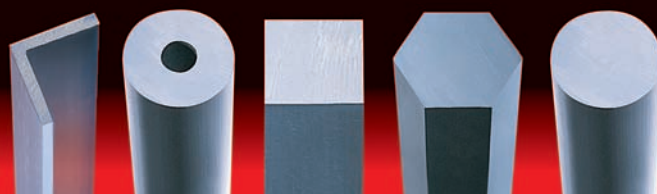


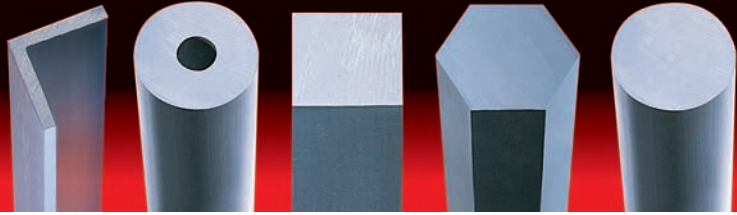
PVC & CPVC Machining Shapes



The QUALITY Line



PVC & CPVC Machining Shapes



SUPERIOR QUALITY

Harvel's state-of-the-art extrusion process provides porosity-free, stressed-reduced products with optimum physical properties and exacting tolerances, products that consistently machine with ease, part after part. Innovation and the latest technical know-how, combined with processing experience since 1964, enable Harvel to produce quality stock machining shapes from 1/8" through 12" diameters. Available products include solid bar, hollow bar, square, rectangular, hexagonal bar, angle and joining strip.

Harvel's "Quality Line" of PVC and CPVC machining shapes provide cost-effective solutions for numerous industrial applications. These materials offer excellent chemical and corrosion resistance, mechanical strength, and good thermal and electrical properties. They are noncontaminating for purity applications, and have excellent flammability characteristics.

APPLICATIONS

An endless variety of finished parts and subcomponents can be readily produced using conventional machining methods such as cutting, boring, drilling, turning and threading. This provides a means to produce many custom assemblies and fixtures that are not available as extruded or molded items. Machined components and fixtures can then be incorporated into large assemblies or existing systems using standard solvent cementing, heat forming/bending, or hot-air welding techniques, providing material consistency and integration for an entire system.

Typical products produced from extruded shapes include valve bodies and components, strainers, filters, pressure vessels, bulkhead fittings, pump components, bushings, compression fittings, flanges, hangers, headers, hooks, adapters, spacers, caps, sleeves, plugs, stiffeners, hubs, nuts, bolts, rollers, and numerous other mechanical components and appurtenances.



Machined valves courtesy
RK Industries, Ontario, CA

MATERIALS

Harvel uses only the finest raw materials, which have been carefully evaluated to ensure consistency in the finished item. Harvel PVC material (white or gray) and Harvel Clear PVC materials are listed by NSF International to Standard 61 as being safe for use in potable water applications.

Polyvinyl Chloride (PVC)

Various shapes produced from PVC provide excellent machining and fabrication characteristics for components used in corrosive environments. The use of this material can provide a cost savings advantage with well-balanced physical properties for many applications. Harvel's standard PVC machining shapes are dark gray in color, signifying industrial grade product. PVC shapes are suitable for a maximum service temperature use of 140°F. PVC white is also inventoried, and a variety of custom colors are available upon request for specialty projects.

Clear PVC

Many unique and specialty items can be machined from Harvel's line of transparent PVC shapes. Harvel Clear PVC shapes provide the reliable chemical resistance of standard PVC, and are also fully compatible with standard PVC products with regard to machining characteristics, solvent cementing and other joining methods. In addition to exhibiting desirable physical properties and optimum transparency, this material complies with the provisions of Title 21 of the FDA Code of Federal Regulations as being safe for use in food-contact applications.

Chlorinated Polyvinyl Chloride (CPVC)

CPVC provides advantages in elevated temperature environments due to its high heat-distortion temperature. This enables the fabrication of end items or parts for use in applications with service temperatures up to 200°F. Harvel CPVC products also have exceptional fire resistance properties providing end products with low flame spread and smoke generation characteristics. This ensures consistency and compatibility of Harvel shapes with other end products produced from CPVC compounds such as pipe, duct, fittings and sheet. Standard industrial grade CPVC shapes are light gray in color.

Various configurations of machining and joining shapes produced from specialty Corzan® 4910 CPVC are also available. Harvel Corzan® 4910 shapes offer exceptional fire performance characteristics, and can be used in the joining of duct, sheet and other components for use in the construction of wet benches and other units used in clean room work-stations. Harvel Corzan® 4910 products are off-white in color signifying cleanliness. Contact factory for availability.

Harvel PVC and CPVC machining shapes exhibit excellent chemical resistance to a wide variety of corrosives and aggressive reagents. Compatibility with service conditions should be investigated prior to use. Detailed chemical resistance information is available from Harvel.

Harvel PVC

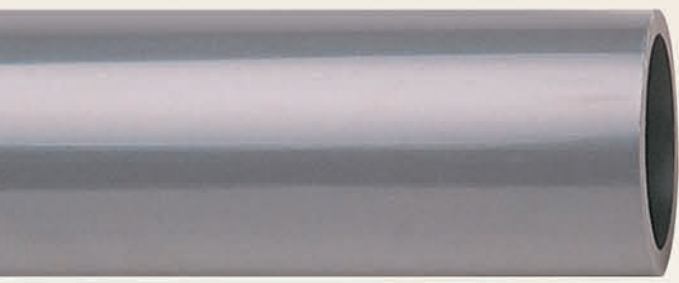
Property	Value	Test Method
Max. Service Temp.	140°F	
Cell Classification	12454	ASTM D1784
Specific Gravity	1.38 ± 2 g/cu.cm @73°F	ASTM D792
Tensile Strength @ yield	7,300 psi @ 73°F	ASTM D638
Modulus of Elasticity	410,000 psi @ 73°F	ASTM D638
Flexural Modulus	420,000 psi @ 73°F	ASTM D790
Izod Impact	0.8 ft-lbs / inch notch @ 73°F	ASTM D256
Coefficient of Linear Expansion	2.9 x 10 ⁻⁵ in / in / °F	ASTM D696
Flammability	V-O	UL-94
Hardness, Shore D	80 ± 3	ASTM D2240

Harvel Clear PVC

Property	Value	Test Method
Max. Service Temp.	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	8.0 ft-lbs./in.	ASTM D256
Notched – Method A, Against Grain-Comp. Molded, 0.125 in. bars, 73°F	2.0 ft-lbs./in.	
Tensile Strength @ yield	7260 psi @73°F	ASTM D638
Tensile Modulus	392,000 psi	ASTM D638
Flexural Strength	12,000 @75°F	ASTM D790
Flexural Modulus	398,000 @75°F	ASTM D790
Compressive Strength	8,300 @75°F	ASTM D695
Compressive Modulus	307,000 @75°F	ASTM D695
Coefficient of Linear Expansion	4.1 x 10 ⁻⁵ in/in °F	ASTM D696
Flammability	V-O	UL-94
Heat Distortion Temperature	154°F	ASTM D256
Glass Transition Temperature	176°F	
Hardness, Shore D	84	ASTM D2240

Harvel CPVC

Property	Value	Test Method
Max. Service Temp.	200°F	
Cell Classification	23437	ASTM D1784
Specific Gravity	1.55 ± 2 g/cu.cm @73°F	ASTM D792
Tensile Strength @ yield	8,100 psi @ 73°F	ASTM D638
Modulus of Elasticity	370,000 psi @ 73°F	ASTM D638
Flexural Modulus	350,000 psi @ 73°F	ASTM D790
Izod Impact	1.5 ft-lbs / inch notch @ 73°F	ASTM D256
Coefficient of Linear Expansion	3.4 x 10 ⁻⁵ in / in / °F	ASTM D696
Flammability	V-O, 5VB, 5VA	UL-94
Hardness, Rockwell	119	ASTM D2240



INDUSTRY STANDARD

More than 35 years of processing experience has enabled Harvel to refine the art of extruding machining shapes into an exacting science. This experience has made it possible to customize dedicated production equipment, addressing specific extrusion requirements.

Every aspect of the process, from raw material traceability through online testing, is continually monitored, and finalized with formal quality-control testing of finished product. Rigorous in-house TQM/SPC requirements and tough self-taught standards ensure consistency in product quality from start to finish. Key processing techniques that contribute to final product properties are carefully balanced during production to provide optimum quality.

In addition to maintaining tight dimensional tolerances, emphasis is placed on processing conditions that effect end product properties, performance, and overall quality. Focusing on and balancing the following quality requirements maximize product performance.

Degree of Fusion – Proper fusion of materials during the manufacturing process optimizes physical properties such as tensile strength, tensile modulus, flexural strength, impact resistance and other important properties that contribute to end product quality.

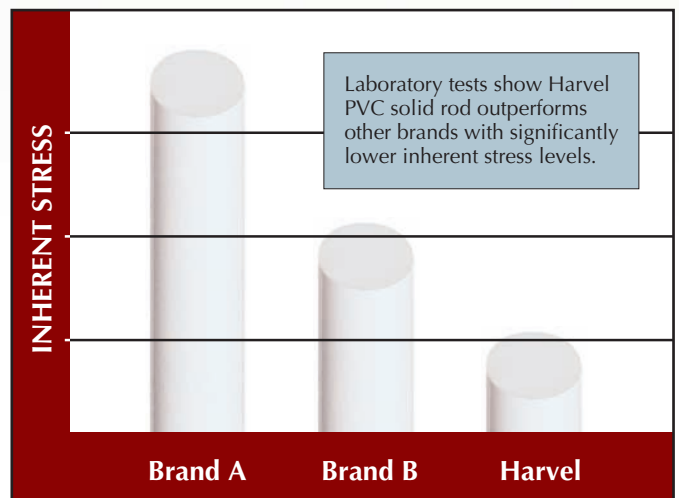
In addition, end-product performance in aggressive environments is dependent on the compatibility of the material selected with chemicals used during service. The degree of fusion and consistency of the melt during the manufacturing process greatly affects chemical compatibility. Product that is not properly fused during the extrusion process can result in substandard components with poor chemical resistance. This issue is addressed at Harvel with online and formal Q.C. tests to measure the degree of fusion throughout the entire product profile.

Porosity – Porosity and material contamination issues can create costly scrap and downtime when working with machine stock. Harvel uses only the finest raw materials and narrow, well-defined processing conditions for each type of product manufactured. This greatly reduces risks associated with material contamination related to substandard compound, and porosity caused by poor processing techniques.

Dimensional Stability – Harvel has painstakingly developed methods without secondary annealing processes to reduce and monitor internal stress levels, addressing the dimensional stability characteristics of finished product when subjected to machining procedures. Residual stresses are inherent in all extruded profiles due to the nature of the extrusion process. The amount of inherent stress will affect the product's long-term stability, toughness, and machining characteristics. Stress created by the manufacturing process of Harvel profiles is minimized to ensure consistent machine stock with excellent dimensional stability.

Low inherent stress levels reduce the potential for fatigue and stress fracturing when products are subjected to heat cycling and various other physical demands caused by machining. Optimal product quality is achieved by producing machining shapes that can consistently withstand the vigorous demands and intricacies of complicated machining practices.

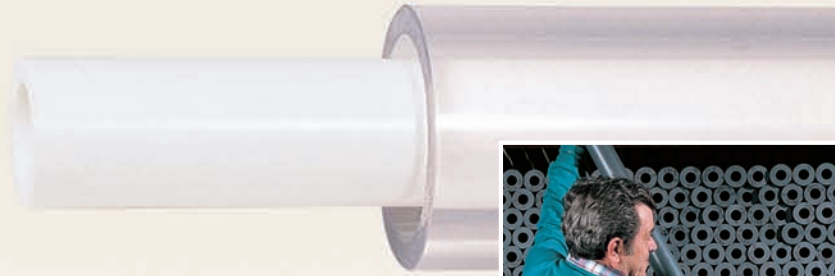
PVC Solid Rod Internal Stress Comparison



Camber and Bow – In addition to maintaining exacting tolerances on outside diameters, care is taken to ensure straightness of Harvel extruded products. Keeping close tolerances on camber and bow is second nature on all Harvel products. This enables successful machining of specialty products where overall length of a finished part is critical.

Traceability – Each finished product produced by Harvel is stamped and identified for tracking purposes. Careful handling, packaging and storage ensure quality is maintained from door to door.

Quality Assurance



PRODUCT AVAILABILITY

Harvel offers quality-machining shapes in a wide variety of sizes and configurations to suit most application requirements. The following charts refer to standard stocking items. Other specialty materials such as static dissipative PVC, custom colors, additional sizes and special lengths are available upon request. Contact factory for details.

Solid Round Bar

Harvel's quality line of solid bar provides optimum machine stock for everything from thumbscrews to valve components and other items requiring complicated machining techniques.

Size (in.)	O.D	Tol. -0; +	Camber & Bow	Material (Weight Lbs./ft.)				
				Gray PVC	White PVC	Black PVC	CPVC	Clear
1/4	.250	.008	N/A	.029	.029	.029	.032	.029
3/8	.375	.015	N/A	.066	.066	.066	.074	.066
1/2	.500	.015	1-1/2	.117	.117	.117	.131	.117
5/8	.625	.020	1-1/2	.183	.183	.183	-	.183
3/4	.750	.022	1-1/2	.265	.265	.265	.296	.265
7/8	.875	.025	1-1/2	.358	.358	.358	-	.358
1	1.000	.030	1-1/2	.471	.471	.471	.526	.471
1-1/8	1.125	.035	1-1/4	.594	.594	.594	-	-
1-1/4	1.250	.035	1-1/4	.736	.736	.736	.821	-
1-3/8	1.375	.040	1-1/4	.891	.891	.891	.994	-
1-1/2	1.500	.040	1-1/4	1.060	1.060	1.060	1.183	-
1-5/8	1.625	.045	1-1/4	1.244	1.244	1.244	-	-
1-3/4	1.750	.050	1	1.440	1.440	1.440	1.618	-
1-7/8	1.875	.055	1	1.657	1.657	1.657	-	-
2	2.000	.060	1	1.890	1.890	1.890	2.109	-
2-1/8	2.125	.060	1/2	2.128	-	-	-	-
2-1/4	2.250	.068	1/2	2.384	-	-	-	-
2-3/8	2.375	.071	1/2	2.658	-	-	-	-
2-1/2	2.500	.075	1/2	2.950	-	-	3.375	-
2-3/4	2.750	.080	1/2	3.560	-	-	-	-
3	3.000	.090	1/4	4.240	-	-	4.595	-
3-1/4	3.250	.100	1/4	4.975	-	-	-	-
3-1/2	3.500	.105	1/4	5.770	-	-	6.439	-
4	4.000	.120	1/4	7.550	-	-	8.460	-
4-1/2	4.500	.135	1/4	9.555	-	-	-	-
5	5.000	.150	1/4	11.700	-	-	13.950	-
5-1/2	5.500	.165	1/4	14.300	-	-	-	-
6	6.000	.180	1/4	17.100	-	-	20.395	-
7	7.000	.210	1/8	24.010	-	-	-	-
8	8.000	.240	1/8	31.360	-	-	-	-
9	9.000	.270	1/8	39.690	-	-	-	-
10	10.000	.300	1/8	49.000	-	-	-	-
11	11.000	.330	1/16	59.290	-	-	-	-
12	12.000	.360	1/16	74.000	-	-	-	-

1/4" thru 2" stocked in 10 ft lengths; 2 1/8" thru 5 1/2" stocked in 5 ft and 10 ft lengths; 6" thru 10" stocked in 5 ft lengths; 11" and 12" stocked in 1 ft and 2 ft lengths. Tolerance on lengths = ±1".

Camber (straightness) tolerances shown apply as follows: 1/2" thru 2" diameter rod per 10 ft length; 2 1/8" thru 10" diameter rod per 5 ft length; 11" thru 12" diameter rod per 2 ft length.

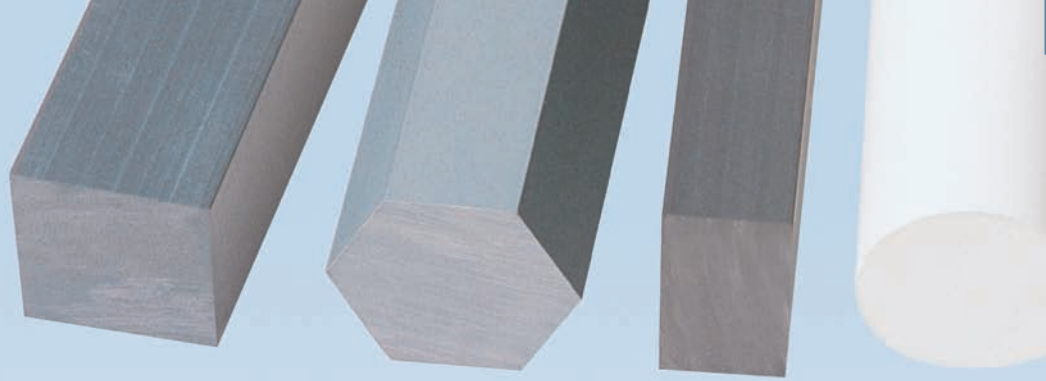
Hollow Bar

Substituting hollow bar for solid round can result in considerable savings where parts are bored. Only an internal finish cut is required, as close tolerances on OD dimensions are maintained.

O.D. Minimum (in.)	I.D. Maximum (in.)	Material (Weight Lbs./ft.)	
		PVC	CPVC
1.625	0.562	1.154	1.288
1.900	0.562	1.647	-
1.900	0.906	1.410	-
2.000	1.250	1.285	-
2.125	0.750	2.010	2.243
2.250	1.125	2.025	2.260
2.250	1.500	1.625	-
2.375	1.000	2.393	2.671
2.500	1.000	2.680	-
2.500	1.500	2.209	-
2.625	1.500	2.511	2.802
2.750	1.000	3.299	3.682
2.875	1.500	-	3.525
3.000	1.000	3.976	-
3.000	1.250	3.770	4.207
3.000	1.500	3.375	-
3.000	2.000	2.798	-
3.250	1.250	4.506	-
3.500	1.500	5.037	-
3.563	1.500	5.245	5.853
4.000	2.500	5.153	5.751
4.000	3.000	3.845	-
4.250	1.750	7.452	8.316
4.250	3.000	4.948	-
4.500	2.000	8.099	-
4.750	3.000	7.069	7.889
5.000	3.000	8.217	9.170
5.563	4.000	7.954	-
6.000	2.437	15.200	-
6.000	4.000	11.190	-
6.625	2.875	18.030	20.121
6.625	4.000	14.910	16.640
8.625	5.750	21.400	-

OD dimension shown is minimum. ID dimension shown is maximum. 1.625" x .562" thru 5" x 3" stocked in 10 ft lengths ± 1". 5.563" x 4.000" thru 8.625" x 5.750" stocked in 5 ft lengths ± 1".

Note: Centerless ground PVC & CPVC solid bar available 1/4" thru 2 1/2" diameters. OD tolerance on all centerless ground bar ± .003".



ADDITIONAL PROFILES

Additional quality profiles include Hex, Square, and Rectagonal shapes for use in component fabrication. Items such as nuts, bolts, washers and spacers can be readily machined from these items to provide durable corrosion-resistant components. Emphasis is placed on providing extrusions with minimal sink and smooth surfaces for dimensional consistency and easy reproduction of machined components.

Hexagonal Bar

Size (in.)	Tol. Across Flats (in.)	Material (Weight Lbs./ft.)		
		Gray PVC	CPVC	Clear
7/16	±.030	.108	.121	—
1/2	±.030	.142	.159	—
9/16	±.030	.180	.202	—
5/8	±.030	.222	.249	—
3/4	±.030	.320	.359	—
13/16	±.030	.375	.421	—
7/8	±.030	.435	.489	—
1	±.030	.569	.639	—
1-1/8	±.030	.721	.810	—
1-1/4	+ .0625 - 0	.890	.999	—
1-3/8	+ .0625 - 0	1.080	1.213	—
1-1/2	+ .0625 - 0	1.283	1.441	—
1-3/4	+ .0625 - 0	1.746	—	—
2	+ .0125 - 0	2.280	2.560	—

All sizes stocked in 10 ft lengths ± 1".

Square Bar

Size (in.)	Tol. Across Flats (in.)	Material (Weight Lbs./ft.)		
		Gray PVC	CPVC	Clear
1/2	±.030	.157	—	—
5/8	±.030	.238	—	—
3/4	±.030	.360	—	—
1	±.030	.629	—	—
1-1/4	±.0625	1.033	—	—
1-1/2	±.0625	1.464	—	—
2	+ .075 - .020	2.452	—	—

1/2" thru 1" stocked in 10 ft lengths ± 1".

1 1/4" thru 2" stocked in 8 ft lengths ± 1".

Rectangular Bar

Size (in.)	Tol. Across Flats (in.)	Material (Weight Lbs./ft.)		
		Gray PVC	CPVC	Clear
1/2 x 3/4	1/2" flats ± .020 3/4" flats ± .030	.225	—	—

All sizes stocked in 10 ft lengths ± 1".

Angle

Size (in.)	Material (Weight Lbs./ft.)			
	Gray PVC	White PVC	CPVC	Clear
1" x 1" x 1/8"	.141	.141	.180	.141
1-1/4" x 1-1/4" x 3/16"	.262	.262	.325	.262
1-1/2" x 1-1/2" x 3/16"	.316	.316	.395	.316
1-1/2" x 1-1/2" x 1/4"	.415	—	—	.415
2" x 2" x 1/4"	.563	.563	.645	.563

All sizes stocked in 10 ft lengths ± 1".





MACHINING RECOMMENDATIONS

Certain machining practices, regardless of the material being machined (plastic or metal), can generate excessive stress. When induced stresses caused by the effects of machining are added to any residual stress, product failure can result. Causes of excessive stress induced by machining include:

- Excessive heat generation (frictional heat caused by improper speed and/or feed rates)
- Taking too much material at once
- Using worn, dull or improper tooling
- Improper support of product during machining

Speed and feed rates will be determined by the finish desired, the amount of stock removed, and the tool used.

The maximum speed that a cutting tool can be operated without generating excessive heat should be determined by actual testing. Machine vibration and way clearances must be kept to a minimum. The following machining recommendations will help minimize the amount of stress induced during the machining process.

- 1. Heat Generation** should be kept to a minimum during all machining processes.
 - a. Actual testing should be conducted to determine the maximum speed at which a particular tool can be used without generating excessive heat and/or chipping. All tools must be kept clean and sharp.
 - b. Cutting solutions of water, soapy water, a suitable lubricant, or cool air jet should be considered for cooling during the machining process.

CAUTION: Certain oils and lubricants typically used for machining of metallics contain stress-cracking agents that are not compatible with PVC or CPVC materials. Contact the lubricant manufacturer for compatibility prior to use.

- 2. Turning and Boring** - High-speed steel and carbide tools are typically used for most plastics. A common practice is to follow the feed and speed rates that are typically used for machining brass. Speed rates for high-speed steel tools commonly vary between 250 - 500 ft./min.; speed rates for carbide tools can vary from 500 to 1500 ft./min. Tools used should have less clearance and more rake than those used for steel or other metals.

- 3. Drilling** - Carbide-tipped bits are recommended for high volume production. Extra clearance at the back edges of the flutes is desirable to reduce heat generation caused by friction. Drill speeds can be as high as 12,000 to 15,000 rpm with carbide-tipped bits. Bit points should have an included angle of 55° to 60° for thin sections and 90° for thicker sections; clearance angle should be 15°. Lubrication or an air jet should be provided to avoid excessive heating and aid in chip removal. Commercial high-speed steel drill bits specifically designed for use with plastics are available; they have large flutes for easy chip removal.

- 4. Tapping and Threading** - A high-speed, steel-nitrided, chromium-plated tap with a rake from 0° to -5° is recommended for tapping small holes. Tapping speeds usually vary from 40 to 55 ft./min. The size of the hole should allow for approximately three-quarters of the standard thread depth. When cutting a 60° thread (such as ANSI B1.2.1), the tool used should be ground to cut on one side only, and fed in at an angle of 30° by setting the compound rest at this angle.

NOTE: The machining characteristics of different plastics vary somewhat. The recommendations given are general and may require modification to obtain the best results. The data furnished herein is provided as a courtesy and is based on past experience, limited testing, and other information believed to be reliable. This information may be considered as a basis for recommendation only, and not as a guarantee for its accuracy, suitability for particular applications, or the results to be obtained therefrom. Materials should be machined and tested under actual use conditions to determine suitability for a particular purpose.

SAMPLE SPECIFICATIONS

All PVC stock machining shapes shall be manufactured from a rigid, unfilled, general-purpose-grade Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454, per ASTM D1784. (Callout Designation S-PVC0111 per ASTM D6263).

All CPVC stock machining shapes shall be manufactured from a rigid, unfilled, general-purpose-grade Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23437, per ASTM D1784. (Callout Designation S-CPVC0211 per ASTM D6263).

Product shall meet the applicable requirements of ASTM D6263, Standard Specification for Extruded Rods and Bars Made From Rigid PVC and CPVC. This shall include requirements pertaining to classification and material, physical properties, degree of fusion, dimensions, dimensional stability, lengthwise camber, workmanship, finish and appearance.

All stock machining shapes shall be manufactured in strict compliance to Harvel Plastics, Inc. requirements for extrusion profiles, consistently meeting and/or exceeding the Quality Assurance testing of this requirement with regard to material, workmanship, dimensions and extrusion quality. All shapes shall be porosity free, and shall be tested for internal stress levels. These products shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer, and shall be stored indoors after production at the manufacturing site until shipped from factory.



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



PPFA ASTM



300 Kuebler Rd., P.O. Box 757, Easton, PA 18044-0757
Tel 610-252-7355 • Fax 610-253-4436

www.Harvel.com e-mail: harvel@harvel.com

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