EME a MW Seminář 2019

High precision AZ/EL mount for MW EME dish

OK1DFC - ZDENĚK SAMEK

Why we need high precision gears

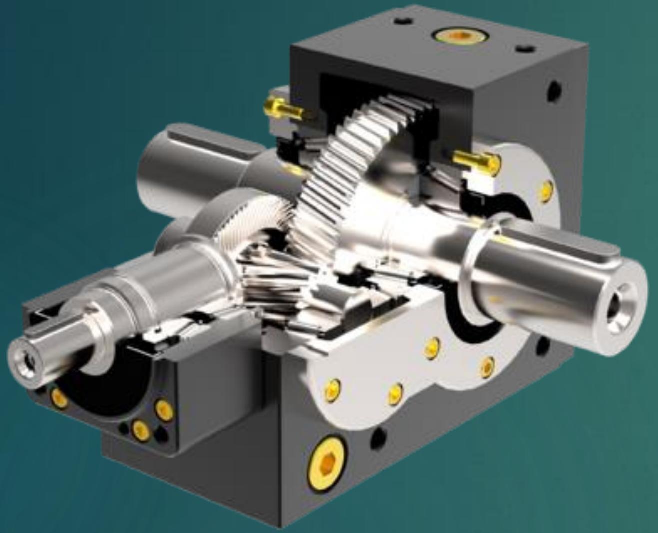
- We need very low or zero backlash
- Dish on MW band has very narrow radiation angle
- 1,8m dish – 10 GHz = 1,2°
- 1,8m dish – 24 GHz = 0,5° - maximum diameter manageable on portable EME operation
- 2,4m dish – 10 GHz = 0,9°
- 2,4m dish – 24 GHz = 0,4°

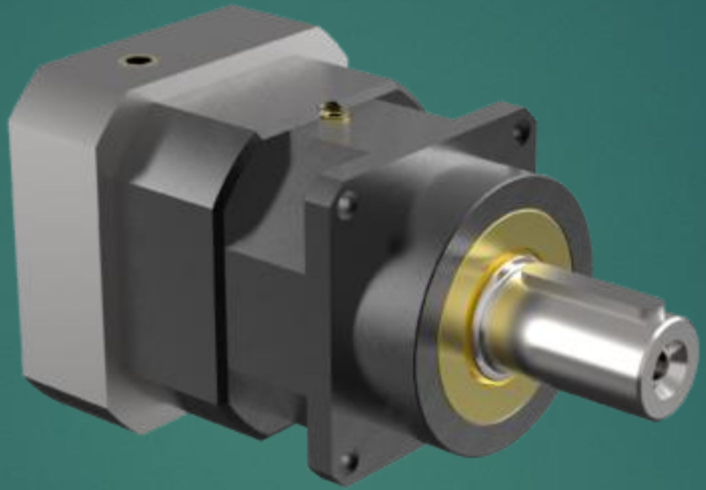
- 6m dish – 10 GHz = 0,3°
- 6m dish – 24 GHz = 0,1°

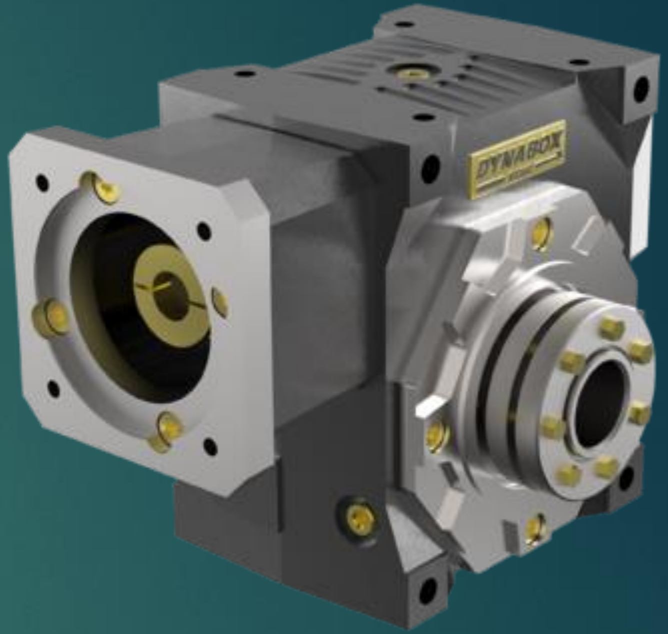
What we can use today

- Maybe for small diameter dish on low frequency

Type of gears which we have

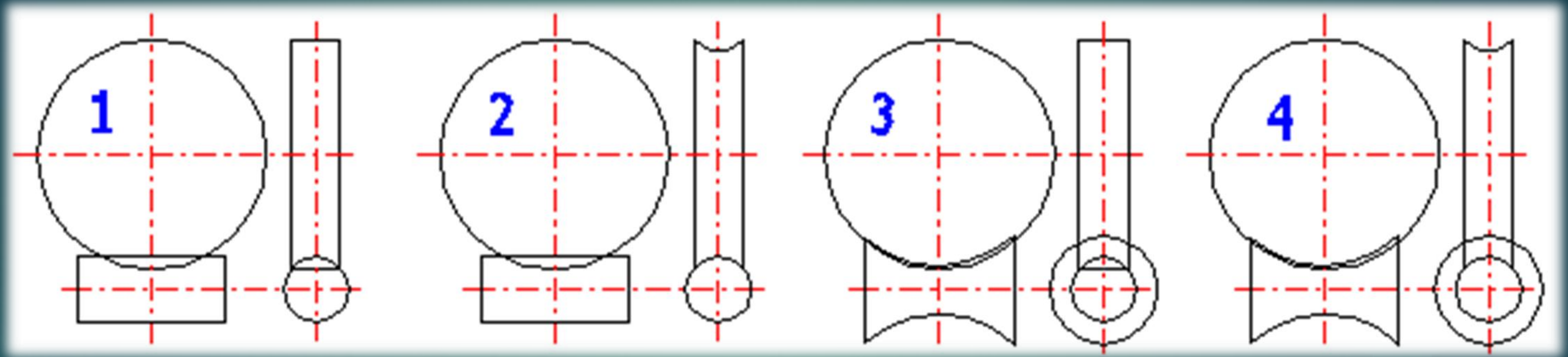






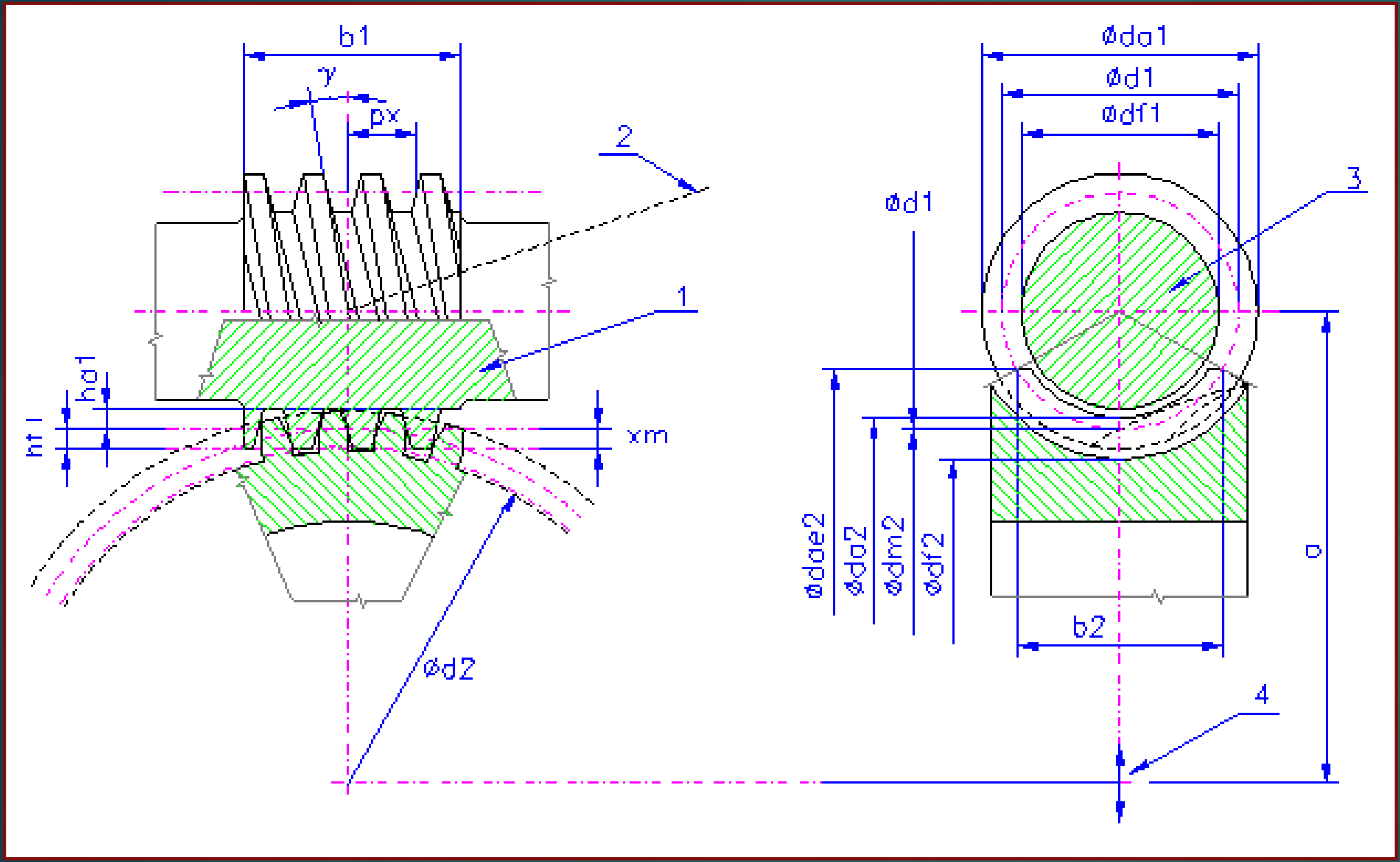
- Standard gearing
- Planetary gear
- **Snail gear**

Snail gears



- 1 – cylindrical wheel – cylindrical snail
- 2 – globoid wheel – cylindrical snail
- 3 – cylindrical wheel – globoid snail – theoretical solution, not in practical use
- **4 – Globoid wheel – globoid snail – heavy gears with very high precision, very low backlash**

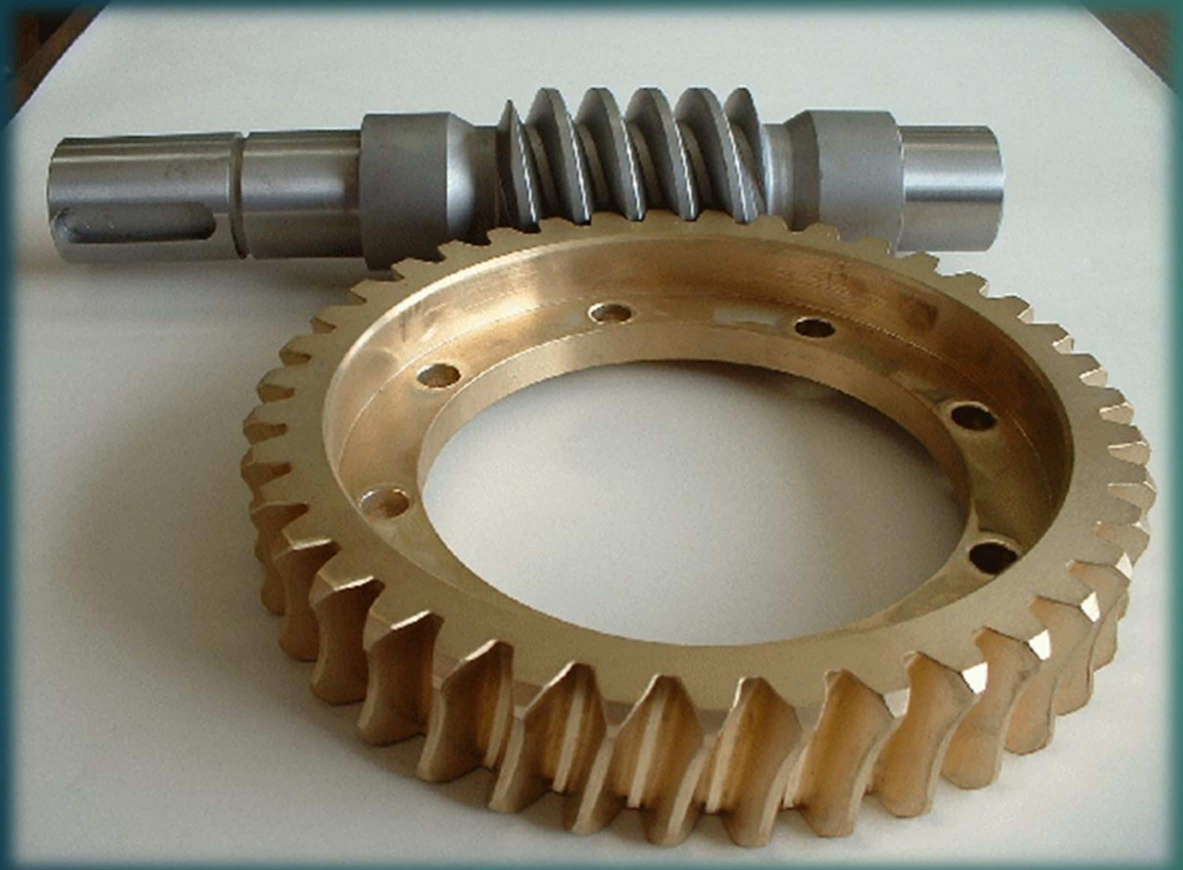
Snail gears



	Šnek	Šnekové kolo
Parametry:	z_1, $x_1 = 0$	z_2 , $x_2 = x$
Převodový poměr	$i = w_1 / w_2 = z_2 / z_1$	
Směr stoupání šroubovice	pravý(levý)	pravý(levý)
Parametry základního profilu (v osovém řezu šneku)	m, a, h_a^*, c^*, r_f^* ($m = m_{x1}$, $a = a_{x1}$) běžně a = 20°, $h_a^* = 1$, $c^* = 0,25$, $r_f^* = 0,38$	
Počet zubů virtuálního kola		$z_{v2} = z_2 / cos^3 g$
Rozteč.průměr	$d_1 = (m_x / tgg) . z_1 = q . m$	$d_2 = m_x . z_2$
Hlavový průměr	$d_{a1} = d_1 + 2. h_a^*. m_x$	$d_{a2} = d_2 + 2. (h_a^* + x) . m_x$ $d_{ae2} = d_{a2} + m$ (obvykle)
Patní průměr	$d_{f1} = d_1 - 2. (h_a^* + c^*) . m_x$	$d_{f2} = d_{a2} - 2. (h_a^* + c^* - x) . m_x$
Valivé průměry	$d_{w1} = d_1 + 2x. m_x$	$d_{w2} = d_2$
Výška hlavy zubu	$h_{a1} = h_a^*. m_x$	$h_{a2} = (h_a^* + x) . m_x$
Výška paty zubu	$h_{f1} = (h_a^* + c^*) . m_x$	$h_{f2} = (h_a^* + c^* - x) . m_x$
Úhel stoupání	$tgp = m_x. z / d_1 = z_1 / q$; $tgg_w = (d_1 / d_{w1}) . tga$	
Délka šneku	$l_1 = (11 + 0,06 . z_2) . m_x$ ... $z_1 < 4$ $l_1 = (12,5 + 0,09 . z_2) . m_x$ ... $z_1 >= 4$	
Šířka věnce	$b_2 = 0,75 . (1 + 2/q) . d_1$ ... $z_1 < 4$ $b_2 = 0,67. (1 + 2/q) . d_1$ ... $z_2 >= 4$	
Osová vzdálenost	$a_w = 0,5.(d_1 + d_2) + x . m_x = 0,5 . m_x . (q + z_2 + 2x)$	

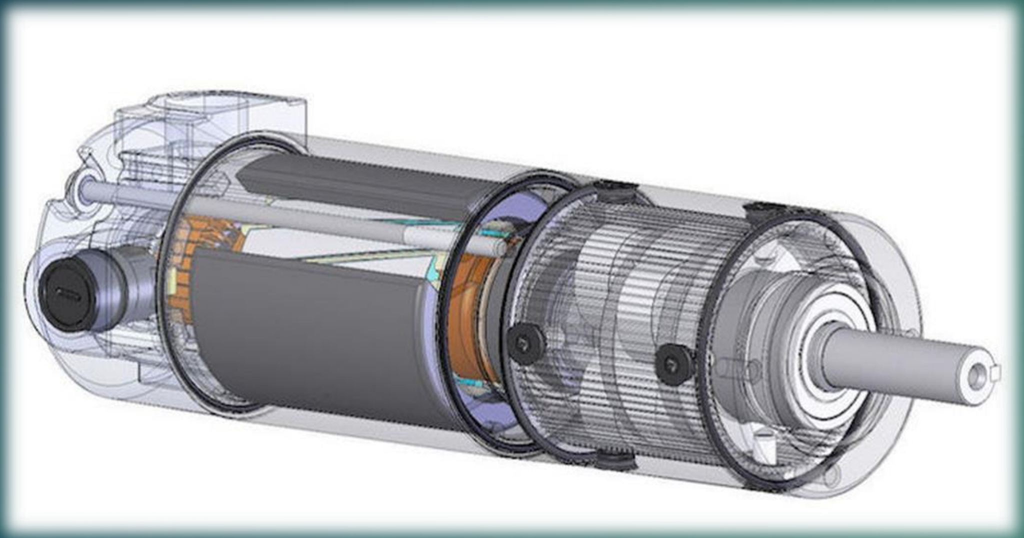
- m

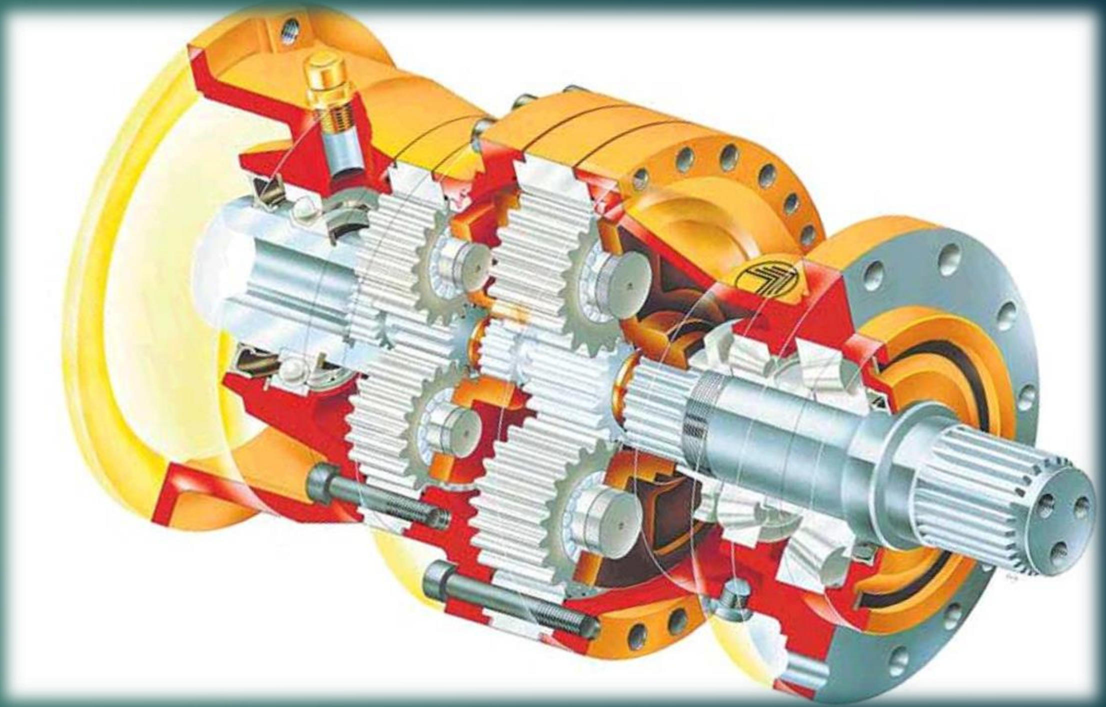
Globoid snail gears



- Globoid wheel – cylindrical snail
- Globoid snail – cylindrical snail

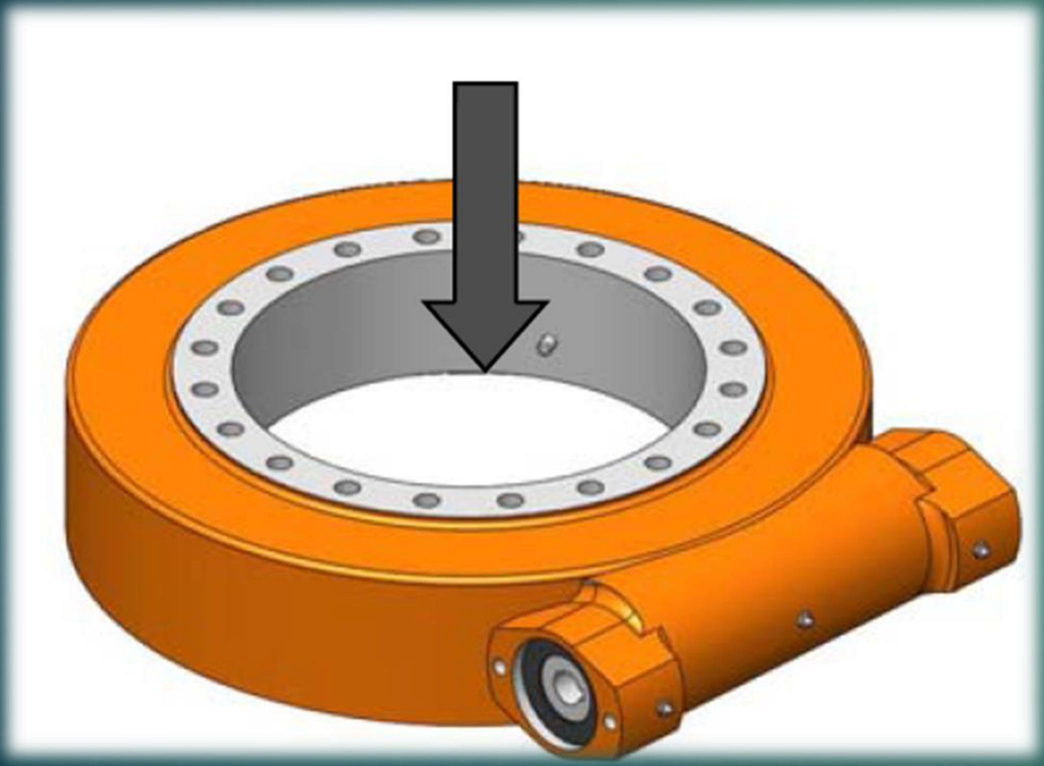
DC engine with planetary gear

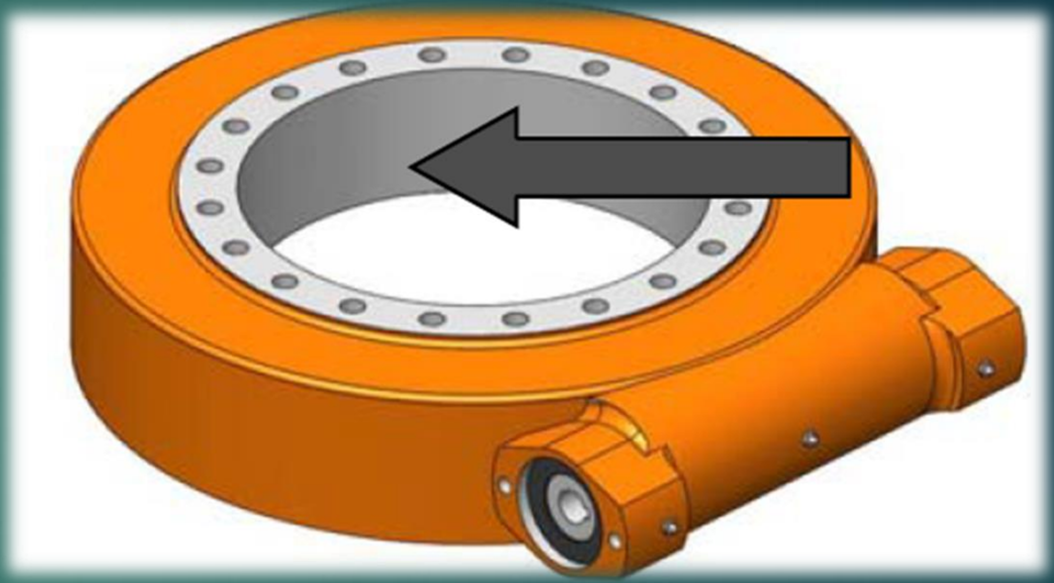




- 24V DC engine with planetary gear
- Very high torque
- Low current consumption
- Possible to control direct by OE5JFL

Globoid snail gears for solar panels - parameters

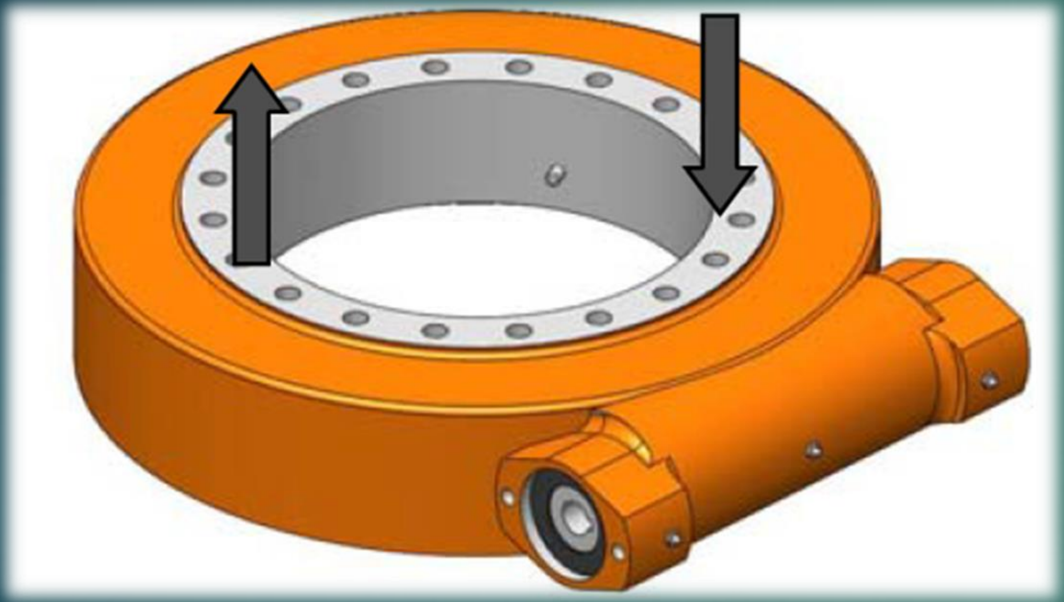




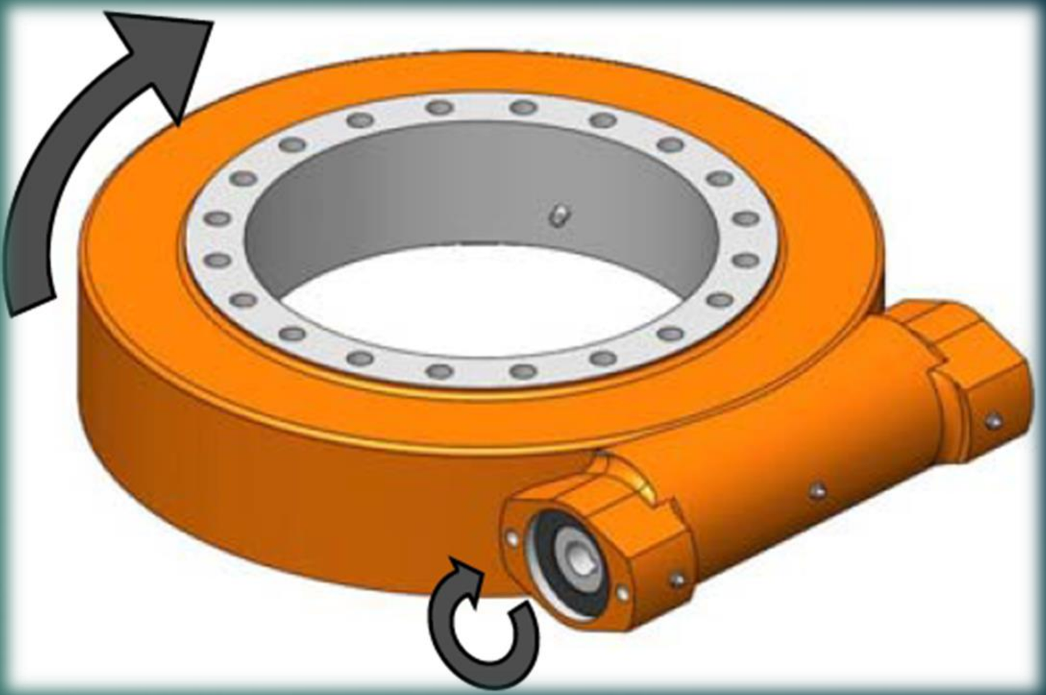
- Radial load

- Axial load

Globoid snail gears for solar panels -parameters

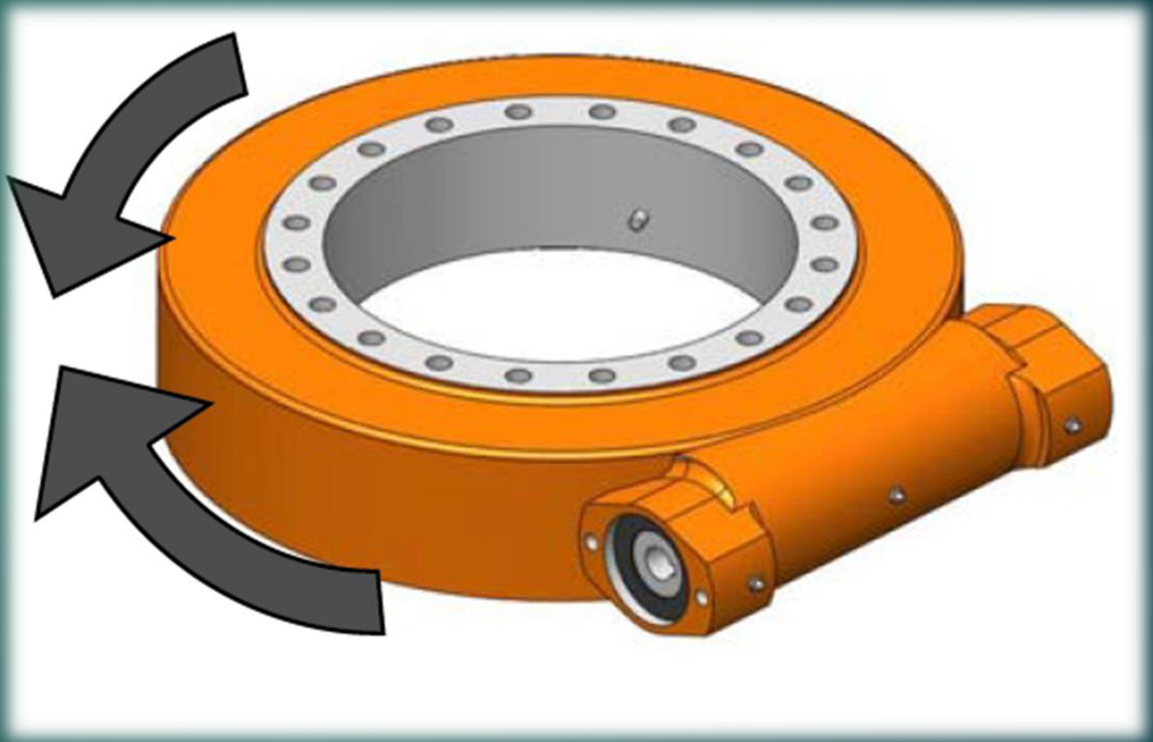


- Tilting moment



- Nominal and maximal output torque

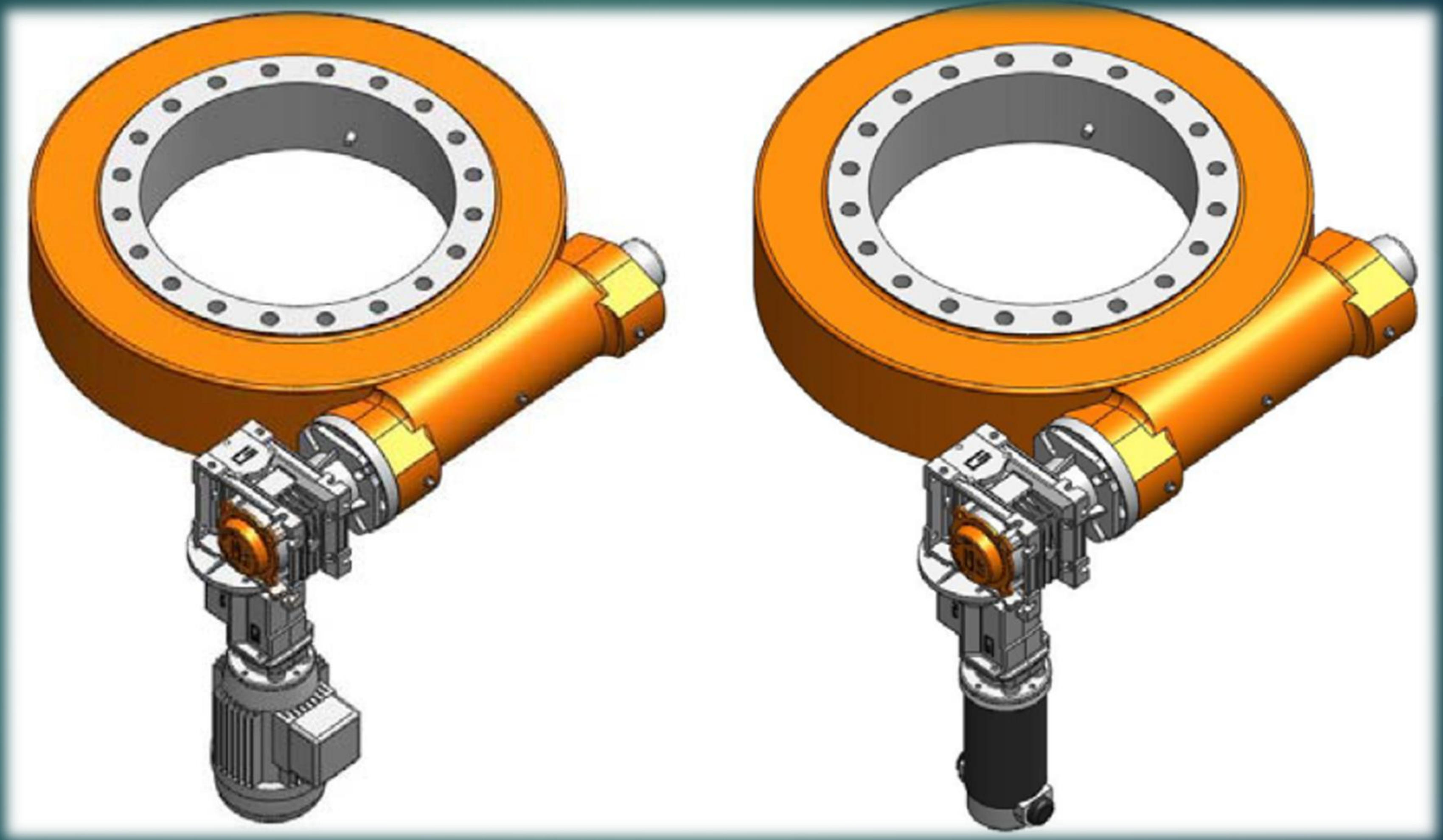
Globoid snail gears for solar panels -parameters



- Holding torque

Globoid snail gears for solar panels

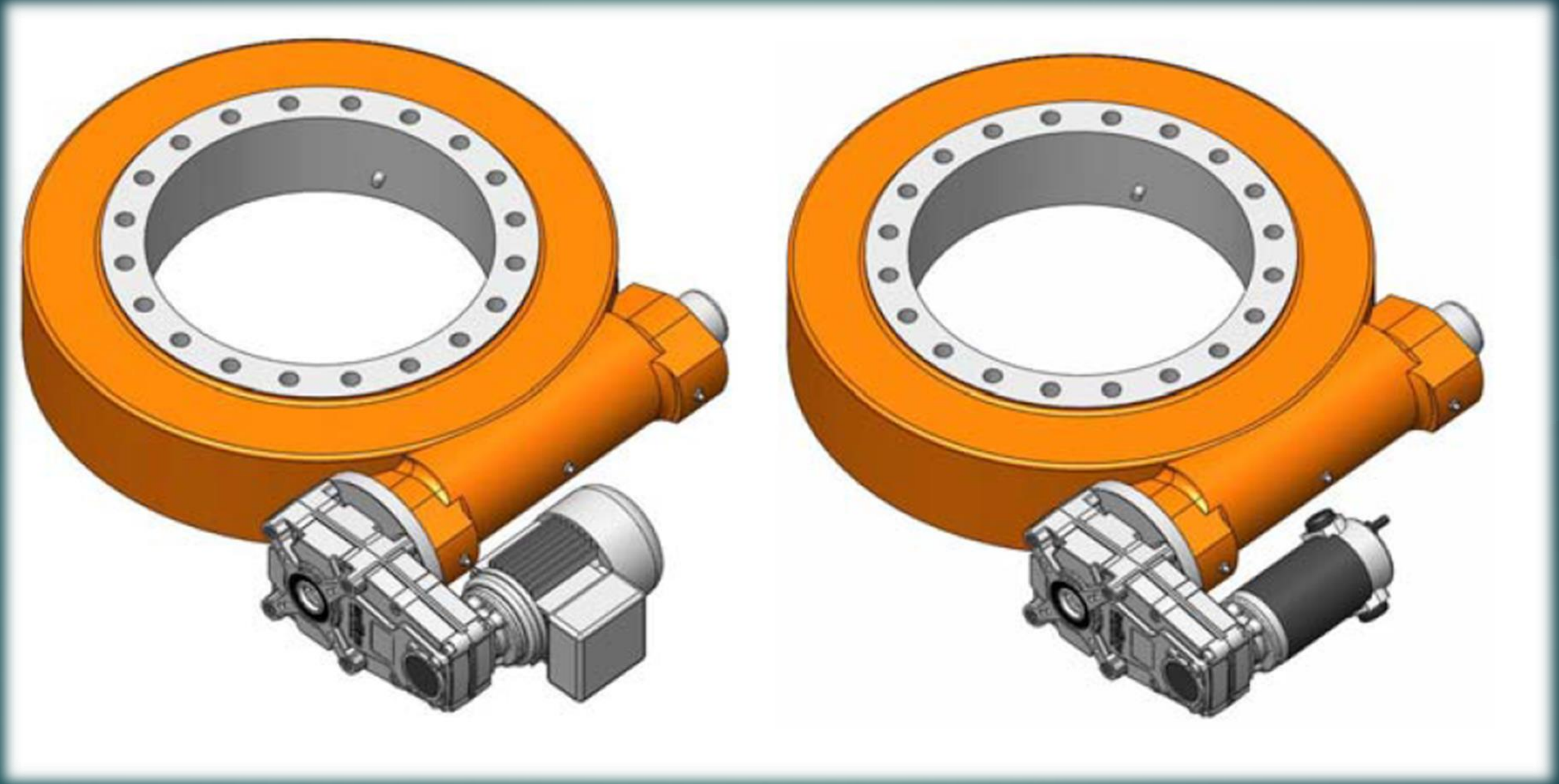
right angle gear and engine



- Torque by AC 230V engine
- Torque by DC24 or 48V engine

Globoid snail gears for solar panels

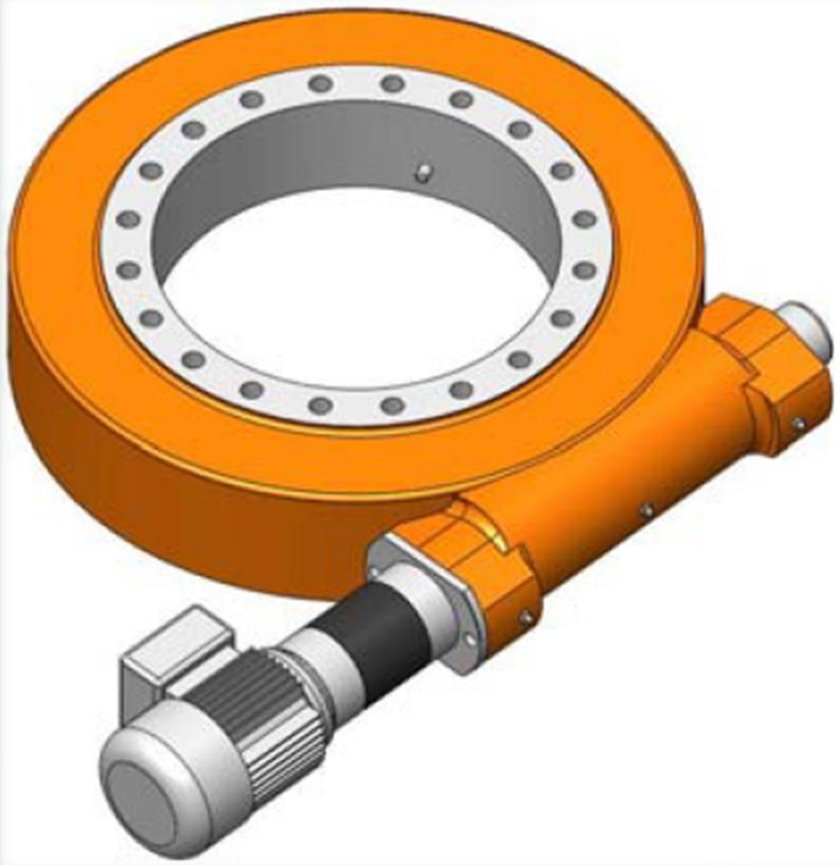
aditional gear and engine

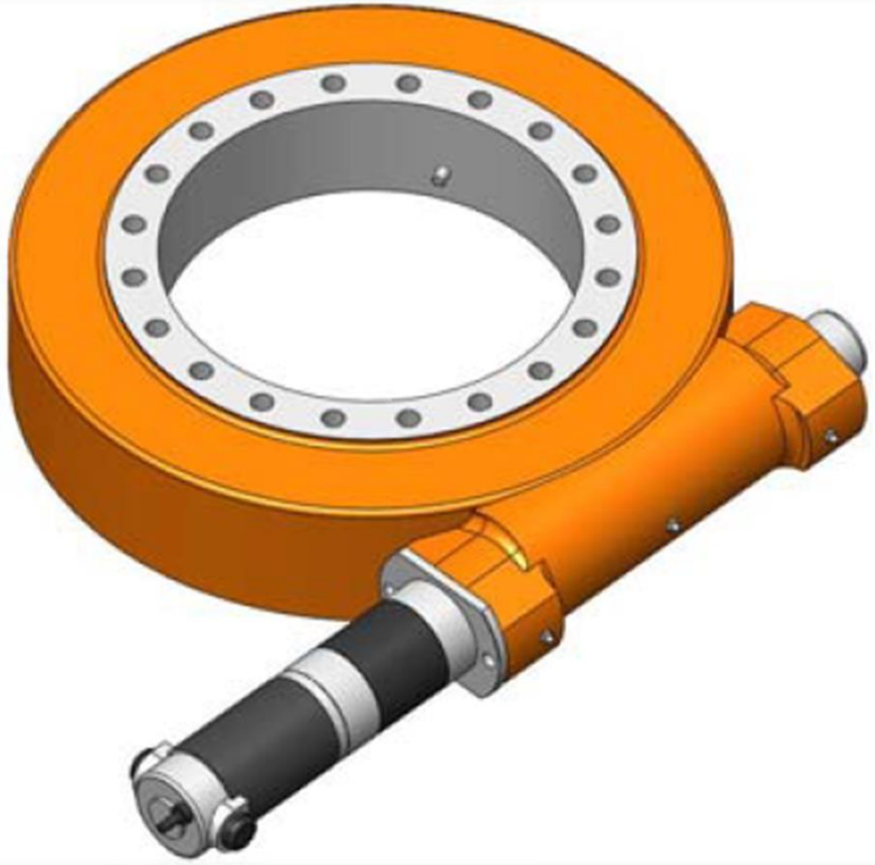


- Torque by AC 230V engine
- Torque by DC24 or 48V engine

Globoid snail gears for solar panels

additional planetary gear and engine

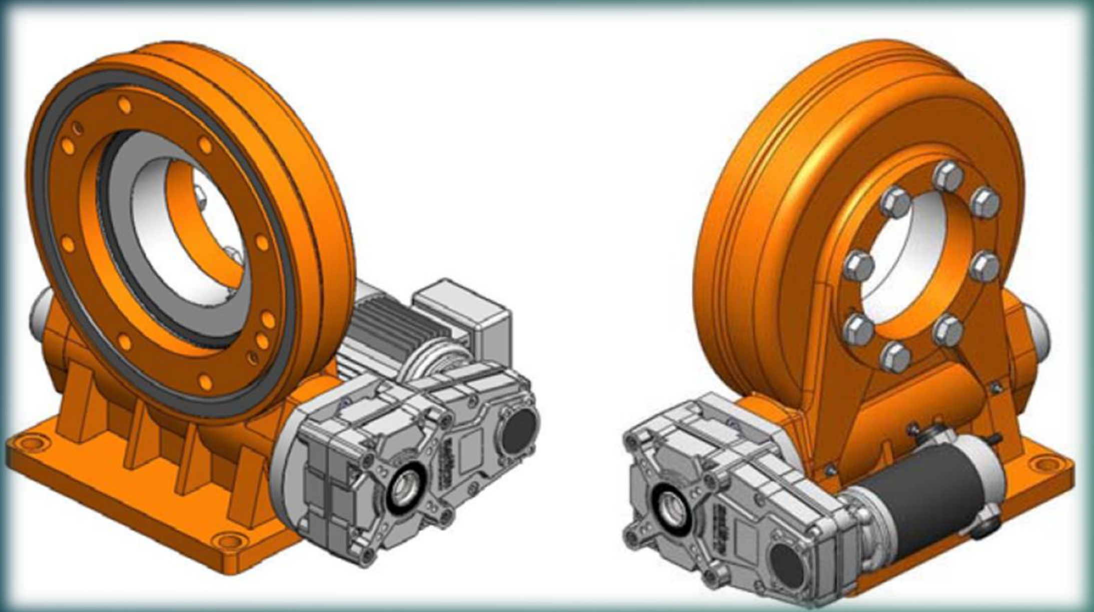




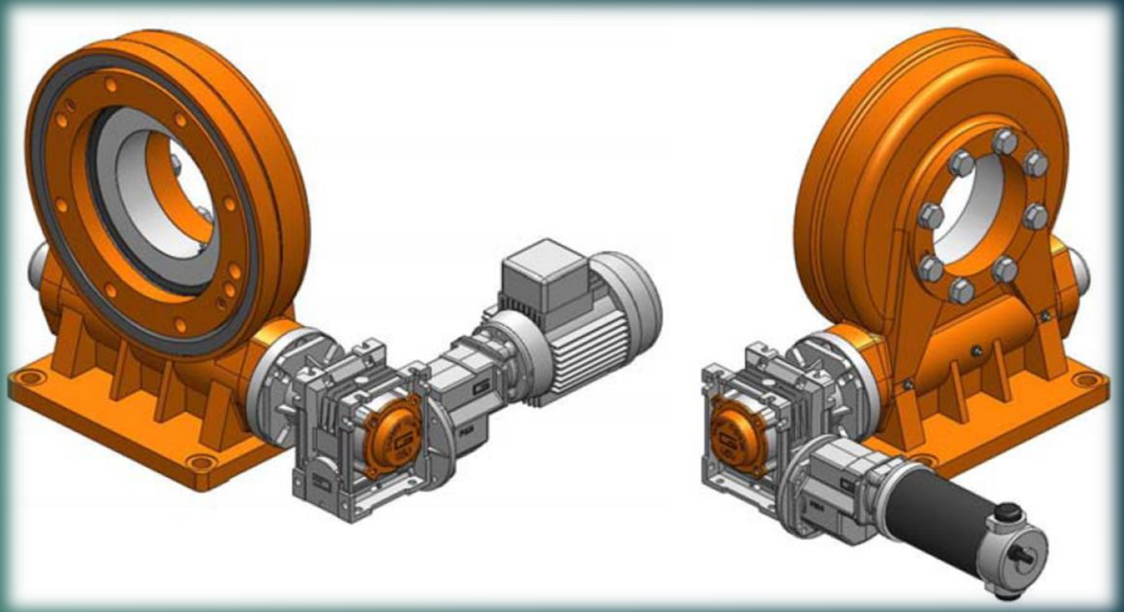
- Torque by AC 230V engine
- Torque by DC24 or 48V engine

Globoid snail gears for solar panels

same as before, but axial solution



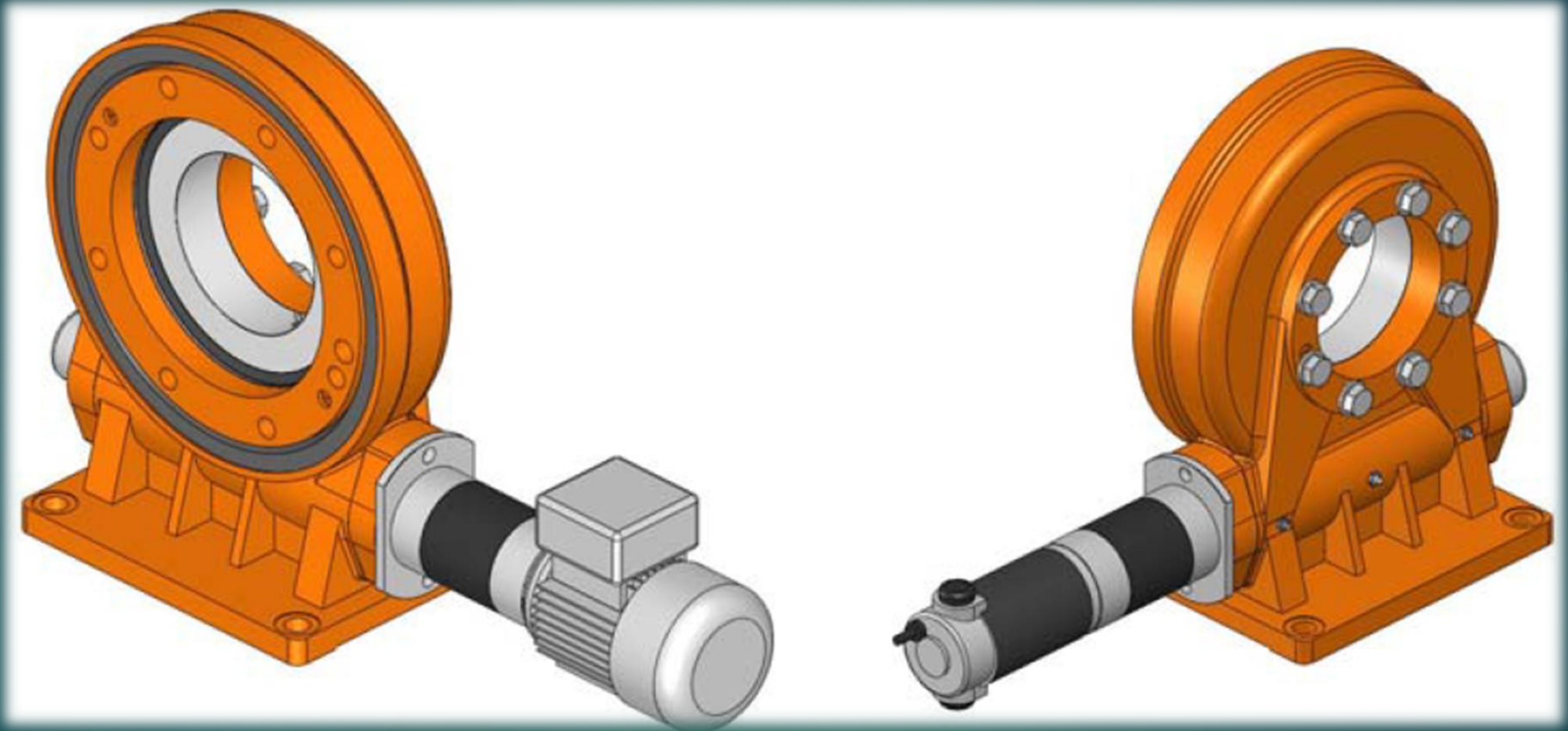
- Torque by AC 230V engine



- Torque by DC24 or 48V engine

Globoid snail gears for solar panels

our best solution



- Torque by AC 230V engine
- Torque by DC24 or 48V engine

OK2AQ and OK1DFC solution 9“

	ST9-61-25H -R	PT9-61-25H-R
Ratio	61	
Nominal torque	6,5 kNm	
Max torque	7,0 kNm	
Holding torque	38,7 kNm	
Max tilting mo-ment	33,8 kNm	
Max dynamic axial load	81 kN	
Max dynamic radial load	71 kN	
Static axial load	338 kN	
Static radial load	135 kN	
Efficiency	40%	
Backlash	≤ 0,17°	≤ 0,05°

- Expecting use for 2,4m solid offset dish
- 24V DC engine
- DFC with planetary gear 360° 25 minutes 24V/1,8A
- AQ without planetary gear 360° 2,5 minutes 24V/8A

OK1DFC portable solution

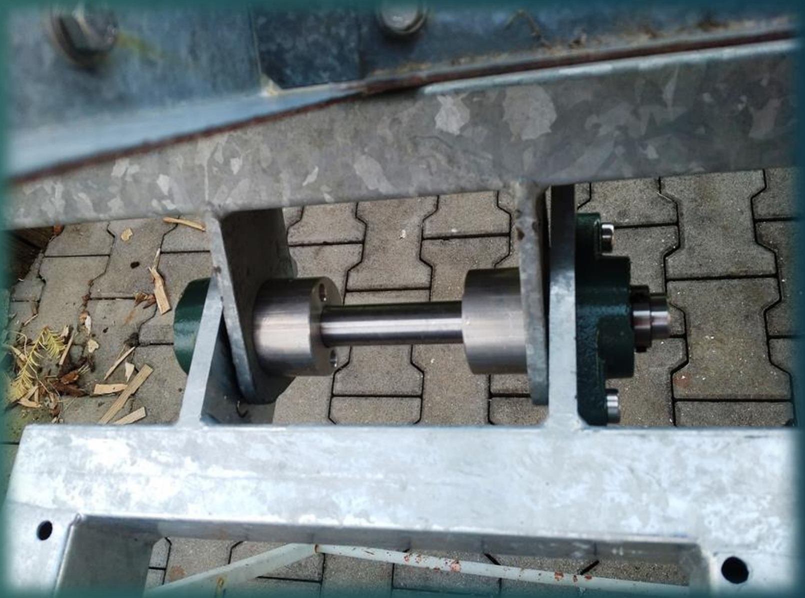
- Expecting use for 1,8m solid PF dish
- 24V DC engine – OE5JFL direct controller
- DC engines with planetary gear 360° 25 minutes – 90°elevation 12 minutes
- Full load 234V/2,2A DC

	SVT3-62-12R	PVT3-62-12R
Ratio	62	
Nominal torque	400 Nm	
Max torque	600 Nm	
Holding torque	2,0 kNm	
Max tilting mo-ment	500 Nm	
Max dynamic axial load	9,6 kN	
Max dynamic radial load	8,4 kN	
Static axial load	30 kN	
Static radial load	15 kN	
Efficiency	30%	
Backlash	≤ 0,2°	≤ 0,08°

OK1DFC practical application

- 1,8m solid PF dish
- 24V DC engine – OE5JFL direct controller
- Posital EL read out and MAB25 AZ read out with 0,1°resolution
- Test without contra weight
- Today used contra weight 10kg on 1m length arm

OK2AQ & OK1DFC 2,4m offset



OK2AQ & OK1DFC 2,4m offset

- 9“ gear for 2,4m dish
- MAB25 read out in ALU box

OK2AQ & OK1DFC

OK2AQ & OK1DFC 2,4m offset

Thank you for attention !!!

Questions ????