

Construction and Assembling of a Semi-professional Dish Support

EME Meeting 2015 in Örebro

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aka SA6BUN

.....very much amateur-like →





What to talk about...

- Driving force behind the project and some principal considerations, which led to the actual solution using inexpensive slewing gears
- Some essential properties of slewing gears
- Practical implementation for a zero-backlash dish support structure
- Some pictures of the present building state



How to get SA6BUN on the moon...

- Purchased a 3m solid prime focus dish (Parabolic make), procurement & transportation by Ben, SM6CKU
- Dish surface good for 10G, maybe higher?
- Support structure needed





Specifications for Support Structure

- Real zero-backlash in both Az and El axis
- Enough mechanical strength for windspeeds exceeding 120km/h for a 3m solid dish / 5 m micro-mesh dish.....for OPERATION!!!
- Tracking control directly by OE5JFL-controller
- 360° + Az rotation, $(180 + 2 \times 7.5^\circ) = 195^\circ$ El rotation
- No actuators, screw jacks, sprocket drives please...no backlash, please!
- No more amateur-like bricolage...
- Affordable (!!!!!)



Slewing gear....what's that?

- The idea came from discussions with our good friend Zdenek after his Az/EI drive broke in a storm
- Slewing gear drives widely used in PV supply industry ex China
- 2-axis sun tracking of pretty large PV panels
- not far from what we need...??



source: H-Fang Industries



Can't be that wrong, or...??

Typical applications for slewing drives:

cranes

robotic arms

wind turbines

excavators

PV tracking

and.....

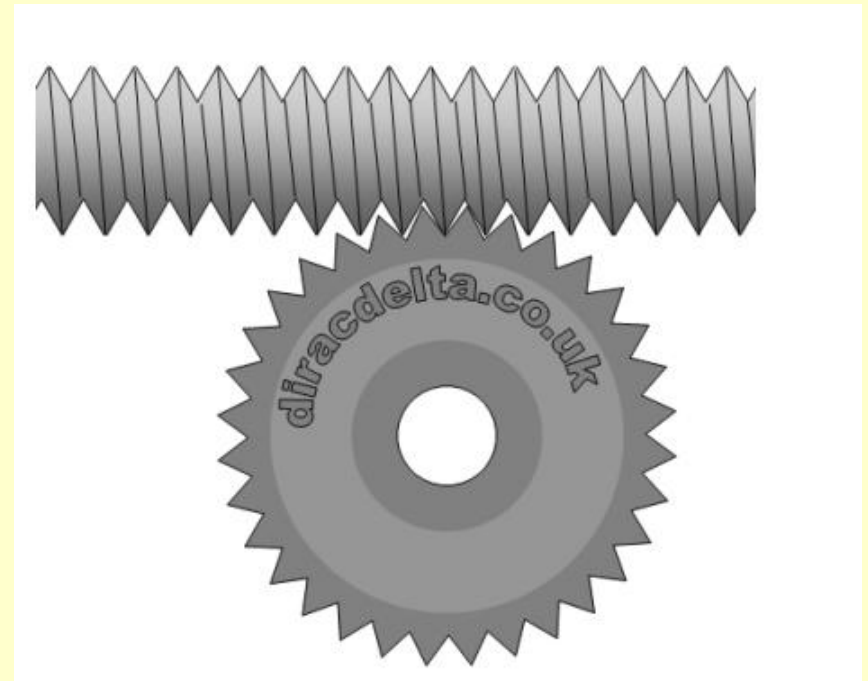
parabolic dishes





Pro's & con's of worm gears

- A conventional worm gear can be adjusted to nearly zero backlash, BUT:
- Susceptible to temperature changes
- Only one to two teeth of the gear engaged during rotation of worm
- High wear out by static forces upon self-locking, but: less friction

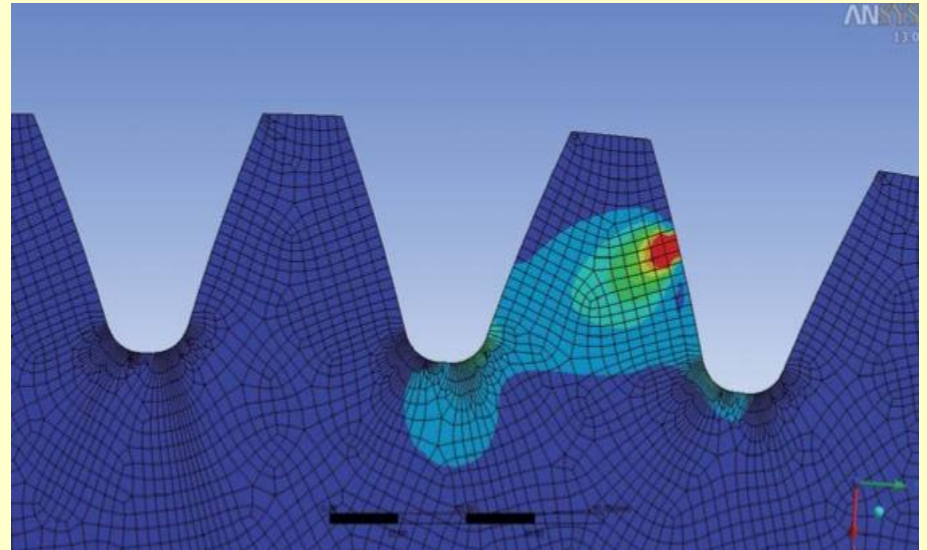


source: diracdelta corp.



Stress on gear teeth

- Contact between worm and gear tooth is a single line, which wanders down the flank of a tooth on motion of the worm
- Limitation for transmissible forces
- So, how to improve?

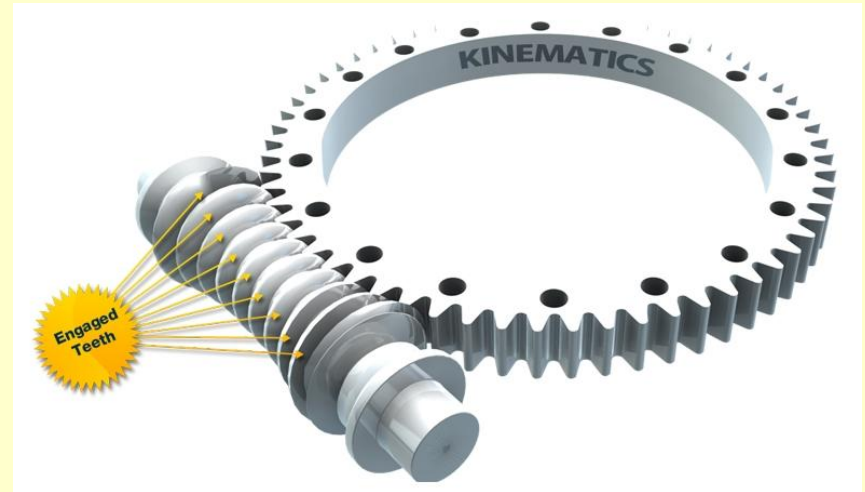


source: Galperti Tech



Hourglass worm gear

- Shape of worm follows outline of gear
- Improved contact area on gear teeth
- Up to 11 teeth in contact with worm
- Largely improved torque capacity and shock load resistance



source: Kinematics Mfg



ZE12 slewing drive specs

Outer ring: 18 x M16 bolts

Inner ring: 20 x M16 bolts

Diameter: 12" > 428mm

Axial load: 475 kN > 47.5 to

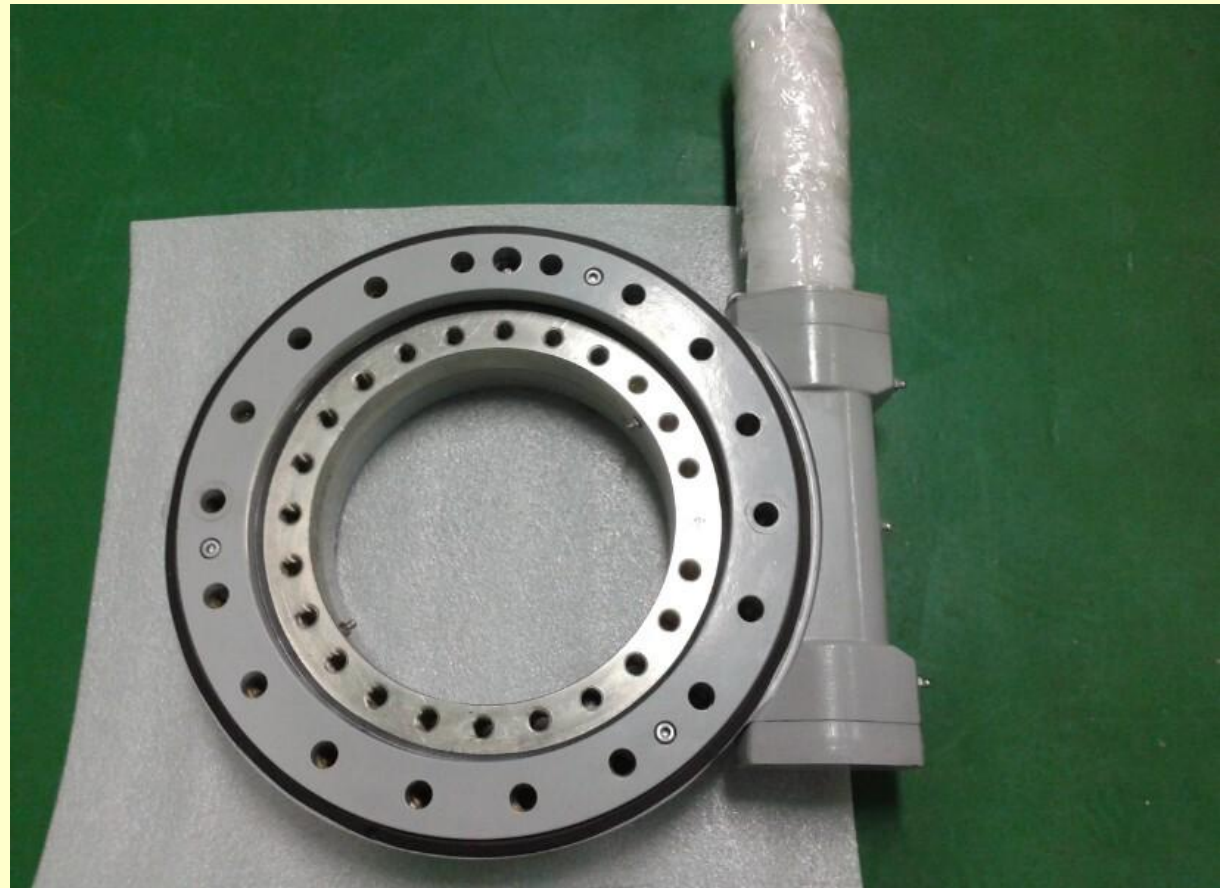
Radial load: 222 kNm > 22 to
load to a 1m lever

Tilting moment torque: 55
kNm

Holding torque 43 kNm > 4.3
to load to a 1m lever

Output torque: 6240 Nm

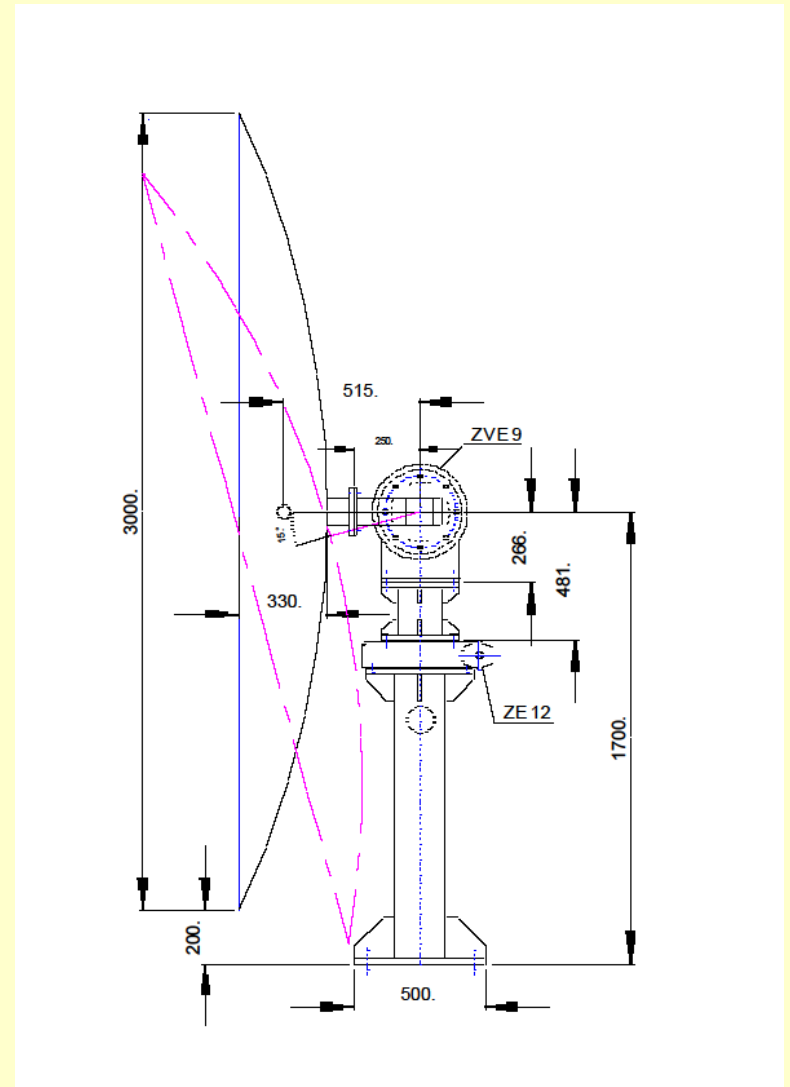
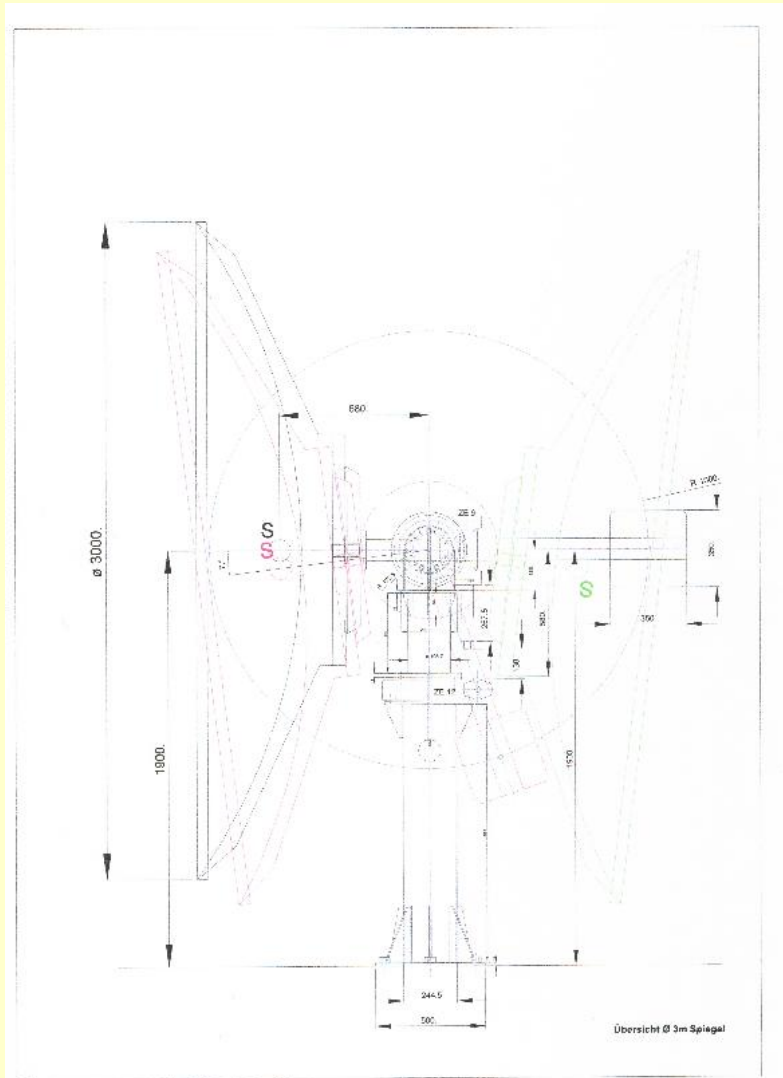
Weight: 61 kg



Price: 1027 US\$ ex factory

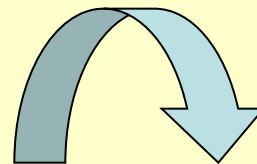


CAD-drawings courtesy Jürgen, DL3YBR





Status in March 2015



Rear side of dish fits onto support arm





Details





Details



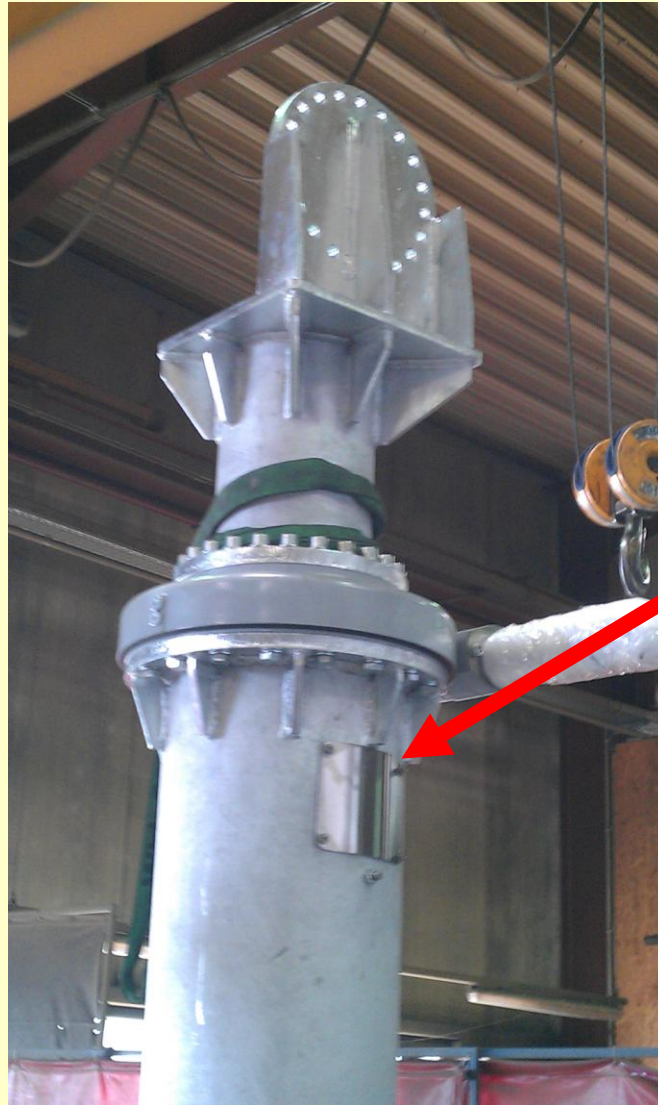


Motor drive

- 24 VDC / 150 W motors with planetary gear 422 : 1
- Output torque of reduced motors 200Nm
- Working into slewing gear, reduced 78 : 1
- Output torque of 9" gear 4880 Nm < 480 kg to 1m lever arm, 12" gear 6240 Nm
- Results in slow rotation movement, no PWM needed



May 2015: the big pedestal



Access to 3-axis-adjustable support for absolute encoder sensing AZ-rotation



Combo of twin pedestals



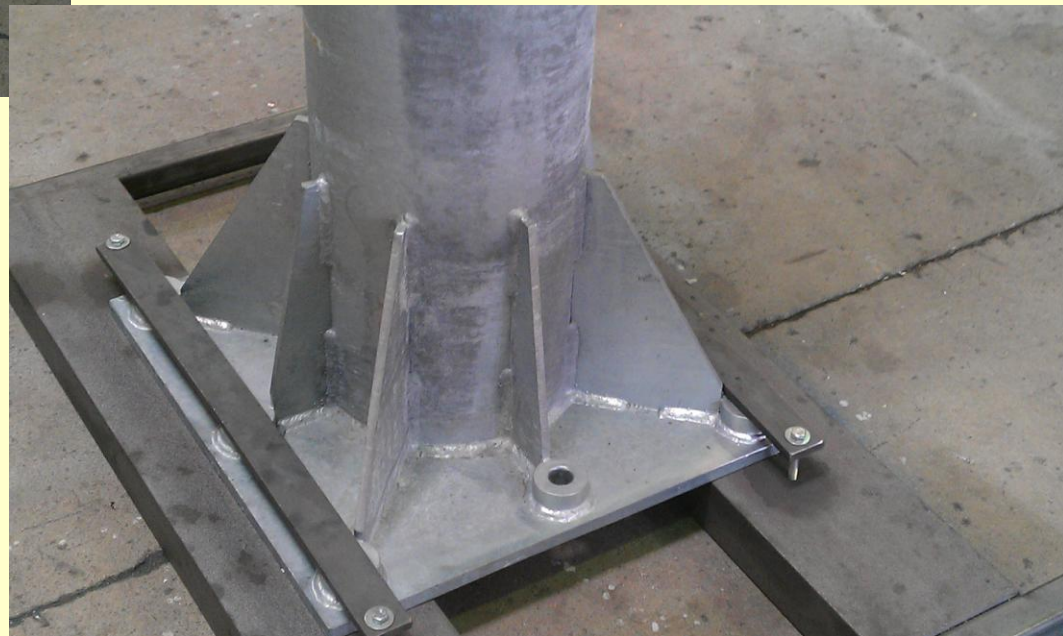


The 2 Base plates



gee...the prof's talk about laser-cutting of *sheet* metal.....25 and 40 mm caliper....

The weight of the bigger pedestal is 1.2 tons.... w/o counterpoise





The Team



right to left: Henning Griese
(licensed welder), Kurt Griese
(comp. owner), Jürgen Peter
(DL3YBR), strange guy w. hands
buried in pockets

