

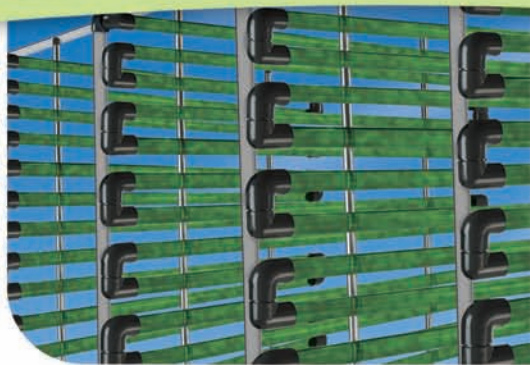
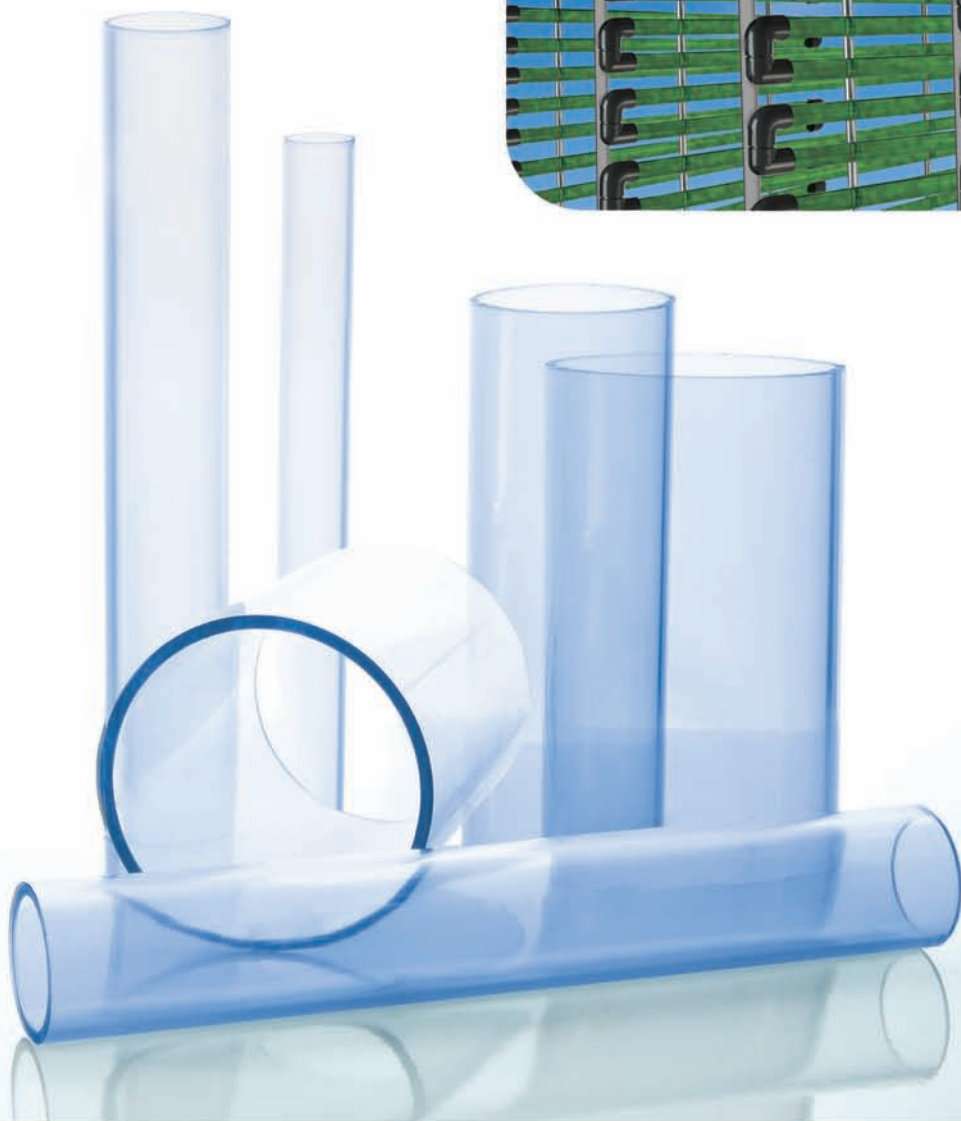


EnviroKing™

UV Resistant Clear PVC Piping

UV

A cost-effective solution for photobioreactors and other green energy applications.





EnviroKing™ UV

UV Resistant Clear PVC Piping

Harvel® EnviroKing™UV has been developed as a clear PVC piping that is suitable for exposure to sunlight. Unique UV blocking technology reduces harmful ultraviolet light wavelengths from penetrating the plastic while allowing beneficial wavelengths through.

These unique attributes provide a durable containment vessel that has been optimized to improve light transmission through the pipe without jeopardizing product integrity. This enables Harvel® EnviroKing™UV to provide a cost-effective solution for photobioreactor tubing used in the renewable energy industry and other outdoor applications.



Materials

Harvel EnviroKing™UV piping is produced from a unique, rigid, transparent PolyVinyl Chloride (PVC) compound with a Cell Classification of 11553 per ASTM D1784. This material, which shows a slight blue tint, has been specifically formulated to block damaging UV light. Harvel EnviroKingUV is compatible with conventional IPS size PVC pipe, fittings, and valves and can be incorporated into existing PVC systems via the solvent cement joining process. It exhibits similar chemical resistance properties to conventional clear PVC, and in general is resistant to most acids, bases, salts, and oxidants. Chemical compatibility should be confirmed prior to use in chemical service environments. Please contact Harvel Technical Services at 610-252-7355 for additional information.

Harvel EnviroKingUV piping provides a versatile, cost-effective alternative for many piping applications where light transmission through the pipe is critical, or other applications where visual monitoring of processes is necessary (i.e., sight glass applications).

This product possesses the well-known benefits of rigid PVC such as: exceptional corrosion resistance; smooth interior walls for unimpeded flow and reduced sediment buildup; fast, reliable solvent-welded connections; good pressure-bearing capability; and ease of handling and installation, to name a few. All of these important attributes are now available in a unique transparent product with UV stability.

Harvel EnviroKing™UV ThinWall™

Harvel EnviroKing™UV is a low-pressure containment pipe which provides optimum dimensions for use as photobioreactor vessels and similar green technology applications. For example, when used in photobioreactors, the unique wall dimensions improve light transmission characteristics beneficial for enhanced algae growth, while maintaining product rigidity.

| Nominal Pipe Size (inches) | O.D. | Average I.D. | Min. Wall | Nominal Wt./Ft. | Max. W.P. PSI* |
|----------------------------|--------|--------------|-----------|-----------------|----------------|
| 2 | 2.375 | 2.173 | 0.091 | 0.456 | 80 |
| 3 | 3.500 | 3.210 | 0.135 | 0.966 | 80 |
| 4 | 4.500 | 4.134 | 0.173 | 1.569 | 80 |
| 6 | 6.625 | 6.251 | 0.172 | 2.391 | 70 |
| 8 | 8.625 | 8.251 | 0.172 | 3.134 | 53 |
| 10 | 10.750 | 10.376 | 0.172 | 3.923 | 43 |
| 12 | 12.750 | 12.376 | 0.172 | 4.666 | 36 |

*Pressure ratings shown are for water, non-shock@73°F

Product Ratings

Harvel EnviroKingUV piping is available in two iron pipe size (IPS) pipe dimensions; **ThinWall™** dimensions specifically developed for use in photobioreactor construction, and standard **Schedule 40** dimensions.

Pressure ratings are dependent on the pipe diameter selected, the wall thickness, and 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 tables above for dimensions, tolerances, and pressure ratings.

The temperature de-rating factors shown at right are to be multiplied by the pressure ratings listed to determine the maximum pressure rating of the pipe at elevated temperatures.

De-rating Factors

| 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 |

Harvel EnviroKing™UV Schedule 40

Harvel EnviroKing™UV is also manufactured in IPS sizes to Schedule 40 dimensions, which provide sufficient wall thickness for many pressure applications. 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.

| Nominal Pipe Size (inches) | O.D. | Average I.D. | Min. Wall | Nominal Wt./Ft. | Max. W.P. PSI* |
|----------------------------|-------|--------------|-----------|-----------------|----------------|
| ½ | 0.840 | 0.602 | 0.109 | 0.170 | 300 |
| ¾ | 1.050 | 0.804 | 0.113 | 0.226 | 240 |
| 1 | 1.315 | 1.029 | 0.133 | 0.333 | 220 |
| 1¼ | 1.660 | 1.360 | 0.140 | 0.450 | 180 |
| 1½ | 1.900 | 1.590 | 0.145 | 0.537 | 170 |
| 2 | 2.375 | 2.047 | 0.154 | 0.720 | 140 |
| 2½ | 2.875 | 2.445 | 0.203 | 1.136 | 150 |
| 3 | 3.500 | 3.042 | 0.216 | 1.488 | 130 |
| 3½ | 4.000 | 3.521 | 0.226 | 1.789 | 120 |
| 4 | 4.500 | 3.998 | 0.237 | 2.118 | 110 |
| 6 | 6.625 | 6.031 | 0.280 | 3.733 | 90 |

*Pressure ratings shown are for water, non-shock@73°F

Product Features

- Manufactured to both ThinWall™ and standard Schedule 40 dimensions
- Joined utilizing simple solvent-welded joining techniques
- Manufactured to IPS dimensions—Fully compatible with standard PVC pipe, fittings, and valves
- Corrosion resistant
- Non-conductive
- Lightweight, easy to handle and install
- Lower overall installed cost than glass, acrylic, or other transparent alternatives

Physical Properties

| GENERAL | Value | Test Method |
|---|--------------------------------|-------------|
| Cell Classification | 11553 | ASTM D1784 |
| Maximum Service Temperature | 140°F | |
| Color | Transparent / slight blue tint | |
| Specific Gravity, (g/cu.cm @ 73°F) | 1.38 | ASTM D792 |
| Hardness, Shore D | 85 | ASTM D2240 |
| Hazen-Williams Factor | C = 150 | |
| MECHANICAL | | |
| Tensile Strength, psi @ 73°F | 8,250 | ASTM D638 |
| Tensile Modulus of Elasticity, psi @ 73°F | 416,000 | ASTM D638 |
| Flexural Strength, psi @ 75°F | 13,600 | ASTM D790 |
| Flexural Modulus, psi @ 75°F | 423,000 | ASTM D790 |
| Izod Impact notched – injection molded, .125 in. bars, 73°F | 3.9 ft.-lbs./in. | ASTM D256 |
| THERMAL | | |
| Coefficient of Linear Expansion (in/in/°F) | 3.9 x 10 ⁻⁵ | ASTM D696 |
| Heat Distortion Temperature, Unannealed, 264 psi, .125 in. Bars | 142°F | ASTM D648 |
| FIRE PERFORMANCE | | |
| Flammability Rating | V-0 | UL-94 |
| OTHER | | |
| Product is not NSF Listed for potable water use | | |

System Design

Storage & Handling

Although Harvel EnviroKing™UV products are tough and corrosion resistant, they should not be dropped, have objects dropped on them, nor subjected to external loads. Thermoplastics can be damaged by abrasion and gouging. Pipe must not be dragged across the ground or over obstacles. Impacts such as dropping from sizable heights and/or rough handling should be avoided, particularly in cold weather. The product shall be inspected for any scratches, splits, or gouges that may have occurred from improper handling or storage. If found, these sections must be cut out and discarded.

Joining Techniques

Harvel EnviroKingUV is compatible with conventional IPS size PVC pipe, fittings, and valves and can be joined via the solvent cement joining process, providing a quick, strong, leak-tight seal. For optimum joint integrity, Harvel recommends the use of a medium-bodied, fast-setting PVC solvent cement in conjunction with a PVC primer, such as IPS Weld-on 705 Clear cement and IPS Weld-on P-70 Clear primer. Details on proper solvent cementing techniques are available from Harvel and must be reviewed for proper assembly and joint integrity. Refer to Harvel Engineering & Installation Guide (HPB-112/401), www.EnviroKingUV.com, or contact Harvel Technical Services for additional information.

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, threaded fittings, and unions. Joining options are limitless when overall system clarity is not a necessity. When threaded fittings are utilized Harvel recommends the use of Teflon® tape for making reliable threaded connections. (Certain thread paste compounds may contain stress cracking agents; contact the paste manufacturer for compatibility with PVC prior to use.) 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.

Threading or grooving of Harvel EnviroKingUV pipe is not recommended due to insufficient wall thickness. Use standard PVC specialty transition fittings where applicable.

and Installation

Thermal Expansion and Contraction

Harvel EnviroKingUV piping will expand and contract with changes in temperature. This issue must be addressed with appropriate system design—and during installation—to prevent damage to the piping system. The change in length generated as the result of temperature changes must be calculated based on the anticipated change in temperature that the system will be exposed to. The coefficient of linear expansion for Harvel EnviroKingUV pipe is 3.9×10^{-5} in./in./°F. The rate of expansion or contraction can be calculated as follows:

$\Delta L = 12 yL (\Delta T)$ where:
 ΔL = expansion or contraction in inches
 $y = 3.9 \times 10^{-5}$ (coefficient of linear expansion)
 L = length of piping run in feet
 ΔT = temperature change °F
(T max. - T@ installation)

In many cases the movement caused by thermal expansion/contraction must then be compensated for by the construction of appropriately sized expansion loops, offsets, bends, or the installation of expansion joints. These configurations will absorb stresses generated from the movement, thereby minimizing damage to the piping. The effects of thermal expansion and contraction must be considered for systems involving long runs, and particularly piping systems exposed to environmental temperature extremes (i.e., exposed outdoors, summer to winter). Contact Harvel Technical Services for additional information.



Hangers and Supports

Support location and spacing is dependent on the pipe diameter, the 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 that is free of any rough or sharp edges that could damage the piping during use. Hangers must also not restrict linear movement of the system due to the effects of expansion and contraction. Overtightening of hangers/supports must be avoided.

Support Spacing

ThinWall™

| Pipe Size (inches) | Maximum Support Spacing in Feet | | | | |
|--------------------|---------------------------------|------|-------|-------|-------|
| | 60°F | 80°F | 100°F | 120°F | 140°F |
| 2 | 4½ | 4½ | 4 | 3½ | 3 |
| 3 | 5½ | 5½ | 5 | 4½ | 3½ |
| 4 | 6½ | 6 | 5½ | 5 | 4 |
| 6 | 6½ | 6 | 5½ | 5 | 4 |
| 8 | 6 | 5½ | 5 | 4½ | 4 |
| 10 | 5½ | 5½ | 5 | 4½ | 3½ |
| 12 | 5 | 5 | 4½ | 4 | 3½ |

Schedule 40

| Pipe Size (inches) | Maximum Support Spacing in Feet | | | | |
|--------------------|---------------------------------|------|-------|-------|-------|
| | 60°F | 80°F | 100°F | 120°F | 140°F |
| ½ | 4½ | 4½ | 4 | 2½ | 2½ |
| ¾ | 4½ | 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 |

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 EnviroKing™UV 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. These facts should be considered if optimum clarity is required for the system by testing under actual use conditions at the initial design phase of the project. Chemical compatibility should be confirmed prior to use in chemical service environments, Please contact Harvel Technical Services at 610-252-7355 for additional information.

Threading or grooving of Harvel EnviroKingUV pipe is not recommended due to insufficient wall thickness. Use standard PVC specialty transition fittings where applicable.

Harvel EnviroKingUV products are suitable for use in areas where ambient temperatures are within the range of 35°F to 140°F. Appropriate temperature de-rating factors must be applied when working at elevated temperatures to determine the maximum allowable pressure. Since pressure bearing capacity is not reduced with a decrease in temperature, EnviroKingUV is suitable for use in colder temperature environments provided the fluid medium is protected from freezing, consideration is given to the effects of expansion and contraction, and additional care is given during handling, installation and operation of the system to prevent physical damage caused by impact or other mechanical forces.

Sample Specification

All transparent pipe used for photobioreactor or other outdoor applications shall be manufactured from a PolyVinyl Chloride (PVC) compound with a minimum Cell Classification of 11553 per ASTM D1784. This material shall be a UV stabilized PVC material and shall exhibit a slight blue tint. The pipe shall be manufactured to iron pipe size diameters in either ThinWall pipe dimensions that have been optimized for light transmission, or Schedule 40 pipe dimensions as applicable. The pipe shall be manufactured in the USA by an ISO 9001 certified manufacturer. All PVC clear pipe shall be packaged immediately after its manufacture to prevent damage, and shall then be stored indoors at the manufacturing site until shipped from factory. All pipe shall be manufactured by Harvel® Plastics, Inc., trade name EnviroKing™UV ThinWall™, or EnviroKing™UV Schedule 40 as applicable.



CAUTION EnviroKingUV piping products must be protected from freezing.

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