

Comments on prototype 5M dishes for Tianlai.

By Jeff Peterson December 16, 2012, Xinglong station

We assembled, erected and tested three 5M commercial off the shelf dishes.

The dishes are manufactured by

Company X

Address

Phone number

Person who handled the transaction.

The cost was RMB xxxx, which is about \$1000.

The focal ratio  $f/d = 0.38$

The company refuses to make any changes to the design and the 5M size is the largest they make.

Construction:

The surface is divided into 12 panels. The frame of each panel is made of three ribs formed to parabolic shape. The rib cross section is rectangular aluminum tubing about 25 x 20 mm x 1mm thick and the ribs are curved in the 25 mm plane (the hard way). Ring sections connect the ribs. These are curved both ways (compound curve) so the 20 mm side lies tangent to the parabolic surface. Three ribs and ten ring section members are all welded together to make the frame of a panel.

Two wedges of expanded aluminum mesh sheet are then attached to the frame to create the reflecting surface. The two wedges overlap at the center rib. Pop rivets are used for attachment with a washer between rivets and mesh. The panels are painted black with acrylic paint.

The mesh 'bubbles' up a bit between rivets in a few places and occasional bubbles also appear in areas far from any rib or ring. I estimate the maximum excursion to be 3 mm, and less than 5 % of the surface has bubbles that I could spot by eye. That would contribute an rms error of perhaps 1 mm or  $\lambda/200$  at our shortest wavelength. A bead of construction adhesive, applied through the mesh, combined with some clamping while the adhesive set could eliminate bubbling, but the panels should probably just be used as-is, without improvement.

The panels are attached to their neighbors with 6 mm bolts, to form the parabolic dish surface. The holes for these bolts are centered in the 25 mm face. It is easy to over-tighten these bolts, slightly collapsing the rib tubing.

The bolt kit provided with the dish consisted of cadmium-plated steel bolts and nuts with no lock washers.

**Recommendation: Replace the supplied hardware with stainless steel bolts and self-locking (nylock) stainless nuts. Use a stainless washer on each side. This will allow higher bolt tension without rib collapse, and will not rust or work loose due to wind-driven vibration. The required size is ¼-20 x 2" or 6mm x 25 mm.**

The dish is supported by a two-ring welded steel structure. The diameter is 94 cm and height is 31 cm. The rings are rolled of steel 3mm thick by 5 cm wide. A welded rectangular structure of steel angle connects the two rings. The front ring connects to the 12 double-ribs where panels join. The back ring has the elevation bearing (25mm bolts) and also flanges for 24 struts that stiffen the dish.

The struts are steel tubing 25 mm diameter 1 mm wall thickness with ends flattened and drilled to create a flange.

The elevation jackscrew is 25 mm threaded rod that passes though a slot in a horizontal arm. The arm is made of c-section steel about 10 cm wide. A nut and flat washer are provided on each side of the arm, one to lift the dish and the other to lock the elevation. The top end of the jackscrew tee's onto a steel tube. The weld at this joint is in tension when the dish points horizontal. The tension is several times the dish weight.

No counter-weight is provided for the dish.

**Recommendation: Add a counter weight. This can attach to the angle-iron structure with bolts. This will make elevation adjustment easier and greatly reduce tension on the jackscrew weld joint.**

**Recommendation: Redesign the elevation adjustment nut.**

After these improvements one person will be able to smoothly adjust elevation.

Conclusion: The dish construction is sufficiently sturdy and precise for Tianlai. A few minor improvements will make elevation adjustments easier.



Needs a counterweight



Rectangular shape made from angle is the core of the mount. Rolled steel rings create attachment points for the dish and struts.



The elevation jackscrew uses nuts and washers on each side of the horizontal arm. The weld at the top of the screw is in tension.



The azimuth mount tube is not a good fit to the supplied post. Try to procure a post that fits with smaller gap.