

MANUAL

**Instructional manual with
designs and plans for
building waveguide antennas**

Córdoba

Argentina



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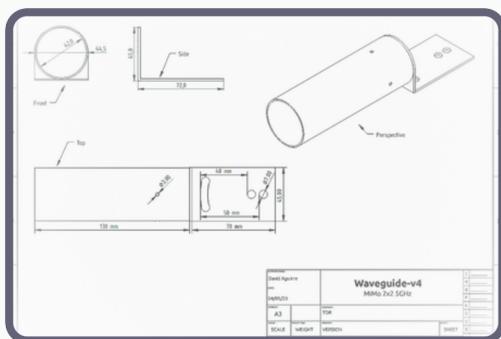
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INTRO

Why do we make a manual to build a waveguide?



Open hardware

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We intend to

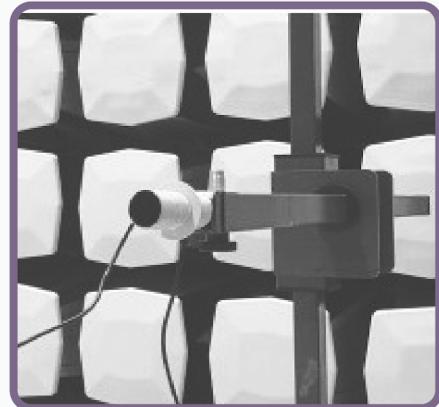
To make it possible with designs and instructions for people without extensive technological knowledge to easily understand and share material.

Attention

TdR is not responsible for any damage caused by the performance of the procedures proposed in this informative material.

To contact us

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WHAT DO WE NEED?

MATERIALS

- **48mm x 70mm Rectangle of Sheet No. 18**
- **PETG filament for 3D printing**
- **Anticorrosion paint**
- **130mm spout
44.5mm diameter
Waveguide**
- **Heat shrinkable 12mm**
- **2 meters RF coaxial cable 50ohms (LMR200 - UHF 95/30)**
- **2 RP-SMA-Male connectors**

TOOLS

- **Grinder**
- **Bench vise**
- **Marking point**
- **Hammer**
- **Electric arc welder**
- **Induction soldering iron**
- **SMA Crimper**
- **Coax cable strippers**
- **Caliber**
- **3mm and 7mm drill and drill bits**
- **Painting equipment**



STEPS TO BE TAKEN

WAVEGUIDE DRILLING AND TINNING

WORKSPACE

For this task, we use the central workbench with the bench drill.

TOOLS

- Bench drill
- Induction soldering iron
- Tin

HOW IS IT DONE?

With the 44.5mm diameter and 130mm long pipe we proceed to prepare the workbench to drill the waveguide, using a drill mould designed for this task. Once the pipe is drilled we tin around the holes.

WARNINGS

It is important that the holes in the waveguide are aligned with the holes in the hole pattern, as this may affect the quality of the antenna.



MARKING BRACKETS

WORKSPACE

For this process, we use a table and a wooden block to help us mark out a custom-made template and then drill the brackets.

TOOLS

- Solid table
- Wooden block
- Drilling template
- 2mm thick metal sheet
48mm x 80mm with a 90° fold 48mm x 48mm,
- Marking point
- Hammer

HOW IS IT DONE?

We use the work table with a wooden block that holds the metal plate to mark it, supporting the template to make the perforations on it.

With the help of the template we proceed to mark the sheet with a marking point and hammer.

WARNINGS

It is important that the template is aligned with the bracket, so that there are no problems when aligning the antennas.



DRILLING BRACKETS

WORKSPACE

We use the central workbench with the bench drill, and the template designed for this purpose.

TOOLS

- Wick 6mm
- Round and flat file (to remove burrs)
- Bench drill
- Bench vise

HOW IS IT DONE?

**With the metal sheets marked out, we proceed to drill them with the bench drill.
We use a wooden dowel that the clamp of the bench drill can hold and allows us to rest the support on top of it to drill on it.**

**Once the holes have been drilled, we file off the burrs.
If you do not have a bench drill, you can use a hand drill to drill the brackets.**

WARNINGS

It is advisable not to take too long when drilling to avoid damaging the wick, as it gets very hot due to friction. We also recommend using a low speed for metal drilling.



TRIMMING EDGES

WORKSPACE

We use the central table in the workshop.

TOOLS

- Veneer scissors
- File

HOW IS IT DONE?

The pipe of the waveguide is used as a template to mark the supports. Then with the sheet metal cutter, following the markings, the rounded shape is formed.

WARNINGS

Always remember to use personal safety equipment, in this case gloves.



WELDING BRACKETS

WORKSPACE

We use the work table, with a plate to protect the table from sparks falling during welding.

TOOLS

- Sheet metal
- Electric arc welder
- Electrodes E-6013 (or similar)
- Morza
- Pipe and support
- Welding or leather gloves
- Protective mask

HOW IS IT DONE?

With the support clamped to the mortise by its perforated side, we place the waveguide with the perforations facing downwards and one of them facing the rounded side of the support.

WARNINGS

It is very important to use eye protection, the masks used must be appropriate for electric welders.



GRINDING AND PUTTYING

WORKSPACE

We use the central table of the workshop with the bench vise in place.

TOOLS

- Morza
- Grinder
- Grinding disc
- Wave guide with welded brackets

HOW IS IT DONE?

Holding the waveguide firmly with the clamp, we remove the excess solder from the bracket and the waveguide.

WARNINGS

Use personal protection elements, in this case glasses, gloves, hearing protection and work clothes that cover the whole body, so that the metal shavings do not harm us. Also, work with the corresponding ventilation.



PAINTING

PAINTING PROCEDURE

WORKSPACE

The painting machine is used in a spray booth or outdoors, as the working space inside the workshop is very small, and the machine sprays a large amount of paint.

TOOLS

- High resistance synthetic paint.
- Painting machine.
- Thinner.

HOW IS IT DONE?

To use the machine for painting, the paint must first be diluted so that it is sufficiently liquid to be sprayed by the machine.



WARNINGS

For drying, we use a hanging device where they can remain for the necessary time, without hindering the work in the rest of the workshop, until the drying process is completed.

In case of not having a painting machine, this procedure can be done with a brush.



CABLE ASSEMBLY

HOW TO ASSEMBLE PIGTAIL CABLES

WORKSPACE

This part of the production is carried out on a table free of metal filings or shavings.

TOOLS

- Soldering iron and tin
- Flat pliers.
- Wire stripper.
- Caliper.
- RP-SMA Male connectors.
- LMR200, 95/30 or RG58 coaxial cable.

HOW IS IT DONE?

Cut the cable to 75 cm.
We place the SMA RP male connectors.
To finish the process, they are crimped and heat-shrunk.
At the other end of the cable, we strip the sheath to obtain the 11.7mm long pin that will illuminate the waveguide.
Leaving the strands of the mesh to be soldered to the waveguides.

WARNINGS

It is important that the cut of the 11.7mm tenon is as neat as possible, the finish can be improved with sandpaper or a fine file to achieve a perpendicular finish.



CABLE WELDING

HOW TO SOLDER PIGTAIL CABLES

WORKSPACE

This process can be performed on the auxiliary workbench, where we have installed a device with slots to hold the cables.

TOOLS

- Tin
- Vesuvius soldering iron
- 5mm (3/8") segment of 8mm (3/8") aluminum pipe
- Pigtail cable x2

HOW IS IT DONE?

We tin the perforations previously brushed, then we take the pigtail cable, we place it in the perforation and we solder the mesh to the pipe (wave guide).

If you do not have a Vesuvius soldering iron, you can do this work with a zinguero soldering iron.

WARNINGS

We must make sure that the soldering iron is very hot and clean, in order to minimize the contact time and thus not burn the cable sheath.



PORTACHAIN

3D PRINTED PORTACHAIN RINGS

WORKSPACE

We use a piece of furniture where the 3D printer is positioned, sheltered from the hostility of the workshop.

TOOLS

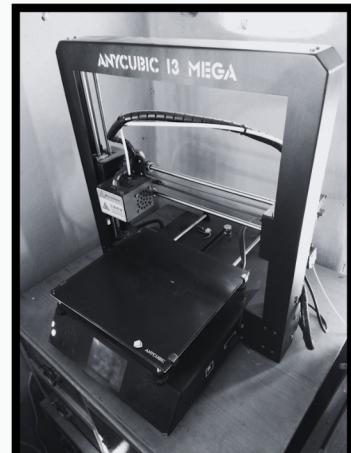
- Designs made in Freecad
- 3D Printer
- Petg Filament

HOW IS IT DONE?

We laminate the designs (.stl) made in Freecad to obtain them in .gcode format in this case, we store them in a memory card that we insert in the 3D printer to print them.

ADVERTENCIAS

It is important that the printer is installed in a space with proper ventilation.



PLACEMENT OF PORTACHAIN RINGS

WORKSPACE

This work can be done on the work table, clean and clear of chips.

TOOLS

- Chain holder rings
- Antenna with welded cables
- 3/8" aluminum spout

HOW IS IT DONE?

The larger ring is inserted through the waveguide, until it reaches the place where the cable is located. Then attach the rear carrier, using a 5mm segment of 3/8" aluminum pipe, passing it through the cable and bringing it up to the two carriers together, and crimping it to hold the cables securely.

WARNINGS

Handle the rings carefully.



TESTEO

HOW TO TEST ANTENNAS

WORKSPACE

This work can be performed on the device created to hold the cables.

TOOLS

- RC Antena SWR Meter.

HOW IS IT DONE?

First of all, an ocular inspection is carried out in order to arrange the two pins at 90 degrees. Once this procedure is done, one of the wires is connected to the RC antenna meter and the waves emitted by that chain are measured first, and then those of the other one.

WARNINGS

For the tests it is necessary that the space in front of the antennas is clear.



TERMINATION

TO PLACE THE LIDS TO FINALIZE THE PROCESS

WORKSPACE

This work can be done on the work table, clean and clear of chips.

TOOLS

- Plastic cover or lid
- Assembled waveguide

HOW IS IT DONE?

To protect the illuminators, the waveguide is closed with a plastic cover and silicone sealant to prevent leakage.

WARNINGS

Check that the dowels are positioned at 90° to each other before fitting the cover.



FINISHED ANTENNA



Acknowledgments

To the friends of AlterMundi for their support and the path we have taken.

To contact us

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LoPaLiR Project

**This project was made possible thanks to funding from NINet.
To learn more about the project,
please visit our website
<https://tdr.libre.org.ar>**



APPENDIX

Useful information

IMPORTANT LINKS

IMPORTANT LINKS Punching mold:

<https://github.com/TecnologiadRaiz/LoPALiR/blob/main/PLANOS/MOLDE%20DE%20PERFORACION%20-%20V2.svg>

Explanatory videos: how to assemble connectors to cables:

<https://player.vimeo.com/video/780569067?h=7d256afc33>
<https://player.vimeo.com/video/780568264?h=076a3a0531>

TdR Repository. Contains all design files, drawings and instructions for download:

<https://github.com/TecnologiadRaiz/LoPALiR/tree/main>

ANTENNA PLAN

