

Watertight Enclosure Documentation



Introduction

Blue Robotics offers a series of watertight enclosures for use on ROVs, AUVs, and other marine vehicles. A modular design consisting of a tube, sealing flanges, and various end caps allows lots of flexibility and modification. The enclosures are made of high-quality, precision machined parts and are simple to assemble.

Important Notes

- ⚠** Always inspect the O-rings before operation in water and especially when replacing the end-caps, aluminum flanges, or penetrators. Any dust, hair, or other particles can cause a leak.
- ⚠** Use plastic tools, NOT steel or other hard tools, to remove the O-rings from the aluminum sealing flange. Hard tools can create scrapes that will compromise sealing ability.

Specifications: (2" Series)



Specification Table (2" Series)

2" Series Enclosure		
Maximum Depth Rating (Acrylic Tube)	330 ft	100 m
Maximum Depth Rating (Aluminum Tube)	3280 ft	1000 m
Maximum Depth Rating (Dome)	3280 ft	1000 m
Maximum Tested Depth (Acrylic Tube) (failure)	660 ft	200 m
Maximum Tested Depth (Aluminum Tube)	3280 ft	1000 m
Maximum Tested Depth (Dome)	3280 ft	1000 m
Failure Depth (https://youtu.be/1rX_jH3785I) (for 12" length acrylic)	660 ft	200 m
Maximum External Pressure Rating	146 psi	1000 kPa
Weight in Air (12" Length)	1.1 lb	500 g
Weight in Water (Freshwater)	-0.72 lb	-326 g

2" Series Enclosure			
Displacement		50.3 in^3	825 cm^3
Tube Inner Diameter		2 in	50.8 mm
Tube Outer Diameter		2.25 in	57.2 mm
Tube Thickness		0.125 in	3.2 mm
End Cap Thickness		0.24 in	6.0 mm
Aluminum Flange Inner Diameter		1.5 in	38 mm
Total Length		12.7 in	322 mm
Radial Seal O-ring (2 used)		AS568-133, Buna-N	
Face Seal O-ring (1 used)		AS568-030, Buna-N	
End Cap Screws		M2x10 (Stainless Steel 316)	
Inner Mounting Holes		M3 threading	

2D Drawings (2" Series)

2" Series Enclosure	
Assembly	WTE2-ASM-R1 Drawing (/assets/images/WTE/drawings/WTE2/WTE2-ASM-2-R1.png)
Aluminum O-ring Flange	WTE2-M-FLANGE-SEAL-R2 Drawing (/assets/images/WTE/drawings/WTE2/WTE2-M-FLANGE-SEAL-R2.png)
Plain Solid End Cap	WTE2-P-END-CAP-R1 Drawing (/assets/images/WTE/drawings/WTE2/WTE2-SIMPLE-END-CAP-R1.png)
End Cap with 2 x 10mm Holes	WTE2-P-END-CAP-2X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE2/WTE2-P-END-CAP-2-2X10MM-R1.png)
Dome End Cap	WTE2-ASM-DOME-R1 Drawing (/wte/cad/WTE2-ASM-DOME-R1.PNG)

3D Models (2" Series)

All 3D models are provided in zip archives containing the follow file types:

- SolidWorks Part (.sldprt)
- IGES (.igs)
- STEP (.step)
- STL (.stl)

2" Series Enclosure	
Assembly Model	WTE2-ASM-R1.zip (http://www.bluerobotics.com/models/WTE2-ASM-R1.zip)
Tube (Standard 11.75", 298mm length)	WTE2-P-TUBE-12-R1.zip (http://www.bluerobotics.com/models/WTE2-P-TUBE-12-R1.zip)
Aluminum O-ring Flange	WTE2-M-FLANGE-SEAL-R2.zip (http://www.bluerobotics.com/models/WTE2-M-FLANGE-SEAL-R2.zip)
Plain Solid End Cap	WTE2-P-END-CAP-R1.zip (http://www.bluerobotics.com/models/WTE2-P-END-CAP-R1.zip)
End Cap with 2 x 10mm Holes	WTE2-P-END-CAP-2X10MM-R1.zip (http://www.bluerobotics.com/models/WTE2-P-END-CAP-2X10MM-R1.zip)
Dome End Cap	WTE2-ASM-DOME-R1.zip (/wte/cad/WTE2-ASM-DOME-R1.zip)

Specifications: 3" Series



Specification Table (3" Series)

3" Series Enclosure		
Maximum Depth Rating (Acrylic Tube)	500 ft	150 m
Maximum Depth Rating (Aluminum Tube)	1640 ft	500 m
Maximum Depth Rating (Dome)	1640 ft	500 m
Maximum Tested Depth (Acrylic Tube)	660 ft	200 m
Maximum Tested Depth (Aluminum Tube)	2460 ft	750 m
Maximum Tested Depth (Dome)	3280 ft	1000 m
Failure Depth	TBD	
Maximum External Pressure Rating	215 psi	1500 kPa
Tube Inner Diameter	3 in	76.2 mm
Tube Outer Diameter	3.5 in	88.9 mm
Tube Thickness	0.25 in	6.3 mm
End Cap Thickness	0.47 in	12.0 mm
Aluminum Flange Inner Diameter	2.5 in	63.5 mm
Total Length	12.93 in	329 mm
Radial Seal O-ring (2 used)	AS568-230, Buna-N	
Face Seal O-ring (1 used)	AS568-148, Buna-N	
End Cap Screws	M3x12 (Stainless Steel 316)	
Inner Mounting Holes	M3 threading	

2D Drawings (3" Series)

3" Series Enclosure	
Assembly Model	WTE3-ASM-R1 Drawing (/assets/images/WTE/drawings/WTE3/WTE3-ASM-R1.png)
Aluminum O-ring Flange	WTE3-M-FLANGE-SEAL-R2 Drawing (/assets/images/WTE/drawings/WTE3/WTE3-M-FLANGE-SEAL-R2.png)
Plain Solid End Cap	WTE3-P-END-CAP-R1 Drawing (/assets/images/WTE/drawings/WTE3/WTE3-PM-END-CAP-R1.png)
End Cap with 4 x 10mm Holes	WTE3-P-END-CAP-4X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE3/WTE3-PM-END-CAP-4X10MM-R1.png)

3" Series Enclosure	
End Cap with 7 x 10mm Holes	WTE3-P-END-CAP-7X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE3/WTE3-PM-END-CAP-7X10MM-R1.png)
Clamp	WTE3-M-CLAMP-R1 Drawing (/wte/cad/WTE3-M-CLAMP-R1.PNG)
Aluminum Tube	WTE3-M-TUBE-8P75-R1 Drawing (/wte/cad/WTE3-M-TUBE-8P75-R1.PNG)
Dome End Cap	WTE3-ASM-DOME-R1 Drawing (/wte/cad/WTE3-ASM-DOME-R1.PNG)

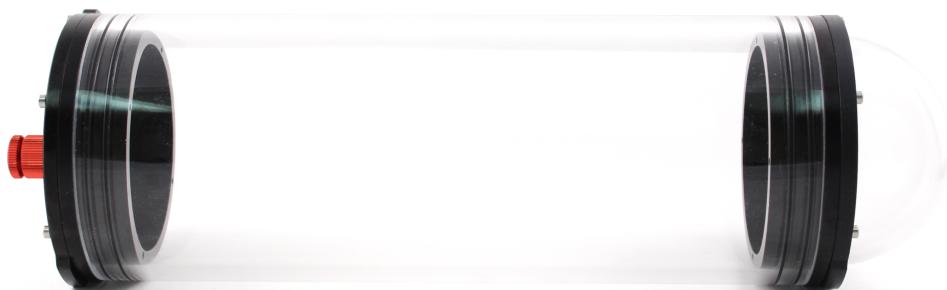
3D Models (3" Series)

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3" Series Enclosure	
Assembly Model	WTE3-ASM-R1.zip (http://www.bluerobotics.com/models/WTE3-ASM-R1.zip)
Acrylic Tube (Standard 11.75", 298mm length)	WTE3-P-TUBE-R1.zip (http://www.bluerobotics.com/models/WTE3-P-TUBE-R1.zip)
Aluminum Tube (Standard 8.75", 222mm length)	WTE3-M-TUBE-8P75-R1.zip (/wte/cad/WTE3-M-TUBE-8P75-R1.zip)
Aluminum O-ring Flange	WTE3-M-FLANGE-SEAL-R1.zip (http://www.bluerobotics.com/models/WTE3-M-FLANGE-SEAL-R1.zip)
Plain Solid End Cap	WTE3-P-END-CAP-R1.zip (http://www.bluerobotics.com/models/WTE3-P-END-CAP-R1.zip)
End Cap with 4 x 10mm Holes	WTE3-P-END-CAP-4X10MM-R1.zip (http://www.bluerobotics.com/models/WTE3-P-END-CAP-4X10MM-R1.zip)
End Cap with 7 x 10mm Holes	WTE3-P-END-CAP-7X10MM-R1.zip (http://www.bluerobotics.com/models/WTE3-P-END-CAP-7X10MM-R1.zip)
Clamp	WTE3-M-CLAMP-R1.zip (/wte/cad/WTE3-M-CLAMP-R1.zip)
Dome End Cap	WTE3-ASM-DOME-R1.zip (/wte/cad/WTE3-ASM-DOME-R1.zip)

Specifications: 4" Series



Specification Table (4" Series)

4" Series Enclosure		
Maximum Depth Rating (Acrylic Tube)	330 ft	100 m
Maximum Depth Rating (Aluminum Tube)	1300 ft	400 m
Maximum Tested Depth (Acrylic Tube)	500 ft	150 m
Maximum Tested Depth (Aluminum Tube)	2000 ft	610 m
Maximum Pressure	146 psi	1000 kPa
Tube Inner Diameter	4 in	101.6 mm
Tube Outer Diameter	4.5 in	114.3 mm
Tube Thickness	0.25 in	6.3 mm
End Cap Thickness	0.47 in	12.0 mm
Aluminum Flange Inner Diameter	3.5 in	89 mm
Total Length	13.15 in	334 mm
Radial Seal O-ring (2 used)	AS568-238, Buna-N	
Face Seal O-ring (1 used)	AS568-154, Buna-N	
End Cap Screws (Acrylic Endcaps)	M3x16 (Stainless Steel 316)	
End Cap Screws (Aluminum & Dome Endcaps)	M3x12 (Stainless Steel 316)	
Inner Mounting Holes	M3 threading	

2D Drawings (4" Series)

4" Series Enclosure	
Assembly Model	WTE4-ASM-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-ASM-4-R1.png)
Aluminum O-ring Flange	WTE4-M-FLANGE-SEAL-R2 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-M-FLANGE-SEAL-R3.png)
Plain Solid End Cap	WTE4-P-END-CAP-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-M-END-CAP-R1.png)
Aluminum Solid End Cap	WTE4-M-END-CAP-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-M-END-CAP-R1.png)
Aluminum End Cap with 10 x 10mm Holes	WTE4-M-END-CAP-10X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-M-END-CAP-10-10MM-R1.png)
End Cap with 5 x 10mm Holes	WTE4-P-END-CAP-5X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-P-END-CAP-5-10MM-R1.png)
End Cap with 10 x 10mm Holes	WTE4-P-END-CAP-10X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-M-END-CAP-10-10MM-R1.png)
End Cap with 14 x 10mm Holes	WTE4-M-END-CAP-14X10MM-R1 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-M-END-CAP-14X10MM-R1.png)
Dome End Cap	WTE4-P-DOME-R2 Drawing (/assets/images/WTE/drawings/WTE4/WTE4-P-DOME-R2.PNG)
Clamp	WTE4-M-CLAMP-R1 Drawing (/wte/cad/WTE4-M-CLAMP-R1.PNG)
Aluminum Tube	WTE4-M-TUBE-12-R1 Drawing (/wte/cad/WTE4-M-TUBE-12-R1.PNG)

3D Models (4" Series)

All 3D models are provided in zip archives containing the follow file types:

- SolidWorks Part (.sldprt)
- IGES (.igs)
- STEP (.step)
- STL (.stl)

4" Series Enclosure	
Assembly Model	WTE4-ASM-R2.zip (http://www.bluerobotics.com/models/WTE4-ASM-R2.zip)
Acrylic Tube (Standard 11.75", 298mm length)	WTE4-P-TUBE-12-R1.zip (http://www.bluerobotics.com/models/WTE4-P-TUBE-12-R1.zip)
Aluminum Tube (Standard 11.75", 298 mm length)	WTE4-M-TUBE-12-R1.zip (/wte/cad/WTE4-M-TUBE-12-R1.zip)
Aluminum O-ring Flange	WTE4-M-FLANGE-SEAL-R2.zip (http://www.bluerobotics.com/models/WTE4-M-FLANGE-SEAL-R2.zip)
Plain Solid End Cap	WTE4-P-END-CAP-R1.zip (http://www.bluerobotics.com/models/WTE4-P-END-CAP-R1.zip)
Aluminum Solid End Cap	WTE4-M-END-CAP-R1.zip (http://www.bluerobotics.com/models/WTE4-M-END-CAP-R1.zip)
Aluminum End Cap with 10 x 10mm Holes	WTE4-M-END-CAP-10X10MM-R1.zip (http://www.bluerobotics.com/models/WTE4-M-END-CAP-10X10MM-R1.zip)
End Cap with 5 x 10mm Holes	WTE4-P-END-CAP-5X10MM-R1.zip (http://www.bluerobotics.com/models/WTE4-P-END-CAP-5X10MM-R1.zip)
End Cap with 10 x 10mm Holes	WTE4-P-END-CAP-10X10MM-R1.zip (http://www.bluerobotics.com/models/WTE4-P-END-CAP-10X10MM-R1.zip)
End Cap with 14 x 10mm Holes	WTE4-M-END-CAP-14X10MM-R1.zip (/wte/cad/WTE4-M-END-CAP-14X10MM-R1.zip)
Dome End Cap	WTE4-P-DOME-R1.zip (/wte/cad/WTE4-P-DOME-R2.zip)
Clamp	WTE4-M-CLAMP-R1.zip (/wte/cad/WTE4-M-CLAMP-R1.zip)

Specifications: 6" Series

Specification Table (6" Series)

6" Series Enclosure		
Maximum Tested Depth (Saltwater)	210 ft	65 m
Maximum Pressure	91.1 psi	637.6 kPa
Tube Inner Diameter	6.0 in	152.4 mm
Tube Outer Diameter	6.5 in	165.1 mm
Tube Thickness	0.25 in	6.4 mm
Acrylic End Cap thickness	0.5 in	12.7 mm
Aluminum End Cap Thickness	0.24 in	6 mm
Aluminum Flange Inner Diameter	5.0 in	127 mm
Total Length	12.0 in	304.8 mm
Radial Seal O-ring (2 used)	AS568-432, Buna-N	
Face Seal O-ring (1 used)	AS568-162, Buna-N	
End Cap Screws (Acrylic Endcaps)	M3x16 (Stainless Steel 316)	

6" Series Enclosure	
End Cap Screws (Aluminum Endcaps)	M3x12 (Stainless Steel 316)
Inner Mounting Holes	M3 threading

2D Drawings (6" Series)

6" Series Enclosure	
Assembly Model	ASSEM-WTE6-R1 Drawing (/wte/cad/ASSEM-WTE6-R1.PNG)
Aluminum O-ring Flange	WTE6-M-FLANGE-SEAL-R1 Drawing (/wte/cad/WTE6-M-FLANGE-SEAL-R1.PNG)
Acrylic Solid End Cap	WTE6-P-END-CAP-R1 Drawing (/wte/cad/WTE6-P-END-CAP-R1.PNG)
Aluminum Solid End Cap	WTE6-M-END-CAP-R1 Drawing (/wte/cad/WTE6-M-END-CAP-R1.PNG)
Aluminum End Cap with 5 x 10mm Holes	WTE6-M-END-CAP-5-10MM-R1 Drawing (/wte/cad/WTE6-M-END-CAP-5-10MM-R1.PNG)
Aluminum End Cap with 15 x 10mm Holes	WTE6-M-END-CAP-15-10MM-R1 Drawing (/wte/cad/WTE6-M-END-CAP-15-10MM-R1.PNG)

3D Models (6" Series)

All 3D models are provided in zip archives containing the follow file types:

- SolidWorks Part (.sldprt)
- IGES (.igs)
- STEP (.step)
- STL (.stl)

6" Series Enclosure	
Assembly Model	ASSEM-WTE6-R1.zip (/wte/cad/ASSEM-WTE6-R1.zip)
Tube (Standard 11.75", 298mm length)	WTE6-P-TUBE-R1.zip (/wte/cad/WTE6-P-TUBE-R1.zip)
Aluminum O-ring Flange	WTE6-M-FLANGE-SEAL-R1.zip (/wte/cad/WTE6-M-FLANGE-SEAL-R1.zip)
Acrylic Solid End Cap	WTE6-P-END-CAP-R1.zip (/wte/cad/WTE6-P-END-CAP-R1.zip)
Aluminum Solid End Cap	WTE6-M-END-CAP-R1.zip (/wte/cad/WTE6-M-END-CAP-R1.zip)
End Cap with 5 x 10mm Holes	WTE6-M-END-CAP-5-10MM-R1.zip (/wte/cad/WTE6-M-END-CAP-5-10MM-R1.zip)
End Cap with 15 x 10mm holes	WTE6-M-END-CAP-15-10MM-R1.zip (/wte/cad/WTE6-M-END-CAP-15-10MM-R1.zip)

Specifications: 8" Series

Specification Table (8" Series)

8" Series Enclosure	
Maximum Tested Depth (Saltwater)	130 ft
Maximum Pressure	56.4 psi
Tube Inner Diameter	8.0 in
Tube Outer Diameter	8.5 in
Tube Thickness	0.25 in
	40 m
	392.4 kPa
	203.2 mm
	215.9 mm

8" Series Enclosure		
Acrylic End Cap Thickness	0.5 in	12.7 mm
Aluminum End Cap Thickness	0.24 in	6 mm
Aluminum Flange Inner Diameter	7.0 in	177.8 mm
Total Length	12.0 in	304.8 mm
Radial Seal O-ring (2 used)	AS568-442, Buna-N	
Face Seal O-ring (1 used)	AS568-170, Buna-N	
End Cap Screws (Acrylic Endcaps)	M3x16 (Stainless Steel 316)	
End Cap Screws (Aluminum & Dome Endcaps)	M3x12 (Stainless Steel 316)	
Inner Mounting Holes	M3 threading	

2D Drawings (8" Series)

8" Series Enclosure	
Assembly Model	ASSEM-WTE8-R1 Drawing (/wte/cad/ASSEM-WTE8-R1.PNG)
Aluminum O-ring Flange	WTE8-M-FLANGE-SEAL-R1 Drawing (/wte/cad/WTE8-M-FLANGE-SEAL-R1.PNG)
Acrylic Solid End Cap	WTE8-P-END-CAP-R1 Drawing (/wte/cad/WTE8-P-END-CAP-R1.PNG)
Aluminum Solid End Cap	WTE8-M-END-CAP-R1 Drawing (/wte/cad/WTE8-M-END-CAP-R1.PNG)
Aluminum End Cap with 5 x 10mm Holes	WTE8-M-END-CAP-5-10MM-R1 Drawing (/wte/cad/WTE8-M-END-CAP-5-10MM-R1.PNG)
Aluminum End Cap with 15 x 10mm Holes	WTE8-M-END-CAP-15-10MM-R1 Drawing (/wte/cad/WTE8-M-END-CAP-15-10MM-R1.PNG)
Aluminum End Cap with 25 x 10mm Holes	WTE8-M-END-CAP-25-10MM-R1 Drawing (/wte/cad/WTE8-M-END-CAP-25-10MM-R1.PNG)
Dome End Cap	WTE8-P-DOME-R1 Drawing (/wte/cad/WTE8-P-DOME-R1.PNG)

3D Models (8" Series)

All 3D models are provided in zip archives containing the follow file types:

- SolidWorks Part (.sldprt)
- IGES (.igs)
- STEP (.step)
- STL (.stl)

8" Series Enclosure	
Assembly Model	ASSEM-WTE8-R1.zip (/wte/cad/ASSEM-WTE8-R1.zip)
Tube (Standard 11.75", 298mm length)	WTE8-P-TUBE-R1.zip (/wte/cad/WTE8-P-TUBE-R1.zip)
Aluminum O-ring Flange	WTE8-M-FLANGE-SEAL-R1.zip (/wte/cad/WTE8-M-FLANGE-SEAL-R1.zip)
Acrylic Solid End Cap	WTE8-P-END-CAP-R1.zip (/wte/cad/WTE8-P-END-CAP-R1.zip)
Aluminum Solid End Cap	WTE8-M-END-CAP-R1.zip (/wte/cad/WTE8-M-END-CAP-R1.zip)
End Cap with 5 x 10mm Holes	WTE8-M-END-CAP-5-10MM-R1.zip (/wte/cad/WTE8-M-END-CAP-5-10MM-R1.zip)
End Cap with 15 x 10mm Holes	WTE8-M-END-CAP-15-10MM-R1.zip (/wte/cad/WTE8-M-END-CAP-15-10MM-R1.zip)

8" Series Enclosure	
End Cap with 25 x 10mm Holes	WTE8-M-END-CAP-25-10MM-R1.zip (/wte/cad/WTE8-M-END-CAP-25-10MM-R1.zip)
Dome End Cap	WTE8-P-DOME-R1.zip (/wte/cad/WTE8-P-DOME-R1.zip)

Assembly

The assembly process is simple and straightforward - it will take a few minutes!

Tools Needed:

- Silicone grease
- 2.5mm Hex Driver
- Isopropyl alcohol

Video Tutorial

Blue Robotics Tutorial: Assembling the Watertight Enclosure



Steps



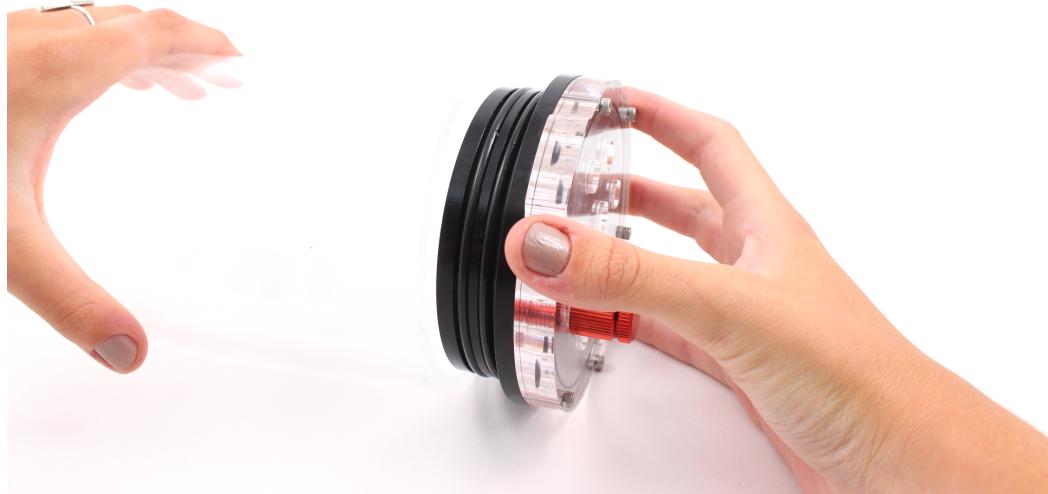
1. We recommend first cleaning the O-rings and the O-ring grooves with isopropyl alcohol. This will ensure a good seal. Next, lubricate the three O-rings with a thin layer of silicone grease and then install the two thick O-rings into the grooves on the flange. The thin O-ring is placed in the groove in the face of the flange.



1. Attach the end-caps to the flanges with 6 socket cap screws. Gently tighten the screws in an alternating cross pattern so that the O-ring is compressed but not so tight as to damage the plastic. Do not overtighten the screws!



1. Install the vent and any necessary cable penetrators into the end-cap.

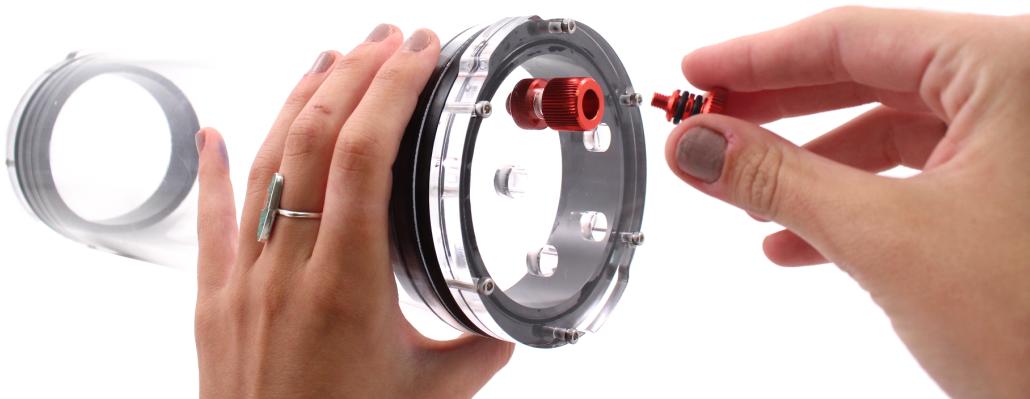


2. Install the flanges onto the tube and replace the vent cap to seal.

Opening Enclosure

Opening the enclosure is straightforward.

Steps:



1. Remove the vent plug.



1. Remove the flange using the tabs on the sides of the end cap.

Making Custom End Caps

One of the cool things about the watertight enclosure design is that it's compatible with all sort of end cap sizes and shapes. We've got a few different ones available but we encourage you to design your own to perfectly suit your application.

The CAD files above as well as the DXF drawing file attached below will give you a good starting point for your design. You'll need access to either 3D modeling software like SolidWorks or AutoCAD or 2D drawing software like Adobe Illustrator, Inkscape, and others.

- WTE2-P-END-CAP-R1.DXF ([/wte/dxf/WTE2-P-END-CAP-R1.DXF](#))
- WTE3-P-END-CAP-R1.DXF ([/wte/dxf/WTE3-P-END-CAP-R1.DXF](#))
- WTE4-P-END-CAP-R1.DXF ([/wte/dxf/WTE4-P-END-CAP-R1.DXF](#))

Here are a few things to remember:

- We recommend the following thicknesses of cast acrylic to handle the pressure:
 - 2" Series: 6mm / 0.25"
 - 3" Series: 9mm / 0.375"
 - 4" Series: 12mm / 0.50"
- Note the inner diameter of the aluminum sealing flange and ensure that any holes are within that diameter
- Feel free to extend beyond the original shape to add mounting holes, etc.

Once you have a design, you can cut the parts yourself if you have a laser cutter or use an online service. We have frequently used Pololu Laser Cutting (<https://www.pololu.com/product/749>) with great results!

