GF Piping Systems

Schedule 40 and 80 Rigid PVC Piping Systems

Harvel Clear™ PVC

GF's Harvel Clear™ Schedule 40 and 80 Rigid PVC Piping Systems

GF Piping Systems' Harvel Clear™ rigid PVC piping system provides a versatile, cost-effective alternative for many piping applications, particularly those where visual monitoring of processes is critical.

The benefits of rigid PVC piping systems are well recognized: exceptional corrosion resistance; smooth interior walls for unimpeded flow and reduced sediment buildup; non-contaminating for purity applications; fast, reliable solvent-welded connections; good pressure-bearing capability; and ease of handling and installation, to name a few.

All of these important benefits are now available in a unique product with optimum clarity. This clarity provides the all-round visibility that specialized applications demand — whether it be clean room applications, sight glass, dual-containment or various other processing applications where continuous monitoring is necessary.

Material

Harvel Clear PVC piping system from GF Piping Systems is produced from a rigid, virgin Polyvinyl Chloride (PVC) compound with a Cell Classification of 16443 per ASTM D1784. This material enables Clear PVC piping to safely carry a maximum service temperature of 140°F when appropriate temperature/pressure de-rating factors are applied. In addition to exhibiting desirable physical properties and optimum transparency, this material is listed by the National Sanitation Foundation as being safe for use with potable water (NSF International Standard 61), and also complies with the provisions of Title 21 of the United States FDA Code of Federal Regulations as being safe for use in food contact applications. Due to the non-contaminating nature of Clear PVC piping system products, extensive chemical extraction testing has been conducted to evaluate their use in ultra-pure applications. Details pertaining to extractable analysis is available from GF upon request.

GF Piping Systems' Harvel Clear PVC material provides similar reliable chemical resistance properties that conventional PVC piping systems have demonstrated over the years. In general, it is resistant to most acids, bases, salts and oxidants. Detailed chemical resistance data is available and should be referenced for proper material selection.

Since this material is a nonconductor, PVC pipe is not subject to electrolytic or galvanic corrosion. Harvel Clear PVC exhibits excellent flammability characteristics as well.

This material is compatible with conventional PVC pipe, fittings and valves, and can be incorporated into existing PVC systems via the solvent cement joining process. In addition to a full line of Schedule 40 clear fittings for most applications, an endless array of standard PVC components and accessories are readily available.

Typical Applications

GF's Harvel Clear PVC provides several advantages over traditional materials in many applications. It is routinely used as dual-containment piping for high purity piping runs where quick identification of primary tubing and visual leak detection is critical. From semiconductor clean rooms to aggressive chemical processing applications, Clear PVC provides durable leak-free containment piping with optimum visibility.

Compatibility with standard PVC piping systems makes the product ideal for sight gauge assemblies in many applications.

The wide range of sizes and clear fittings available enable custom in-process monitoring of process fluids.

Other applications include:

- Chemical Processing
- Medical/Hospital Use
- Electroplating
- Food Processing
- Dual Containment
- Displays/Exhibits
- Laboratory Applications
- Environmental Applications
- Cosmetics
- Beverage Processing
- Visual Test Equipment
- Fish Hatcheries
- Sight Glass

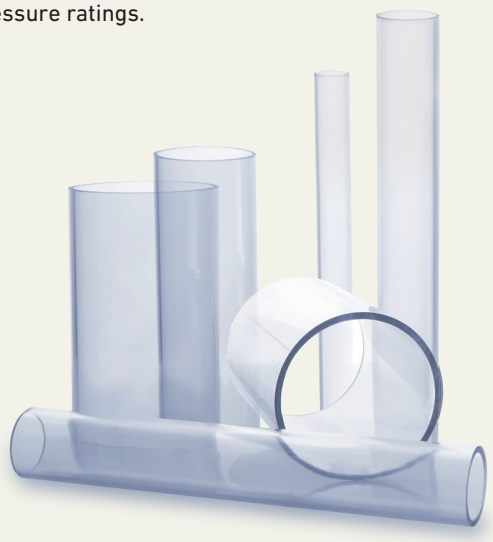
Harvel Clear™ Benefits

- Pipe manufactured to Schedule 40 and Schedule 80 IPS dimensions
- Full line of clear fittings available
- Simple solvent-welded joining techniques
- Fully compatible with standard PVC pipe, fittings and valves
- Corrosion resistant
- Non-conductive
- Resists bacterial and biological activity
- Wide range of chemical resistance
- Lightweight, easy to handle and install
- Neatly boxed and packaged, providing clean, scratch-free quality with every order
- Standard plain-end 10-foot lengths; belling and custom lengths available
- Lower overall installed cost than other alternatives

Product Ratings And Capability

Harvel Clear PVC pipe is manufactured in IPS sizes to Schedule 40 & 80 dimensions for optimum performance. This provides sufficient wall thickness for most pressure applications without jeopardizing clarity. As a rigid PVC piping system, GF's Harvel Clear PVC maintains its integrity in harsh environments. It is suitable for use in both positive and negative pressure applications (i.e., vacuum service).

As with all schedules of thermoplastic pipe, pressure rating is dependent on the pipe diameter selected as well as the operating temperature of the system. As temperatures rise, the pressure rating of the system decreases. Smaller diameter piping can withstand higher pressures than large diameter piping. Refer to the table below for dimensions, tolerances and pressure ratings.



De-rating Factor

Operating Temp. (°F)	De-rating Factor
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

Critical Collapse Pressure PSI @ 73°F

Pipe Size (in.)	Sch 40	Sch 80
¼	7,504	22,172
⅜	3,714	11,869
½	3,255	9,370
¾	1,722	4,985
1	1,399	3,841
1¼	767	2,158
1½	554	1,599
2	327	1,014
2½	431	1,176
3	279	809
3½	211	-
4	169	521
6	84	333
8	57	-
10	43	-
12	35	-

Temperature de-rating factors are to be multiplied by the pressure ratings listed to determine the maximum pressure rating of the system at elevated temperatures. Note: Critical collapse pressure is the maximum allowable pressure that can be applied externally to the pipe. Examples include buried pipe subjected to soil loads, underwater applications, and vacuum service. Values in psi are based at 73°F with no safety factor. Temperature de-rating factors must be applied to determine collapse ratings at temperatures greater than 73°F.

Pipe Dimensions and Pressure Ratings

		Schedule 40				Schedule 80			
Nominal Pipe Size (in.)	O.D.	Average I.D.	Minimum Wall	Nominal Weight lbs./ ft.	Maximum W.P. PSI*	Average I.D.	Minimum Wall	Nominal Weight lbs./ ft.	Maximum W.P. PSI*
¼	.540	.344	.088	.086	390	.282	.119	.105	570
⅜	.675	.473	.091	.115	310	.403	.126	.146	460
½	.840	.602	.109	.170	300	.526	.147	.213	420
¾	1.050	.804	.113	.226	240	.722	.154	.289	340
1	1.315	1.029	.133	.333	220	.936	.179	.424	320
1¼	1.660	1.360	.140	.450	180	1.255	.191	.586	260
1½	1.900	1.590	.145	.537	170	1.476	.200	.711	240
2	2.375	2.047	.154	.720	140	1.913	.218	.984	200
2½	2.875	2.445	.203	1.136	150	2.290	.276	1.500	210
3	3.500	3.042	.216	1.488	130	2.864	.300	2.010	190
3½	4.000	3.521	.226	1.789	120	–	–	–	–
4	4.500	3.998	.237	2.118	110	3.786	.337	2.938	160
6	6.625	6.031	.280	3.733	90	5.709	.432	5.610	140
6 × ⅛*	6.625	6.335	.110	1.647	45	–	–	–	–
8	8.625	7.942	.322	5.619	80	–	–	–	–
10	10.750	9.976	.365	7.966	70	–	–	–	–
12	12.750	11.889	.406	10.534	70	–	–	–	–

*This size does not meet Schedule 40 criteria. Pressure ratings shown are for water, non-shock @73°F

System Design and Installation

Joining Techniques

Harvel Clear PVC pipe is easily joined by the solvent cementing process, providing a quick, strong, leak-tight seal for pressure applications. To maintain the system's clarity, GF Piping Systems recommends the use of a clear, medium-bodied, fast-setting cement in conjunction with a clear primer for optimum joint integrity, such as IPS Weld-On® 705 Clear cement and IPS Weld-On® P-70 Clear primer. As an added advantage due to the product's transparency, joint integrity is readily identified during the solvent cement joining process. Details on proper solvent cementing techniques are available and must be reviewed for proper assembly and joint integrity.

GF recommends the use of PTFE tape for making reliable threaded connections. Generally, two to three wraps of tape in the direction of the threads on the male end, followed by one to two turns beyond finger tight is all that is required to make a leak-free connection.

> Note: Certain thread paste compounds may contain stress cracking agents; contact the paste manufacturer for compatibility with PVC prior to use.

Where disassembly is required, Harvel Clear PVC can be easily joined in the field using GF's standard Schedule 40 or Schedule 80 PVC pipe fittings and joining techniques such as flanges, adapters, and unions. Joining options are limitless when overall system clarity is not a necessity.

Physical Properties

Property	Value	Test Method
Maximum Service Temperature	140°F	
Cell Classification	16443	ASTM D1784
Specific Gravity	1.33 g/cm^3 @73°F	ASTM D792
Izod Impact Notched — Method A, with Grain-Comp. Molded, 0.125 in. bars, 73°F Notched — Method A, against Grain-Comp. Molded 0.125 in. bars, 73°F	8.0 ft-lbs./in. 2.0 ft-lbs./in.	ASTM D256
Tensile Strength @ yield	7260 psi @73°F	ASTM D638
Tensile Modulus	392,000 psi	ASTM D638
Flexural Strength	12,000 psi @75°F	ASTM D790
Flexural Modulus	389,000 psi @75°F	ASTM D790
Compressive Strength	8,300 psi @75°F	ASTM D695
Compressive Modulus	307,000 psi @75°F	ASTM D695
Coefficient of Linear Expansion	4.1×10^{-5} in/in °F	ASTM D696
Flammability	V–0	UL–94
Heat Distortion Temperature	154°F	ASTM D648
Glass Transition Temperature	176°F	
Hardness, Shore D	84	ASTM D2240

Thermal Expansion and Contraction

As with other thermoplastic materials, consideration must be given to the effects of thermal expansion and contraction during the design and installation of the system. The coefficient of linear expansion for GF's Harvel Clear PVC pipe is 4.1×10^{-5} in./in./°F. The rate of expansion or contraction can be calculated as follows:

DL = 12 yL (T) where:
DL = expansion or contraction in inches
y = 4.1×10^{-5} (coefficient of linear expansion)
L = length of piping run in feet
T = temperature change °F
(T max. – T@ installation)

Heat Bending

Bending of GF's Harvel Clear PVC pipe may be desirable under certain conditions where long-radius bends and unusual configurations are required. Various sizes and wall thicknesses of rigid PVC pipe have been successfully heat-formed for many years into numerous angles, long-radius sweeps for conduit and flow conditions, U-bends for thermal compensation, and offsets in congested areas.

> The following information is provided as a general guide for a better understanding of heat bending techniques commonly used in the field, and does not attempt to address specialized shop fabrication methods or procedures.

Successful bending requires that the appropriate amount of heat be applied uniformly to the required length of pipe to be bent. This presents the greatest challenge for field bending, as the heating method used must provide the necessary amount of heat over the required length of pipe in a reasonable amount of time. Several common pipe heating methods used in the field involve the use of hot air ovens, electric box heaters, electric pipe heating blankets, and flameless hot gas torches. Temperatures necessary to heat the pipe are dependent on pipe size and the severity of the desired bend radius. In general, PVC pipe should be heated from 225°F to 275°F for the minimum amount of time necessary to achieve uniform softening. Care should be taken to avoid exposing the pipe to bending temperatures for an excessive length of time, as irreparable distortion and deformation will occur. Localized overheating must be avoided. Successful minor bends (<30°) can be achieved with minimum distortion in the lower temperature range (225°F) without internal support. Sharp bends

(>30°) require higher temperatures (250°–275°F) as well as internal support to prevent wall distortion/collapse.

Common methods used to provide internal support to the pipe during the bending process include using a filling medium such as sand or perlite (cat litter), inserting a coiled spring into the pipe, or in some cases providing internal pressure. Filling the pipe with fine grain sand or perlite prior to heating furnishes the internal support necessary to prevent collapse, while at the same time provides an excellent medium for uniform heat distribution during the heating process.

The filling medium used should be packed tightly into the pipe to achieve the desired bend radius with minimum distortion.

During this process, the pipe ends are capped or plugged and the filling medium is compacted as much as possible to remove any air pockets prior to heating. Once the bend is formed and cooled, the sand is emptied from the pipe and any remaining particles can be easily removed by rinsing with water.

To provide fabrication consistency in the field, standard pipe bending forms which provide the required radius and are sized (grooved) for the proper diameter can be used to bend plastic pipe. Plywood jigs constructed on site have also been used successfully in many applications. The minimum radius at bend should not be less than five times the pipe outside diameter to prevent flattening. Due to the recovery characteristics of the material, the pipe should be bent slightly beyond the desired radius and allowed to spring back to the required angle once uniformly heated at the correct temperature. When the bend is obtained, the pipe should be held in place and cooled quickly using a wet sponge or other application of water. It should be noted that most bending procedures will induce stress into the pipe wall which can be retained in the material after the bend radius is formed. The amount of stress induced is dependent on the severity of the bend, the diameter and wall thickness of the pipe bent, and the bending method used. This residual stress will be added to the normal stresses created by internal pressure, installation procedures, and the effects of temperature. Therefore, pipe bending should be limited to applications for use at ambient temperatures or lower where maximum operating pressures are not utilized.

It should also be noted that during the bending process of GF's Harvel Clear PVC pipe, the material will become cloudy during the heating process but will regain clarity when cooled, provided excessive bending stresses are not retained. The use of a filling medium during the bending process can also cause slight pitting and other interior surface blemishes depending on the method used.

Attempting to form bends in rigid thermoplastic piping at temperatures too low (below 200°F) can induce excessive stress into the pipe, thereby jeopardizing its physical performance.

Hangers and Supports

Support location and spacing is dependent on the pipe diameter, operating temperature of the system, and the location of any concentrated stress loads (i.e., valves, flanges, and any other heavy system components). Proper support spacing is critical to ensure that deflection is kept to a minimum. Hangers used must have an adequate load-bearing surface free of any rough or sharp edges that could damage the piping during use. They must also not restrict linear movement of the system due to the effects of expansion and contraction; overtightening must be avoided.

Schedule 40

Nom. Pipe Size (in.)	Maximum support spacing in feet				
	60°F	80°F	100°F	120°F	140°F
¼	4	3½	3½	2	2
⅜	4	4	3½	2½	2
½	4½	4½	4	2½	2½
¾	4	4½	4	2½	2½
1	5½	5	4½	3	2½
1¼	5½	5½	5	3	3
1½	6	5½	5	3½	3
2	6	5½	5	3½	3
2½	7	6½	6	4	3½
3	7	7	6	4	3½
3½	7½	7	6½	4	4
4	7½	7	6½	4½	4
6	8½	8	7½	5	4½
6×⅛	7½	7	6½	4½	4
8	9	8½	8	5	4½
10	10	9	8½	5½	5
12	11½	10½	9½	6½	5½

Schedule 80

Nom. Pipe Size (in.)	Maximum support spacing in feet				
	60°F	80°F	100°F	120°F	140°F
¼	4	4	3½	2½	2
⅜	4½	4½	4	2½	2½
½	5	4½	4½	3	2½
¾	5½	5	4½	3	2½
1	6	5½	5	3½	3
1¼	6	6	5½	3½	3
1½	6½	6	5½	3½	3½
2	7	6½	6	4	3½
2½	7½	7½	6½	4½	4
3	8	7½	7	4½	4
4	9	8½	7½	5	4½
6	10	9½	9	6	5

Sample Specification

All PVC Schedule 40 and Schedule 80 Harvel Clear pipe shall be manufactured from a Type II, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 16443 per ASTM D1784. This material shall comply with the provisions of Title 21 of the United States FDA Federal Code of Regulations as being safe for use in food contact applications. The pipe shall be manufactured in strict compliance to ASTM D1785, consistently meeting and/or exceeding the applicable Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be manufactured in the USA by an ISO 9001 certified manufacturer. All PVC Schedule 40 and Schedule 80 Harvel Clear pipe shall be packaged immediately after its manufacture to prevent damage, and shall be stored indoors at the manufacturing site until shipped from factory. All Harvel Clear PVC pipe shall be manufactured by GF Piping Systems.

Caution Areas

GF Piping Systems does not recommend the use of this product or other rigid PVC/CPVC piping system products for the transportation or storage of compressed air or gases, nor the testing of these systems using compressed air or gases. Although Harvel Clear PVC maintains its physical properties when exposed to many substances, exposure to certain chemicals can affect the clarity of the product over time. Certain nitrogen-containing organics, bleaches, oxidative agents and acids may result in discoloration. Testing under actual use conditions is recommended.

Standard Harvel Clear PVC does not contain UV inhibitors and is not recommended for outdoor use (direct exposure to sunlight). Direct exposure to sunlight will result in discoloration, loss of clarity, and loss of physical properties.

Standard threading or grooving can be conducted with Schedule 80 Clear pipe. Threading or grooving of Schedule 40 Clear pipe is not recommended due to insufficient wall thickness. Use specialty clear transition fittings for threaded assemblies or standard PVC transition fittings where applicable.

GF Piping Systems

Our sales companies and representatives ensure local customer support in over 100 countries.

Argentina / Southern South America
Georg Fischer Central Plastics
Sudamérica S.R.L.
Buenos Aires, Argentina
Phone +5411 4512 02 90
gfcentral.ps.ar@georgfischer.com

Australia
George Fischer Pty Ltd
Riverwood NSW 2210 Australia
Phone +61(0)2 9502 8000
australia.ps@georgfischer.com
www.georgfischer.com.au

Austria
Georg Fischer
Rohrleitungssysteme GmbH
3130 Herzogenburg
Phone +43(0)2782 856 43-0
austria.ps@georgfischer.com
www.georgfischer.at

Belgium / Luxembourg
Georg Fischer NV/SA
1070 Bruxelles/Brüssel
Phone +32(0)2 556 40 20
be.ps@georgfischer.com
www.georgfischer.be

Brazil
Georg Fischer Sist. de Tub. Ltda.
04795-100 São Paulo
Phone +55(0)11 5525 1311
br.ps@georgfischer.com
www.georgfischer.com.br

Canada
Georg Fischer Piping Systems Ltd
Mississauga, ON L5T 2B2
Phone +1(905)670 8005
Fax +1(905)670 8513
ca.ps@georgfischer.com
www.georgfischer.ca

China
Georg Fischer Piping Systems Ltd
Shanghai 201319
Phone +86(0)21 3899 3899
china.ps@georgfischer.com
www.georgfischer.cn

Denmark / Iceland
Georg Fischer A/S
2630 Taastrup
Phone +45 (0)70 22 19 75
info.dk.ps@georgfischer.com
www.georgfischer.dk

Finland
Georg Fischer AB
01510 VANTAA
Phone +358 (0)9 586 58 25
Fax +358 (0)9 586 58 29
info.fi.ps@georgfischer.com
www.georgfischer.fi

France
Georg Fischer SAS
95932 Roissy Charles de Gaulle Cedex
Phone +33(0)1 41 84 68 84
fr.ps@georgfischer.com
www.georgfischer.fr

Germany
Georg Fischer GmbH
73095 Albershausen
Phone +49(0)7161 302-0
info.de.ps@georgfischer.com
www.georgfischer.de

India
Georg Fischer Piping Systems Ltd
400 076 Mumbai
Phone +91 224007 2001
in.ps@georgfischer.com
www.georgfischer.in

Italy
Georg Fischer S.p.A.
20063 Cernusco S/N (MI)
Phone +3902 921 861
it.ps@georgfischer.com
www.georgfischer.it

Japan
Georg Fischer Ltd
556-0011 Osaka,
Phone +81(0)6 6635 2691
jp.ps@georgfischer.com
www.georgfischer.jp

Korea
Georg Fischer Piping Systems
271-3 Seohyeon-dong Bundang-gu
Seongnam-si, Gyeonggi-do
Seoul 463-824
Phone +82 31 8017 1450
Fax +82 31 8017 1454
kor.ps@georgfischer.com
www.georgfischer.kr

Malaysia
George Fischer (M) Sdn. Bhd.
40460 Shah Alam, Selangor Darul Ehsan
Phone +60 (0)3 5122 5585
my.ps@georgfischer.com
www.georgfischer.my

Mexico / Northern Latin America
Georg Fischer S.A. de C.V.
Apodaca, Nuevo Leon
CP66636 Mexico
Phone +52 (81)1340 8586
Fax +52 (81)1522 8906
mx.ps@georgfischer.com
www.georgfischer.mx

Middle East
Georg Fischer
Piping Systems (Switzerland) Ltd.
Dubai, United Arab Emirates
Phone +971 4 289 49 60
gcc.ps@georgfischer.com
www.export.georgfischer.com

Netherlands
Georg Fischer N.V.
8161 PA Epe
Phone +31(0)578 678 222
nl.ps@georgfischer.com
www.georgfischer.nl

New Zealand
Georg Fischer Ltd
13 Jupiter Grove, Upper Hutt 5018
PO Box 40399, Upper Hutt 5140
Phone +64(0)4 527 9813
nz.ps@georgfischer.com
www.gfps.com/nz

Norway
Georg Fischer AS
1351 Rud
Phone +47(0)67 18 29 00
no.ps@georgfischer.com
www.georgfischer.no

Poland
Georg Fischer Sp. z o.o.
05-090 Sekocin Nowy
Phone +48(0)22 31 31 0 50
poland.ps@georgfischer.com
www.georgfischer.pl

Romania
Georg Fischer
Piping Systems (Switzerland) Ltd.
020257 Bucharest - Sector 2
Phone +40(0)21 230 53 80
ro.ps@georgfischer.com
www.export.georgfischer.com

Russia
Georg Fischer
Piping Systems (Switzerland) Ltd.
Moscow 125047
Tel. +7 495 258 60 80
ru.ps@georgfischer.com
www.georgfischer.ru

Singapore
George Fischer Pte Ltd
11 Tampines Street 92, #04-01/07
528 872 Singapore
Phone +65 6747 0611
sgp.ps@georgfischer.com
www.sg.piping.georgfischer.com

Spain / Portugal
Georg Fischer S.A.
28046 Madrid
Phone +34(0)91 781 98 90
es.ps@georgfischer.com
www.georgfischer.es

Sweden
Georg Fischer AB
117 43 Stockholm
Phone +46(0)8 506 775 00
info.se.ps@georgfischer.com
www.georgfischer.se

Switzerland
Georg Fischer
Rohrleitungssysteme (Schweiz) AG
8201 Schaffhausen
Phone +41(0)52 631 30 26
ch.ps@georgfischer.com
www.piping.georgfischer.ch

Taiwan
Georg Fischer Co., Ltd.
San Chung Dist., New Taipei City
Phone +886 2 8512 2822
Fax +886 2 8512 2823
www.georgfischer.tw

United Kingdom / Ireland
George Fischer Sales Limited
Coventry, CV2 2ST
Phone +44(0)2476 535 535
uk.ps@georgfischer.com
www.georgfischer.co.uk

USA / Caribbean
Georg Fischer LLC
Irvine, CA 92618
Phone +1(714) 731 88 00
Toll Free 800 854 40 90
us.ps@georgfischer.com
www.gfpiping.com

Vietnam
George Fischer Pte Ltd
136E Tran Vu, Ba Dinh District, Hanoi
Phone +84 4 3715 3290
Fax +84 4 3715 3285

International
Georg Fischer
Piping Systems (Switzerland) Ltd.
8201 Schaffhausen/Switzerland
Phone +41(0)52 631 30 03
Fax +41(0)52 631 28 93
info.export@georgfischer.com
www.export.georgfischer.com

www.gfps.com

GF Piping Systems
9271 Jeronimo Road, Irvine, CA 92618
Tel. (714) 731-8800, Toll Free (800) 854-4090, Fax (714) 731-6201
e-mail: us.ps@georgfischer.com
www.gfpiping.com

+GF+

Item #1349 (7/20)