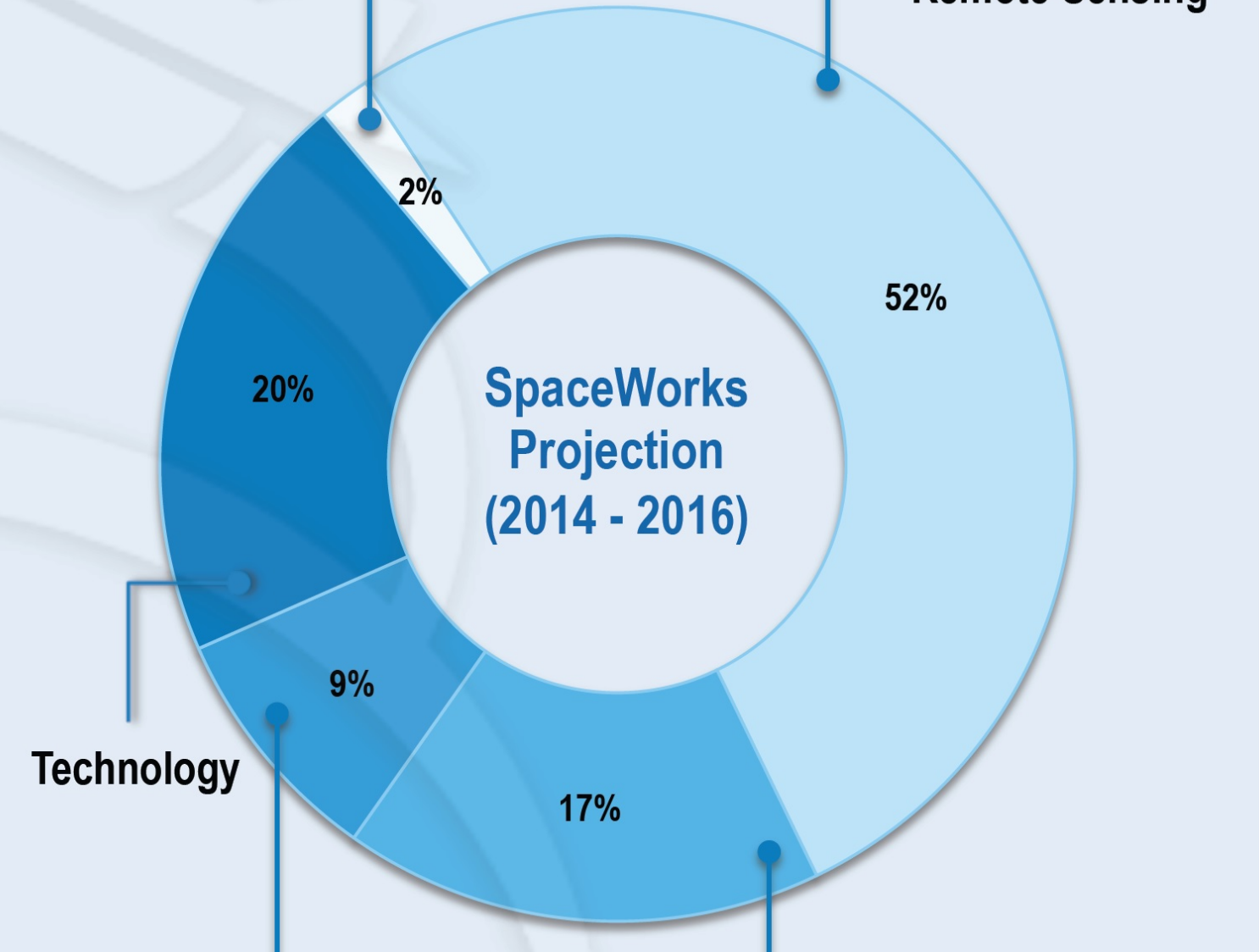




**A “nano” rotary compressor with
a 1:12 compression ratio for CubeSats
Olly Dmitriev**

Reconnaissance

Earth Observation/
Remote Sensing



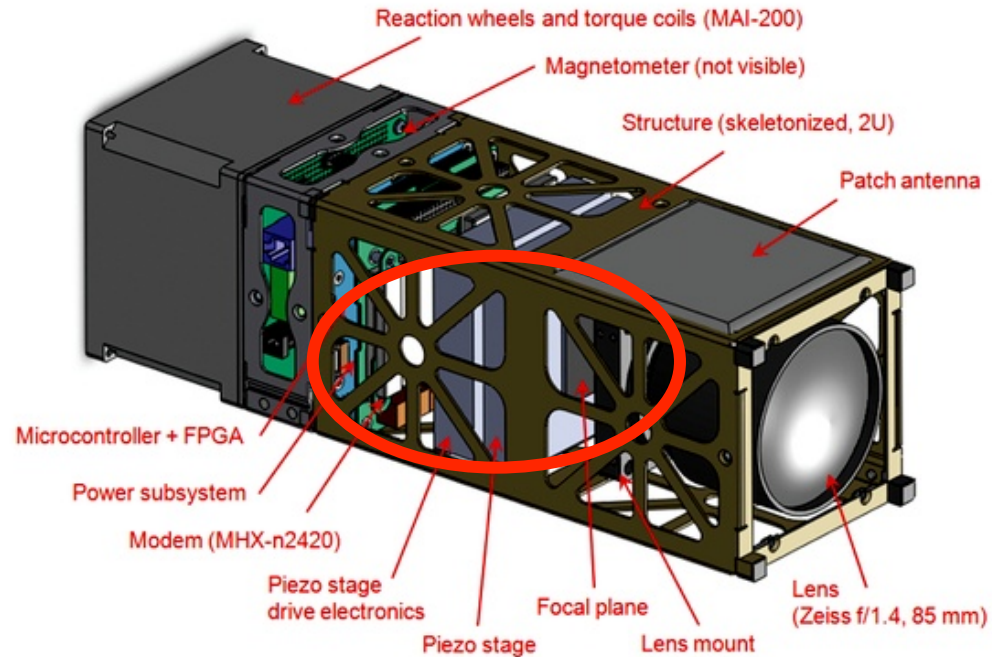
Total: 650

Communications

Scientific

(c) SpaceWorks

INCREASING POWER BUDGETS ON CUBESATS HEAT REMOVAL IS AN ISSUE FOR EARTH OBSERVATION AND REMOTE SENSING



$$n_0 = k_3 T^{-1.5} e^{-(k_4/T)}$$

PASSIVE HEAT SINKS:

over 258K

TARGET T FOR PHOTO DETECTORS: below 180K

CRYOCOOLER BY LOCKHEED MARTIN

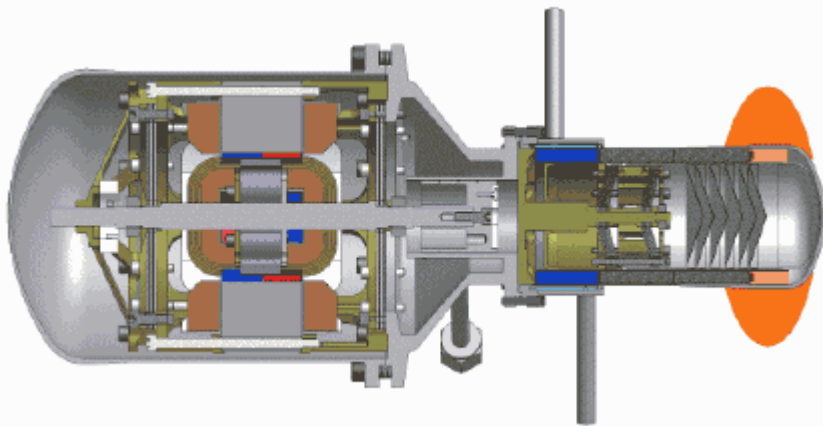
10W INPUT POWER

650mW @ 150K

HELIUM

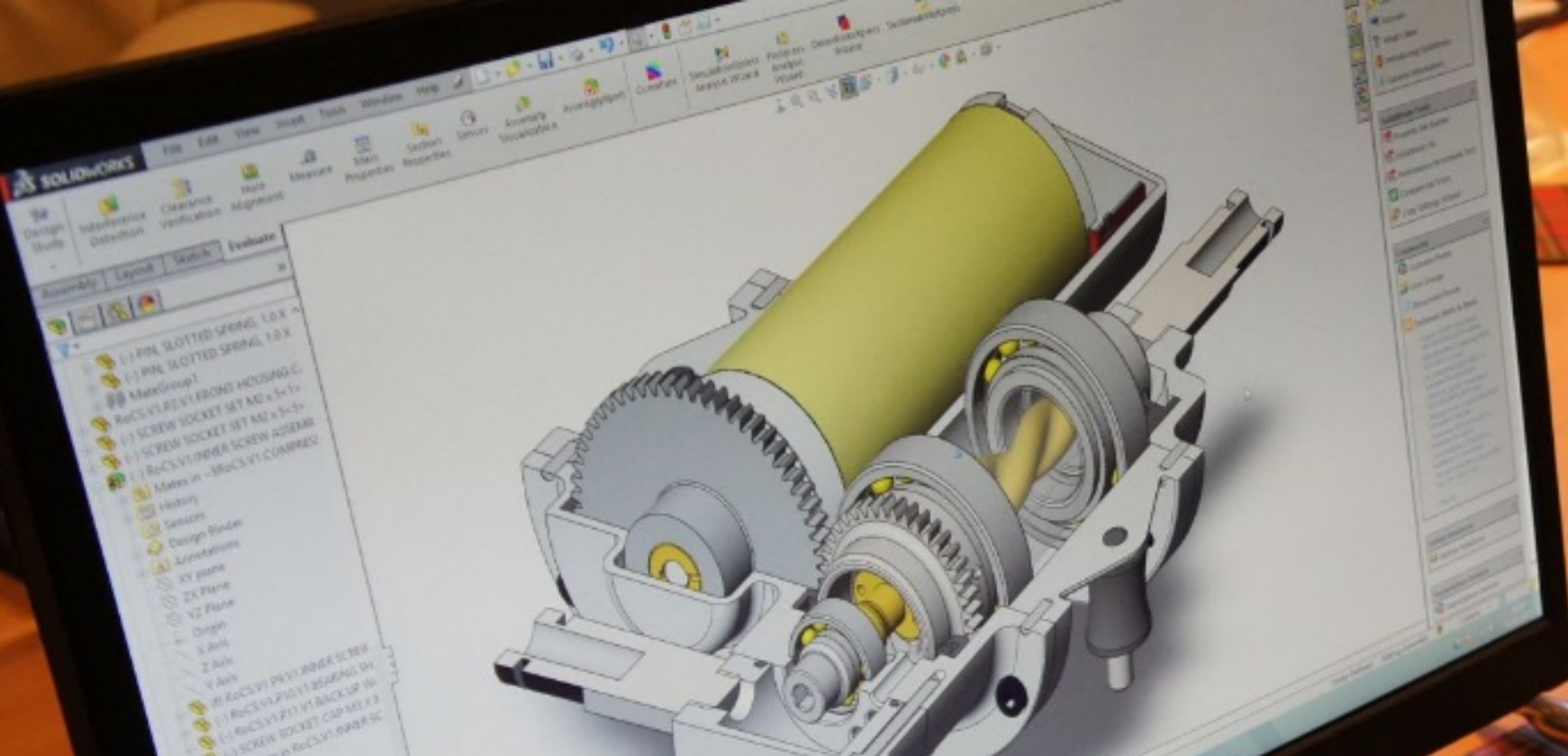
**RECIPROCATING COMPRESSOR
(VIBRATION)**

CLASSIC STIRLING TYPE



COMPRESSOR DESIGN SPECS

1. COOL OPTICAL SENSORS FROM 313K TO 180K OR LESS
2. REMOVE 20W
- 3. MINIMAL VIBRATION**
4. FIT 100x100x40mm
5. <200g

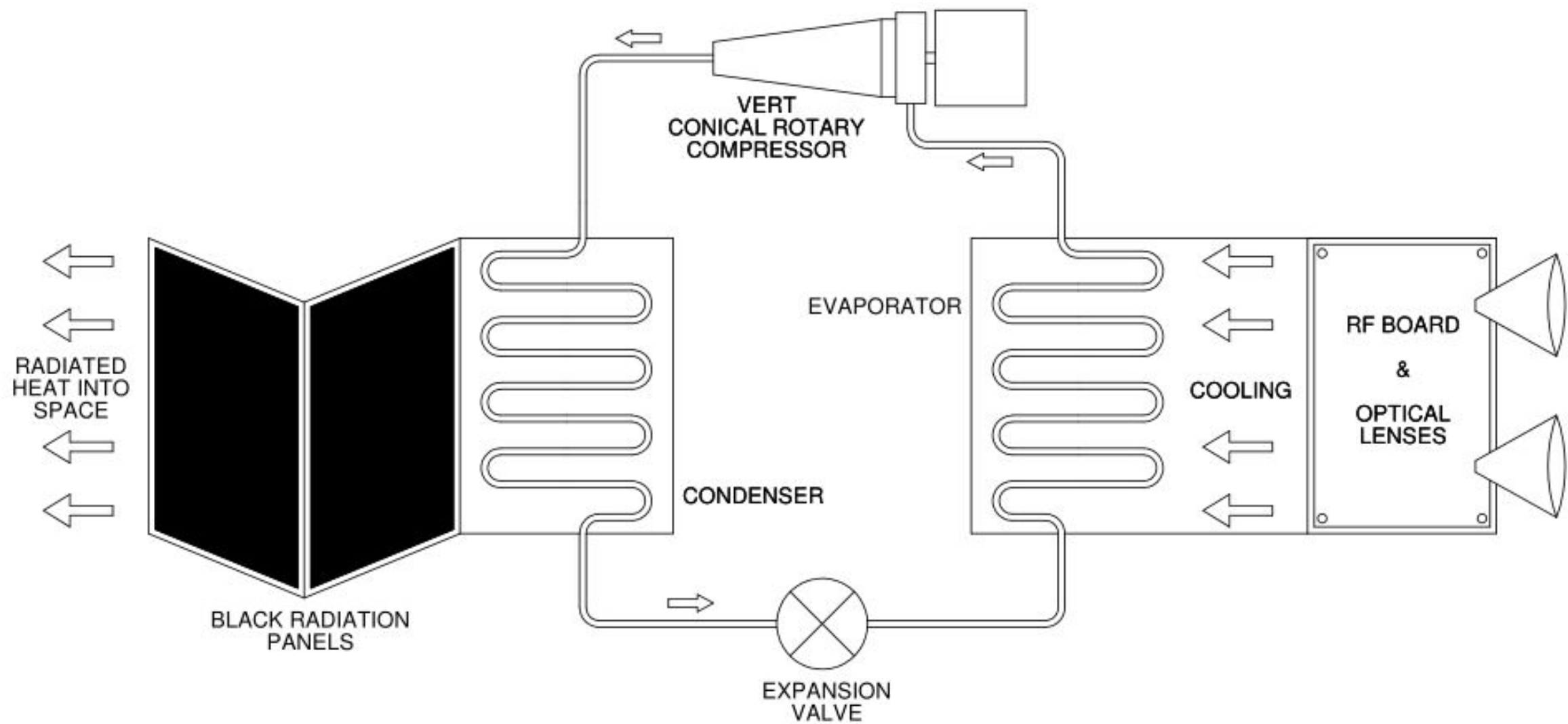


APPROACH

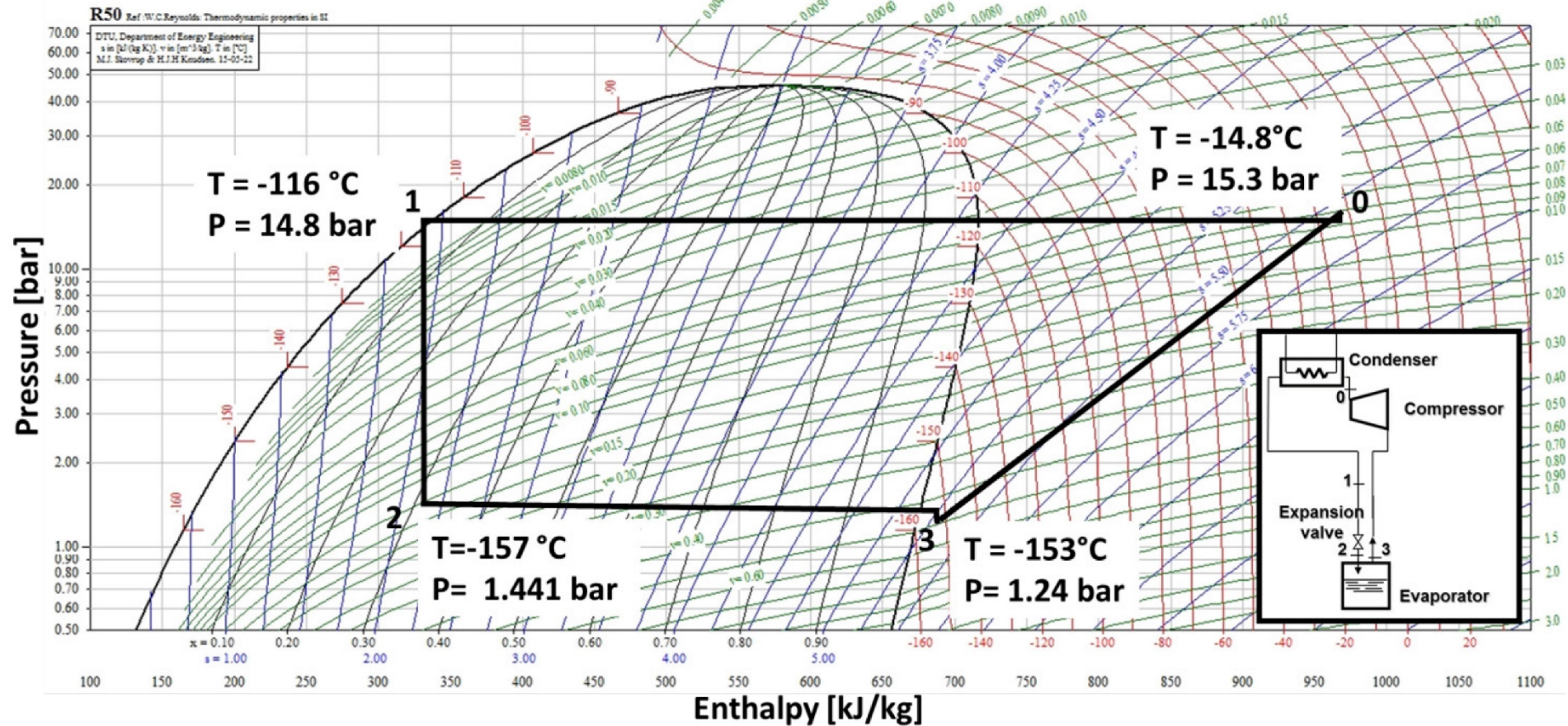
ROTARY COMPRESSOR TO MINIMISE VIBRATION

$$P = A \varepsilon \sigma T_{\text{Rad}}^4$$

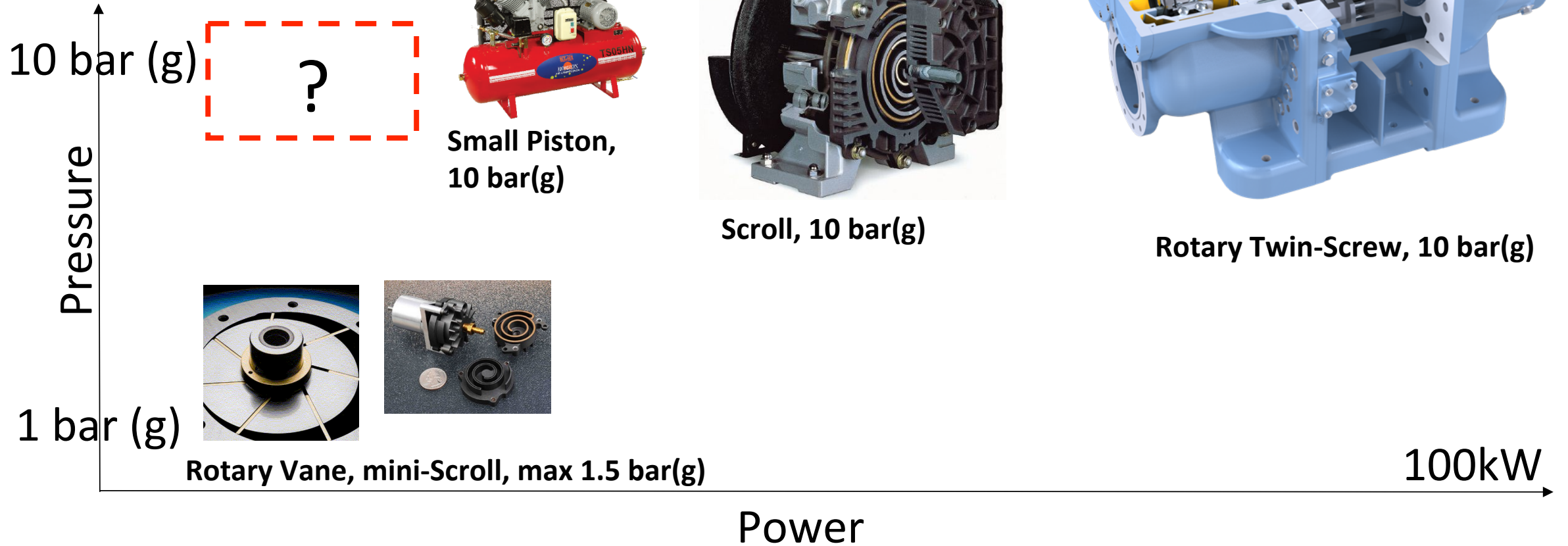
HEATING IS BENEFICIAL => HIGH COMPRESSION RATIO



THE MODEL
20W HEAT REMOVAL
COOLING TO 120K
COMPRESSION RATIO 1:12
COMPRESSOR POWER 20W
RADIATION PANEL SURFACE AREA 0.24 M²



AVAILABILITY OF COMPRESSORS

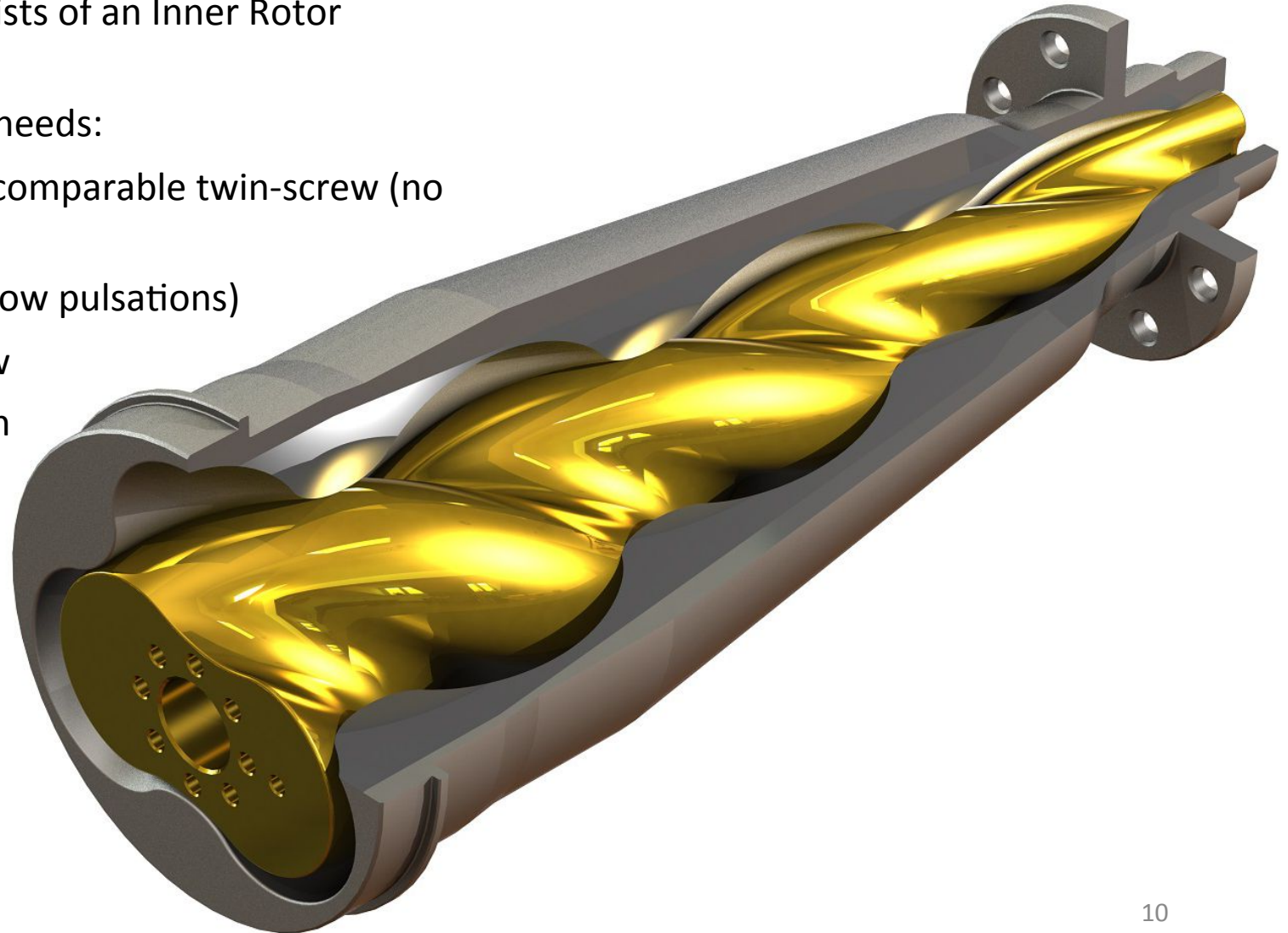


VERT ROTORS' CONICAL TYPE

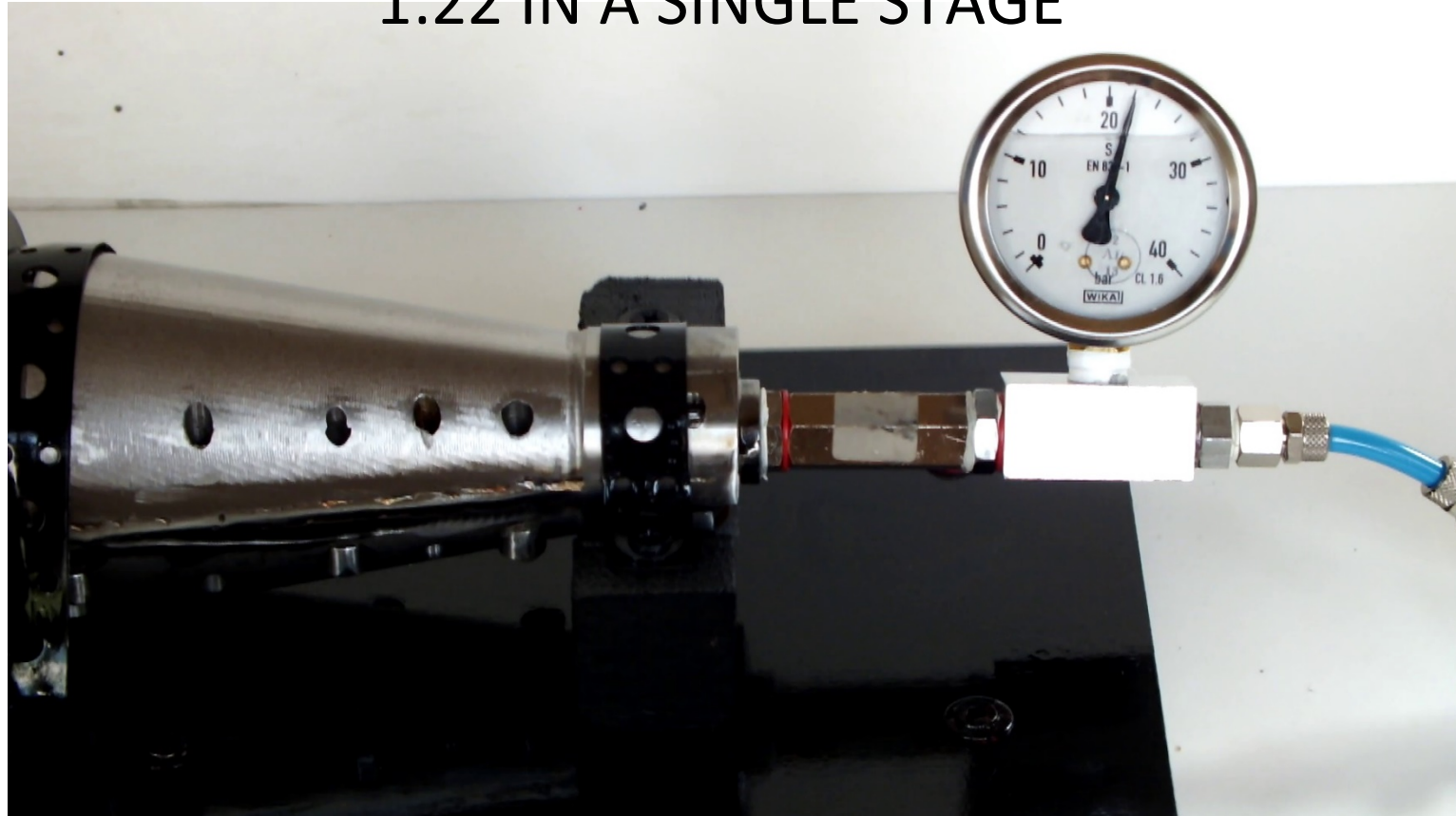


- VERT Rotors has developed a new type of Conical Rotary Compressor (CRC) with improved efficiency. The CRC consists of an Inner Rotor revolving *inside* an Outer Rotor
- Tests have verified that the CRC meets these needs:
 - Volumetric efficiency 20% better than a comparable twin-screw (no blowhole, less leakage flow)
 - Very low noise (small axial discharge => low pulsations)
 - 40% smaller than comparable twin-screw
 - 100% oil-free air ISO 8573-1 CLASS 0 with water injection instead of oil

CRC is the most compact rotary compressor on the market that produces 10 bar(g) at standard motor speeds with virtually no vibration and low noise



**TESTS OF THE MAXIMUM COMPRESSION RATIO OF
CRC:
1:22 IN A SINGLE STAGE**



TESTS OF THE 2kW CRC HAVE VERIFIED:

42% smaller than comparable twin-screw

Volumetric efficiency 20% better than a comparable twin-screw



Screw rotor
Flow rate

length 225mm, diam 75mm
225 l/min @ 2 900 r/min @ 8 bar load

[Click to watch](#)

MK03 // "NANO" ROTARY COMPRESSOR

SCREW ROTOR LENGTH

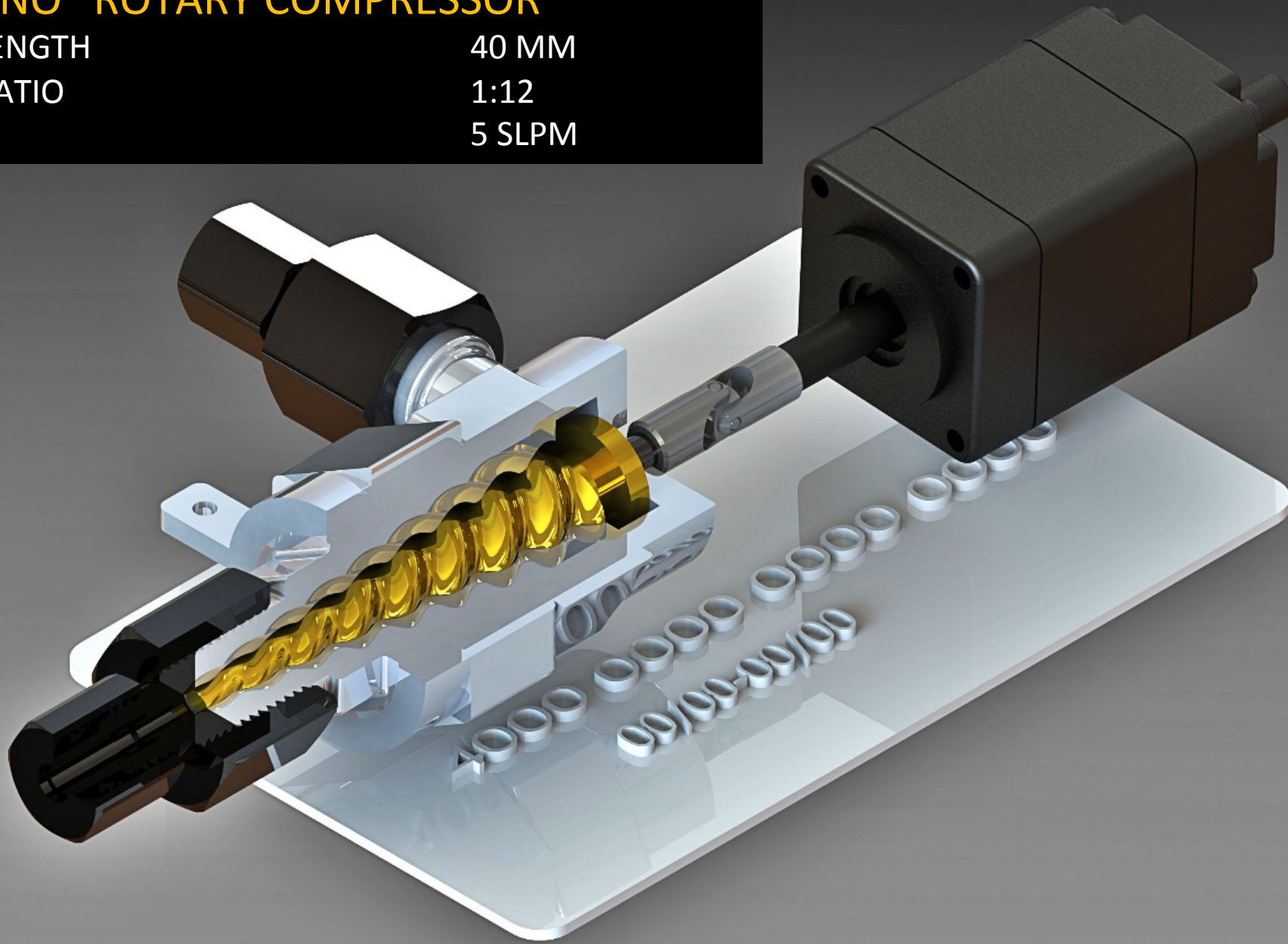
40 MM

COMPRESSION RATIO

1:12

FLOW RATE

5 SLPM









QUESTIONS?

OLLY DMITRIEV

olly@VERTrotors.com

www.VERTrtrotors.com