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## JKT Observatory, Status Report, March 2024.

Hi Terry,

Here is a summary of the work at the JKT.

On 18<sup>th</sup> October 2023 we received a report that the JKT dome could not be opened. I contacted Jorge Gmelch at ORM and they took a look and said it was “serious”.

In summary, they found that the motor to open the dome had suffered a complete failure, that the gearbox it was attached to was also defective, and that the driver (Variable Frequency Drive) had failed.

These items were not available on the island, and they said it would be best if I could import them.

The gearbox and motor were the original 1980 parts supplied with the dome, made by Britannia Steel Co in Canada. Unsurprisingly, they are no longer available. Indeed, that size is no longer around, so I looked at suitable alternatives with easily replaceable NEMA / ISO parts.

I placed the order with my supplier on 30 October and they arrived on the first of November. I ordered one spare of everything, and I also ordered an enclosure to mount equipment outside, including a camera to inspect the dome. Total \$2,903.

The parts, together with adapter plates and spacers we fabricated in our shop, were shipped in three consolidated boxes 09 November by UPS international 3 day.



In the meantime, I travelled to La Palma on October 31 to deal with the pre-scheduled aluminizing of the JKT primary mirror. I took the enclosure with me, and other equipment, in two suitcases. Was only \$60 excess bag on Iberia, much cheaper than sending by UPS / FedEx, and I had the parts with me!

The aluminizing went as planned, after a bit of an administrative hassle. The crane and moving platform had to be re-certified, something that must be done every year, which seems a bit excessive to me, but that’s the EU law.

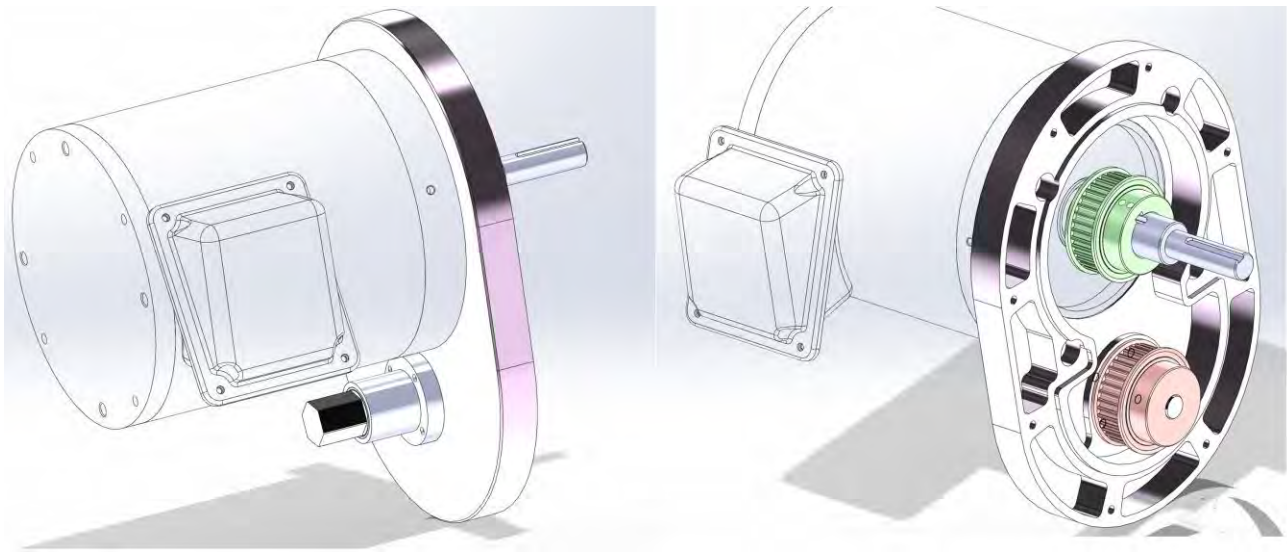
I took out the mirror petals and worked extensively on them. Alas, there was a problem that they did not fit (I tried to get measurements from IAC but gave up and guessed from drawings and photos). The design was too long by 2mm, super irritating. I replaced them (at my expense) with new parts.

I left before the dome parts arrived. The shipment of the parts went astray. Josie and I spent a ridiculous amount of time trying to solve that problem. The web site claimed they were at various

stages of import, etc, but it was all just lies. UPS then claimed they lost were lost, but I knew better than that! We found them after about a month of emails, phone calls, and aggravation with their international department. They were where I thought they would be, stuck in the customs warehouse. UPS contacted the wrong clearing agent, despite the correct info in the documents, and they fell into a black hole. They then cleared customs, only to have yet another delay, because the local delivery driver could not find CALP, the observatory headquarters! The three boxes eventually arrived the week before Christmas. Not exactly the three-day service we paid for, a mere 40 days late. I tried to get money back, but it was impossible. At least they arrived in perfect condition, completely unopened and uninspected.

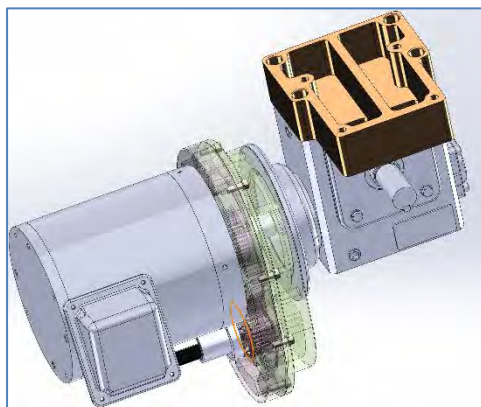
I then realized, after my visit in November, that there was an important feature missing in the design of the new gearbox/motor for the dome. In the old setup the back of the motor has a 22mm hexagonal shaft sticking out of the back. A long wrench, similar to a car tire change tool, fits on the shaft and allows the dome to be opened and closed manually. This feature is not available on the replacement motors.

I therefore designed an inline gearbox to solve this problem. That was definitely not trivial, as I had my hands tied with pre-existing dimensions.



The gearbox was made in two halves. A pair of pulleys with shaft extensions and bearings were designed and fabricated, inside a lightweight housing.

This sub-assembly was attached to the other half of the gearbox housing, to create the finished assembly:



The (almost) finished assembly. You can see the spacer at the top, which sets the correct height. Not shown we had to fabricate a new drum, drum shaft, bearing spacers, and so on.

After the last shipment fiasco, I designed this to be light enough to fit in some suitcases. There is a graveyard of suitcases at the JKT!

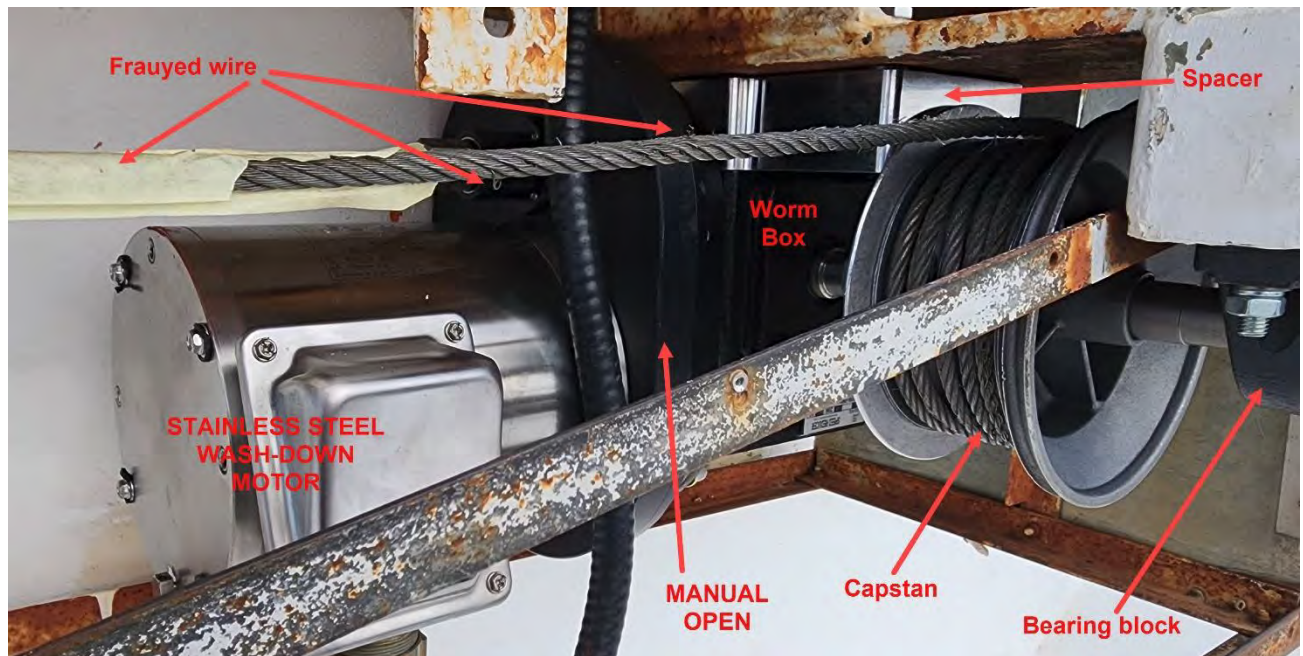
All this was installed on the February trip to the JKT.

My belief that the drum could not be taken off the old gearbox turned out to be true. When the IAC staff tried to disassemble things the bearing block broke apart and the drum (a.k.a. “the Capstan”) was an integral part of the gearbox.

I am in two minds whether or not to have that sent back to Tucson so we can salvage the drum. The replacement drum seems to be working fine, but it is made of aluminum.



Here is the new assembly. The new motor is a stainless-steel washdown inverter duty type of motor.



It's hard to tell it this photo, but some of the clearances are very tight, less than a few millimeters, and installation was a real pain. A couple of days with an angle grinder, drilling tapping, etc. Trying to get simple parts on the fly is really difficult on the island. I think I know every industrial supplier on La Palma!

You will note the painters' tape over the wire. The wire rope is frayed with ultra-sharp little pieces sticking out. I got it stuck on my arm and boy, that was not nice! The tape was my attempt to protect my arms during assembly and on the whole it worked. Here is a close-up view of the wire rope, with the fraying.



The dome was made in Canada and the bolts are all imperial or American style, not metric. I replaced them with metric where I could, but for blind tapped holes you have no choice when it is impossible to drill them out and put in a large metric thread.

Having installed the assembly, we went to thread the wire rope back on. That was a half a day of effort because the bolts that hold the parts together has stripped out, and I could not get new ones. I made a temporary work-around to try and get the dome operational.

The wire has to be at the correct tension, and the tensioning bar was not working.

I took that apart and serviced it. The main leadscrew had seized up and there was zero grease in the assembly. I replaced all the fasteners.



Having done all this we were now in a position to try and open the dome manually, using the hand crank on the new gearbox.

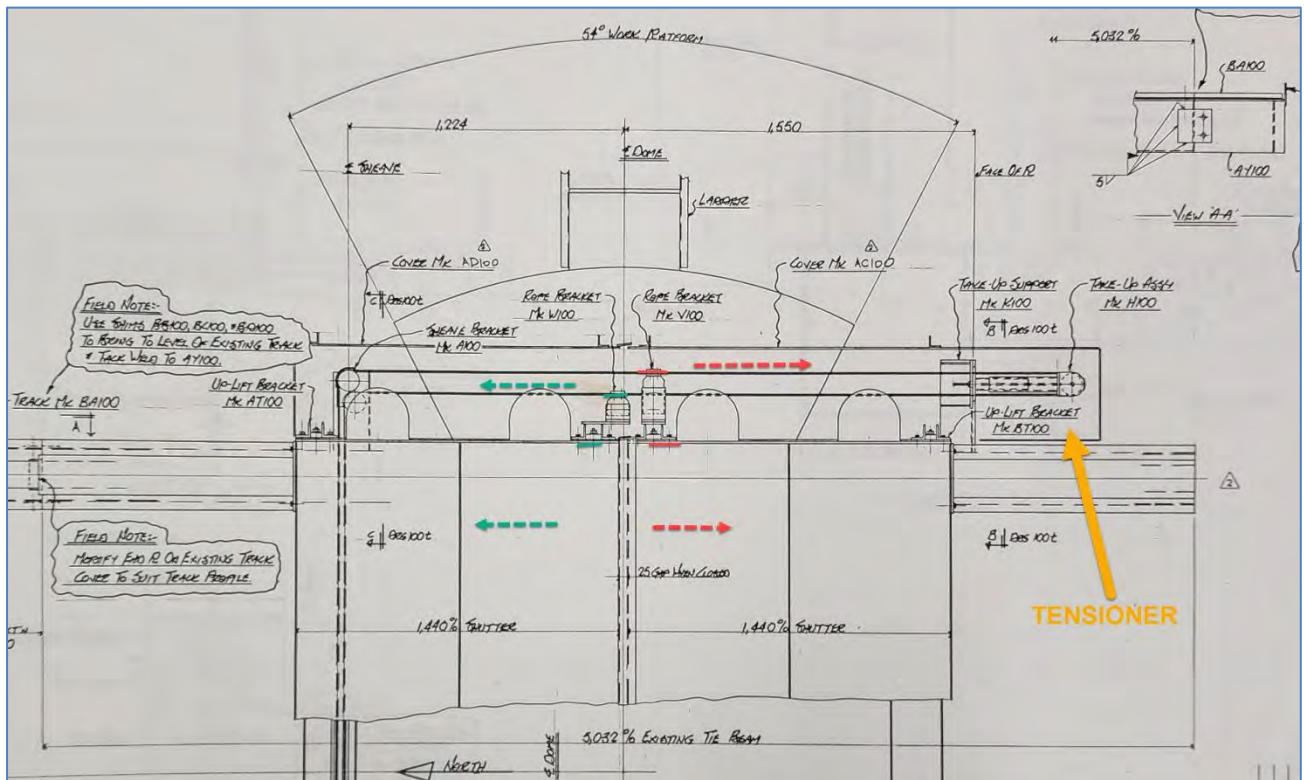
Unfortunately, indeed really disappointingly after the effort, the dome started to move (showing that the capstan was working) but then it stopped.

I analyzed the system for a whole afternoon pondering what could be wrong, and the next day I ran it past Joaquin at IAC who came up to the dome.

We are certain that the problem can only be one (or both) of two things, and that the problem lies at the top of the dome.

When the dome was built, they put an external ladder at the back to gain access to a 54-inch-wide platform at the top of the dome. However, this no longer meets any of the safety requirements and besides, some of the parts are located far from the platform.

A two-man bucket lift is required to gain access to the service areas. One is readily available for rent on the island, and we will need it for a week, because there is more than one thing it will be used for.



Here is a diagram showing the top of the dome. I will try to explain how it works and have annotated parts to help in this endeavor. The **GREEN** parts are for the left-hand door, and the **RED** parts are for the right-hand door.

The wire rope comes up the left side in a track from the bottom, passes over a pulley, and attaches to the left door at the point where I have put the small green line. The rope continues, passes over the tensioner, and then attaches to the right door, at the point indicated by the short red line. The rope then continues over a second pulley, to the bottom, goes around the capstan and attaches to the left door, the tensioner, and the right door. Most importantly, there are no joints in the rope. Both end points are at the lower section.

We know that the wire rope is not broken. What we believe is wrong is that one or both of the clamping mechanisms that attach the door to the rope have become loose. This means that the door(s) are not effectively attached to the rope and the result is that the doors bind. If we take the doors and shake them, we can, with considerable effort, get them to open while moving the hand crank.

These mechanisms are repeated on the lower section of the rope, and I had to service them. They are attached by 5/16-18 bolts into tapped holes. The threads on the lower bolts had stripped out and we believe the same has happened with the top pair of clamps. They should be replaced with Grade 8 fasteners. Unavailable on the island.

The upper tensioner unit may also need servicing.

Finally, and we believe rather improbable, the castors at the top may have seized up. However, I don't think so since we can shake the doors open. I poured through the documentation and the part number for the casters is not documented. They should have grease nipples and we will service them.

I pointed out that the main rope is frayed. If we are up there repairing things with the man lift it might just be prudent to replace the cable. It is a 3/8 stainless steel rope, with everything specific in

the drawings except the length! I estimate it to be 25 meters (adding up dimensions from the drawings), which is 92ft. It comes in 100ft or 200ft lengths. The problem is, if I am short we are out of luck. I am seeing if I can find another supplier where I can buy 125 ft, and then I would feel comfortable. (It costs around \$1000 for a 100ft length, or \$10/ft).

Next, there is the problem of the weather seal.



This image shows that the doors are not closing parallel, which supports the theory that the clamping mechanisms at the top are loose.

The weather seal must be replaced. Even when the doors really are fully shut (touching each other) rain can get in.

To replace the weather seal, we have to open the shutter doors and then remove some long-curved sections that are sandwiching the rubber on.

They are held on by  $\frac{1}{4}$ -20 x 1.5-inch socket head cap screws. Difficult to get off; we need to take an impact driver tool.

This area can only be accessed with the two-man bucket lift. If all goes well this should only take one day. What can go wrong? The screws are rusted over and difficult to get out. The replacements are zinc plated Grade 8. If we shear any off that requires drill & tap operations, which could make the job longer.

The weather seal is available at several suppliers and I am getting samples to check for the stiffness of the rubber.

Regarding help, ING staff have indicated they are willing to help, and I believe IAC staff can also help. I have been told that safety regulations require two persons to be on the lift. And it will go way quicker with two people.

Here is what I propose:

- 1) You must replace the weather seal.
- 2) You would probably be prudent to replace the main rope that is frayed.  
This is a least another day of effort and will require a third person.

A shipment from the US is needed. It will be a small wooden crate since the seal is bulky and the rope is heavy. It also requires a few hundred dollars' worth of fasteners to be shipped out there since they are impossible to source locally.

Finally, ING really recommends that we repair the floor on the moving platform. It has disintegrated. It is currently vinyl tiles and epoxy paint, like in a garage, would work better.

We could get that contracted at the same time, but I need to get an estimate for you.

I'm trying my best to expedite this; I know everyone is hurting.

Best regards,

- Peter.