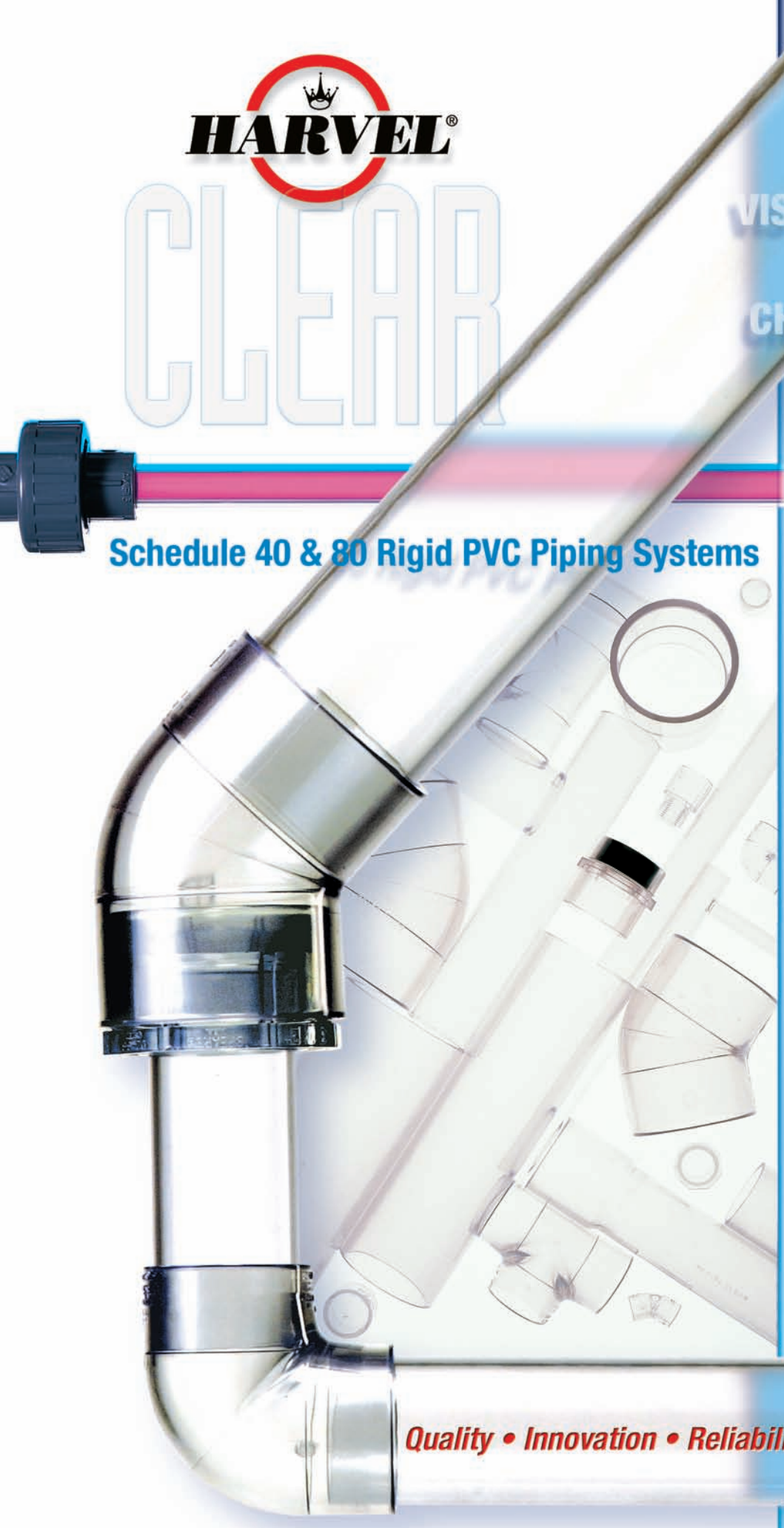
HARVEL®

HPB 107
Effective 4/28/10

CLEAR

Schedule 40 & 80 Rigid PVC Piping Systems



VISUAL LEAK DETECTION

CHEMICAL PROCESSING

FOOD & BEVERAGE

LABORATORY

ENVIRONMENTAL

FILTRATION

FISH HATCHERIES

DUAL CONTAINMENT

AQUACULTURE

SIGHT GLASS

DISPLAYS/EXHIBITS

ELECTROPLATING

PROCESS R&D

Quality • Innovation • Reliability



Harvel Clear™ Rigid PVC piping 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 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 is produced from a rigid, virgin Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. This material enables Harvel Clear™ 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 wa ter (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 Harvel Clear™ PVC piping products, extensive chemical extraction testing has been conducted to evaluate their use in ultra-pure applications. Details pertaining to extractable analysis is available from Harvel upon request.

Harvel Clear™ provides similar reliable chemical resistance properties that conventional PVC piping has 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, Harvel pipe is not subject to electrolytic or galvanic corrosion.

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. Harvel Clear™ PVC exhibits excellent flammability characteristics as well.

PHYSICAL PROPERTIES

Property	Value	Test Method
Maximum Service Temperature	140°F	
Cell Classification	12454	ASTM D1784
Specific Gravity	1.33 g/cu.cm @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 x 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

Schedule 40 & 80 Rigid PVC Piping Systems

- ✔ *Manufactured to Schedule 40 and Schedule 80 IPS dimensions*
- ✔ *Full line of 1/4" through 8" Clear fittings*
- ✔ *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 on-line, 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*

TYPICAL APPLICATIONS

Harvel Clear™ provides several advanta ges 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 a ggressive chemical processing applications, Harvel Clear™ 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 c lear 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*

PRODUCT RATINGS AND CAPABILITY

Harvel Clear™ pipe and fittings are 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, 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
1/4	7504	22172
3/8	3714	11869
1/2	3255	9370
3/4	1722	4985
1	1399	3841
1-1/4	767	2158
1-1/2	554	1599
2	327	1014
2-1/2	431	1176
3	279	809
3-1/2	211	-
4	169	521
6	84	333
8	57	-
10	43	-
12	35	-

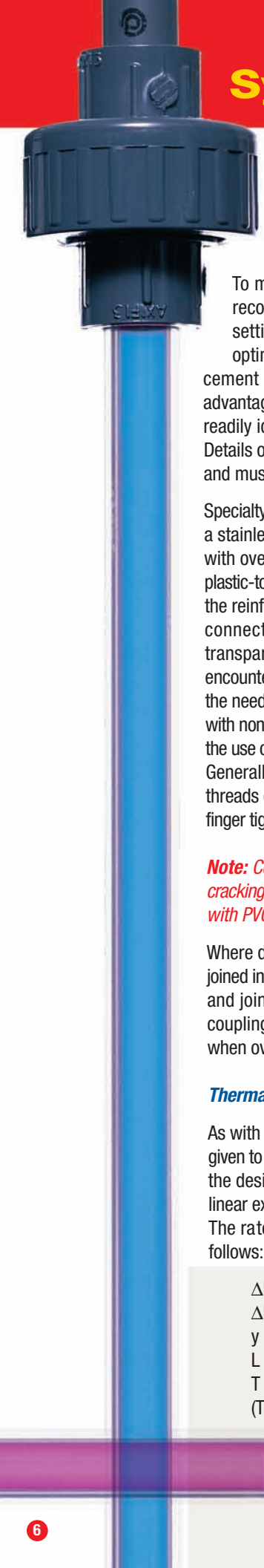
Temperature de-rating factors are to be multiplied by the pressure ratings listed to determine the maximum pressure rating of the system at elevated temperatures.

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.*

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*
1/4	.540	.344	.088	.086	390	.282	.119	.105	570
3/8	.675	.473	.091	.115	310	.403	.126	.146	460
1/2	.840	.602	.109	.170	300	.526	.147	.213	420
3/4	1.050	.804	.113	.226	240	.722	.154	.289	340
1	1.315	1.029	.133	.333	220	.936	.179	.424	320
1-1/4	1.660	1.360	.140	.450	180	1.255	.191	.586	260
1-1/2	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
2-1/2	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
3-1/2	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 x 1/8*	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*



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, Harvel Plastics, Inc. 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.

Specialty clear female threaded transition fittings, incorporating a stainless steel retaining ring, reduce problems associated with overtightening and provide a strong, leak-tight seal for plastic-to-metal transitions. When used with clear male adapters, the reinforced female adapters provide an excellent threaded connection for disassembly while maintaining system transparency. The reinforced design reduces radial stress encountered with typical threaded connections, and eliminates the need for system pressure de-rating traditionally associated with non-reinforced plastic threaded joints. Harvel recommends the use of Teflon® 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™ can be easily joined in the field using standard rigid thermoplastic pipe fittings and joining techniques such as flanges, molded grooved coupling adapters and unions. Joining options are limitless when overall system clarity is not a necessity.

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 Harvel Clear™ pipe is 4.1×10^{-5} in./in./°F. The rate of expansion or contraction can be calculated as follows:

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

Heat Bending

Bending of Harvel Clear™ 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 allo wed 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 a pplications 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 clear PVC pipe, the material will become cloudy during the hea ting process but will regain c larity 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 a t temperatures too low (below 200° F) can induce excessive stress into the pipe, thereby jeopardizing its physical performance.

CAUTION AREAS

Harvel Plastics, Inc. does not recommend the use of this product or other rigid PVC/CPVC piping 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™ 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.

Harvel standard 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.

***NOTE:** Harvel EnviroKing®UV clear PVC has been developed for sight glass and other outdoor applications as it contains UV inhibitors and has been specifically optimized for exposure to sunlight. Additional information on this product line can be found at www.EnviroKingUV.com.*

Standard threading or grooving can be conducted with Harvel Schedule 80 Clear pipe. Threading or grooving of Harvel 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.

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

Nominal Pipe Size (in.)	Maximum Support Spacing in Feet				
	60°F	80°F	100°F	120°F	140°F
1/4	4	3-1/2	3-1/2	2	2
3/8	4	4	3-1/2	2-1/2	2
1/2	4-1/2	4-1/2	4	2-1/2	2-1/2
3/4	4	4-1/2	4	2-1/2	2-1/2
1	5-1/2	5	4-1/2	3	2-1/2
1-1/4	5-1/2	5-1/2	5	3	3
1-1/2	6	5-1/2	5	3-1/2	3
2	6	5-1/2	5	3-1/2	3
2-1/2	7	6-1/2	6	4	3-1/2
3	7	7	6	4	3-1/2
3-1/2	7-1/2	7	6-1/2	4	4
4	7-1/2	7	6-1/2	4-1/2	4
6	8-1/2	8	7-1/2	5	4-1/2
6 x 1/8	7-1/2	7	6-1/2	4-1/2	4
8	9	8-1/2	8	5	4-1/2
10	10	9	8-1/2	5-1/2	5
12	11-1/2	10-1/2	9-1/2	6-1/2	5-1/2

SCHEDULE 80

Nominal Pipe Size (in.)	Maximum Support Spacing in Feet				
	60°F	80°F	100°F	120°F	140°F
1/4	4	4	3-1/2	2-1/2	2
3/8	4-1/2	4-1/2	4	2-1/2	2-1/2
1/2	5	4-1/2	4-1/2	3	2-1/2
3/4	5-1/2	5	4-1/2	3	2-1/2
1	6	5-1/2	5	3-1/2	3
1-1/4	6	6	5-1/2	3-1/2	3
1-1/2	6-1/2	6	5-1/2	3-1/2	3-1/2
2	7	6-1/2	6	4	3-1/2
2-1/2	7-1/2	7-1/2	6-1/2	4-1/2	4
3	8	7-1/2	7	4-1/2	4
4	9	8-1/2	7-1/2	5	4-1/2
6	10	9-1/2	9	6	5

SAMPLE SPECIFICATION

All PVC Schedule 40 Clear pipe and fittings and Schedule 80 Clear pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 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 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 clear PVC pipe shall be manufactured by Harvel Plastics, Inc.; trade name Harvel Clear.™

HARVEL®

CLEAR

ISO 9001 CERTIFIED

Harvel Plastics, Inc.
Quality Systems Certificate Nos. 270/455
Assessed to ISO 9001

member iapd

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