Building a Weatherproof Case & Internals for a Thomas Jacquie Allsky Camera

Version 2.0
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March 5, 2021
Building a Weatherproof Case & Internals

A variety of weatherproof case designs along with a variety of internal structures to hold the Raspberry Pi and camera are possible. This document describes the case and internal structure built by the author, which copies the internal structure used by Thomas Jacquin.

For background, here are links to the Thomas Jacquin allsky camera:
Description of Allsky camera:
https://www.instructables.com/id/Wireless-All-Sky-Camera/

GitHub site with the software for the raspberry Pi which runs the all sky camera.
https://github.com/thomasjacquin/allsky

Here's a link to an operating all-sky camera in Bend, Oregon
http://www.cbstarrynights.com/allsky1/
The picture shows the internal structure as described in the pages that follow. The design is similar to the Thomas Jacquin design, with the difference that the RPI is mounted in its plastic case with a cooling fan attached. And the plastic case is only attached to the plywood by electrical tape.

An experiment shows that the plastic case with cooling fan keeps the CPUs on the RPI about 15 degrees C cooler (at about 55 degrees C) than with an exposed board without the cooling fan. During warm summer days, the extra 15 degrees C of leeway may be critical, as the CPU is rated to begin reduced operation above 85 degrees C.

Note the 90-degree angled USB-C power connector at “A” which is required to fit the RPI-with-case inside the 4” internal diameter pipe enclosure and to otherwise avoid damaging the straight-on power cord.
Materials needed to build a weatherproof enclosure & internal structure (page 1)

1) Four-inch, inner diameter, black plastic drain pipe, 12 inches long. This is sold in home supply stores, typically in 2ft lengths or 20ft lengths.

2) Flat-topped plastic drain cap to fit over the outer diameter of the four inch pipe at the top of the enclosure. We will drill a 2” hole in the center of this cap. The inner central face of the cap should be flat out to the diameter of the camera body, to avoid complications of seating the camera up against that surface later.

3) Male fitting to slide over the bottom of the four inch pipe; this fitting is threaded on the bottom inside to take a threaded plug

4) Threaded plastic base plug to screw into the Male fitting #3. This threaded plug forms the bottom of the enclosure.

Continued on next page
Materials needed to build a weatherproof enclosure & internal structure

5) Six screws ½” long to attach the acrylic dome over the top of the enclosure – we assume that you previously acquired a 3” acrylic dome as described in a different document

6) Two pieces of stiff plywood as an internal support structure to hold the camera and computer;
   • This plywood is 3/16” thick – don’t use thicker plywood – the parts won’t fit inside the pipe
   • The circular piece of plywood is 96mm in diameter, with a slot cut out of the edge to accommodate the camera USB plug; the “circular” piece shown in the picture has straight sides but that shaping is not needed
   • The “H”-shaped piece of plywood is 97mm wide by about 350mm long; the width is critical because the inner rim of the bottom plastic plug has to contact the bottom outer edges of this plywood to hold the camera and assembly in place; the length is also critical and must be fitted to the length of your pipe assembly, as described later. Cut this piece plywood long – you will trim its length to the exact length needed later.
   • The “H” cutout on the top, toward the camera, is 80mm long x 35mm wide to give access to the camera bolt
   • The “H” cutout on the bottom side makes room for the power supply and plug assembly – that “H” cutout is 50mm wide and about 130mm long

7) Two Steel bracket with 90 degree angle to attach together the internal plywood support structure at “A” in the picture

8) Short bolts to attach the steel brackets to the plywood at “A” in the picture

9) A ½” long x ¼”-20 standard bolt at “B” in the picture, to attach camera to the circular piece of plywood; if your bolt is longer, use washers to accommodate the length of the bolt
Materials needed to build a weatherproof enclosure & internal structure

10) Tube of clear silicone caulking compound to seal the acrylic dome to the top of the case

11) PVC Cement to attach the top cap and male base fitting to either end of the four inch length of pipe

12) Right-angle USB-C connector to attach RPI power supply; right-angle connector is need to fit RPI case inside the enclosure without damaging the straight-line USB-C connector on the power supply that came with the CanaKit

13) Electrical extension cord, outdoor rated, for temporary setup; replaced later by electrician-installed power line

14) Electrical female plug to attach to cutoff extension cord inside the case to power the system

15) Ethernet cable, outdoor rated, to connect system to local network

16) Two large hose clamps to attach the case to a vertical post; two rubber or foam spacers to separate the case from the post under the hose clamps
Materials needed to build a weatherproof enclosure & internal structure

1) Screwdrivers, plyers, a flat chisel, metal hacksaw, fine sandpaper

2) Drill press and clamps to hold odd-shaped items

3) Two-inch diameter bit to drill through plastic cap – here are two different kinds of hole cutters

4) Set of normal size drill bits

5) Saw to cut 4” black plastic pipe square off and also cut the plywood pieces – a bandsaw is useful here

6) Circular rasp or file to make a suitable hole in the bottom cap for ethernet cable access
Construction Steps

1) Cut the 4” inner diameter black plastic pipe to 12” long; both ends of the pipe need to be cut at right angles so that they sit flush into the mating caps at each end; sand away plastic bits left on the edges on this cut and all other cuts and holes described below.

2) Drill a 2” hole in the center of the flat upper plastic cap; place the rim of the camera through the 2” hole – does it fit; if not perhaps use the rasp or a circular file to enlarge the hole?

3) Center the 3” acrylic dome over the center of the hole in the upper plastic cap; and hold it in place while you mark the locations of the six holes around the rim of the plastic cap.

4) Drill the six holes in the plastic cap of a diameter suitable for the screws that you are using;

5) Drill out to enlarge the holes in the acrylic cap to accommodate the actual diameter of your six screws if necessary; likely your screws are a larger diameter than the existing holes in the acrylic cap; you won’t want to stress the acrylic material my forcing a large diameter screw into a small hole – it’s best to drill out the holes in the acrylic so the screws pass easily through the acrylic.

6) Clean the acrylic dome – remove dust; clean the top of the flat top cap; spread a bead of the silicone caulking compound around the perimeter of the acrylic dome where it will contact the plastic flat top cap; this contact needs to be waterproof, so a continuous bead of the silicone is required; use rubber gloves for hand protection.

7) Align the holes in the acrylic dome with the holes in the top cap and screw it down with the six screws.

8) Clean up any excess caulking compound with a rag.

9) Use the PVC cement to attach the top cap with acrylic dome to one end of your 4” inner diameter plastic pipe.

10) Use the PVC cement to attach the bottom male fitting to the other side of the plastic pipe.

11) Drill out two holes in the middle of the bottom cap. One hole is the diameter of the electrical cord, the other for the ethernet cable; use a rasp to enlarge into a square shape the ethernet access hole; An alternative to passing the ethernet cable end through the base cap is to get a weatherproof ethernet connector and insert that into the base plug.

12) Clean up the interior of the plastic pipe assembly – remove particles and dust.

Continued on next page
Construction Steps continued

13) Cut the two pieces of 3/16” plywood to size as described on a previous slide; A key part of this is to make the “H”-shaped piece of plywood longer than you need – we will trim it later; so you now have a circular piece and a long slender piece with “H” cutouts; as a test, slide the “H”-shaped plywood into the plastic pipe – we want it to fit into the pipe diameter-wise without much leeway.

14) Draw a line across the diameter of the circular plywood, and draw two other parallel lines adjacent to it, the width apart of the other piece of plywood; these lines will help position the “H”-shaped plywood directly across the diameter of the circular plywood.

15) Drill a ¼” hole in the middle of the circular plywood.

16) Attach the camera to the circular plywood temporarily to accommodate positioning the brackets.

17) Manually position each angle bracket to see how they fit adjacent to the camera on the circular piece of plywood. The metal brackets cannot extend beyond the outer perimeter of the circular plywood and they cannot impinge on the camera either. Depending on the size of the angle brackets, you may need to cut off a short length of one side of the bracket and drill new holes in the metal brackets.

18) Remove the camera and attach the two pieces of plywood together with the angle brackets, with the longer “H” cutout positioned away from the camera end; as a test, slide the assembled plywood into the pipe – we want it to fit into the pipe;

19) Attach the camera to the circular plywood temporarily again – slide the plywood and camera assembly into the pipe to confirm that it fits inside, with the camera fitting into the hole in the cap below the acrylic dome.

20) Next we will figure out what length to cut the “H”-shaped plywood; Remove the assembly from the pipe; Screw in the bottom cap, hand-tight. Put a piece of masking tape up against the threads of the bottom cap to mark how far it extends into the pipe; then unscrew the cap and measure how far the cap extended into the pipe assembly.
Construction Steps continued

21) Attach the camera to the circular plywood temporarily again – slide the plywood and camera assembly into the pipe with the camera inserted into the 2” diameter hole at the top; Use a pencil to mark accurately where the “H”-shaped plywood extends out the bottom of the pipe assembly.

22) Subtract the “E” measurement to that length marked in #19 – draw a line there; cut off the bottom of the plywood legs to that new line; in practice you will want to iterate on this cutoff mark – that is, cut the “H”-shaped plywood a little long, then put the camera assembly into the pipe and screw on the base – is the camera held tightly in place with enough threads on the base cap grabbing the pipe assembly? Decide if you need to trim off anymore of the plywood length and iterate.

23) Position the Raspberry Pi near the top of the plywood with the ethernet socket pointed downward and a little more space on the left side to accommodate the 90-degree USB-C power connection; use electrical tape to attach the RPI to the plywood “H” See pictures below

24) Cut off the female end of the electrical cord extension, pass that end of the cord through the plastic base cap and attach the new female connection – yellow connector in the pictures below;

25) Make connections to the RPI – see pictures below – connect the power line via the 90-degree USB-C adapter; tape down the power line; connect the USB cable from the camera to one of the RPI USB-C slots, connect the ethernet cable and tape it down to the plywood; tape the excess length of power cord to the other side of the plywood “H”
Miscellaneous Installation and Operational Tips:

• Don’t forget to take the lens cap off the camera before inserting into the weatherproof case
• You can paint the exterior of the weatherproof case to match the surroundings; paint it white to reduce temperature increase from solar impact
• The RPI is rated to 85 degrees C (185 degrees F). Above those temperatures, the internal circuitry slows down the CPUs to reduce thermal output, and it may shutdown the RPI altogether. If so, unplug and wait for cool down, then restart.
• You may want to caulk over the hole made in the plastic bottom cap to give access to the ethernet cable – to keep out bugs and moisture