swab Replacement



Nominal pipe size (Inches)	Product Code
Swab is disposable and replaceable	359826

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SYSTEM PRESSURE AND TEMPERATURE RATINGS

NOTICE

Maximum operating temperature of AquaRise systems must not exceed 160°F (71°C).

NOTICE

Maximum operating temperatures and pressures of the lowest rated component in the piping system must not be exceeded during pressure testing or system operation. Always design to limit and accommodate all surge pressures in an AquaRise system.

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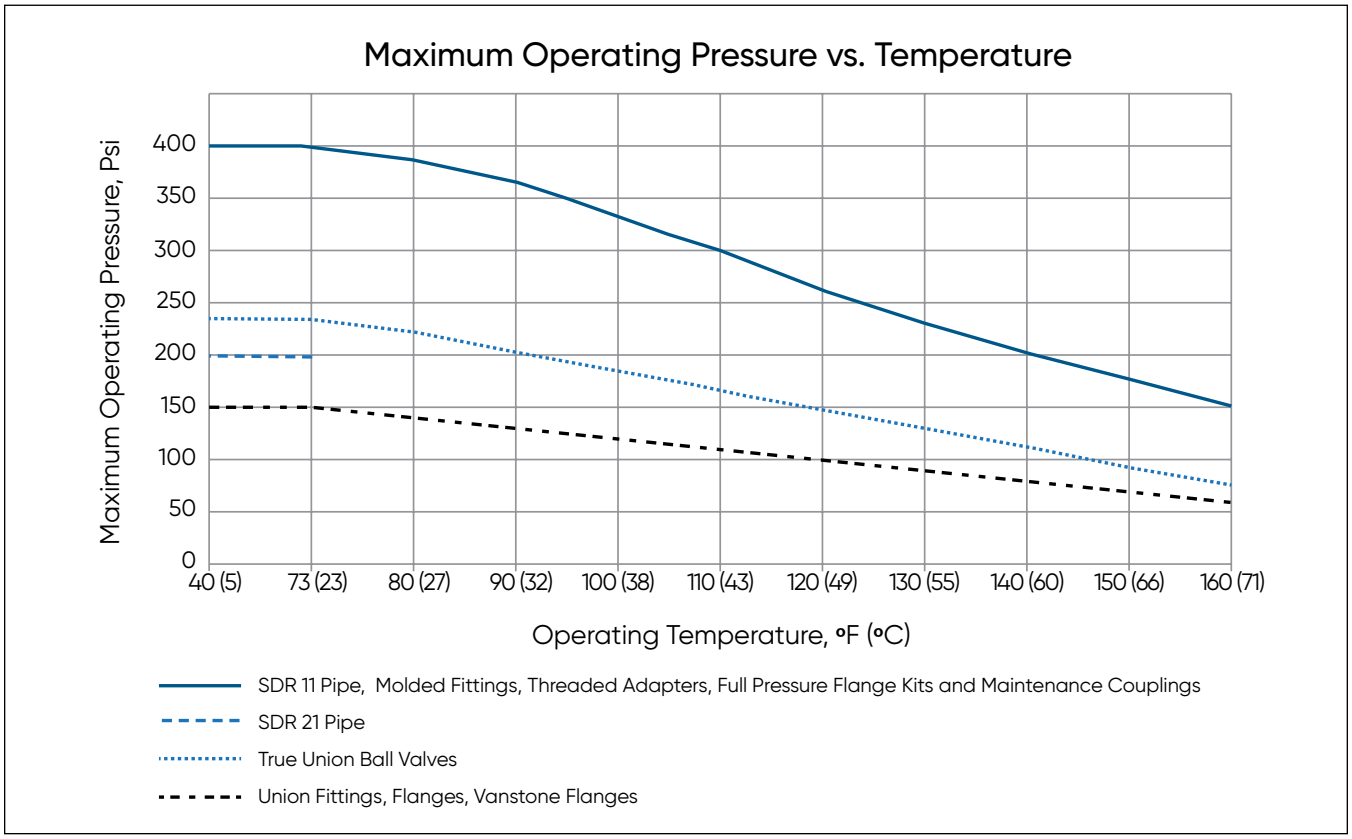
Temperature (F)	Pressure (PSI)			
	SDR 11 Pipe, Molded Fittings, Threaded Adapters, Full Pressure Flange Kits and Maintenance Couplings	SDR 21 Pipe	True Union Ball Valves	Union Fittings, Flanges, Vanstone Flanges
40	400	200	232	150
73	400	200	232	150
80	385		219	144
90	364		201	137
100	330		182	129
110	296		164	111
120	260		145	98
130	230		127	89
140	200		109	75
150	176		90	64
160	150		72	57

The following graph provides a quick reference for maximum operating pressure of pipe, valves and fittings at various temperatures in hot and cold potable water distribution systems.



Maximum operating temperatures and pressures of the lowest rated component in the piping system must not be exceeded during pressure testing or system operation. Always design to limit and accommodate all surge pressures in an AquaRise system.

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In compliance with plumbing code requirements, AquaRise pipe, molded fittings (couplings, tees, elbows, bushings and caps) and threaded adapter fittings are certified to CSA B137.6 and applicable ASTM Standards. Union fittings and flanges are certified to applicable ASTM standards.

See SECTION 5: SPECIFICATIONS for a list of standards.

PIPE, ONE-PIECE BALL VALVES & MOLDED FITTINGS

SDR 11

All AquaRise SDR 11 (Hot & Cold Water) pipe and the following molded fittings (couplings, tees, elbows, bushings and caps) have a pressure rating of 400 psi at 73°F (2,758 kPa at 23°C) and 150 psi at 160°F (1,034 kPa at 71°C).

SDR 21

All AquaRise SDR 21 (Cold Water) pipe has a pressure rating of 200 psi at 73°F (1,379 kPa at 23°C).

THREADED ADAPTER FITTINGS

AquaRise Threaded Adapter Fittings provide a transition from AquaRise to metallic threaded accessories such as valves, pumps or alternative materials. The adapter fittings have the same pressure ratings as AquaRise pipe – and are rated at 400 psi at 73°F (2,758 kPa at 23°C) and 150 psi at 160°F (1,034 kPa at 71°C).

TRUE UNION BALL VALVES

AquaRise true union ball valves have a pressure rating of 232 psi at 73°F (1,600 kPa at 23°C) and 72 psi at 160°F (496 kPa at 71°C).

UNION FITTINGS AND FLANGES

Due to the presence of mechanical seals, AquaRise unions and flanges have a cold water pressure rating of 150 psi at 73°F (1,034 kPa at 23°C). This rating is reduced at higher temperatures with a limit of 57 psi at 160°F (393 kPa at 71°C).

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FULL PRESSURE (FP) FLANGE KITS

IPEX FP Flange Kits are specifically designed to increase the pressure capability of an AquaRise one-piece flange. The AquaRise Full Pressure Flange Kits have a pressure rating equal to that of AquaRise pipe in each of the 3 sizes offered (2-1/2", 3" and 4"). The pressure rating is valid for connections to solid flat face metal flanges or to a second AquaRise FP Flange Kit. The Full Pressure Flange Kits have a maximum pressure rating of 400 psi at 73°F (2,758 kPa at 23°C) and 150 psi at 160°F (1,034 kPa at 71°C).

MAINTENANCE COUPLINGS

Maintenance Couplings provide a fast 'pipe to pipe' alternative connection for AquaRise. They are ideal for quick repairs of AquaRise pipe in need of maintenance without possible delays due to necessary cure times associated with solvent cement.

Available sizes are 1" through 4". The couplings carry the same pressure ratings as AquaRise pipe – and are rated at 400 psi at 73°F (2,758 kPa at 23°C) and 150 psi at 160°F (1,034 kPa at 71°C).

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HYDRAULIC DESIGN

SIZING AQUARISE PIPE

Proper sizing design is necessary to create a balance between flow velocity, flow volume and pressure head losses. Due to similar inside diameter dimensions, AquaRise may use design sizes similar to copper. Depending on design velocity considerations, AquaRise may even permit designers to use one nominal size smaller than copper.

INSIDE DIAMETER COMPARISON

An AquaRise water distribution system offers increased flow capacity when compared to alternative piping materials. AquaRise and Type L copper have similar inside diameters while PEX and CTS CPVC are considerably smaller. Most of the time, during pipe sizing of a water distribution system, AquaRise can be used as a direct substitute for Type L copper for new designs and system replacements while one nominal size larger of PEX or CTS CPVC may be required to maintain equivalent flow and velocity.

In addition, it is also important to remember that the comparative volume flow capacities are proportional to the square of the inside diameters. For example, 1" SDR 11 (Hot & Cold Water) has a 23% larger inside diameter than 1" PEX. This results in a 52% larger flow area than PEX.

AquaRise Inside Diameter Comparison

Nom. Pipe Size (in)	AquaRise SDR 11 (in)	AquaRise SDR 21 (in)	Copper Type L (in)	PEX SDR 9 (in)	CTS CPVC (in)
1/2	0.679	-	0.545	0.475	0.479
3/4	0.847	-	0.785	0.670	0.695
1	1.061	-	1.025	0.861	0.903
1-1/4	1.340	-	1.265	1.054	1.104
1-1/2	1.534	1.700	1.505	1.245	1.310
2	1.917	2.129	1.985	1.629	1.717
2-1/2	2.321	2.581	2.465	-	-
3	2.826	3.146	2.945	-	-
4	3.633	4.046	3.905	-	-

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FLOW CAPACITY AND FRICTION LOSS THROUGH PIPING

The flow capacity of a pipe is related to its inside diameter. As fluid flows through a piping system, it will experience friction resistance between the fluid and the pipe wall resulting in a pressure loss. This pressure loss is a result of fluid density, viscosity, velocity, temperature, type of flow, and smoothness of the pipe wall.

Friction loss for AquaRise pipe can be determined using the following equations.

DARCY-WEISBACH EQUATION

The most widely used equation to calculate friction loss in water distribution systems is the Darcy-Weisbach equation. This equation takes into account the density of water at a given temperature, the pipe roughness, the water velocity, and the length of the pipe run.

$$H_L = f \left(\frac{L}{d_i}\right)\left(\frac{V^2}{2g}\right)$$

Where:

H_L = Frictional head loss (ft. water)
(One ft. of water = 0.4335 psi)

f = friction factor (dimensionless)

L = length of pipe (ft)

d_i = inside diameter of pipe (ft)

V = flow velocity (ft/s)

g = gravitational acceleration (32.2 ft/s^2)

First, designers are reminded of the velocity and flow rate relationship.

Velocity = Volumetric Flow / Pipe Area, or V = Q/A.

To allow the use of the formula with commonly used units of measure, it can be rearranged as follows:

$$V = \frac{(0.4085)Q}{d_i^2}$$

Where:

V = flow velocity (ft/s)

Q = volumetric flow (US gpm)

d_i = inside diameter of pipe (in)

Next, the dimensionless friction factor (f) must be determined. Water distribution systems generally operate in the turbulent flow regime. Therefore, the friction factor is derived using the Colebrook equation, where f is solved implicitly.

$$\left(\frac{1}{\sqrt{f}}\right) = -2\log\left(\frac{\varepsilon}{3.7d_i} + \frac{2.51}{Re\sqrt{f}}\right)$$

Where:

f = friction factor (dimensionless)

E = absolute pipe roughness (5 x 10^{-6} ft for AquaRise pipe)

d_i = inside diameter of pipe (ft)

Re = Reynolds number (Re = ρVD/μ)

For turbulent flow, the Reynolds number is greater than > 4000.

The friction factor (f) can also be determined using a standard Moody chart. The Moody chart shows the relationship between the friction factor, the Reynolds number, and the relative pipe roughness (the ratio between the absolute pipe roughness (ε) and inside diameter of the pipe (d_i), ε / (d_i))

Once the friction factor has been determined, it can then be used in the Darcy-Weisbach equation to calculate the frictional head loss.

The friction loss tables on the pages that follow use the Darcy-Weisbach equation to determine head loss for AquaRise pipe. At ipexaquarise.com, there is a convenient AquaRise® Pipe Flow Capacity and Friction Loss Calculator.

Contact IPEX for further assistance.

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HAZEN-WILLIAMS EQUATION

A commonly used equation to calculate friction loss in water distribution systems is the Hazen-Williams equation. This equation is generally valid for water flowing in pipe sizes larger than 2" and temperatures between 40°F and 75°F. Using this equation, designers can calculate the friction losses, also known as Head Loss (H_L) for a given pipe size and the flow rate, Q.

First, designers are reminded of the velocity and flow rate relationship.

Velocity = Volumetric Flow / Pipe Area, or V = Q/A.

To allow the use of the formula with commonly used units of measure, it can be rearranged as follows:

$$V = \frac{(0.4085)Q}{d_i^2}$$

Where:

V = flow velocity (ft/s)

Q = volumetric flow (US gpm)

d_i = inside diameter of pipe (in.)

The Hazen-Williams empirical formula for calculating head loss is as follows,

$$H_L = \frac{0.2083(100/C)^{1.852}(Q)^{1.852}}{(d_i)^{4.8655}}$$

Where:

H_L = Frictional head loss (ft. water/100ft)
(One foot of water = 0.4335 psi)

C = Hazen-William factor (150 for AquaRise)

d_i = Inside diameter of pipe (in)

This formula can be simplified for use with AquaRise by substituting C =150 and by converting units for H_L to read as,

$$H_L = \frac{0.0983(Q)^{1.852}}{(d_i)^{4.8655}}$$

DESIGN VELOCITY

The maximum design velocity for AquaRise systems is 8 ft/s (2.44 m/s). This limit is considered a good balance between maximizing flow capacity while minimizing frictional head losses and water hammer potential. This velocity limit does not account for possible erosion of metallic system components and fixtures. The system must be designed and installed utilizing good engineering practices.

To minimize water hammer and prevent damage to the system, use slow closing valves and water hammer arrestors, regardless of the velocities.

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AQUARISE SDR 11 (HOT & COLD WATER) FLOW CAPACITY AND FRICTION LOSSES – PIPE

Note: These tables summarize the velocity and head loss of AquaRise SDR 11 pipe for all sizes and for various volumetric flow rates. The upper velocity limit of 8 ft/s is used for all sizes.

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	1/2"		1/2"		1/2"		1/2"		1/2"		1/2"		1/2"	
1	0.06	0.89	0.94	0.41	0.85	0.37	0.79	0.34	0.74	0.32	0.70	0.30	0.67	0.29	0.65	0.28
2	0.13	1.77	3.07	1.33	2.81	1.22	2.62	1.14	2.47	1.07	2.36	1.02	2.26	0.98	2.18	0.94
3	0.19	2.66	6.18	2.68	5.69	2.46	5.32	2.31	5.04	2.18	4.81	2.08	4.62	2.00	4.47	1.93
4	0.25	3.54	10.20	4.42	9.42	4.08	8.83	3.82	8.37	3.63	8.01	3.47	7.71	3.34	7.46	3.23
5	0.32	4.43	15.07	6.52	13.94	6.04	13.10	5.67	12.44	5.39	11.91	5.16	11.48	4.97	11.12	4.81
6	0.38	5.32	20.75	8.98	19.23	8.33	18.09	7.83	17.21	7.45	16.49	7.14	15.91	6.89	15.42	6.68
7	0.44	6.20	27.21	11.78	25.26	10.94	23.79	10.30	22.65	9.81	21.74	9.41	20.98	9.09	20.36	8.82
8	0.50	7.09	34.44	14.91	32.01	13.86	30.18	13.07	28.76	12.45	27.62	11.96	26.68	11.55	25.90	11.22
9	0.57	7.97	42.41	18.36	39.46	17.09	37.25	16.13	35.53	15.38	34.14	14.78	33.00	14.29	32.06	13.88

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	3/4"		3/4"		3/4"		3/4"		3/4"		3/4"		3/4"	
1	0.06	0.57	0.33	0.14	0.30	0.13	0.28	0.12	0.26	0.11	0.25	0.11	0.24	0.10	0.23	0.10
2	0.13	1.14	1.08	0.47	0.99	0.43	0.92	0.40	0.87	0.37	0.82	0.36	0.79	0.34	0.76	0.33
3	0.19	1.71	2.17	0.94	1.99	0.86	1.86	0.81	1.76	0.76	1.68	0.73	1.61	0.70	1.55	0.67
4	0.25	2.28	3.57	1.55	3.29	1.42	3.08	1.33	2.92	1.26	2.78	1.21	2.68	1.16	2.59	1.12
5	0.32	2.85	5.27	2.28	4.86	2.11	4.56	1.97	4.32	1.87	4.13	1.79	3.98	1.72	3.85	1.67
6	0.38	3.42	7.25	3.14	6.70	2.90	6.29	2.72	5.97	2.58	5.71	2.47	5.50	2.38	5.33	2.31
7	0.44	3.99	9.49	4.11	8.79	3.81	8.26	3.58	7.85	3.40	7.52	3.26	7.25	3.14	7.02	3.04
8	0.50	4.56	12.00	5.20	11.13	4.82	10.47	4.53	9.96	4.31	9.54	4.13	9.20	3.98	8.92	3.86
9	0.57	5.12	14.76	6.39	13.70	5.93	12.90	5.59	12.28	5.32	11.78	5.10	11.37	4.92	11.03	4.78
10	0.63	5.69	17.78	7.70	16.52	7.15	15.56	6.74	14.83	6.42	14.23	6.16	13.74	5.95	13.34	5.77

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	1"		1"		1"		1"		1"		1"		1"	
5	0.32	1.81	1.81	0.78	1.67	0.72	1.56	0.68	1.48	0.64	1.41	0.61	1.35	0.59	1.31	0.57
6	0.38	2.18	2.49	1.08	2.29	0.99	2.15	0.93	2.04	0.88	1.94	0.84	1.87	0.81	1.81	0.78
7	0.44	2.54	3.25	1.41	3.00	1.30	2.82	1.22	2.67	1.16	2.56	1.11	2.46	1.07	2.38	1.03
8	0.50	2.90	4.11	1.78	3.80	1.65	3.57	1.54	3.39	1.47	3.24	1.40	3.12	1.35	3.02	1.31
9	0.57	3.27	5.05	2.19	4.67	2.02	4.39	1.90	4.17	1.81	4.00	1.73	3.85	1.67	3.73	1.62
10	0.63	3.63	6.08	2.63	5.63	2.44	5.29	2.29	5.03	2.18	4.82	2.09	4.65	2.01	4.51	1.95
15	0.95	5.44	12.42	5.38	11.55	5.00	10.90	4.72	10.39	4.50	9.98	4.32	9.64	4.17	9.36	4.05
20	1.26	7.26	20.68	8.95	19.29	8.35	18.23	7.90	17.41	7.54	16.75	7.25	16.21	7.02	15.75	6.82

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SYSTEM DESIGN

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AQUARISE SDR 11 (HOT & COLD WATER) FLOW CAPACITY AND FRICTION LOSSES – PIPE

Note: These tables summarize the velocity and head loss of AquaRise SDR 11 pipe for all sizes and for various volumetric flow rates. The upper velocity limit of 8 ft/s is used for all sizes.

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	1-1/4"		1-1/4"		1-1/4"		1-1/4"		1-1/4"		1-1/4"		1-1/4"	
8	0.50	1.82	1.36	0.59	1.25	0.54	1.17	0.51	1.11	0.48	1.06	0.46	1.02	0.44	0.99	0.43
9	0.57	2.05	1.66	0.72	1.54	0.67	1.44	0.62	1.37	0.59	1.31	0.57	1.26	0.54	1.22	0.53
10	0.63	2.27	2.00	0.87	1.85	0.80	1.74	0.75	1.65	0.71	1.58	0.68	1.52	0.66	1.47	0.64
15	0.95	3.41	4.08	1.77	3.78	1.64	3.56	1.54	3.39	1.47	3.25	1.41	3.13	1.36	3.04	1.32
20	1.26	4.55	6.78	2.93	6.30	2.73	5.95	2.57	5.67	2.45	5.44	2.36	5.26	2.28	5.10	2.21
25	1.58	5.69	10.06	4.36	9.38		8.86	3.84	8.46	3.66	8.13	3.52	7.86	3.41	7.64	3.31
30	1.89	6.82	13.91	6.03	12.99	5.63	12.29	5.32	11.74	5.09	11.30	4.89	10.94	4.74	10.64	4.61
35	2.21	7.96	18.32	7.93	17.12	7.41	16.22	7.02	15.51	6.72	14.94	6.47	14.47	6.27	14.08	6.10

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	1-1/2"		1-1/2"		1-1/2"		1-1/2"		1-1/2"		1-1/2"		1-1/2"	
10	0.63	1.74	1.05	0.46	0.97	0.42	0.91	0.39	0.86	0.37	0.83	0.36	0.79	0.34	0.77	0.33
15	0.95	2.60	2.14	0.93	1.98	0.86	1.87	0.81	1.77	0.77	1.70	0.74	1.64	0.71	1.59	0.69
20	1.26	3.47	3.55	1.54	3.30	1.43	3.11	1.35	2.96	1.28	2.84	1.23	2.74	1.19	2.66	1.15
25	1.58	4.34	5.27	2.28	4.91	2.13	4.63	2.01	4.42	1.91	4.24	1.84	4.10	1.78	3.98	1.72
30	1.89	5.21	7.29	3.16	6.79	2.94	6.42	2.78	6.13	2.65	5.89	2.55	5.70	2.47	5.53	2.40
35	2.21	6.08	9.58	4.15	8.95	3.87	8.46	3.67	8.09	3.50	7.78	3.37	7.53	3.26	7.32	3.17
40	2.52	6.94	12.16	5.26	11.36	4.92	10.76	4.66	10.29	4.45	9.91	4.29	9.59	4.15	9.33	4.04
45	2.84	7.81	15.01	6.50	14.04	6.08	13.30	5.76	12.73	5.51	12.27	5.31	11.88	5.15	11.57	5.01

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	2"		2"		2"		2"		2"		2"		2"	
20	1.26	2.22	1.23	0.53	1.14	0.49	1.07	0.46	1.02	0.44	0.98	0.42	0.94	0.41	0.91	0.39
25	1.58	2.78	1.82	0.79	1.69	0.73	1.59	0.69	1.52	0.66	1.45	0.63	1.40	0.61	1.36	0.59
30	1.89	3.33	2.51	1.09	2.34	1.01	2.20	0.95	2.10	0.91	2.02	0.87	1.95	0.84	1.89	0.82
35	2.21	3.89	3.30	1.43	3.08	1.33	2.90	1.26	2.77	1.20	2.66	1.15	2.57	1.11	2.50	1.08
40	2.52	4.45	4.18	1.81	3.90	1.69	3.69	1.60	3.52	1.52	3.38	1.47	3.27	1.42	3.18	1.38
45	2.84	5.00	5.16	2.23	4.82	2.08	4.55	1.97	4.35	1.88	4.19	1.81	4.05	1.75	3.94	1.70
50	3.15	5.56	6.22	2.69	5.81	2.52	5.50	2.38	5.26	2.28	5.06	2.19	4.90	2.12	4.76	2.06
55	3.47	6.11	7.38	3.19	6.90	2.99	6.53	2.83	6.25	2.71	6.02	2.61	5.83	2.52	5.67	2.45
60	3.79	6.67	8.62	3.73	8.06	3.49	7.64	3.31	7.31	3.17	7.04	3.05	6.82	2.95	6.64	2.87
65	4.10	7.23	9.94	4.31	9.31	4.03	8.83	3.82	8.45	3.66	8.15	3.53	7.89	3.42	7.68	3.33
70	4.42	7.78	11.36	4.92	10.64	4.61	10.09	4.37	9.66	4.18	9.32	4.04	9.03	3.91	8.80	3.81

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SYSTEM DESIGN

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AQUARISE SDR 11 (HOT & COLD WATER) FLOW CAPACITY AND FRICTION LOSSES – PIPE

Note: These tables summarize the velocity and head loss of AquaRise SDR 11 pipe for all sizes and for various volumetric flow rates. The upper velocity limit of 8 ft/s is used for all sizes.

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	2-1/2"		2-1/2"		2-1/2"		2-1/2"		2-1/2"		2-1/2"		2-1/2"	
30	1.89	2.27	1.01	0.44	0.94	0.41	0.88	0.38	0.84	0.36	0.81	0.35	0.78	0.34	0.75	0.33
35	2.21	2.65	1.32	0.57	1.23	0.53	1.16	0.50	1.11	0.48	1.06	0.46	1.03	0.44	0.99	0.43
40	2.52	3.03	1.68	0.73	1.56	0.68	1.47	0.64	1.41	0.61	1.35	0.58	1.30	0.56	1.26	0.55
45	2.84	3.41	2.07	0.90	1.93	0.83	1.82	0.79	1.74	0.75	1.67	0.72	1.61	0.70	1.56	0.68
50	3.15	3.79	2.49	1.08	2.32	1.01	2.20	0.95	2.10	0.91	2.02	0.87	1.95	0.84	1.89	0.82
55	3.47	4.17	2.95	1.28	2.76	1.19	2.61	1.13	2.49	1.08	2.39	1.04	2.32	1.00	2.25	0.97
60	3.79	4.55	3.45	1.49	3.22	1.39	3.05	1.32	2.91	1.26	2.80	1.21	2.71	1.17	2.63	1.14
65	4.10	4.93	3.98	1.72	3.72	1.61	3.52	1.52	3.36	1.46	3.24	1.40	3.13	1.36	3.05	1.32
70	4.42	5.31	4.54	1.97	4.24	1.84	4.02	1.74	3.84	1.66	3.70	1.60	3.58	1.55	3.49	1.51
75	4.73	5.69	5.14	2.22	4.80	2.08	4.55	1.97	4.35	1.89	4.19	1.82	4.06	1.76	3.95	1.71
80	5.05	6.07	5.76	2.50	5.39	2.34	5.11	2.21	4.89	2.12	4.72	2.04	4.57	1.98	4.45	1.92
85	5.36	6.45	6.42	2.78	6.02	2.60	5.70	2.47	5.46	2.36	5.26	2.28	5.10	2.21	4.96	2.15
90	5.68	6.82	7.12	3.08	6.67	2.89	6.32	2.74	6.06	2.62	5.84	2.53	5.66	2.45	5.51	2.39
95	5.99	7.20	7.84	3.39	7.35	3.18	6.97	3.02	6.68	2.89	6.44	2.79	6.25	2.70	6.08	2.63
100	6.31	7.58	8.59	3.72	8.06	3.49	7.65	3.31	7.33	3.18	7.07	3.06	6.86	2.97	6.68	2.89

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	3"		3"		3"		3"		3"		3"		3"	
40	2.52	2.05	0.66	0.28	0.61	0.26	0.57	0.25	0.55	0.24	0.52	0.23	0.51	0.22	0.49	0.21
45	2.84	2.30	0.81	0.35	0.75	0.33	0.71	0.31	0.67	0.29	0.65	0.28	0.63	0.27	0.61	0.26
50	3.15	2.56	0.97	0.42	0.91	0.39	0.85	0.37	0.81	0.35	0.78	0.34	0.76	0.33	0.73	0.32
55	3.47	2.81	1.15	0.50	1.07	0.46	1.01	0.44	0.97	0.42	0.93	0.40	0.90	0.39	0.87	0.38
60	3.79	3.07	1.34	0.58	1.25	0.54	1.18	0.51	1.13	0.49	1.09	0.47	1.05	0.45	1.02	0.44
65	4.10	3.32	1.55	0.67	1.45	0.63	1.37	0.59	1.31	0.57	1.25	0.54	1.21	0.53	1.18	0.51
70	4.42	3.58	1.77	0.77	1.65	0.71	1.56	0.68	1.49	0.65	1.43	0.62	1.39	0.60	1.35	0.58
75	4.73	3.84	2.00	0.87	1.87	0.81	1.77	0.77	1.69	0.73	1.62	0.70	1.57	0.68	1.53	0.66
80	5.05	4.09	2.24	0.97	2.10	0.91	1.98	0.86	1.90	0.82	1.83	0.79	1.77	0.76	1.72	0.74
85	5.36	4.35	2.50	1.08	2.34	1.01	2.21	0.96	2.12	0.92	2.04	0.88	1.97	0.85	1.92	0.83
90	5.68	4.60	2.77	1.20	2.59	1.12	2.45	1.06	2.35	1.02	2.26	0.98	2.19	0.95	2.13	0.92
95	5.99	4.86	3.05	1.32	2.85	1.24	2.70	1.17	2.59	1.12	2.49	1.08	2.41	1.04	2.35	1.02
100	6.31	5.11	3.34	1.45	3.13	1.35	2.97	1.28	2.84	1.23	2.73	1.18	2.65	1.15	2.58	1.12
120	7.57	6.14	4.63	2.01	4.34	1.88	4.12	1.78	3.95	1.71	3.81	1.65	3.69	1.60	3.59	1.55
140	8.83	7.16	6.11	2.65	5.73	2.48	5.45	2.36	5.22	2.26	5.04	2.18	4.89	2.12	4.76	2.06

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SYSTEM DESIGN

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AQUARISE SDR 11 (HOT & COLD WATER) FLOW CAPACITY AND FRICTION LOSSES – PIPE

Note: These tables summarize the velocity and head loss of AquaRise SDR 11 pipe for all sizes and for various volumetric flow rates. The upper velocity limit of 8 ft/s is used for all sizes.

Flow Rate		Velocity	40°F (5°C)		60°F (16°C)		80°F (27°C)		100°F (38°C)		120°F (49°C)		140°F (60°C)		160°F (71°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	4"		4"		4"		4"		4"		4"		4"	
65	4.10	2.01	0.47	0.20	0.43	0.19	0.41	0.18	0.39	0.17	0.38	0.16	0.36	0.16	0.35	0.15
70	4.42	2.17	0.53	0.23	0.50	0.21	0.47	0.20	0.45	0.19	0.43	0.19	0.41	0.18	0.40	0.17
75	4.73	2.32	0.60	0.26	0.56	0.24	0.53	0.23	0.51	0.22	0.49	0.21	0.47	0.20	0.46	0.20
80	5.05	2.48	0.67	0.29	0.63	0.27	0.59	0.26	0.57	0.25	0.55	0.24	0.53	0.23	0.51	0.22
85	5.36	2.63	0.75	0.33	0.70	0.30	0.66	0.29	0.63	0.27	0.61	0.26	0.59	0.25	0.57	0.25
90	5.68	2.79	0.83	0.36	0.78	0.34	0.73	0.32	0.70	0.30	0.67	0.29	0.65	0.28	0.63	0.27
95	5.99	2.94	0.92	0.40	0.86	0.37	0.81	0.35	0.77	0.33	0.74	0.32	0.72	0.31	0.70	0.30
100	6.31	3.09	1.00	0.43	0.94	0.41	0.89	0.38	0.85	0.37	0.82	0.35	0.79	0.34	0.77	0.33
120	7.57	3.71	1.39	0.60	1.30	0.56	1.23	0.53	1.18	0.51	1.13	0.49	1.10	0.47	1.07	0.46
140	8.83	4.33	1.83	0.79	1.71	0.74	1.62	0.70	1.55	0.67	1.50	0.65	1.45	0.63	1.41	0.61
160	10.09	4.95	2.33	1.01	2.18	0.94	2.07	0.90	1.98	0.86	1.91	0.83	1.85	0.80	1.80	0.78
180	11.36	5.57	2.87	1.24	2.69	1.17	2.56	1.11	2.45	1.06	2.36	1.02	2.29	0.99	2.23	0.97
200	12.62	6.19	3.47	1.50	3.26	1.41	3.10	1.34	2.97	1.28	2.86	1.24	2.78	1.20	2.71	1.17
220	13.88	6.81	4.12	1.78	3.87	1.68	3.68	1.59	3.53	1.53	3.41	1.48	3.31	1.43	3.22	1.39
240	15.14	7.43	4.82	2.09	4.53	1.96	4.31	1.87	4.13	1.79	3.99	1.73	3.88	1.68	3.78	1.64
250	15.77	7.74	5.19	2.25	4.88	2.11	4.64	2.01	4.45	1.93	4.30	1.86	4.18	1.81	4.07	1.76

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IPEX AquaRise® Potable Water Piping Systems 23

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AQUARISE SDR 21 (COLD WATER) FLOW CAPACITY AND FRICTION LOSSES – PIPE

			40°F (5°C)		73°F (23°C)	
Flow Rate		Velocity	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	1-1/2"		1-1/2"	
15	0.95	2.12	1.31	0.57	1.17	0.50
20	1.26	2.83	2.18	0.94	1.94	0.84
25	1.58	3.53	3.23	1.40	2.89	1.25
30	1.89	4.24	4.46	1.93	4.00	1.73
35	2.21	4.95	5.86	2.54	5.27	2.28
40	2.52	5.65	7.43	3.22	6.69	2.90
45	2.84	6.36	9.17	3.97	8.26	3.58
50	3.15	7.07	11.07	4.79	9.98	4.32
55	3.47	7.77	13.12	5.68	11.85	5.13

			40°F (5°C)		73°F (23°C)	
Flow Rate		Velocity	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	2"		2"	
25	1.58	2.25	1.10	0.48	0.98	0.43
30	1.89	2.70	1.52	0.66	1.36	0.59
35	2.21	3.15	2.00	0.87	1.79	0.78
40	2.52	3.60	2.53	1.10	2.27	0.98
45	2.84	4.06	3.12	1.35	2.81	1.21
50	3.15	4.51	3.77	1.63	3.39	1.47
55	3.47	4.96	4.46	1.93	4.02	1.74
60	3.79	5.41	5.21	2.26	4.70	2.03
65	4.10	5.86	6.01	2.60	5.43	2.35
70	4.42	6.31	6.87	2.97	6.20	2.68
75	4.73	6.76	7.77	3.36	7.02	3.04
80	5.05	7.21	8.72	3.78	7.89	3.41
85	5.36	7.66	9.72	4.21	8.80	3.81

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Note: These tables summarize the velocity and head loss of AquaRise SDR 11 pipe for all sizes and for various volumetric flow rates. The upper velocity limit of 8 ft/s is used for all sizes.

Flow Rate		Velocity	40°F (5°C)		73°F (23°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	2-1/2"		2-1/2"	
35	2.21	2.15	0.80	0.35	0.71	0.31
40	2.52	2.45	1.01	0.44	0.90	0.39
45	2.84	2.76	1.24	0.54	1.12	0.48
50	3.15	3.07	1.50	0.65	1.35	0.58
55	3.47	3.37	1.78	0.77	1.60	0.69
60	3.79	3.68	2.07	0.90	1.86	0.81
65	4.10	3.99	2.39	1.04	2.15	0.93
70	4.42	4.29	2.73	1.18	2.46	1.06
75	4.73	4.60	3.09	1.34	2.78	1.20
80	5.05	4.91	3.46	1.50	3.12	1.35
85	5.36	5.21	3.86	1.67	3.48	1.51
90	5.68	5.52	4.28	1.85	3.86	1.67
95	5.99	5.83	4.71	2.04	4.26	1.84
100	6.31	6.13	5.16	2.24	4.67	2.02
120	7.57	7.36	7.16	3.10	6.49	2.81
130	8.20	7.97	8.27	3.58	7.50	3.25

Flow Rate		Velocity	40°F (5°C)		73°F (23°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	3"		3"	
50	3.15	2.06	0.58	0.25	0.52	0.23
55	3.47	2.27	0.69	0.30	0.62	0.27
60	3.79	2.48	0.81	0.35	0.72	0.31
65	4.10	2.68	0.93	0.40	0.83	0.36
70	4.42	2.89	1.06	0.46	0.95	0.41
75	4.73	3.10	1.20	0.52	1.08	0.47
80	5.05	3.30	1.34	0.58	1.21	0.52
85	5.36	3.51	1.50	0.65	1.35	0.58
90	5.68	3.71	1.66	0.72	1.49	0.65
95	5.99	3.92	1.82	0.79	1.64	0.71
100	6.31	4.13	2.00	0.87	1.80	0.78
120	7.57	4.95	2.77	1.20	2.50	1.08
140	8.83	5.78	3.65	1.58	3.31	1.43
160	10.09	6.60	4.64	2.01	4.21	1.82
180	11.36	7.43	5.73	2.48	5.21	2.25
190	11.99	7.84	6.32	2.74	5.74	2.49

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AQUARISE SDR 21 (COLD WATER) FLOW CAPACITY AND FRICTION LOSSES – PIPE

Flow Rate		Velocity	40°F (5°C)		73°F (23°C)	
			Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)	Friction Head Loss (ft water/100 ft)	Friction Pressure (psi/100 ft)
gpm US	L/sec	ft/s	4"		4"	
80	5.05	2.00	0.51	0.22	0.36	0.16
85	5.36	2.12	0.61	0.26	0.40	0.17
90	5.68	2.25	0.71	0.31	0.45	0.19
95	5.99	2.37	0.82	0.35	0.49	0.21
100	6.31	2.50	0.93	0.40	0.54	0.23
120	7.57	2.99	1.06	0.46	0.75	0.32
140	8.83	3.49	1.19	0.51	0.99	0.43
160	10.09	3.99	1.32	0.57	1.25	0.54
180	11.36	4.49	1.47	0.63	1.55	0.67
200	12.62	4.99	1.61	0.70	1.87	0.81
220	13.88	5.49	1.77	0.77	2.23	0.96
240	15.14	5.99	2.46	1.06	2.61	1.13
260	16.40	6.49	3.25	1.41	3.01	1.30
280	17.67	6.99	4.13	1.79	3.45	1.49
300	18.93	7.49	5.12	2.22	3.91	1.69
320	20.19	7.99	5.65	2.45	4.39	1.90

Note: These tables summarize the velocity and head loss of AquaRise Cold Water SDR 21 pipe for all sizes and for various volumetric flow rates. The upper velocity limit of 8 ft/s is used for all sizes.

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A common design aid for sizing distribution water pipe is a Fixture Unit Table. More details on this method including the values assigned for various fixtures can be found in the National Plumbing Code of Canada or other local regional codes. However, work is beginning in some jurisdictions to recognize that a single one-size-fits-all table may not be adequate to properly size water lines given the wide variety of inside diameters available. To help address this, IPEX has derived an alternative table using the actual pipe inside diameters of various commonly available water pipe materials. The Maximum Fixture Unit values are presented for each type and nominal size of water pipe based on a maximum recommended velocity and using the Average Pressure Loss Method. Note that Type L Copper is shown for two different maximum velocity values with the higher one being a cold water limit and the lower one being a limit for hot water not greater than 140°F (60°C).

As can be seen below, there are significant differences amongst pipe materials in terms of maximum fixture units permitted to be served. Designers are cautioned that the use of a single fixture unit table as presented in many Codes may not be appropriate or applicable for piping with inside diameters smaller than the nominal pipe size.

Water Pipe Sizing - Maximum Number of Fixture Units Served Using Average Pressure Loss Method

Nominal Pipe Size (In.)	WATER VELOCITY																	
	AquaRise SDR 11 (Hot & Cold)			AquaRise SDR 21 (Cold)			Type L Copper (Cold)			Type L Copper (Hot)			PEX SDR 9			CPVC SDR 11 (CTS)		
	2.4 m/s (8 ft/s)						2.4 m/s (8 ft/s)			1.5 m/s (5 ft/s)			2.4 m/s (8 ft/s)			2.4 m/s (8 ft/s)		
	FLOW AND FIXTURE UNITS SERVED (SYSTEM WITH FLUSH TANKS)																	
	L/s	GPM	Fixture Units	L/s	GPM	Fixture Units	L/s	GPM	Fixture Units	L/s	GPM	Fixture Units	L/s	GPM	Fixture Units	L/s	GPM	Fixture Units
1/2	0.57	9.0	12	-	-	-	0.37	5.8	7	0.23	3.6	3.5	0.28	4.4	4.5	0.28	4.5	5
3/4	0.89	14.1	20	-	-	-	0.76	12.1	16	0.48	7.6	9	0.55	8.8	11.5	0.60	9.5	12.5
1	1.39	22.1	34	-	-	-	1.30	20.6	31	0.81	12.9	18	0.92	14.5	20.5	1.01	16.0	23
1-1/4	2.22	35.2	67	-	-	-	1.98	31.3	56	1.24	19.6	29	1.37	21.8	34	1.51	23.9	39
1-1/2	2.90	46.0	112	3.57	56.6	158	2.80	44.4	105	1.75	27.7	48	1.91	30.3	55	2.12	33.6	62
2	4.54	71.9	235	5.59	88.6	318	4.87	77.1	260	3.04	48.2	121	3.28	51.9	138	3.64	57.8	164
2-1/2	6.66	105.5	405	8.23	130.4	535	7.51	119.0	473	4.69	74.4	246	-	-	-	-	-	-
3	9.87	156.4	676	12.22	193.7	906	10.7	169.8	750	6.70	106.1	405	-	-	-	-	-	-
4	16.3	258.5	1414	20.22	320.5	1960	18.8	298.7	1765	11.8	186.7	860	-	-	-	-	-	-

Note: This table should be used as a general guide only. Refer to the local plumbing code for water distribution pipe sizing rules.

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HEAD LOSS CHARACTERISTICS – FITTINGS AND VALVES

In addition to head losses that result from frictional forces in the pipe, losses also occur when water flows through fittings and valves in the system. These losses are difficult to calculate due to the complex internal geometry of the various fittings. Generally, loss values are determined for each fitting configuration by experimental tests and are expressed in equivalent length of straight pipe. Typical equivalent length values or pressure drops for fittings can be found below.

Pressure drops through valves also contribute to the overall friction loss of fluid through a piping system.

Flow rate coefficients (Cv) are defined as the flow rate in gallons per minute (US gpm) through an open valve resulting in a pressure drop of 1 psi. Flow rate coefficients are listed below:

Friction Loss through Fittings (Equivalent pipe length in feet)

Size (in.)	Tee Run	Tee Branch	90° Bend	45° Bend
1/2	1.0	3.8	1.5	0.8
3/4	1.4	4.9	2.0	1.1
1	1.7	6.0	2.5	1.4
1-1/4	2.3	7.3	3.8	1.8
1-1/2	2.7	8.4	4.0	2.1
2	4.0	12.0	5.7	2.6
2-1/2	4.9	14.7	6.9	3.1
3	6.1	16.4	7.9	4.0
4	7.9	22.0	11.4	5.1

Flow Coefficients for AquaRise Ball Valves

Size (in.)	Flow Coefficient Cv	
	One-Piece Ball Valve	True Union Ball Valve
1/2	12	14
3/4	19	27
1	41	54
1-1/4	-	77
1-1/2	-	123
2	-	238
2-1/2	-	347
3	-	486
4	-	652

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The following formula can be used to calculate the pressure loss across a valve under a given flow rate:

$$f = sg\,(Q/Cv)^2$$

Where:

f = pressure drop (friction loss) across the valve (psi)

sg = specific gravity of fluid (water = 1.0)

Q = flow through the valve (US gpm)

Cv = flow rate coefficient

Example:

What is the pressure loss across a 2" True Union ball valve in an AquaRise system having a flow rate of 50 US gpm. Calculate the answer in equivalent feet of pipe and psi.

f = sg $(Q/Cv)^2$

Q = 50 US gpm

Cv = 238

f = 1 x $(50/238)^2$ = 0.044 psi

From the AquaRise Flow Capacity and Friction Losses - Pipe chart: 50 US gpm through a 2" pipe generates a loss of 2.5 psi/100ft.

Therefore: $\frac{0.044}{(2.5/100)}$ = 1.76 ft of pipe

SURGE PRESSURE CALCULATIONS

POTENTIAL SURGE PRESSURE GIVEN FLOW CONDITIONS

Never exceed a maximum pressure rating for AquaRise components. Never exceed a maximum velocity of 8 ft/s for AquaRise components.

The following formulae can be used to predict the potential surge pressure in AquaRise for given flow conditions.

$$a = \frac{4660}{\sqrt{1 + \left[\frac{k(DR-2)}{E}\right]}}$$

$$P = \frac{(a)\,(dV)}{2.31g}$$

where:

a = wave velocity (ft/s)

k = fluid bulk modulus (= 300,000 psi for water)

DR = pipe dimension ratio (= 11 for AquaRise)

E = Modulus of elasticity for pipe (see table below)

g = acceleration due to gravity (= 32.2 ft/s^2)

P = pressure surge (psi)

dV = velocity change (ft/s)

Modulus of Elasticity and Working Stress for AquaRise

Temperature		Modulus, E psi	Stress, S psi	Pressure Derating Factor
°F	°C			
73	23	423,000	2,000	1.00
90	32	403,000	1,800	0.91
110	43	371,000	1,500	0.74
120	49	355,000	1,300	0.65
140	60	323,000	1,000	0.50
160	71	291,000	800	0.38

Simplifying the equations for AquaRise with DR = 11 and k = 300,000 psi for water,

$$a = \frac{4660}{\sqrt{1 + \left[\frac{2\,700,000}{E}\right]}}$$

and

$$P = \frac{a\,(dV)}{74.4}$$

To prevent rapid closing creating high surge pressures the minimum closure time of a valve can be calculated using the following equation:

$$T = \frac{2 \times L}{a}$$

Where:

T = Minimum closure time of a valve (With linear characteristics) seconds

L = Length of a pipe run upstream of the valve ft

a = wave velocity of the fluid ft/s

It is not possible to apply firm rules to the time period for actuation of a valve since this depends on pressure and flow conditions specific to the installation and these times should wherever possible be determined by computer modeling software. Controlling transient surges is a complex task. It is one of the more important phases of piping design. A design engineer should assess if surge pressures will occur and provide recommendations to manage these surge events. It is not always reasonable to assume the rate of change in velocity is uniform. Most types of valves have non-linear characteristics that result in most of the effect occurring in the last 10-20% of closure. Therefore, the effective closure times are considerably less than nominal times.

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Example: A cold water flow of 35 US gpm in 2" SDR 11 AquaRise is suddenly stopped due to a rapid valve closure. The run is 250 ft long. The system pressure is 100 psi at 73°F. What potential water hammer (surge pressure) could be generated?

Solution: First calculate the system velocity using velocity

$$V = \frac{(0.4085)Q}{d_i^2}$$

$$= \frac{(0.4085)\ (35)}{1.917^2} = 3.89 \text{ ft/s}$$

formula presented earlier,

Next, we must determine the value of E for cold water flow. By referring to table above, select the lowest temperature value (T= 73°F) where E = 423,000 psi.

$$a = \sqrt{\frac{4660}{1+\left[\frac{2{,}700{,}000}{423{,}000}\right]}} = 1{,}715 \text{ ft/s}$$

Now wave velocity 'a' can be calculated:

$$P = \frac{(1715) \times (3.89)}{74.4} = \mathbf{89.7\ psi}$$

Now calculate surge pressure,

Thus, the potential surge pressure for this piping system would be 89.7 psi.

Therefore, the total line pressure that the piping system could see would be 100 psi (static pressure) + 89.7 psi (surge pressure) = 189.7 psi.

It is also interesting to note that a similar calculation for 2" Type L copper at 35 US gpm would yield a potential surge pressure of 285 psi (100 static pressure + 185 surge pressure) due to the higher rigidity of the copper pipe.

1.What is the minimum valve closure time required to prevent an instantaneous pressure surge?

Solution:

From the previous example, the total line pressure that the piping could see would be 100 psi + 89.7 psi = 189.7 psi.

$$T = \frac{2 \times 250 \text{ ft}}{1715 \text{ ft/s}} \qquad T = 0.29 \text{ seconds}$$

One Ft/s Surge Pressures vs. Temperature

The following table represents the resultant surge pressure for a 1 ft/s instantaneous velocity change (i.e. start-up or shutdown) in AquaRise pipe at varying operating temperatures. The surge pressure values in this table can be multiplied by the actual system velocity to obtain potential surge pressures for that velocity. For example, if V = 3.5 ft/s, then the potential surge for that system would be the table value x 3.5.

Operating Temperature		One Ft/s Surge Pressure	
°F	°C	(psi)	(kPa)
73	23	24.1	166.2
90	32	23.6	162.7
110	43	22.8	157.2
120	49	22.3	153.8
140	60	21.4	147.5
160	71	20.5	141.3

Never exceed a maximum velocity of 8 ft/s

THRUST FORCES

Thrust forces can occur at any point in a piping system where the directional or cross-sectional area of the waterway changes or where additional structure loads, such as valves, are installed. These forces must be accommodated by means of reinforcement using anchors, riser clamps, or restraining hangers.

The size or need for reinforcements should be based on the design engineer's evaluation of flow velocities and pressure increases due to the fluid's momentum.

Note: the thrust created at unrestrained fittings can be considerable (as shown in table below) and must be addressed during installation.

Thrust at Fittings in Pounds per 100 psi of Internal Pressure

Size	Blank Ends and Junctions	90° Bends	45° Bends
1/2	60	85	50
3/4	90	130	70
1	140	200	110
1-1/4	220	320	170
1-1/2	300	420	230
2	450	630	345
2-1/2	650	910	500
3	970	1,360	745
4	1,600	2,240	1,225

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EXPANSION AND CONTRACTION DESIGN

As with all construction materials, AquaRise piping undergoes expansion and contraction when subjected to changes in temperature. The coefficient of linear expansion for AquaRise is 3.8 x 10^{-5} in/in/°F which corresponds to a change in length of 0.456 in per 10°F temperature change per 100 ft. of pipe length.

NOTICE

Designers and installers must anticipate and account for the total change in temperature (ΔT) between the date of installation and the peak temperature the AquaRise system will see. As an example, for installations at 40°F (5°C), in combination with usage at the maximum operating system temperature of 160°F (71°C), the AquaRise systems would see a ΔT as high as 120°F (66°C).

NOTICE

Failure to properly design and accommodate for expansion and contraction due to temperature changes can lead to system failure.
Follow all IPEX recommendations for accommodating expansion and contraction.

NOTICE

Correctly sized expansion loops are required on all hot water vertical risers.

CALCULATING EXPANSION AND CONTRACTION

Determine the total amount of expansion that any particular straight section of piping will undergo. To do this, the formula below should be used:

$$\Delta L = Y \times \frac{(T - F)}{10} \times \frac{L}{100}$$

Where, ΔL = change in length due to temp. variance (in.)

Y = expansion coefficient for AquaRise (0.456 in / 10°F / 100 ft.)

T = initial system installation temperature (°F)

F = final system operating temperature (°F)

L = length of straight section (ft.)

For reference, a table of expansion values is presented on the following page for various temperature changes and pipe section (run) lengths. Note that these expansion length values are independent of pipe size.

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AquaRise Linear Thermal Expansion or Contraction (ΔL in inches)

Temp. Change ΔT (°F)	Length of Run (feet)									
	10	20	30	40	50	60	70	80	90	100
10	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36	0.41	0.46
20	0.09	0.18	0.27	0.36	0.46	0.55	0.64	0.73	0.82	0.91
30	0.14	0.27	0.41	0.55	0.68	0.82	0.96	1.09	1.23	1.37
40	0.18	0.36	0.55	0.73	0.91	1.09	1.28	1.46	1.64	1.82
50	0.23	0.46	0.68	0.91	1.14	1.37	1.60	1.82	2.05	2.28
60	0.27	0.55	0.82	1.09	1.37	1.64	1.92	2.19	2.46	2.74
70	0.32	0.64	0.96	1.28	1.60	1.92	2.23	2.55	2.87	3.19
80	0.36	0.73	1.09	1.46	1.82	2.19	2.55	2.92	3.28	3.65
90	0.41	0.82	1.23	1.64	2.05	2.46	2.87	3.28	3.69	4.10
100	0.46	0.91	1.37	1.82	2.28	2.74	3.19	3.65	4.10	4.56
110	0.50	1.00	1.50	2.01	2.51	3.01	3.51	4.01	4.51	5.02
120	0.55	1.09	1.64	2.19	2.74	3.28	3.83	4.38	4.92	5.47
130	0.59	1.19	1.78	2.37	2.96	3.56	4.15	4.74	5.34	5.93
140	0.64	1.28	1.92	2.56	3.19	3.83	4.47	5.11	5.75	6.38

AquaRise Linear Thermal Expansion or Contraction (ΔL in mm)

Temp. Change ΔT (°C)	Length of Run (m)									
	3	6	9	12	15	18	21	24	27	30
5	1.0	2.1	3.1	4.1	5.1	6.2	7.2	8.2	9.2	10.3
10	2.1	4.1	6.2	8.2	10.3	12.3	14.4	16.4	18.5	20.5
15	3.1	6.2	9.2	12.3	15.4	18.5	21.5	24.6	27.7	30.8
20	4.1	8.2	12.3	16.4	20.5	24.6	28.7	32.8	36.9	41.0
25	5.1	10.3	15.4	20.5	25.7	30.8	35.9	41.0	46.2	51.3
30	6.2	12.3	18.5	24.6	30.8	36.9	43.1	49.2	55.4	61.6
35	7.2	14.4	21.5	28.7	35.9	43.1	50.3	57.5	64.6	71.8
40	8.2	16.4	24.6	32.8	41.0	49.2	57.5	65.7	73.9	82.1
45	9.2	18.5	27.7	36.9	46.2	55.4	64.6	73.9	83.1	92.3
50	10.3	20.5	30.8	41.0	51.3	61.6	71.8	82.1	92.3	102.6
55	11.2	22.4	33.7	44.9	56.1	67.3	78.5	89.8	101.0	112.2
60	12.2	24.5	36.7	49.0	61.2	73.4	85.7	97.9	110.2	122.4
65	13.3	26.5	39.8	53.0	66.3	79.6	92.8	106.1	119.3	132.6
70	14.3	28.6	42.8	57.1	71.4	85.7	100.0	114.2	128.5	142.8
75	15.3	30.6	45.9	61.2	76.5	91.8	107.1	122.4	137.7	153.0

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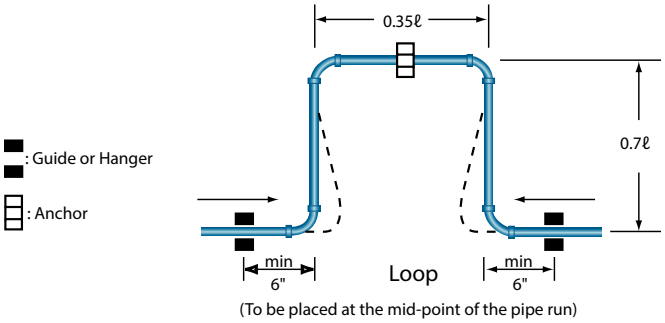
ACCOMMODATING EXPANSION AND CONTRACTION

After determining the amount of expansion or contraction to be expected in the AquaRise piping system, designers and installers must choose a method to accommodate the movement. Below are the acceptable methods for accommodating expansion and contraction.

1. EXPANSION LOOPS

It is very important to properly size expansion loops. Under-sizing a loop in any of its critical dimensions will actually increase stresses in the system. Diagrams for an expansion loop, sample loop calculations, and reference charts are shown below:



(To be placed at the mid-point of the pipe run)

The critical length "ℓ" must be calculated in order to design the expansion loop. **At ipexaquarise.com there is a convenient "ℓ" dimension calculator.**

To calculate "ℓ" manually, the following formula can be used:

$$\ell = \sqrt{\frac{3ED(\Delta L)}{S}}$$

Where, ℓ = critical length (in.)

E = Modulus of Elasticity for AquaRise at maximum operating temperature (psi)

D = outside diameter of pipe (in.)

ΔL = change in length due to expansion (in.)

S = working stress at maximum operating temperature (psi)

Example: For a run of 90 ft. of 3" nominal size AquaRise pipe, installed at 65°F and operating at 140°F, how long should the loop legs be for an expansion loop in order to compensate for the system expansion?

Step 1: Calculate the amount of expansion to be expected.

$$\Delta L = Y \times \frac{(T - F)}{10} \times \frac{L}{100}$$

Known: L = 90 ft, T = 140°F, F = 65°F,

Y = 0.456 in/10°F/100 ft

(Coefficient of Thermal Expansion)

$$\Delta L = 0.456 \times \frac{(140 - 65)}{10} \times \frac{90}{100}$$

$$\Delta L = 3.08 \text{ in.}$$

Step 2: Calculate the critical expansion loop length

$$\ell = \sqrt{\frac{3ED(\Delta L)}{S}}$$

Known: ΔL = 3.08 in., E = 323,000 psi, S = 1000 psi

(from Surge Pressure Section – Modulus of Elasticity & Working Stress for AquaRise), D = 3.5 in (OD, from physical dimension and weights section)

$$\ell = \sqrt{\frac{3 \times 323{,}000 \times 3.5 \times 3.08}{1000}}$$

$$\ell = 102.2 \text{ inches}$$

Therefore: 0.7ℓ = 71.5 in. and 0.35ℓ = 35.8 in.

Placement of Expansion Loops

Expansion loops for AquaRise shall be centered along the pipe run in which they are installed. For example, if 2 loops are required in a section, they should be placed as close as possible to be 1/3 and 2/3 along the pipe section.

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2. CHANGE OF DIRECTION

A simple change of direction can also effectively relieve stress caused by thermal expansion/contraction, but as with expansion loops, the 'ℓ' dimension is just as critical. Too short a distance to a guide will reduce the flexibility in the system. 'ℓ' can be calculated as was shown in the previous loops section.

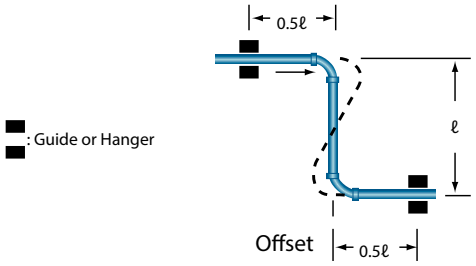
Using the previous example, the critical dimension ℓ = 102.2 in

Change of direction

3. OFFSETS

Offsets are similar to loops and changes of directions, and the critical ℓ dimension is calculated in the same way. Unlike a loop, no restraint should be placed between the guides.

Using the previous example, the critical dimension 0.5ℓ = 51.1 in., and ℓ = 102.2 in



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THERMAL CONDUCTIVITY

The rate of thermal conductivity for AquaRise is 0.95 BTU/hr•ft^2•°F•in. This value compares very favorably to those of metal pipe being 380 times lower than steel and 2,800 times lower than copper.

CONDENSATION POTENTIAL

The high thermal resistance of AquaRise greatly reduces the potential of condensation forming on the outside of the pipe.

However, to accurately assess individual installations, IPEX can assist designers in calculating condensation potential. To calculate condensation potential, the following parameters must be known by the designer: pipe diameter of AquaRise, cold water temperature, indoor air temperature, design relative humidity and insulation thickness (if any). Using these input variables, both the pipe surface temperature and the Dew Point temperature can be calculated. Should the pipe surface temperature exceed the Dew Point temperature, condensation will not occur. IPEX can also assist in assessing other pipe materials including copper.

To assist designers, IPEX has prepared the following tables of pipe surface temperatures for AquaRise for a given set of relative humidities, water temperature, ambient air temperature and the resulting Dew Point temperature. Should the pipe surface temperature be at or below the Dew Point temperature, condensation will occur.

Condensation Potential for AquaRise SDR 11 (°F)

Condensation will occur.

Water Temp. (°F)	45					
Relative Humidity	45%			50%		
Air Temp. (°F)	65	70	75	65	70	75
Dew Point (°F)	43.1	47.7	52.2	45.9	50.5	55.1

Pipe Size (in)	Pipe Surface Temp (°F)					
1/2	48.8	49.7	50.7	48.8	49.7	50.7
3/4	49.6	50.8	52.0	49.6	50.8	52.0
1	50.6	52.0	53.5	50.6	52.0	53.5
1 1/4	51.7	53.5	55.2	51.7	53.5	55.2
1 1/2	52.5	54.4	56.4	52.5	54.4	56.4
2	53.8	56.1	58.4	53.8	56.1	58.4
2 1/2	55.1	57.7	60.4	55.1	57.7	60.4
3	56.5	59.5	62.6	56.5	59.5	62.6
4	58.5	62.0	65.6	58.5	62.0	65.6

Water Temp. (°F)	50					
Relative Humidity	45%			50%		
Air Temp. (°F)	65	70	75	65	70	75
Dew Point (°F)	43.1	47.7	52.2	45.9	50.5	55.1

Pipe Size (in)	Pipe Surface Temp (°F)					
1/2	52.8	53.8	54.8	52.8	53.8	54.8
3/4	53.5	54.7	55.9	53.5	54.7	55.9
1	54.2	55.6	57.1	54.2	55.6	57.1
1 1/4	55.1	56.8	58.6	55.1	56.8	58.6
1 1/2	55.6	57.6	59.5	55.6	57.6	59.5
2	56.7	58.9	61.3	56.7	58.9	61.3
2 1/2	57.6	60.2	62.9	57.6	60.2	62.9
3	58.7	61.7	64.7	58.7	61.7	64.7
4	60.1	63.6	67.2	60.1	63.6	67.2

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Condensation Potential for AquaRise SDR 11 (°C)

Condensation will occur.

Water Temp. (°C)	7.2					
Relative Humidity	45%			50%		
Air Temp. (°C)	18.3	21.1	23.9	18.3	21.1	23.9
Dew Point (°C)	6.2	8.7	11.2	7.7	10.3	12.8

Pipe Size (in)	Pipe Surface Temp (°C)					
1/2	9.3	9.8	10.4	9.3	9.8	10.4
3/4	9.8	10.4	11.1	9.8	10.4	11.1
1	10.3	11.1	11.9	10.3	11.1	11.9
1 1/4	10.9	11.9	12.9	10.9	11.9	12.9
1 1/2	11.4	12.4	13.6	11.4	12.4	13.6
2	12.1	13.4	14.7	12.1	13.4	14.7
2 1/2	12.8	14.3	15.8	12.8	14.3	15.8
3	13.6	15.3	17.0	13.6	15.3	17.0
4	14.7	16.7	18.7	14.7	16.7	18.7

Water Temp. (°C)	10					
Relative Humidity	45%			50%		
Air Temp. (°C)	18.3	21.1	23.9	18.3	21.1	23.9
Dew Point (°C)	6.2	8.7	11.2	7.7	10.3	12.8

Pipe Size (in)	Pipe Surface Temp (°C)					
1/2	11.6	12.1	12.7	11.6	12.1	12.7
3/4	11.9	12.6	13.3	11.9	12.6	13.3
1	12.3	13.1	13.9	12.3	13.1	13.9
1 1/4	12.8	13.8	14.8	12.8	13.8	14.8
1 1/2	13.1	14.2	15.3	13.1	14.2	15.3
2	13.7	14.9	16.3	13.7	14.9	16.3
2 1/2	14.2	15.7	17.2	14.2	15.7	17.2
3	14.8	16.5	18.2	14.8	16.5	18.2
4	15.6	17.6	19.6	15.6	17.6	19.6

Some general conclusions can be seen from these tables which follow sound engineering judgment. These are: (a) there is less potential for condensation as pipe sizes (and thus wall thicknesses) increase; (b) lower relative humidity reduces condensation potential; and (c) warmer water temperature inside the piping system reduces condensation potential.

Hot Water Piping

Designers may wish to use external pipe insulation on AquaRise hot water lines for possible energy savings. This is more of an economic analysis rather than performance assessment. Typically, designers will perform a cost/benefit analysis of pipe insulation versus no insulation in terms of energy consumption costs. Consideration should be given to Local Code Requirements on this topic. Performance of AquaRise pipe will be unaffected with or without insulation on hot water lines. External pipe insulation must always be chemically compatible with AquaRise.

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Condensation Potential for AquaRise SDR 21 Cold Water (°F)

Condensation will occur.

Water Temp. (°F)	45					
Relative Humidity	45%			50%		
Air Temp. (°F)	65	70	75	65	70	75
Dew Point (°F)	43.1	47.7	52.2	45.9	50.5	55.1

Pipe Size (in)	Pipe Surface Temp (°F)					
1 1/2	49.4	50.5	51.6	49.4	50.5	51.6
2	50.2	51.5	52.9	50.2	51.5	52.9
2 1/2	51.0	52.6	54.2	51.0	52.6	54.2
3	52.0	53.8	55.6	52.0	53.8	55.6
4	53.4	55.6	57.9	53.4	55.6	57.9

Water Temp. (°F)	50					
Relative Humidity	45%			50%		
Air Temp. (°F)	65	70	75	65	70	75
Dew Point (°F)	43.1	47.7	52.2	45.9	50.5	55.1

Pipe Size (in)	Pipe Surface Temp (°F)					
1 1/2	53.3	54.4	55.5	53.3	54.4	55.5
2	53.9	55.3	56.6	53.9	55.3	56.6
2 1/2	54.5	56.1	57.7	54.5	56.1	57.7
3	55.3	57.1	58.9	55.3	57.1	58.9
4	56.4	58.5	60.8	56.4	58.5	60.8

Water Temp. (°C)	7.2					
Relative Humidity	45%			50%		
Air Temp. (°C)	18.3	21.1	23.9	18.3	21.1	23.9
Dew Point (°C)	6.2	8.7	11.2	7.7	10.3	12.8

Pipe Size (in)	Pipe Surface Temp (°C)					
1 1/2	9.6	10.3	10.9	9.6	10.3	10.9
2	10.1	10.9	11.6	10.1	10.9	11.6
2 1/2	10.6	11.4	12.3	10.6	11.4	12.3
3	11.1	12.1	13.1	11.1	12.1	13.1
4	11.9	13.1	14.4	11.9	13.1	14.4

Water Temp. (°C)	10					
Relative Humidity	45%			50%		
Air Temp. (°C)	18.3	21.1	23.9	18.3	21.1	23.9
Dew Point (°C)	6.2	8.7	11.2	7.7	10.3	12.8

Pipe Size (in)	Pipe Surface Temp (°C)					
1 1/2	13.1	14.2	15.3	13.1	14.2	15.3
2	13.7	14.9	16.3	13.7	14.9	16.3
2 1/2	14.2	15.7	17.2	14.2	15.7	17.2
3	14.8	16.5	18.2	14.8	16.5	18.2
4	15.6	17.6	19.6	15.6	17.6	19.6

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CHEMICAL RESISTANCE

AquaRise is solely intended for use in hot or cold potable water distribution.

The TempRite® Technology CPVC compound used to make AquaRise pipe, valves and fittings can be damaged by contact with chemicals found in some construction products. Care must be taken to ensure that products contacting AquaRise are chemically compatible.

Confirm chemical compatibility of AquaRise products made with TempRite Technology by checking with the FBC System Compatible Program[1] or the manufacturers of such common piping systems components as:

- fire stop materials
- pipe insulation and adhesives
- heat trace cables
- wear pads or other rubber components
- thread sealants

The general information below gives an overview of chemical compatibility concerns for AquaRise potable water piping. Please refer to the FBC System Compatible program at https://www.lubrizol.com/CPVC/FBC-System-Compatible-Program for the most up to date list of compatibility.[1]

AquaRise Solvent Cements and Primers - These products are designed for use in joining AquaRise by way of solvent welding. The application of these products should be limited to the spigot-socket connection surfaces of a particular joint. Widespread or careless application of cement or primer to other parts of the piping system may cause softening and weakened structural areas in the piping and must be avoided.

Flexible Wire and Cables - These products may contain plasticizers (also called softeners) which if in contact with AquaRise may impose harm in the form of environmental stress cracking.

Rubber and Flexible Materials - For the same reasons as with flexible wires and cables, care must be taken when AquaRise is installed in direct contact with gaskets, electrical tape, hanger padding, vinyl dipped metal parts and flexible hoses or tubes. Plasticizers contained in these substances may impose harm to AquaRise when in direct contact.

Fungicides and Mold Inhibitors - If ever applying these products in close proximity to AquaRise piping during water damage or mold cleanup, isolate the piping from these products by use of an external wrap or sleeve. Avoid direct contact of these products with AquaRise.

Grease and Cooking Oils - If pipe is installed in a kitchen environment, avoid direct or airborne contact with grease or cooking oils.

Leak Detection Substances - Products such as dishwashing liquids with synthetic detergents along with odor emitting products such as colognes, perfumes or scented oils all must be avoided from contacting AquaRise due to their high content of solvents which are potentially harmful to AquaRise.

Proximity to Metal Piping - Some potential harmful effects to AquaRise from nearby installation of metallic piping include burning from contact with torches or molten material and solder flux, and incompatible thread sealants, residual oils, lubricants or leak detectors all of which may be commonly used on metal piping.

Paint - Only water-based latex paint may be used on AquaRise should the piping ever need to be painted. DO NOT USE oil-based paints with AquaRise.

Polyurethane Spray-On Foams - Some of these products have been tested to be compatible for direct contact with AquaRise piping. However, the manner in which they are applied is important. To minimize heat applied to AquaRise due to exothermic heat release by the foam, it is strongly recommended that foam be applied in a maximum layer thickness of 2 inches (50 mm) and that a time lapse of 10 minutes between application of layers is observed. Further information on these products may be obtained from the Spray Polyurethane Foam Alliance (SPFA).

If chemical compatibility with AquaRise is in question, IPEX recommends isolating the suspect product from contact with AquaRise pipe, valves or fittings.

Packing Oils and Pump Grease - Equipment containing packing oil and pump grease must be thoroughly flushed with water before connecting to an AquaRise piping system.

[1] The FBC System Compatible Program is published and updated by Lubrizol Advanced Materials, Inc.

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Always follow the complete AquaRise installation instructions provided in this manual. Failure to comply with handling, storage and installation instructions may cause piping system failure resulting in damage to property.

SAFE HANDLING AND STORAGE OF PIPE, FITTINGS & VALVES

Care must be taken when handling AquaRise products to ensure that pipe, fittings, valves and accessories are not damaged prior to installation. Take the following precautions to ensure AquaRise products remain in top condition prior to installation.

- Store pipe indoors if possible
- Pipe stored outside must be covered with a well-ventilated white tarp
- Always keep pipe clean and covered in its original packaging
- Always store pipe on a flat surface and never store other products on top of pipe
- Do not drop or drag pipe
- Always store fittings and valves indoors in original packaging or repackage to protect from damage, dirt and debris
- Inspect all AquaRise products prior to installation
- Never install AquaRise products that are damaged

SOLVENT WELDING

INTRODUCTION

Creating optimal solvent welded connections requires attention to detail, proper preparation of components and an understanding of all instructions provided in this manual.

SAFE HANDLING AND STORAGE OF PRIMERS AND SOLVENT CEMENTS

AquaRise primer and solvent cement are made from flammable liquids and must be kept away from all sources of ignition. Good ventilation must be maintained to reduce fire hazard and to minimize the breathing of solvent vapors. Refer to ASTM F402, Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings. Always adhere to local jobsite and workplace safety regulations. For additional safety information, consult the material safety data sheet for this product which is available at ipexaquarise.com.

- Always provide proper ventilation when applying primers and cements
- Avoid skin or eye contact with primers and cements
- Wash immediately if contact occurs to avoid prolonged exposure
- Do not solvent weld joints near open flames or soldering torches

WARNING

During the curing of the solvent welded joints, vapors may accumulate inside the piping system, especially should one end of the line be capped. Nearby sparks from welders or torches may inadvertently ignite these vapors and create a hazardous incident. Attention must be given to removing all vapors using air-blowers or water flushing prior to capping one end of an empty piping system.

- Use personal protection equipment (PPE) when handling primers and solvent cements
- Always store primer and cement indoors
- For cold weather installation store primer and cement in a warm location above 40°F (5°C)
- For hot weather installation store primer and cement in a cool, shaded location
- Always check bottom of primer and cement cans for date of manufacture and expiry date
- Never use solvent cement that is older than its recommended shelf life. Use before the expiry date or within 2 years of the manufacturing date stamped on the bottom of the can
- Never use primer that is older than its recommended shelf life. Use before the expiry date or within 3 years of the manufacturing date stamped on the bottom of the can
- Properly discard primer and cement that exceeds its recommended shelf life or expiry date
- Properly discard solvent cement that has hardened or jelled
- Tightly close partially used primer and cement containers

SOLVENT WELDING BASICS

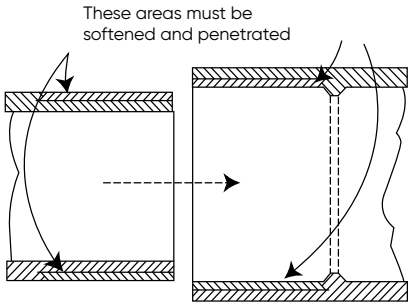
- Dry fit all joints prior to solvent welding to confirm proper interference fit
- Discard fitting joints without proper interference fit
- Do not solvent weld joints that are too loose or too tight
- Always use AquaRise beveling tools to prepare pipe ends before cementing
- Do not solvent weld joints without first beveling pipe ends
- Use only AquaRise primer and solvent cements in accordance with IPEX instructions
- Do not use other cements to connect AquaRise pipe, fittings and accessories
- Follow all solvent welding instructions provided with this product
- Follow all AquaRise installation instructions. Visit ipexaquarise.com for details

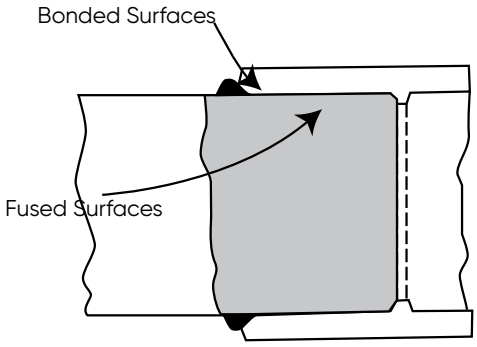
WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

NOTICE

Do not use excessive amounts of primer or solvent cement. Too much primer or solvent cement can lead to puddling in the pipe and fittings which can result in product failures and property damage. Always follow the instructions provided with each can of AquaRise primer and/or solvent cement.

Sufficient cement must be applied to fill the gap in the loose part of the joint. Besides filling the gap, adequate solvent cement layers will penetrate the surfaces and also remain wet until the joint is assembled. If the solvent cement coatings on the pipe and fittings are wet and fluid when assembly takes place, they will tend to flow together and become one solvent cement layer. Also, if the solvent cement is wet, the surfaces beneath them will still be soft, and these dissolved surfaces in the tight part of the joint will fuse together.





As the solvent dissipates, the solvent cement layer and the dissolved surfaces will dry and harden with a corresponding increase in joint strength. Completed joints must not be disturbed until they have properly set. See the Joint Set Schedule table on page 46 for details.

Joint strength continues to develop as the solvent cement dries. To determine when solvent cement joints can be pressure tested see the Joint Cure Schedule table on page 46.

Before beginning, assemble proper materials for the job (AquaRise One-Step Solvent Cement (1/2" – 2") / AquaRise Two-Step Solvent Cement and Primer (2-1/2" – 4"), appropriate applicator for the size of pipe and fittings to be assembled, tape measure, pencil and beveling tool).

Assemble proper Personal Protective Equipment (PPE) for the job (respirator, safety glasses, gloves and protective clothing).

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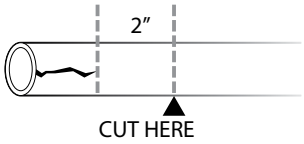
SOLVENT WELDING INSTRUCTIONS

1. CUTTING THE PIPE

It is important to cut the pipe squarely. A square cut provides the surface of the pipe with the maximum bonding area. Pipe can be easily cut with a wheel-type plastic tubing cutter, chop saw or fine toothed saw. Do not use reciprocating saws. Tools used to cut pipe must be designed for AquaRise piping and must be in good condition in accordance with the tool manufacturer's recommendations. If there is any indication of pipe damage or evidence of pipe end cracking, cut off at least 2 inches (50mm) beyond any visible crack.

Use of ratchet cutters is not recommended as they may split the pipe if not properly used and maintained.



2. PREPARING PIPE ENDS

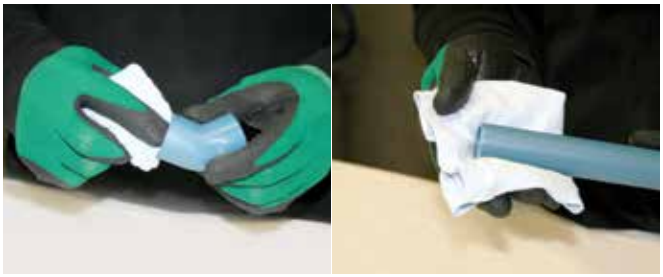
Always bevel pipe ends. Use the tools provided by IPEX which have been specifically designed for this purpose. Remove burrs and filings from the inside of the pipe using a knife edge or file.

AquaRise beveling tool 1/2" to 1" diameter

AquaRise beveling tool 1-1/4" to 4" diameter

3. CLEANING

Using a clean dry cloth, wipe any dirt and moisture from the fitting socket and the pipe end.



4. DRY-FITTING

Before applying primer or solvent cement, test all connections (pipe, fittings and accessories) to confirm a proper interference fit exists. Dry-fit contact between properly beveled pipe and fitting sockets is essential in making a good joint. The beveled pipe should easily enter the fitting socket and make contact with the inner fitting socket wall before bottoming out. A proper interference fit is present when the beveled pipe can only be inserted 1/3 to 2/3 of the way into the fitting socket.

Do not solvent weld pipe, fittings or accessories that fit loosely together or where pipe bottoms out. Proper joint strength cannot be developed.

Do not solvent weld pipe, fittings or accessories if a beveled pipe cannot easily be inserted at least 1/3 of the way into the fitting socket. This may cause excessive stresses during assembly leading to joint failure.

5. APPLICATOR SIZE

Use the applicators (daubers and swabs) provided with AquaRise solvent cements and in accordance with these instructions. Proper applicator size is critical to ensuring the correct amount of AquaRise primer and/or solvent cement is applied to the pipe, fittings and accessories.

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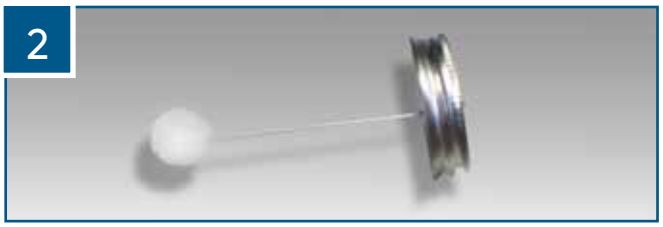
ONE-STEP SOLVENT WELDING PROCEDURE FOR 1/2" TO 2" DIAMETERS

IMPORTANT: For 1/2" to 2" diameters use only AquaRise One-Step (Yellow) solvent cement. Do not use primer with One-Step solvent cement.

1

■ MARKING THE CUT Measure the fitting socket depth and mark the outside of the pipe with this dimension followed by a second mark 1 inch further back. The first line will provide a guide for ensuring enough solvent cement is applied on the pipe. Maintaining a 1 inch distance to the second line once the pipe is inserted into the fitting socket will indicate full and proper insertion of the pipe inside the fitting socket.

2

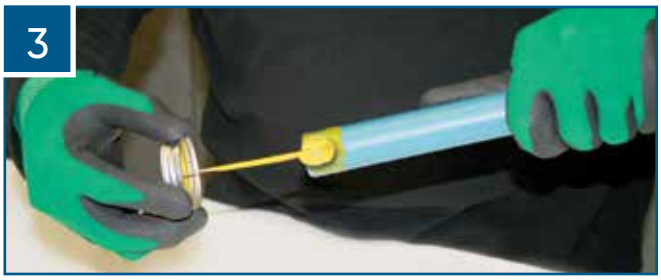


■ AquaRise One-Step cement comes with a small dauber inside the can. Use this small dauber for 1/2", 3/4" and 1" diameter joints. A larger dauber is also provided separately inside this carton. Use the larger dauber for 1-1/4", 1-1/2" and 2" diameter joints.

Do not use the larger dauber for 1/2", 3/4" and 1" joints. Joint failure can occur if excessive amounts of One-Step cement are applied. Do not permit One-Step cement to pool inside of fittings or accessories.

Do not use the small dauber on 1-1/4", 1-1/2" and 2" joints. Sufficient One-Step cement must be applied in a timely manner and kept wet prior to assembly of the joint.

3



■ Apply a medium layer of AquaRise One-Step solvent cement to the beveled pipe end. Apply enough cement to just cover the socket insertion mark on the outside of the pipe. Be aggressive and work One-Step cement onto the pipe surface. Apply enough solvent cement to fill the gap between the pipe and fitting to soften the surfaces.

4

■ Apply a thin, light layer of AquaRise One-Step solvent cement to the inside of the fitting socket and work this thin layer of One-Step cement into the wall of the fitting socket. For smaller diameters it may not be necessary to re-dip the dauber. A thin layer will prevent puddling of the One-Step solvent cement inside of the pipe or fitting. Excessive solvent cement applied to the fitting socket can cause the joint to clog and the wall of the pipe or fitting to weaken due to softening by the trapped solvents.

5

■ Without delay, while the One-Step solvent cement is still wet, assemble the pipe and fitting, and twist 1/8 to 1/4 turn as the pipe is being inserted. Once the pipe end has reached the bottom of the fitting socket, do not turn any further; doing so could break any fusion that is starting to occur.

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NOTES

6

■ Hold the pipe and fitting together for approximately 30 seconds to resist pushout due to tapered sockets. Higher potential for pushout exists in colder weather installations. If pushout does occur, the joint will need to be replaced.

7

■ A bead of One-Step solvent cement must be formed around the entire socket fitting entrance. With a clean, dry cloth remove the excess solvent cement from the surface of the pipe and fitting.

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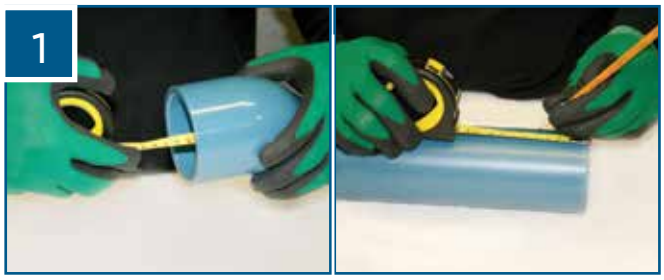
TWO-STEP SOLVENT WELDING PROCEDURE FOR 2-1/2" TO 4" DIAMETERS

IMPORTANT: For 2-1/2" to 4" diameters always use AquaRise (Clear) primer with AquaRise Two-Step (Yellow) solvent cement.

1



■ MARKING THE CUT Measure the fitting socket depth and mark the outside of the pipe with this dimension followed by a second mark 1 inch further back. The first line will provide a guide for ensuring enough solvent cement is applied on the pipe. Maintaining a 1 inch distance to the second line once the pipe is inserted into the fitting socket will indicate full and proper insertion of the pipe inside the fitting socket.

2

■ Apply AquaRise primer to the inside of the fitting socket. Use the dauber supplied in the can of primer.

3

■ Apply AquaRise primer to the pipe end, equal to the depth of the fitting socket. Be aggressive and work the primer into the pipe.

4

■ Apply AquaRise primer to the inside of the fitting socket again.

5

■ AquaRise Two-Step cement comes with a large dauber inside the can. Use the large dauber for 2-1/2" and 3" diameter joints. A Super Swab is also provided separately inside this carton. Use the Super Swab for 4" diameter joints.

Do not use the Super Swab for 2-1/2" and 3" joints. Joint failure can occur if excessive amounts of Two-Step cement are applied. Do not permit Two-Step cement to pool inside of fittings or accessories.

Do not use the large dauber on 4" joints. Sufficient Two-Step cement must be applied in a timely manner and kept wet prior to assembly of the joint.

6

■ While the primer is still wet and the surfaces are soft, use the appropriate dauber to apply a full, even layer of AquaRise Two-Step solvent cement to the pipe end, equal to the depth of the fitting socket. Like the primer, be aggressive and work the cement into the pipe. Remember to apply enough Two-Step solvent cement to fill the gap between the pipe and fitting.

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7

■ Apply a thin layer of AquaRise Two-Step solvent cement to the inside of the fitting socket. This will prevent puddling of the solvent cement inside of the pipe or fitting. Excessive solvent cement applied to the fitting socket can cause the joint to clog and the wall of the pipe or fitting to weaken due to softening by the trapped solvents.

8

■ Apply a second full, even layer of AquaRise Two-Step solvent cement to the pipe end. Excessive solvent cement on the pipe outer diameter (O.D.) can be wiped away after assembly.

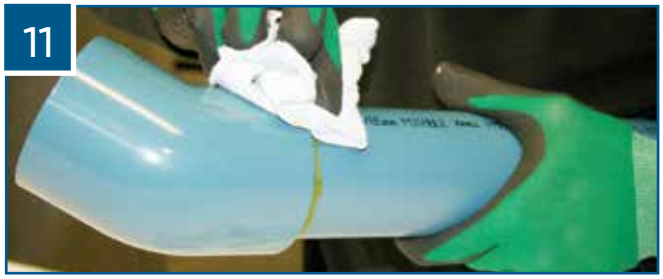
9

■ Without delay, while the solvent cement is still wet, assemble the pipe and fitting, and twist a 1/8 to 1/4 turn as the pipe is being inserted, if possible. Once the pipe end has reached the fitting socket stop, do not turn any further; doing so could break any fusion that is starting to occur.

10

■ Hold the pipe and fitting together for approximately 30 seconds to resist pushout due to tapered sockets. Higher potential for pushout exists in colder weather installations. If pushout does occur, the joint will need to be replaced.

11



■ A bead of solvent cement must be formed around the entire socket fitting entrance. With a clean, dry cloth, remove the excess solvent cement from the pipe and fitting socket entrance. This will allow the solvent to evaporate from within the joint.

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AVERAGE JOINT SET SCHEDULE FOR AQUARISE SOLVENT CEMENT**

Temperature Range	Pipe Sizes 1/2" to 1-1/4"	Pipe Sizes 1-1/2" to 2"	Pipe Sizes 2-1/2" to 4"
60° – 100 °F (15° – 38 °C)	2 minutes	5 minutes	30 minutes
40° – 60 °F (5° – 15 °C)	5 minutes	10 minutes	2 hours

Note: Initial set schedule is the necessary time to allow before the joint can be carefully handled.

** Due to the many variables in the field, these figures are to be used as a general guide only.

AVERAGE JOINT CURE SCHEDULE FOR AQUARISE SOLVENT CEMENT**[1]

Relative Humidity 60% or Less	Cure Time Pipe Sizes 1/2" to 1-1/4"		Cure Time Pipe Sizes 1-1/2" to 2"		Cure Time Pipe Sizes 2-1/2" to 4"	
Temperature Range during assembly and cure periods	Up to 160 psi	Above 160 psi	Up to 160 psi	Above 160 psi	Up to 160 psi	Above 160 psi
60° – 100 °F (15° – 38 °C)	15 min	6 hrs	30 min	12 hrs	1-1/2 hrs	24 hrs
40° – 60 °F (5° – 15 °C)	20 min	12 hrs	45 min	24 hrs	4 hrs	48 hrs

Note: Joint cure schedule is the necessary time to allow before pressurizing the system. In damp or humid weather allow 50% more cure time.

** Due to the many variables in the field, these figures are to be used as a general guide only.

[1] Pressure values shown in this table indicate the maximum test pressure of the piping system. The system should not be pressurized at all until this cure time has elapsed.

NOTICE

The values provided in these charts are for guidance only and do not necessarily reflect the actual return to service time required for every situation. Installers must allow for additional time where possible when returning AquaRise systems to hot water service.

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COLD WEATHER SOLVENT WELDING – BELOW 50°F (10°C)

- Do not solvent weld joints when pipe, fitting, valve or installation temperatures are less than 40°F (5°C)
- Prefabricate as much of the system as possible in a heated area
- Store AquaRise primer and solvent cement in a warm location above 40°F (5°C) when not in use and make certain cement remains fluid
- Take special care to remove moisture including snow and ice from the surfaces being joined including pipe ends and fitting and valve sockets
- Ensure that the pipe, fittings and valves are at the same temperature prior to solvent welding
- Ensure the surfaces are softened before joining. Check for proper softening of surfaces and correct amount of cement on a sample pipe. Surfaces are sufficiently softened when scraping a blade on the treated part results in the effortless removal of a thin layer of the base material
- Colder weather requires longer set and cure times. Refer to the Average Joint SET schedule and the Average Joint CURE schedule before moving or pressure testing joints. A heating blanket may be used to speed up the set and cure times

HOT WEATHER SOLVENT WELDING – ABOVE 86°F (30°C)

- Store AquaRise primer and solvent cement in a cool or shaded area prior to use
- Store pipe and fittings in a shaded area prior to solvent welding
- Cool surfaces to be joined with a clean, damp rag. Be sure the surface is dry prior to solvent welding
- Consider solvent welding joints in the cooler morning hours
- Make sure both surfaces to be joined are still wet with solvent cement when joining them together
- Vigorously stir or shake the AquaRise solvent cement before use

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Notes:

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SOLVENT WELDING BALL VALVES

Solvent weld AquaRise valves using the standard solvent welding procedure outlined in Section 3 of this manual. **To avoid damage to AquaRise valves, follow these important steps during installation:**

INSTALLING THE ONE-PIECE BALL VALVE

(a) Always ensure the valve handle is in the open position. Never install valves with the handle in the closed position as this exposes the ball to dirt, solvent cement, and possible damage.

(b) Always ensure AquaRise valves are properly supported during the solvent welding procedure. The weight of an unsupported valve may cause unwanted stress on new solvent cement joints.

(c) Solvent weld pipe to valve ends.

- IPEX recommends that the valve be solvent welded horizontally before installing the assembly in the final vertical or horizontal position to avoid solvent cement from contacting the ball and interfering with the valve function.

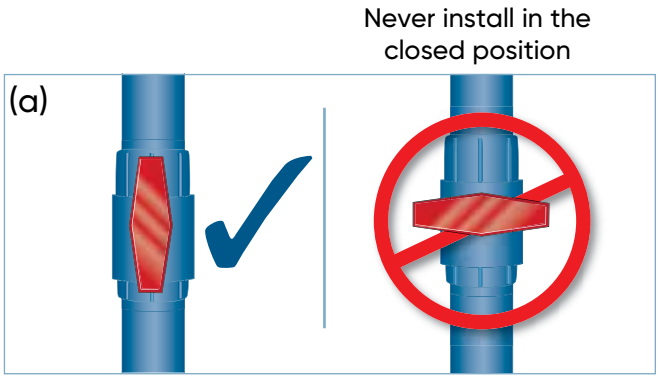
NOTE:

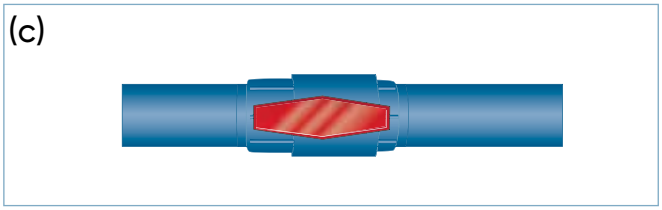
Solvent cement shall only be in contact with the fitting socket and pipe. DO NOT use excessive cement as it may puddle inside the valve and interfere with the sealing surface of the end connectors, the O-ring or ball inside the valve. Solvent cement will damage these components and prevent proper sealing. Discard any valve that has solvent cement on these components.

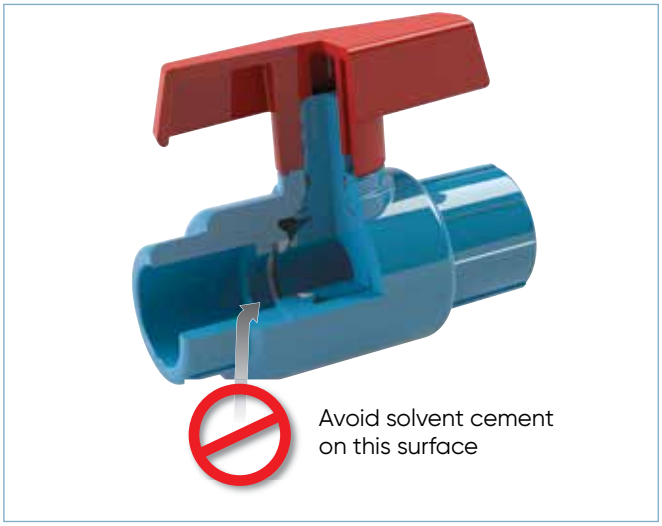
NOTE:

For vertical installations, take extra care not to use excessive solvent cement.

DISMANTLING: The One-Piece Ball Valve cannot be serviced, and must be replaced as required.







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INSTALLING 1/2" - 2" TRUE UNION BALL VALVES

(a) Always ensure the valve handle (6) is in the open position. Never install valves with the handle (6) in the closed position, as this exposes the ball (4) to dirt, solvent cement, and damage.

(b) Completely unscrew the union nuts (1) and end connectors.

(c) Slide union nut (1) onto end of pipe section.

(d) Always ensure AquaRise valves are properly supported during the solvent welding procedure. The weight of an unsupported valve may cause unwanted stress on new solvent cement joints.

(e) Solvent weld the end connectors (2) on the ends of the pipes.

- IPEX recommends that the (bidirectional) valve be solvent welded horizontally before installing the assembly in the final vertical or horizontal position. This will prevent solvent cement from contacting the ball (4) and interfering with the valve function.
- Solvent cement shall only be in contact with the inside socket of the end connector (2) and pipe. Never allow solvent cement to contact the sealing surface of the end connector (2) or the O-ring (8) on the valve end.

(f) Do not use excessive cement as it may puddle inside the valve and interfere with the sealing surface of the end connector (2), the O-ring (8), or the ball (4) inside the valve. Solvent cement will damage these components and prevent proper sealing. Discard any valve that has solvent cement on these components.

(g) Insert the body (3) between the end connectors (2) and if necessary, fix it with the anchoring system. Place the "adjust" end upstream with respect to the direction of flow.

(h) Tighten the downstream union nut. (1)

- Tighten the opposite union nut (1) (with the wording "adjust") until a complete seal is achieved. Hand tightening is typically sufficient to maintain a seal for the maximum working pressure. Over-tightening may damage the threads on the valve body (3) and/or the union nut (1), and may even cause the union nut (1) to crack.

DISMANTLING PROCEDURES:

- Put the valve in the closed position
- Completely loosen the union nuts (1)
- Remove the body (3) from between the union nuts (1)
- Remove the handle (6)
- Insert the lugs placed under the handle (6) in the corresponding notches of the ball seat support (5) and unscrew the ball seat support (5) by turning the handle (6) counter clockwise (Fig I-J)
- Take the ball (4) out
- Push down the stem (7) and remove from the body (3)
- Remove the PTFE seats (10) from the ball seat support (5) and from the body (3)
- If necessary, change the EPDM O-rings (8,9,11,12,13)
- Reassemble components in the reverse order that they were disassembled. Cycle the valve during the first test and tighten the union nuts (1) if necessary.

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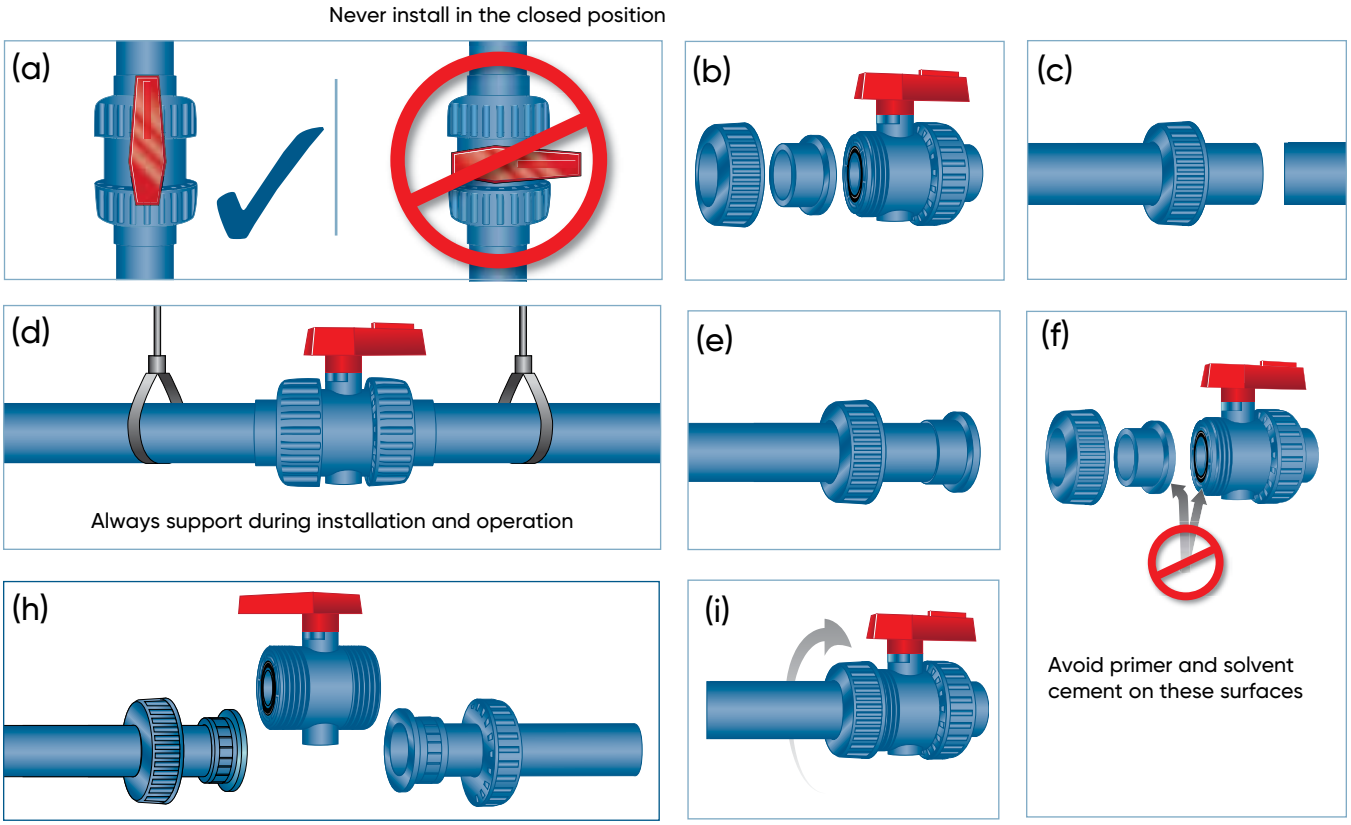

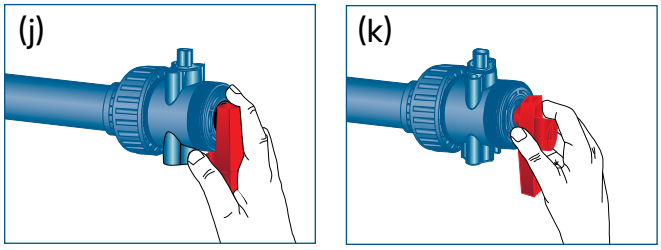

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INSTALLING 2-1/2" - 4" TRUE UNION BALL VALVES

(a) Always ensure the valve handle (2) is in the open position. Never install valves with the handle (2) in the closed position, as this exposes the ball (6) to dirt, solvent cement, and damage.

(b) Completely unscrew the union nuts (13) and remove the end connectors (12).

(c) Slide the union nuts (13) onto the end of the pipes.

(d) Always ensure AquaRise valves are properly supported during the solvent welding procedure. The weight of an unsupported valve may cause unwanted stress on new solvent welded joints.

(e) Solvent cement the end connectors (12) on the ends of the pipes.

- IPEX recommends that the (bidirectional) valve be solvent welded horizontally before installing the assembly in the final vertical or horizontal position. This will prevent solvent cement from contacting the ball (6) and interfering with the valve function.

(f) Primer and solvent cement shall only be in contact with the inside of the socket of the end connectors (12) and pipes. Never allow primer or solvent cement to contact the sealing surface of the end connectors (12) or the O-rings (10) on the valve ends.

- Do not use excessive primer or solvent cement as it may puddle inside the valve and interfere with the sealing surface of the end connector (12), the O-ring (10), or the ball (6) inside the valve. Solvent cement will damage these components and prevent proper sealing. Discard any valve that has solvent cement on these components.

(g) Insert the body (7) between the end connectors (12). Place the "adjust" end upstream with respect to the direction of flow.

(h) Screw on the union nuts (13).

(i) Remove the handle (2) by pressing the tabs on the central hub (15) and connect the tool (1) in the handle (2) to the handle (2) itself.

- Tighten the downstream union nut (13) using the tool (1) provided in the valve handle (2).
- Tighten the opposite union nut (13) using the tool (1) provided in the valve handle (2) (with the wording "adjust") until a complete seal is achieved. It is important to use the tool (1) provided in the valve handle (2) to tighten the union nuts (13). Using an improper tool can lead to over-tightening and damage to the threads on the valve body (7) and/or the union nut (13), and may even cause the union nuts (13) to crack.

(j) Reattach the tool (1) to the handle (2) and reattach the handle (2) back onto the valve.

DISMANTLING PROCEDURES:

Turn the valve handle to the closed position.

(k) Remove the handle (2) by pressing the tabs on the central hub (15).

(l) Completely loosen the union nuts (13) using the tool (1) provided in the valve handle (2).

- Remove the body (7) from between the union nuts (13).
- Insert the lugs placed under the handle (2) in the corresponding notches of the ball seat support (11) and unscrew the ball seat support (11) by turning the handle (2) counter clockwise.

(m) Take the ball (6) out and remove the PTFE seats (5) from the ball seat support (11) and from the body (7).

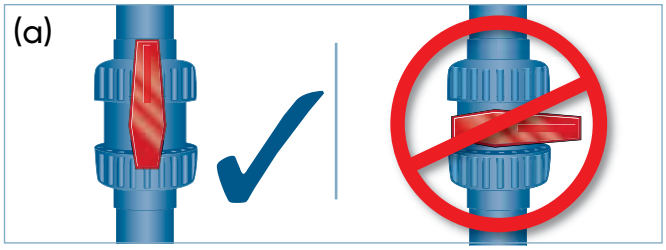
(n) Use the valve handle (2) to remove the central hub (15) from the valve stem (4).

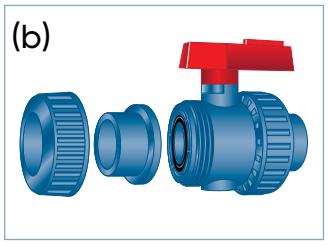
- Push down the stem (4) and remove from the body (7).
- If necessary, change the EPDM O-rings (3,8,9,10).

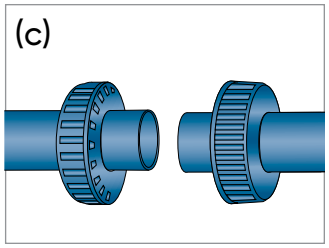
Follow the above steps in reverse to reassemble. Cycle the valve during the first test and tighten the union nuts (13) if necessary.

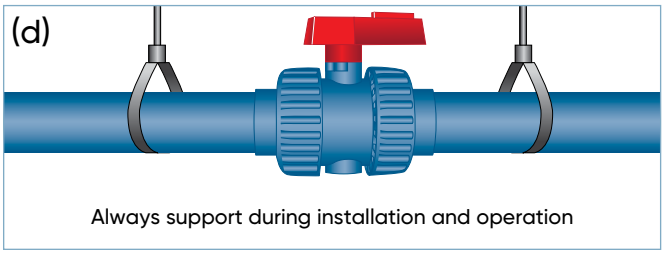
WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

Never install in the closed position

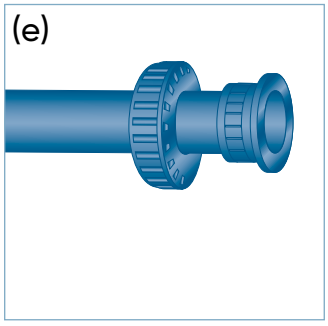


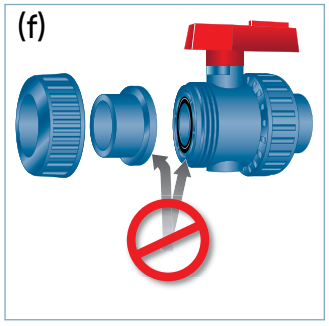


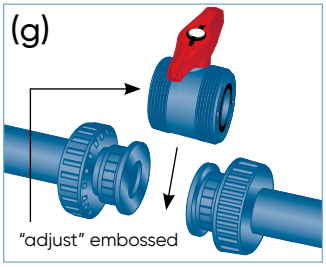


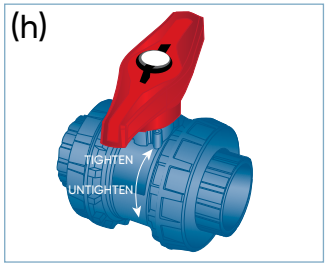


Always support during installation and operation

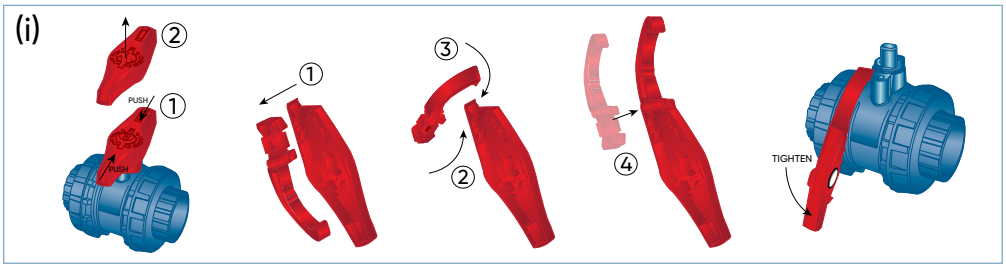


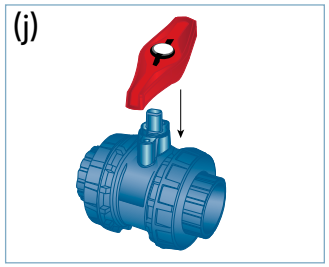


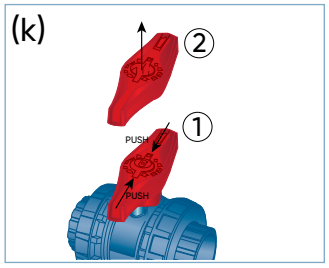


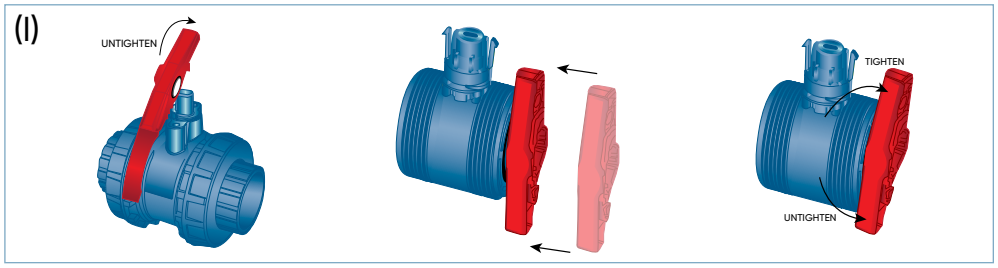


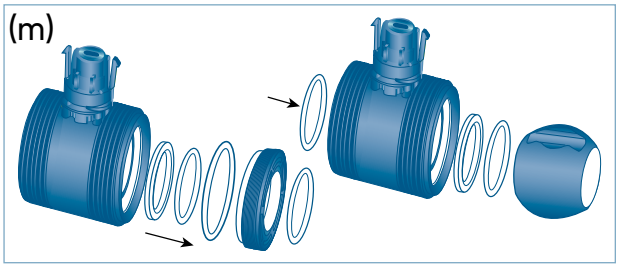
Avoid primer and solvent cement on these surfaces

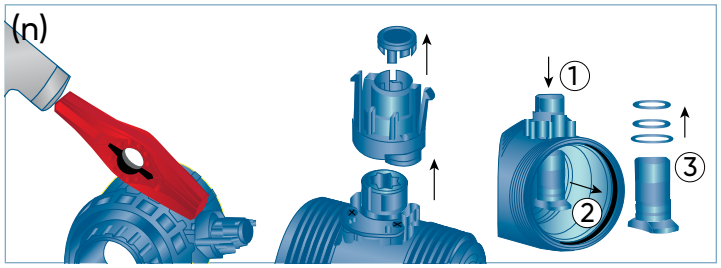












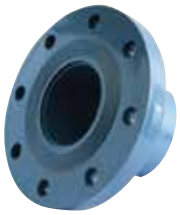
WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

FLANGE CONNECTIONS

Flanges are used where periodic dismantling is required and for convenient transition to metallic piping or components such as pumps and metal valves. AquaRise flanges have solvent cement socket ends and the same bolt hole dimensions as Class 150 metal flanges per ANSI B16.5. All flanges conform to ASTM F1970 and are made using AquaRise fitting compound which is listed to NSF Standard 61 for potable water.

Two types of AquaRise flanges are offered; solid (one-piece) flanges and Vanstone (two-piece) flanges which assist with bolt hole alignment. Both flange styles are pressure rated for 150 psi at 73°F (1,034 kPa at 23°C). When using these flanges at elevated temperatures, the allowable operating pressure is reduced according to the temperature derating chart on page 10.

Solid One-Piece Flange



Vanstone Flange

Flange gaskets must be installed between the AquaRise flange and its mating surface. These gaskets are not supplied by IPEX but they are readily available. Gaskets must be approved for potable water and must be chemically compatible with AquaRise. They must also be full-faced design and appropriately sized for the flange. Finally, flange gaskets must be made of an elastomeric material with a Durometer A hardness of 50 to 70.

Full-Pressure (FP) Flange kits are available to increase the operating pressure of solid AquaRise flanges to the same level of AquaRise SDR 11 pipe and fittings – 400 psi at 73°F (2,758 kPa at 23°C) and 150 psi at 160°F (1,034 kPa at 71°C). These kits consist of a solid flange, split metal backing ring, connecting hardware and a NSF-61 listed elastomeric gasket.

NOTE: FP flange kits are not compatible with two-piece Vanstone flanges.

NOTE: When used with SDR 21 pipe, the pressure rating of AquaRise FP flange kits is 200 psi at 73°F (1,379 kPa at 23°C).

Full Pressure (FP) Flange Kit

WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

FLANGE INSTALLATION GUIDELINES

SOLVENT WELDING FLANGES

In all cases, avoid excessive force on the solvent welded end of AquaRise flanges. Failure to properly support the flanged connection can lead to excessive stress and failure of the solvent weld flange connection.

If possible, complete the flange bolt connections first and ensure the bolts are fully tightened in accordance with the instructions outlined in this manual. Once this is completed and the flange is fully supported, the solvent weld connection can be performed on the socket end of the flange. Follow all solvent welding procedures in this manual. Ensure the solvent welded joint is fully cured before modifying the bolted flange connection or pressure testing the system. See the set and cure tables shown on page 46.

If the solvent welded connection of the flange must be completed first, ensure that the solvent welded joint is fully cured and properly supported before assembling the bolted portion of the flange. See the set and cure tables shown on page 46.

SOLID AND VANSTONE FLANGE CONNECTIONS

1. Make sure all bolt holes of the matching flanges are aligned.
2. Ensure a proper full-faced gasket is installed between the flange surfaces.
3. Make sure mating flange faces are in contact with each other prior to tightening bolts. Do not use bolt tightening to close gaps between flange faces as this can lead to excessive stress on the flange.
4. AquaRise Flanges can be installed against mating surfaces that include an integrated gasket, like wafer-style butterfly valves.
5. To assist with tightening, lubricate bolt threads with a lubricant fully compatible with AquaRise such as IPEX Ring-Tite pipe lubricant.
6. Always tighten nuts in incremental stages following the cross star bolt tightening sequence on page 52. Always use a torque wrench to ensure values in the Recommended Torque Table are not exceeded. Uniform stress across the flange will prevent leaks.
7. Always support the flange connection and accessory (pump, valve, etc.) to eliminate potential stress.

Solid and Vanstone Flanges – Bolt Dimensions

Pipe Size (in.)	# of Holes	Bolt Diameter (in.)	Bolt Length (in.)
1/2	4	0.50	1.75
3/4	4	0.50	2.00
1	4	0.50	2.00
1-1/4	4	0.50	2.25
1-1/2	4	0.50	2.50
2	4	0.63	2.75
2-1/2	4	0.63	3.00
3	4	0.63	3.00
4	8	0.63	3.25

Note: Bolt length will vary if metal backing rings are used.

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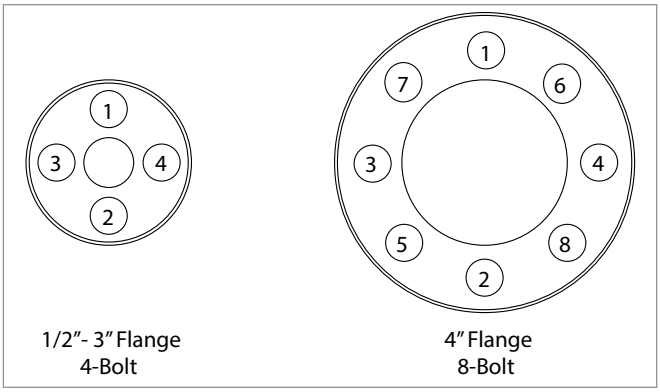
Solid and Vanstone Flanges – Maximum Bolt Torque Values

Flange Size	Recommended Maximum Torque	
(in.)	(ft.lb)	(Nm)
1/2 to 1-1/2	15	20.3
2 to 4	30	40.7

CROSS STAR BOLT TIGHTENING SEQUENCE



1/2"- 3" Flange
4-Bolt

4" Flange
8-Bolt

FULL PRESSURE (FP) FLANGE KIT INSTALLATION

This kit is for installation on solid AquaRise flanges only. Do not install this kit on Vanstone flanges. This kit must be installed using all the components supplied. Any substitution of components such as longer bolts or a replacement gasket must comply with the original kit specifications. Failure to comply with kit specifications nullifies the kit certification and may compromise the pressure rating and flange performance.

INSTALLATION PROCEDURE

1. First, follow all recommended procedures shown in the Solvent Welding Flanges section of this manual.
2. Begin kit installation by placing the backing ring over the back of the hub of the AquaRise flange, ensuring that the bolt holes are aligned.
3. Slip the gasket provided between the two flanges and bring the AquaRise and mating flanges together.
4. Align bolt holes of back up ring, flanges and gasket.
5. The bolt threads must be well lubricated with a lubricant fully compatible with AquaRise such as IPEX Ring-Tite pipe lubricant.
6. Install the provided flat washers beneath each nut and the bolt head.
7. Insert the bolts through the matching holes of both the flanges and backing ring. Use only the bolts supplied in this kit.
8. When the bolts are installed, hand-tighten bolts until flange faces are in light contact.
9. Using a torque wrench, placed over the nut (not on bolt head). Snug tighten the nut first, which is approximately 10-15 ft-lb of torque depending on size.
10. Tighten bolts in incremental steps to the torque values shown in the table below. During bolt tightening use the cross star sequence previously illustrated.
11. Bolts must be tightened with a torque wrench to the final recommended torque values specified in the table below.
12. Once this assembly is complete, perform a check pass of the bolts by starting at one and going around in a clockwise direction ensuring each nut is tightened to the highest recommended torque level for that size.

Incremental Torque Values

Size	Step 1		Step 2		Step 3		Step 4	
(in.)	(ft.lb)	(Nm)	(ft.lb)	(Nm)	(ft.lb)	(Nm)	(ft.lb)	(Nm)
2-1/2	20	27.1	40	54.2	70	94.9	–	
3	20	27.1	40	54.2	70	94.9	–	
4	20	27.1	40	54.2	80	108.5	110	149.1

Notes:

1. AquaRise FP Flange kits can be installed against mating surfaces that include an integrated gasket, like wafer-style butterfly valves. However, a metal "spacer" ring must be used between the valve and the Flange Kit. Longer bolts than those provided in the kit will be required.

   The bolt length will vary for flange size and assembly configuration. The length of bolts supplied in this kit assumes a connection to a metal flange. For AquaRise to AquaRise flange connections, bolts should be 1/2" longer so that the bolts extend approximately 1/4" minimum beyond the nut after final assembly.
2. This Flange assembly has been certified to ASTM F1970. As such, any components that are replaced must comply with the listing in order to maintain the certification.

   Replacement parts shall be: Stress-Saver XP gasket (70 Durometer Hardness), SAE J429 Grade 8 bolts with associated hex nut, two (2) flat washers per bolt.
3. Installers must use a torque wrench for proper assembly.

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CAUTION

1. Do not over-torque flange bolts
2. Use the proper bolt tightening sequence
3. Make sure the system is in proper alignment
4. Flange joints must not be used to draw piping assemblies together
5. Full face gaskets must be used
6. Flat washers must be used under every nut and bolt head
7. Gaskets must be approved for potable water and must be chemically compatible with AquaRise

NOTICE

Hot Water Flange Connections

For flange connections in hot water systems, FP Flange Kits are required when connecting to solid flanges. This provides a full pressure rating of 150 psi at 160°F (1,034 kPa at 71°C).

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THREADED ADAPTER FITTINGS

AquaRise threaded adapter fittings are offered in a range of fitting configurations from 1/2" through 2". Both male and female threaded adapter fittings utilize American National Standard Taper Pipe Threads (NPT) and allow for quick connection from AquaRise to alternative materials or metallic threaded accessories such as valves and pumps.

The strength of the high grade metallic alloy provides a robust thread design, while the material composition of the alloy provides resistance to dezincification and stress cracking caused by harsh water treatment chemicals such as chloramines.

The threaded adapter fittings will provide the following performance: 400 psi at 73°F (2,758 kPa at 23°C), 150 psi at 160°F (1,034 kPa at 71°C), and are listed to CSA B137.6 and ASTM F1970. These fittings carry a potable water listing as per NSF/ANSI 61 and are certified as lead free to NSF/ANSI 372.

INSTALLATION GUIDELINES

1. Begin by applying the PTFE (Teflon™) tape to the male threaded end of the joint. Wrap the tape around the entire thread length beginning with the number two thread from the end. The tape should slightly overlap itself going in the same direction as the threads to prevent the tape from unraveling when the male end is tightened into a female adapter. Overlapping in the wrong direction and/or the use of too much tape can affect tolerances between threads and generate undue stress in the wall of female fittings.

2. After applying the tape, the threaded joint should be started carefully and hand tightened. Fittings should be threaded together until hand-tight, followed by 1 to 2 turns with an appropriate wrench. Tighten the male adapter into the female adapter taking care not to cross-thread the fittings.

NOTICE

DO NOT overtighten the threaded joint.

NOTICE

When connecting to AquaRise threaded adapter fittings, use PTFE (Teflon™) tape only, with a minimum of two wraps as the thread sealant.

NOTICE

Use PTFE (Teflon™) tape with a minimum thickness of 2.5 mil.

NOTICE

Make certain no solvent cement, primer, or cleaner is on the threaded portion of the adapter fitting.

NOTICE

It is imperative that solvent welded connections for AquaRise threaded adapter fittings be given sufficient time to cure to withstand possible pulling and torsion forces.

NOTICE

Do not wrench or clamp the plastic portion of the adapter fitting. Use an 18" pipe wrench or smaller with sufficient clearance between the wrench and the plastic during installation.

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NOTICE

Threading or grooving of AquaRise pipe is not permitted.

CAUTION

Do not connect AquaRise products directly to a hot water heater or boiler. When AquaRise piping is connected to a gas-fired or electric water heater, use a metal nipple to ensure AquaRise piping is a minimum 12" away from the appliance.

NOTE: Verify Code requirements prior to installation.

CAUTION

AquaRise must be installed at least 6" away from any external heat source with a surface temperature greater than 160°F (71°C).

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PIPE SUPPORTS AND RESTRAINTS

As per the Expansion and Contraction Design section of this manual, a system may require hangers/supports, guides, and/or clamps. The devices used MUST:

- Have all residue oils wiped off with a clean, dry rag or cloth before contacting the AquaRise product
- Be free of rough or sharp edges which come in contact with the AquaRise System
- NOT be over tightened causing distortion of pipe or fittings
- NOT contain rubber or incompatible coatings with plasticizers that contact AquaRise products

NOTICE

Maximum support spacing recommendations should always be referenced against local Codes as well as the local Authority Having Jurisdiction.

HORIZONTAL PIPING

Horizontal runs of AquaRise pipe must be supported as per the hanger support spacing found in the table below. Piping must not be anchored tightly to supports, but rather secured with smooth straps or hangers that allow for movement caused by expansion and contraction.

Recommended Maximum Horizontal Support Spacing (ft.) for SDR 11 and SDR 21 Cold Water AquaRise Piping

Nominal Pipe Diameter (in)	Temperature (°F)						
	AquaRise SDR 11					AquaRise SDR 21	
	73°F	100°F	120°F	140°F	160°F	73°F	80°F
1/2	2.8	2.7	2.6	2.6	2.5	-	-
3/4	3.2	3.2	3.1	3.0	2.9	-	-
1	3.8	3.7	3.6	3.5	3.3	-	-
1-1/4	4.4	4.3	4.2	4.0	3.9	-	-
1-1/2	4.8	4.7	4.5	4.4	4.3	4.2	4.2
2	5.6	5.4	5.3	5.1	4.9	4.9	4.9
2-1/2	6.4	6.2	6.0	5.8	5.6	5.6	5.5
3	7.2	7.0	6.8	6.6	6.4	6.3	6.3
4	8.3	7.9	7.7	7.5	7.3	7.5	7.4

Recommended Maximum Horizontal Support Spacing (m) for SDR 11 and SDR 21 Cold Water AquaRise Piping

Nominal Pipe Diameter (in)	Temperature (°C)						
	AquaRise SDR 11					AquaRise SDR 21	
	23°C	38°C	49°C	60°C	71°C	23°C	27°C
1/2	0.85	0.82	0.79	0.79	0.76	-	-
3/4	0.98	0.98	0.94	0.91	0.88	-	-
1	1.16	1.13	1.10	1.07	1.01	-	-
1-1/4	1.34	1.31	1.28	1.22	1.19	-	-
1-1/2	1.46	1.43	1.37	1.34	1.31	1.28	1.28
2	1.71	1.65	1.62	1.55	1.49	1.49	1.49
2-1/2	1.95	1.89	1.83	1.77	1.71	1.71	1.68
3	2.19	2.13	2.07	2.01	1.95	1.92	1.92
4	2.53	2.41	2.35	2.29	2.23	2.29	2.26

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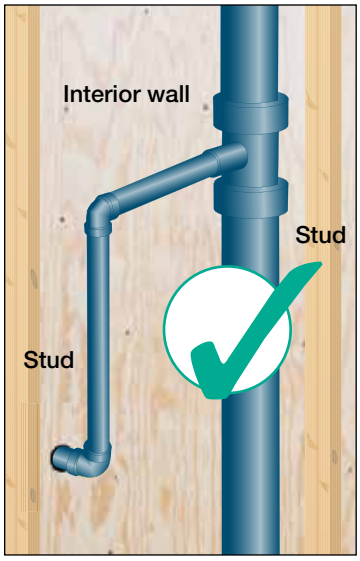
SUPPORTING HORIZONTAL TAKE-OFFS

Horizontal take-offs from the vertical riser should be supported independently, and placed as close to the riser support as possible. Utilize offset configurations with at least one change in direction on horizontal run tie-ins to the riser, which will minimize stress on the horizontal connection if movement of the riser occurs.

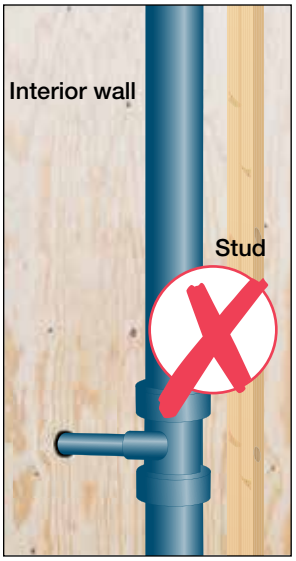
A straight horizontal run from the riser tee through the wall should not be used on AquaRise hot water lines.

ILLUSTRATIONS ARE REPRESENTATIVE EXAMPLES

(NOT TO SCALE)



Offset Configuration



Straight Horizontal run through a wall

NOTICE

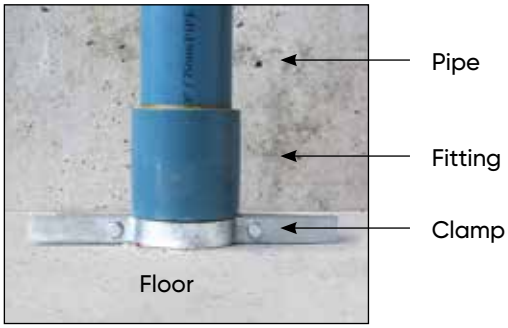
SUPPORTS AND GUIDES must be designed for CPVC piping; designed to withstand the forces generated by thermal expansion and contraction; designed to accommodate the pipe column weight; and must not compress, distort, cut or abrade the piping.

VERTICAL PIPING (RISERS)

Vertical piping shall be supported at its base, and at each floor or every ten feet, whichever is less (as per *International Plumbing Code - Section 308.5, Uniform Plumbing Code - Section 313.3, and CSA B137.6 - Section A.5.4.2).* Supports suitable for this purpose include riser clamps or double bolt type clamps. Supports shall be installed as per the instructions detailed below.

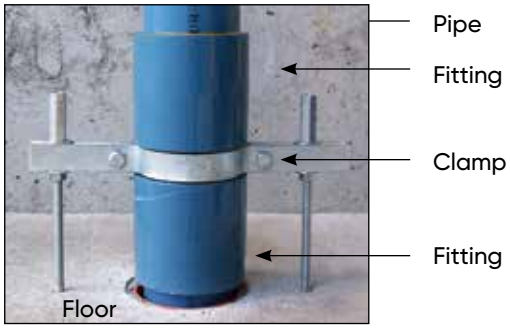
SUPPORTING AquaRise in a vertical application:

AquaRise vertical piping shall be supported by a combination of pipe clamps and fittings as per the diagram below. Pipe clamps shall be tightened to a friction fit directly below a fitting (tee or coupling). The fitting shall rest on the pipe clamp transferring the weight of the AquaRise system into the clamp. Do NOT over tighten the clamps compressing and distorting the pipe.



ANCHORING AquaRise in a vertical application:

Anchors in an AquaRise system are intended to prevent all movement at a particular point in the system. To achieve this, pipe clamps shall be tightened to a friction fit between two fittings as per the diagram below. The pipe clamp can then be anchored to the building. Do NOT over tighten the clamps compressing and distorting the pipe.



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THERMAL EXPANSION OF VERTICAL PIPING (RISERS)

The effects of thermal expansion on water filled vertical piping are typically minimized due to the weight of the water column, in combination with supports utilized at horizontal take-offs. The amount of thermal expansion of the vertical piping must be calculated based on the anticipated temperature change. Refer to the EXPANSION AND CONTRACTION DESIGN section in this manual for further information on calculating thermal expansion.

Vertical piping and horizontal take-offs must be properly supported, as specified by the design engineer, to allow for thermal expansion and contraction movement of the piping. Acceptable methods for accommodating expansion and contraction can be found in the EXPANSION AND CONTRACTION DESIGN section in this manual.

MID-STORY GUIDES

Vertical piping shall have a mid-story guide firmly attached to the structure to prevent lateral movement, while still allowing longitudinal movement of the piping.

SYSTEM ACCEPTANCE (HYDROSTATIC PRESSURE) TEST

After the AquaRise system has been installed, it is important to test and inspect it for joint integrity. Leave all concealed pipe and fittings uncovered until the required test is completed and approved by the local Authority Having Jurisdiction.

Generally, a test pressure of 1.5 times the system working pressure for the pipe installed is adequate to a maximum test pressure of 150 psi (1,034 kPa). It is recommended that hydrostatic testing be carried out before commissioning the line into usage. The following hydrostatic test procedure should be followed after all the solvent welded joints, in the section to be tested, have been allowed to cure fully (see page 46 for Average Joint Cure Schedule).

Pressure testing with compressed air is strictly prohibited with AquaRise.

Prior to testing, precautions must be taken to protect personnel and property in case of test failure.

HYDROSTATIC TEST PROCEDURE

1. Where possible, visually inspect the installed piping for evidence of physical damage or deficiencies.
2. Slowly fill the pipe section with water, preferably at a velocity of 1.0 ft/s or less. Any entrapped air must be evacuated by venting from the high points. Do not pressurize at this stage.
3. Leave the section for at least 1 hour to allow equilibrium temperature to be achieved.
4. Check the system for leaks. If clear, check for and remove any remaining air and increase pressure up to 50 psi (345 kPa). Do not pressurize further at this stage.
5. Leave the section pressurized for 10 minutes. If the pressure drops, inspect for leaks. If the pressure remains constant, slowly increase the hydrostatic pressure to 1.5 times the system working pressure but do not exceed the maximum working pressure of any system components.
6. Leave the section pressurized for a period not exceeding 1 hour. During this time, the pressure should not change if the test is successful. If there is a significant drop in static pressure or extended times are required to achieve pressure, either joint leakage has occurred or air remains in the line. Inspect for leakage and if none is apparent, reduce the pressure and check for trapped air. All air must be removed before further testing.
7. Any joint leaks should be repaired and allowed to cure fully before re-pressurizing and testing. For more details, refer to the Joint Set and Cure schedules on page 46.

WARNING

- **NEVER** use compressed air or gas in AquaRise pipe, fittings and valves.
- **NEVER** use or test AquaRise with compressed air or other gases. Do not use air-over-water boosters.

Use of compressed air or gas in AquaRise pipe, fittings, and valves can result in explosive failures and cause severe injury or death.

NOTICE

Do not exceed the maximum working pressure of any system components including pipe, fittings, valves, threaded adapters, unions, maintenance couplings or flanges.

- The pressure rating of all components must be reduced at temperatures above 73°F (23°C). Refer to de-rating chart on page 7.
- Exceeding the maximum working temperature or pressure of the system may result in system failure and/or property damage.

GENERAL MAINTENANCE

Building maintenance staff and or Plumbing/HVAC maintenance staff should perform routine inspection of piping systems within the building. For AquaRise, ensure that system operating conditions do not exceed the maximum allowable operating temperature and pressure ratings for the AquaRise system. Make system adjustments as needed and contact IPEX for further assistance if operating conditions exceed AquaRise limitations.

Ensure that no materials or chemicals that may be incompatible with AquaRise have come into contact with the AquaRise system. For additional information contact IPEX for further assistance.

Ensure that no other piping systems, accessories or elements of the building are hung from the AquaRise piping system. All other systems, accessories and building materials must be properly anchored and supported in accordance with local Plumbing and Building Codes.

Ensure that no electrical wires or data cabling are wrapped around or in contact with AquaRise pipe and fittings. The plasticizers contained in the plastic jackets of these wires and cables may not be compatible with AquaRise. Remove any wires that are in contact with AquaRise and contact IPEX for further assistance.

Ensure that AquaRise pipe maintains straight alignment and do not bend or snake after the piping system is commissioned. This movement after installation signifies that expansion and contraction forces may not be properly accounted for in the piping system. This movement can cause excessive stresses on solvent welded joints, flange connections, pipes, fittings and lateral branch lines. Contact IPEX for recommendations and assistance if this misalignment is observed.

AGING OF TEMPRITE® TECHNOLOGY

Like all materials, TempRite® Technology ages during its operating life. TempRite® Technology aging can result in changes to physical characteristics such as increased brittleness and the reduction in impact resistance. This can be caused by prolonged elevated operating temperatures or prolonged exposure to UV light. As a result, avoid any forcible contact or impact with the piping system to reduce the chance of cracks or fractures occurring.

SYSTEM REPAIR

Inspect pipes for any damage such as cracking and deep gouges. Locate the end of any pipe cracks and be sure to cut at least 2" beyond the crack line to ensure it is removed.

Carefully inspect any fittings for damage and remove and replace them accordingly.

Additional precautions must be taken when modifying or repairing aged products made with TempRite® Technology as they may be subject to a reduction in impact resistance (increased brittleness) making them more prone to cracking.

CAUTION

When modifying or repairing aged CPVC pipe use only wheel cutters or fine tooth saws that are new and sharp. Do Not use ratchet style cutters.

Repairs can be made by solvent welding new sections of pipe and fittings. However, installation conditions during a repair vary greatly when compared to a new installation. Repairs or cut-ins to an existing system are typically done in confined spaces, on closed end piping systems, and often have more humidity present. All of these factors can inhibit the evaporation of the solvent leading to increased set and cure times. As such, IPEX recommends that the standard set and cure times be increased by 50% for repairs or cut-ins. Refer to set and cure tables on page 46.

When a repair cannot be scheduled or delayed, Maintenance Couplings in conjunction with pre-solvent welded assemblies can get a system back to service in a shorter time.

NOTICE

Removal of threaded connections:
Use a rubber strap wrench to grip the stationary fitting while backing out the threaded component.
Failure to do so will put torque stresses on the pipe and may damage the piping system.

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MAINTENANCE COUPLINGS

The AquaRise Maintenance Coupling is designed specifically for AquaRise pipe. It is NSF 61 listed for potable water and offers full pressure ratings of 400 psi at 73°F (2,758 kPa at 23°C) and 150 psi at 160°F (1,034 kPa at 71°C). The couplings have been tested to ensure reliable long-term performance in hot and cold potable water applications.

The metallic components of the coupling are made with 304 stainless steel. Its steel gripping ring is designed to provide pull-out resistance for AquaRise pipe by providing a low profile, extra wide gripping surface with three rows of gripping teeth. The EPDM sealing gasket is PTFE coated for resistance to aggressive water and potable water treatment chemicals.

The mechanical joint end connections and rubber-lined stainless steel construction provide a fast 'pipe to pipe' alternative connection for AquaRise. They are ideal for quick repairs of AquaRise pipe in need of maintenance without possible delays due to necessary cure times associated with solvent welding. The couplings also permit easier tie-ins to existing AquaRise systems when used with pre-welded pipe-end assemblies.

System changes can be planned in advance with pre-assembly of solvent welded sections done off-site. These new sections can then be quickly and simply connected to the existing AquaRise piping system using AquaRise Maintenance Couplings.

NOTICE

Maintenance Couplings are suitable for pipe to pipe connections only and not suitable for use with any spigot ends of molded fittings.

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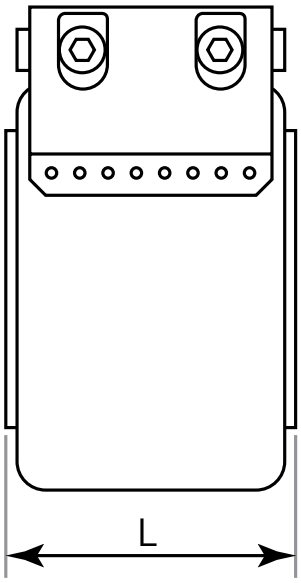
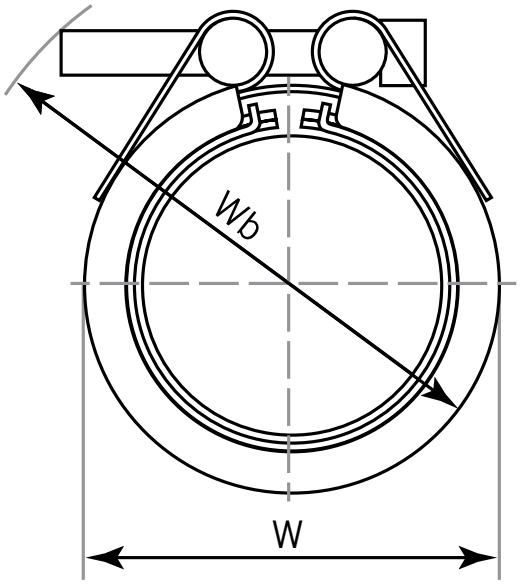
Dimensions: Maintenance Couplings

Nominal Diameter	Length, L		Body Width, W		Overall Width including Bolt, Wb		Torque Wrench Allen Socket Size	Insertion Depth, C	
inches	inches	mm	inches	mm	inches	mm	mm	inches	mm
1	1.81	46	2.05	52	2.95	75	6	0.81	20.5
1-1/4	2.40	61	2.44	62	3.54	90	6	1.10	28
1-1/2	2.40	61	2.68	68	3.74	95	6	1.10	28
2	3.03	77	3.23	82	4.33	110	6	1.42	36
2-1/2	3.70	94	3.94	100	5.12	130	8	1.65	42
3	3.70	94	4.61	117	5.71	145	8	1.65	42
4	3.70	94	5.47	139	6.50	165	8	1.65	42

Note: Torque wrench kits are available through IPEX; tighten locking bolts to the final prescribed torque shown on the coupling label.





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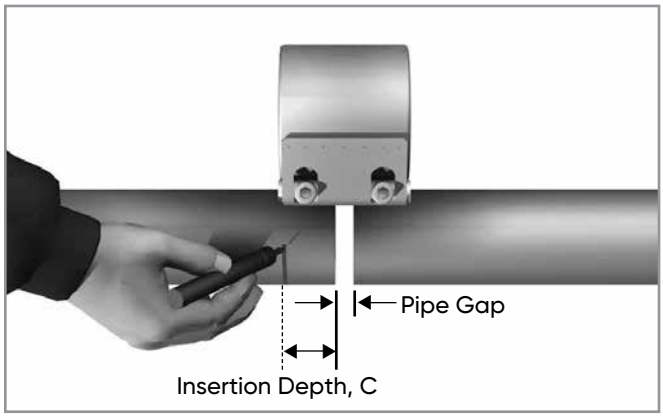
STEP 1: PREPARE AQUARISE PIPE

- Cut pipe squarely
- Remove all sharp edges and burrs on the inner and outer edges of the pipe end with sandpaper
- Clean the pipe surface of all impurities and dirt
- Pipe ends must be clean and free of dirt to ensure a proper seal

STEP 2: PROPERLY FIT THE COUPLING



Pipe	Pipe Gap	
1" – 2"	0.2"	5 mm
2-1/2" – 4"	0.4"	10 mm

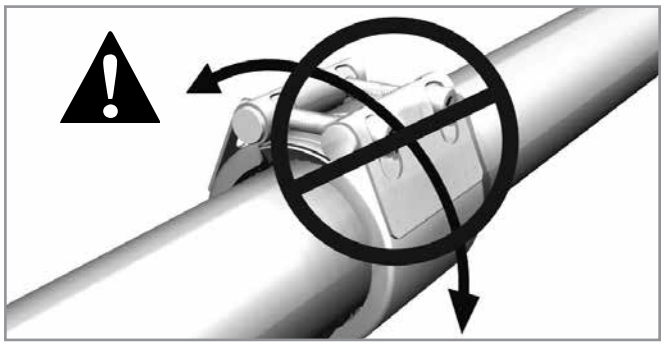
- Ensure proper gap between pipe ends. See chart below for details
- Centre coupling over the gap between pipe ends
- Mark each pipe end to indicate the outer edge of the coupling

STEP 3: INSTALL THE COUPLING

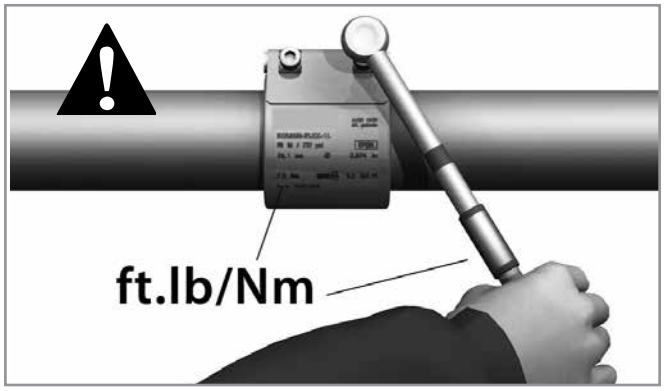
- Fit the coupling over the pipe ends
- Ensure coupling is aligned with marks on pipe ends

STEP 4: TIGHTEN LOCKING BOLTS

- Using a torque wrench, tighten locking bolts lightly and alternately
- Ensure torque wrench is set to the proper torque level shown on the coupling label
- Do not rotate coupling on the pipe joint once teeth are engaged



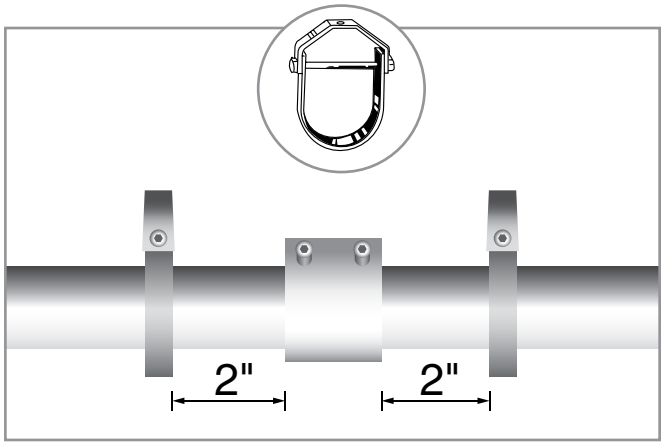
- Tighten locking bolts with a torque wrench to the final prescribed torque shown on the coupling label



- Ensure the prescribed bolt torque is achieved (printed on the coupling)
- Never exceed the prescribed bolt torque

STEP 5: SUPPORT COUPLINGS

- Always maintain straight alignment of pipe and coupling
- For horizontal installations install recommended pipe supports 2" beyond each side of coupling



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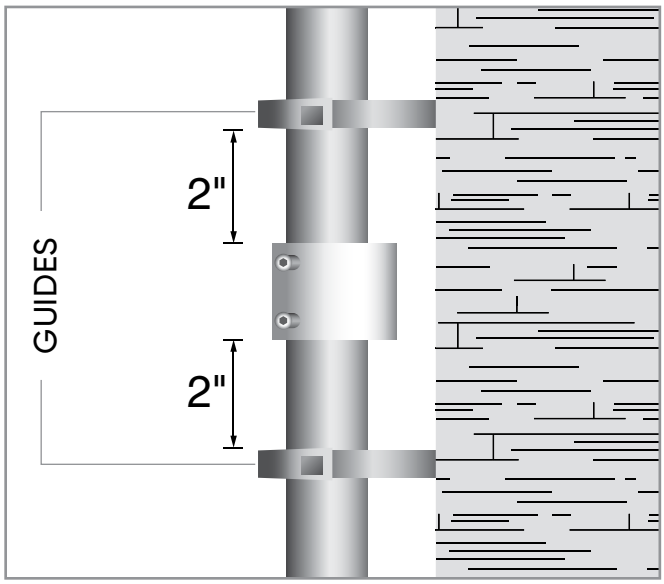
• For vertical installations install recommended guides 2" above and below coupling



MAXIMUM OPERATING PRESSURE

400 psi at 73°F (2,758 kPa at 23°C)
150 psi at 160°F (1,034 kPa at 71°C)

CAUTION

Always operate within the allowable pressures and temperatures shown in the chart below.

Pressure surges must not exceed the maximum operating pressure

REQUIRED MAINTENANCE

AquaRise Maintenance Couplings are maintenance-free. Never re-tighten bolts.

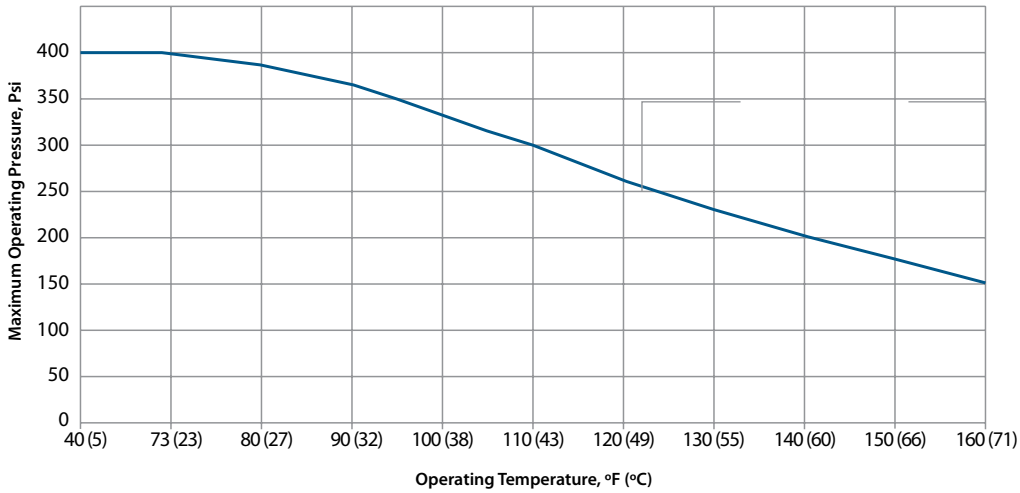
OPERATING LIMITATIONS

- For use on AquaRise pipe to pipe connections only
- Always operate within the allowable pressures and temperatures
- Coupling not intended to account for misalignment or change in direction

FAILURE PREVENTION

- Follow all installation instructions provided with the couplings
- Couplings must be tightened to the specified torque values as printed on each coupling
- Failure to follow all instructions can result in leakage, property damage or injury

Maximum Operating Pressure vs. Temperature



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NOTICE

SAFETY MEASURES BEFORE REMOVING THE MAINTENANCE COUPLING

- Ensure system is not pressurized
- Drain piping system
- Protect yourself and surroundings against spilling water
- Make sure the maintenance coupling is not supporting the pipe ends

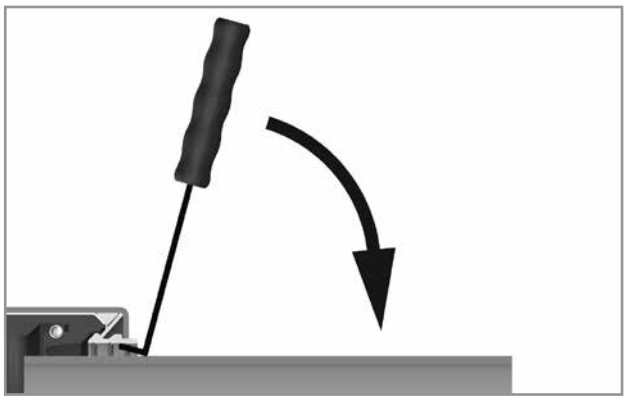
CAUTION

DO NOT HARM RUBBER SEALING SURFACE

- Turn and move coupling smoothly
- Slide coupling beyond pipe joint
- Check rubber seal for any signs of damage
- Clean pipe joint
- Replace damaged coupling with a new coupling
- Reassemble according to instructions

DISASSEMBLY

- Loosen bolts alternately but do not remove completely
- Do not rotate pipe joint on pipe as long as teeth are engaged
- If necessary, loosen teeth engagement.
- Insert tool underneath casing and lift.



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GENERAL REQUIREMENTS

(a) AquaRise is a thermoplastic piping system to be used in hot or cold potable water distribution systems only.

(b) AquaRise SDR 11 systems shall not exceed 160°F (71°C). Cold water systems using AquaRise SDR 21 pipe shall not exceed 80°F (27°C).

AquaRise SDR 21 pipe shall be used in cold water systems only, not exceeding 80°F (27°C)

(c) Installation practices shall conform to manufacturers' guidelines.

(d) Installers shall consult with IPEX to resolve any uncertainties before proceeding with installation.

(e) Pipe, One-Piece ball valves and molded fittings (couplings, tees, elbows, bushings and caps) are third-party certified to CSA B137.6, made to Iron Pipe Size (IPS) Outside Diameter with a wall thickness of SDR 11 (Standard Dimension Ratio).

(f) Cold water pressure rating of SDR 11 pipe and fittings with only solvent welded joints, One-Piece Ball Valves, Threaded Adapter Fittings, Full Pressure Flange Kits and Maintenance Couplings shall be 400 psi at 73°F (2,758 kPa at 23°C).

Cold water pressure rating of SDR 21 pipe and fittings with only solvent welded joints, threaded adapter fittings, full pressure flange kits and maintenance couplings shall be 200 psi at 73°F (1,379 kPa at 23°C).

(g) AquaRise True Union Ball Valves in nominal sizes 1/2" through 4" are rated to 232 psi at 73°F (1,600 kPa at 23°C).

(h) AquaRise Flanges and unions are rated to 150 psi at 73°F (1,034 kPa at 23°C).

(i) All of the above pressure ratings shall be reduced at elevated temperatures.

(j) All solvent weld joints shall be made in nominal pipe sizes 1/2" through 2" using AquaRise One-Step Cement. For sizes 2-1/2" through 4", AquaRise Two-Step Cement shall be used in conjunction with AquaRise Primer. Specific usage instructions can be found in this manual and on the container labels. No alternatives shall be accepted.

BUILDING CODE REQUIREMENTS

(a) AquaRise pipe and fittings shall be listed to ULC S102.2 to exhibit a Flame Spread Rating (FSR) of not greater than 25 and a Smoke Developed Classification (SDC) of not greater than 50.

(b) The above listing shall be achieved without the use of external pipe insulation or filling of the line with water during testing.

(c) All penetrations of fire-rated separations (i.e. ceilings and wall) shall be sealed with a fire stop device or system which has been listed for use with AquaRise for the specific substrate being penetrated. Fire stop listings shall be tested in accordance with ULC S115 and shall include a 50 Pa pressure differential in the test assembly where required by local building codes.

(d) Refer to local building code requirements and the local Authority Having Jurisdiction for the suitability of AquaRise within Vertical Service Spaces.

(e) AquaRise may be used in all areas of buildings classified as Combustible Construction and in most areas of Noncombustible Buildings including Plenums(Sec. 3.6.4.3) and in High Building Construction (Sec. 3.2.6).

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SECTION 6: AQUARISE® SPECIFIC TERMS AND CONDITIONS OF SALE AND LIMITED WARRANTY AND LIMITATION OF LIABILITY

1. Scope

All sales of AquaRise® products are subject to these product-specific terms and conditions ("Specific T&C's"), as posted on the Vendor's website at the time of sale. Purchaser's order is accepted subject to these Specific T&C's and to any terms and conditions agreed to in writing by the Vendor and Purchaser. It is expressly agreed that any terms and conditions contained in the Purchaser's order or otherwise stipulated will be deemed for the Purchaser's internal use only and will not be binding on the Vendor.

2. Orders

Purchaser's orders are conditional upon satisfactory credit approval by the Vendor. The Vendor will only accept orders in excess of $100 before taxes or such greater amount as may be specified for certain products. Once confirmed by the Vendor, orders for custom-made products manufactured to the Purchaser's specifications and orders for large quantities of non-inventoried products cannot be canceled, modified or returned, except with the Vendor's written consent and upon terms which provide for indemnification of the Vendor for the costs and expenses incurred.

3. Shipments

Delivery schedules stipulated in either the quotation ("Quotation") or the order confirmation ("Order Confirmation") are approximate only and shipment will be made within reasonable proximity thereto. Under no circumstances will the Vendor be responsible for any damage whatsoever caused by delays in shipment, whether resulting from causes within or beyond the control of the Vendor. All shipments are F.O.B. the Vendor's location per the American standard sales terminology or Ex Works per the Incoterms international rules applied to foreign trade contracts. The Vendor shall bear no liability for Products lost or damaged during transit. The Vendor may agree to different shipment terms as specified in the Quotation or in the Order Confirmation. Freight prepaid orders, when applicable, will be delivered by the carrier of the Vendor's selection, unless the use of other carriers is agreed to in writing with the Purchaser. Purchaser must verify quantities and report discrepancies within 2 business days of receipt.

4. Prices

All prices quoted or published are F.O.B. the Vendor's location or Ex Works. Published prices are subject to change without notice until orders are accepted by the issuance of an Order Confirmation, whereupon prices will remain firm for those shipments that take place within the 30-day period following the date of the Order Confirmation. For specific projects, contracts or Quotations, the Vendor may agree in writing to protect prices for an extended period of time. Each order may be shipped in whole or in part at the Vendor's discretion. Each shipment made will be immediately invoiced. Quoted or published prices do not include any sales, use, excise or any other tax or levy imposed by any present or future law, regulation or other order, on any of the Products. The Purchaser must provide the Vendor with tax exemption certificates or other documents, as required by the specific tax jurisdiction, in order not to be charged for any of the applicable taxes.

5. Terms of Payment

Unless other terms of payment are agreed to in writing by the Vendor, payment is due upon delivery of the Products. If applicable, cash discounts, expressed as a percentage, are calculated on the net invoiced prices before any taxes, freight or other charges and can only be deducted from payment if the Vendor receives payment from Purchaser on or prior to the due date. Net 30 days means that payment is due within 30 days of the date of invoice and no cash discount is applicable. Overdue accounts shall bear interest at a rate of 18% per annum. The granting of credit by the Vendor is at all times based on its evaluation of the Purchaser's financial condition. If such financial condition does not justify continuance of shipment on credit, the Vendor may require full or partial payment in advance.

6. Title to the Goods Sold

The Purchaser acknowledges and agrees that so long as the Products are in Vendor's possession, title to the Products shall remain with the Vendor until full payment therefore is received by the Vendor. The Purchaser agrees to defend, indemnify and save the Vendor harmless from any and all costs, expenses and damages arising out of any claims asserted against the Vendor pursuant to the exercise of its ownership rights or any recourse in payment of purchase price.

7. Return of Products

The Vendor may accept the return of Products, subject to the following: a) prior to returning any Products, the Purchaser must obtain a Return Material Authorization (RMA) number from the Vendor, b) Products must be returned freight prepaid, unless otherwise authorized by the Vendor and c) Products must be received in good saleable condition and, if required, in full carton quantities and in their original packaging. A minimum return charge of 25% of the purchase price will be applied against any credit issued pursuant to the return of Products, except in the case of a Vendor shipping error. The Vendor may apply additional charges against the credit to cover remarketing costs or may refuse to issue any credit, but will advise the Purchaser accordingly. Certain Products, such as pressure pipe, custom-made configurations, obsolete products, excessive quantities or other specialty products cannot be returned. The Vendor may direct that Products be destroyed for credit rather than returned.

8. Changes to Products

The Vendor reserves the right to make changes or improvements to its Products without assuming any further obligation.

9. Patent Rights

If any claim is made against the Purchaser based on the allegation that any of the Products sold by the Vendor constitute an infringement of any U.S. or Canadian patent, the Purchaser shall notify the Vendor immediately. The Vendor shall have the right, at its own option and expenses, to take any actions to protect and defend its rights.

10. Force Majeure

The Vendor shall in no event be responsible or liable for any non-performance or delay in performance hereunder or any loss or damage of any kind or nature whatsoever, direct or indirect, suffered by the Purchaser, subsequent purchasers, ultimate users of the goods or any other person, as a result of any causes beyond the reasonable control of the Vendor including, without limitation, price alterations, delay in shipments, strikes, lock-outs, fires, floods, civil commotion, riots, wars, acts of God, embargoes, labor shortages, walk-outs, work slowdowns, accidents, breakdowns, delays in manufacture, transportation or delivery of goods or materials, shortages of materials or supplies, government acts or regulations or licensing action.

11. Governing Law

This agreement and all rights and obligations hereunder shall be governed by the laws of the province of Ontario.

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12. Non-waiver

No delay, failure, change or waiver by the Vendor to exercise any one or more of these terms and conditions of sale shall be construed or shall operate to be a waiver thereof or a continuing waiver of such terms and conditions.

13. Warranty and Limitation of Liability

13.1 The Vendor warrants that its AquaRise products are, at the time of their sale by Vendor, free from defects resulting from Vendor's faulty manufacturing.

13.2 THERE IS NO WARRANTY, CONDITION OR REPRESENTATION OF ANY NATURE WHATSOEVER, EXPRESSED OR IMPLIED, BY STATUTE OR OTHERWISE, EXCEPT AS HEREIN CONTAINED. ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS OF THE PRODUCTS FOR A SPECIAL PURPOSE AND ANY OTHER WARRANTY OF QUALITY ARE EXPRESSLY DISCLAIMED.

13.3 The Vendor will replace, free of charge, including shipping charges at the original point of delivery, any Product which is found to breach this limited warranty. Any such defective Product will be replaced with a Product of the same type and size as the defective Product.

13.4 THIS LIMITED WARRANTY IS VALID ONLY FOR THE PERIOD OF 10 YEARS FROM THE DATE OF THE SALE OF THE PRODUCT ALLEGED TO BE DEFECTIVE BY VENDOR AND WILL ONLY APPLY IF ALL OF THE FOLLOWING CONDITIONS ARE MET:

13.4.1 The Product must have been used only in applications and under conditions (handling, installation, testing, use, water temperature, maintenance, repairs, etc.) that are strictly in compliance with the AquaRise Technical Manual currently available from the Vendor at the time of installation. The AquaRise system has specifically designed pipe, fittings, valves and sealants and is designed for operation using only genuine AquaRise products. The use of any non-AquaRise CPVC components within an AquaRise system is prohibited, voiding the warranty for the affected system, unless approved by IPEX in writing prior to installation.

13.4.2 The defect must not be due to faulty installation, misalignment of Products, vibration, ordinary wear and tear, corrosion, erosion, U.V. degradation, incompatible lubricants, pastes and thread sealants, unusual pressure surges or pulsation, water hammer, temperature shocking, or fouling.

13.4.3 The Product must have been installed in good and workmanlike manner consistent with the Vendor's latest published instructions and with the state of the art industry standards and plumbing practices, and in conformance with all applicable laws and regulations.

13.4.4 The Product must have not been altered or modified after leaving the Vendor's premises, and must have been used in no more than one installation, show no evidence of disassembly or tampering, and have not been subjected to abnormal operating conditions, accident, abuse, misuse, unauthorized alteration, or repair.

13.4.5 The Product must not have been subject to acts of nature such as earthquakes, fire, flood, or lightning, or any other event of force majeure.

13.4.6 The Product must not have been subject to water freezing inside any of its components.

13.4.7 If the Product is perishable, the Product must have been used prior to the expiration date as indicated on the Product.

13.4.8 The Claimant must notify the Vendor in writing within ten (10) days of when the defect was discovered, or should have been discovered in the exercise of ordinary care, and the defective Product must be promptly returned to the Vendor. Notice of a defective Product under this limited warranty should be directed to your local IPEX Customer Service representative. Claimant must provide documentary evidence of failure, as well as the failed components themselves or representative samples of Product that is alleged to have failed, and must agree to allow a meaningful and reasonable opportunity for Vendor to inspect the system in which the alleged defective Product was installed.

13.5 ANY LIABILITY IN RESPECT TO THE PRODUCTS IS STRICTLY LIMITED TO THEIR REPLACEMENT AS HEREINBEFORE SPECIFIED AND THERE SHALL NOT, IN ANY EVENT, BE ANY LIABILITY FOR ANY LABOUR CHARGES OR OTHER DAMAGES OR FOR ANY OTHER CLAIM FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL OR PUNITIVE DAMAGES.

13.6 Without limiting the generality of the foregoing, any liability or responsibility is disclaimed:

13.6.1 for labor, materials, and/or other expenses required to replace a defective Product;

13.6.2 for any damage to a person or property caused by a defective Product;

13.6.3 for expenses to repair any damage resulting from the use of a defective Product;

13.6.4 for calculations, product drawings, or engineering design specifications;

13.6.5 regarding the accuracy of any plans, drawings, or specifications furnished to the purchaser as part of the sale of any of its products;

13.6.6 for loss or damage resulting from failure to abide by manufacturer's warnings, safety instructions, or other precautionary guidelines.

13.7 ANY CLAIM, WHETHER IN CONTRACT OR IN TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, WITH RESPECT TO OR ARISING OUT OF THE SALE, DELIVERY, INSTALLATION, REPAIR OR USE OF ANY PRODUCTS SOLD TO BUYER SHALL NOT IN ANY EVENT EXCEED THE PURCHASE PRICE OF THE PRODUCTS FOUND TO BE DEFECTIVE. It is the responsibility of the owner to obtain and pay for emergency repairs.

13.8 No statement, conduct, or description by the Vendor, its affiliate, its representative, its distributor or its agent, in addition to or beyond this Limited Warranty, shall constitute a warranty. This limited warranty may only be modified in a writing signed by an officer of the Vendor.

13.9 ANY DISPUTE, CLAIM, OR CONTROVERSY ARISING OUT OF OR RELATING TO THE TERMS OR EFFECT OF THIS LIMITED WARRANTY SHALL BE RESOLVED BY BINDING ARBITRATION IN ACCORDANCE WITH THE COMMERCIAL ARBITRATION RULES OF ONTARIO. THIS ARBITRATION SHALL BE HELD IN TORONTO, ONTARIO. The obligation to arbitrate shall extend to any affiliate, subsidiary, officer, employee, shareholder, principal, agent, trustee in bankruptcy, or guarantor of a party making or defending any claim hereunder.

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APPENDIX

For your convenience, additional copies of Jobsite Notices are provided here to be cut out and posted at the jobsite.

If additional copies of any instructions are needed, or for any questions concerning the safe and proper installation of IPEX products, contact IPEX Toll Free (866) 473-9462
For the most up-to-date information on AquaRise products, visit: ipexaquarise.com

Always adhere to local jobsite and workplace safety regulations.

WARNING: Do not use or test AquaRise® with compressed air or other gases. Do not use air-over-water boosters. SDR 11 is for Hot & Cold and SDR 21 is exclusively for Cold water distribution.

NOTICE

AquaRISE®

Potable Water Piping Systems
SDR 11 Coloured Teal Blue with a Black Print Line for Hot & Cold Water
SDR 21 Coloured Teal Blue with a White Print Line for Cold Water

Please read the following notice before beginning any activity which could come in contact with this system:

AquaRise piping components may be damaged by certain substances and construction practices.

DO NOT stack, support, hang equipment, or hang flexible wire/cable, especially communications cable, or other material on the AquaRise piping system.

ONLY system compatible materials including, but not limited to, solvent cements, caulks and sealants, as noted in the AquaRise Technical Manual, should be used in contact with this system.

DO NOT expose AquaRise products to incompatible substances, such as cutting oils, non-water based paints, packing oils (commonly found in pumps), traditional pipe thread paste and dope, fungicides, termiticides, insecticides, detergents, building caulks, adhesives tape, solder flux, flexible wire/cable (with special consideration for communications cabling), and non-approved spray foam insulation materials.

DO NOT expose AquaRise products to open flame, solder, and soldering flux.

DO NOT drop, distort, or impact AquaRise products or allow objects to be dropped on them.

DO NOT handle AquaRise products with gloves contaminated with oils (hydrocarbons) or other incompatible materials.

Failure to follow this notice may cause cracks or fractures to develop in AquaRise products resulting in personal injury and property damage due to leaks or flooding. The presence of any visible cracks may require partial or full system replacement. For additional information contact the general contractor or system installer.

FOR ADDITIONAL AQUARISE PRODUCT INFORMATION,
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SALES AND CUSTOMER SERVICE

Customers call IPEX Inc.
Toll free: (866) 473-9462
ipexna.com

About IPEX by Aliaxis

As leading suppliers of thermoplastic piping systems, IPEX by Aliaxis provides our customers with some of the world's largest and most comprehensive product lines. All IPEX by Aliaxis products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, we have earned a reputation for product innovation, quality, end-user focus and performance.

Markets served by IPEX by Aliaxis products are:

- Electrical systems
- Telecommunications and utility piping systems
- PVC, CPVC, PP, PVDF, PE, ABS, and PEX pipe and fittings
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems

Distributed in Canada by IPEX Inc., Mississauga, Ontario.

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