

COMPASS-U: VACUUM VESSEL

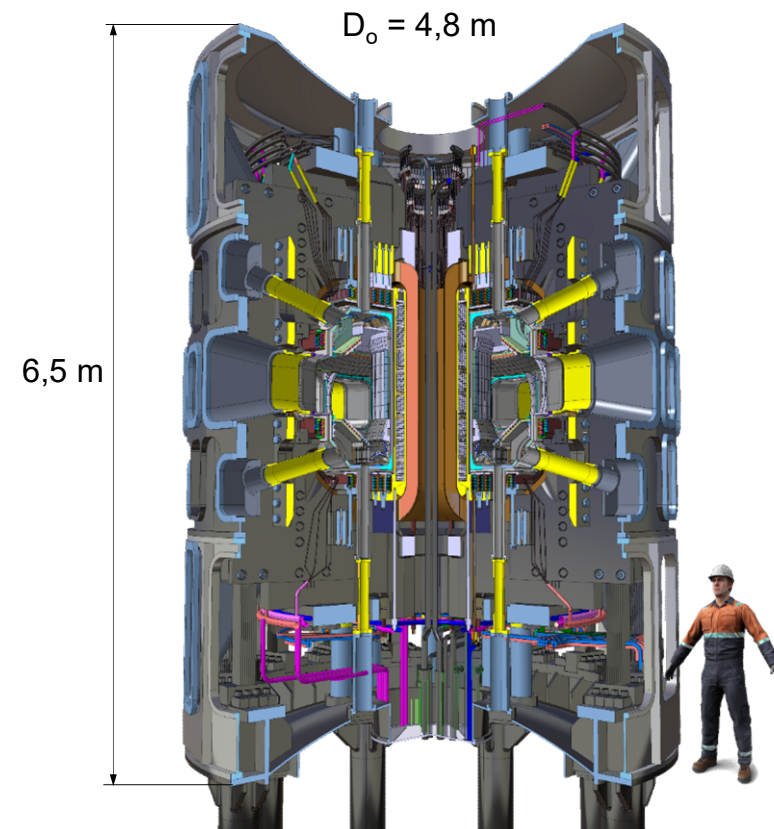
PRELIMINARY MARKET CONSULTATIONS

JAN PŘEVŘÁTIL, REV. 27.06.2022

1. BRIEF MACHINE OVERVIEW – Main tokamak assembly

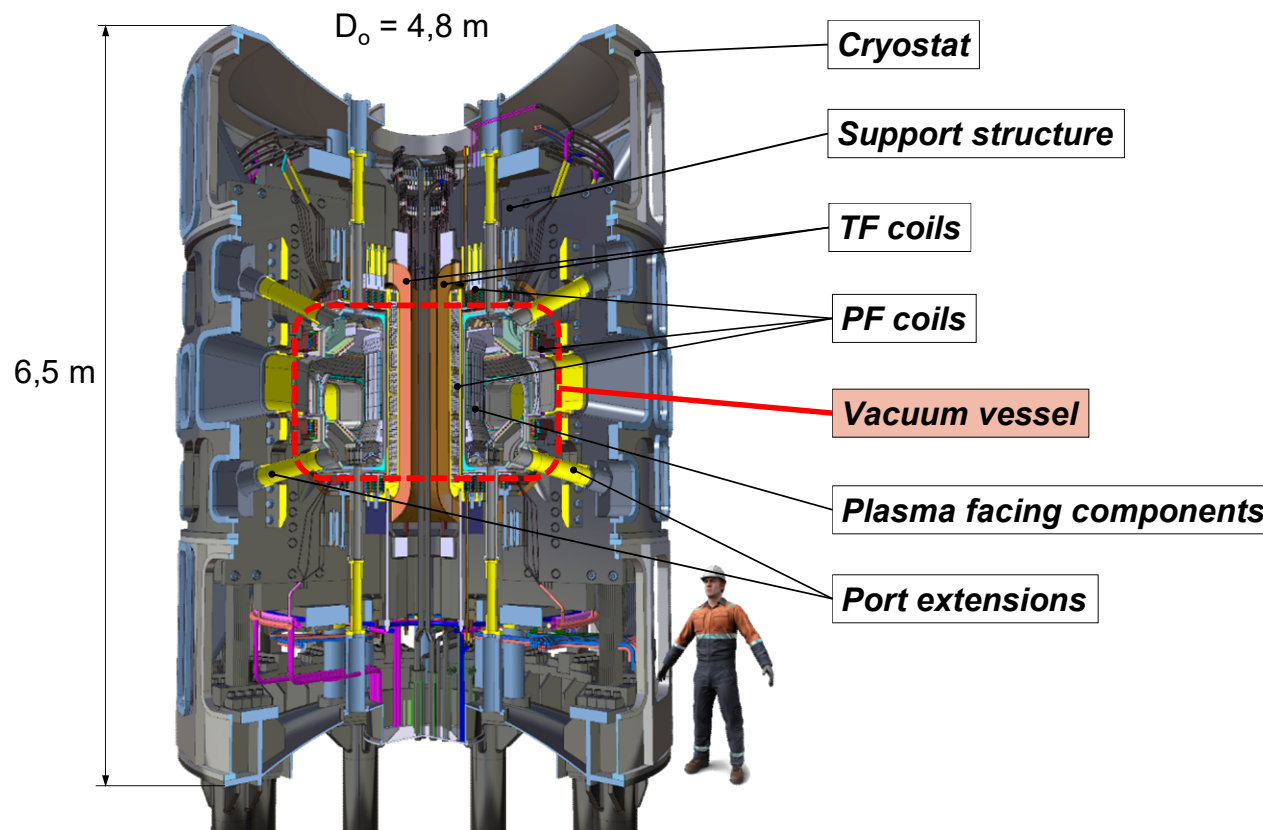
MAIN DESIGN REQUIREMENTS

- Toroidal magnetic field: $B_t = 5 \text{ T}$
- Plasma current: $I_p = 2 \text{ MA}$
- Major radius: $R = 0.894 \text{ m}$
- Minor radius: $a = 0.27 \text{ m}$
- Aspect ratio: $A = 3.3$
- Triangularity: $\delta = 0.3 - 0.6$
- Elongation: $\kappa = 1.8$
- Enough space for different divertors
- Plasma shapes:
 - single lower null, neg. triangularity with limited parameters (Phase 1)
 - double null (Phase 2)
 - snowflake, negative triangularity (Phase 3)
- Heating power:
 - Phase 1 - $\text{PNBI} \geq 3 \text{ MW}$, $\text{PECRH} = 1 \text{ MW}$ ($P \cdot B/R \sim 25$)
 - Phase 2 - up to $\text{PNBI} = 8 \text{ MW}$, $\text{PECRH} = 10 \text{ MW}$ ($P \cdot B/R \sim 100$)
- Vacuum vessel operation temperature up to 500°C (min. 300°C)



1. BRIEF MACHINE OVERVIEW – Main tokamak assembly

KEY COMPONENTS



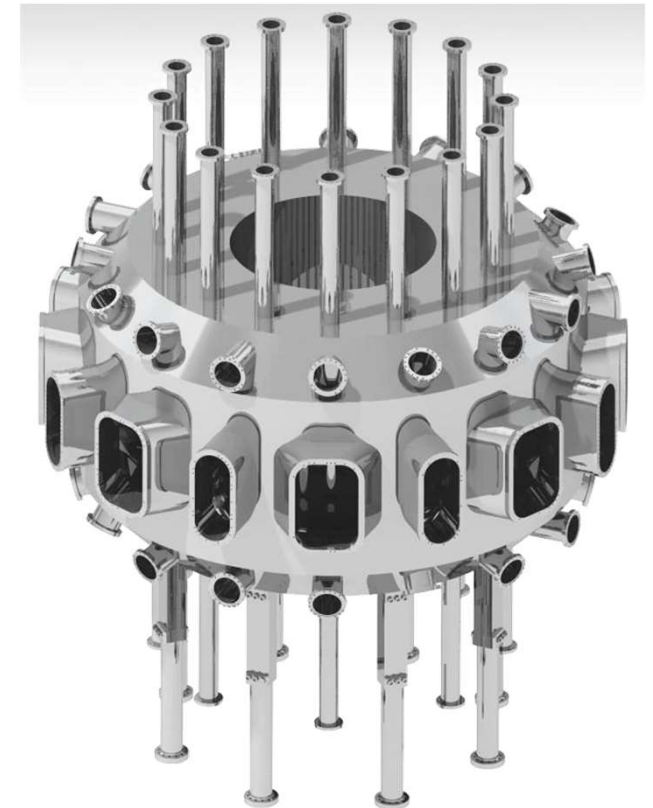
2. VACUUM VESSEL – Design requirements and constraints

DESIGN REQUIREMENTS

- Provide a reliable structural boundary for life time of the tokamak
- **Withstand all possible critical load combinations** from external pressure, component weight to electromagnetic loads
- Provide high vacuum for the experiments
- **Provide structural support for the in-vessel components**
- **Provide access** ports for external diagnostic systems, heating and current drive systems and in-vessel components maintenance
- Material of VV should have high electrical resistance

DESIGN CONSTRAINTS

- **Very high electromagnetic forces during disruptions**
- Design based on believed the worst case load scenarios
- **High temperature operation up to 500 °C**
- **Tight spatial constraints** due to the compact design of the machine
- **Manufacturing and material costs**



4. VACUUM VESSEL – Preliminary drawing definition

VV MAIN BODY

TWO TOLERANCE TYPES:

DESIRED (DE) ... desired manufacturing tolerance to be reached

CRITICAL (CR) ... critical tolerance which shall not be exceeded

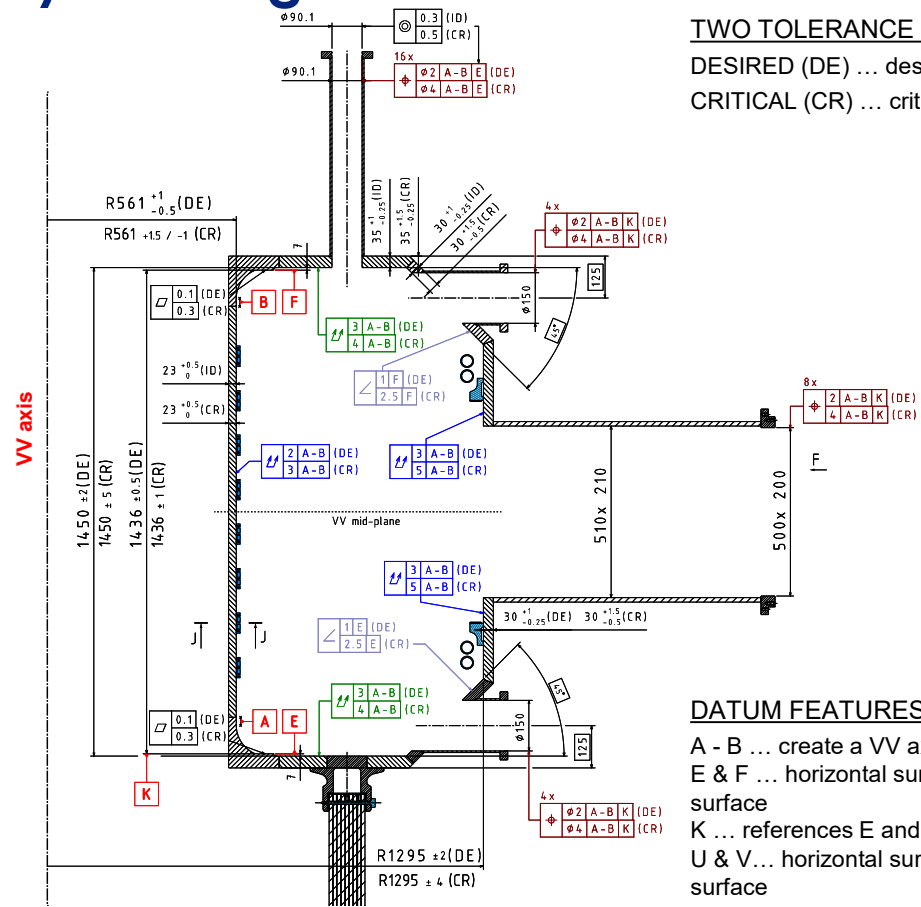
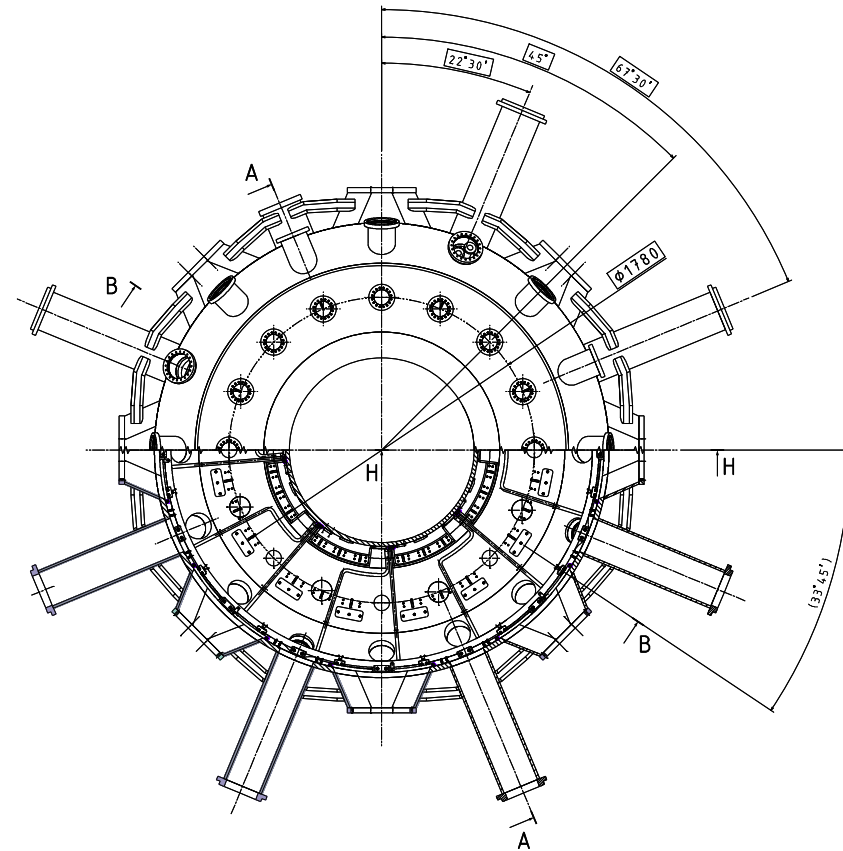
DATUM FEATURES USED:

A - B ... create a VV axis

E & F ... horizontal surfaces of the forged ring create a reference surface

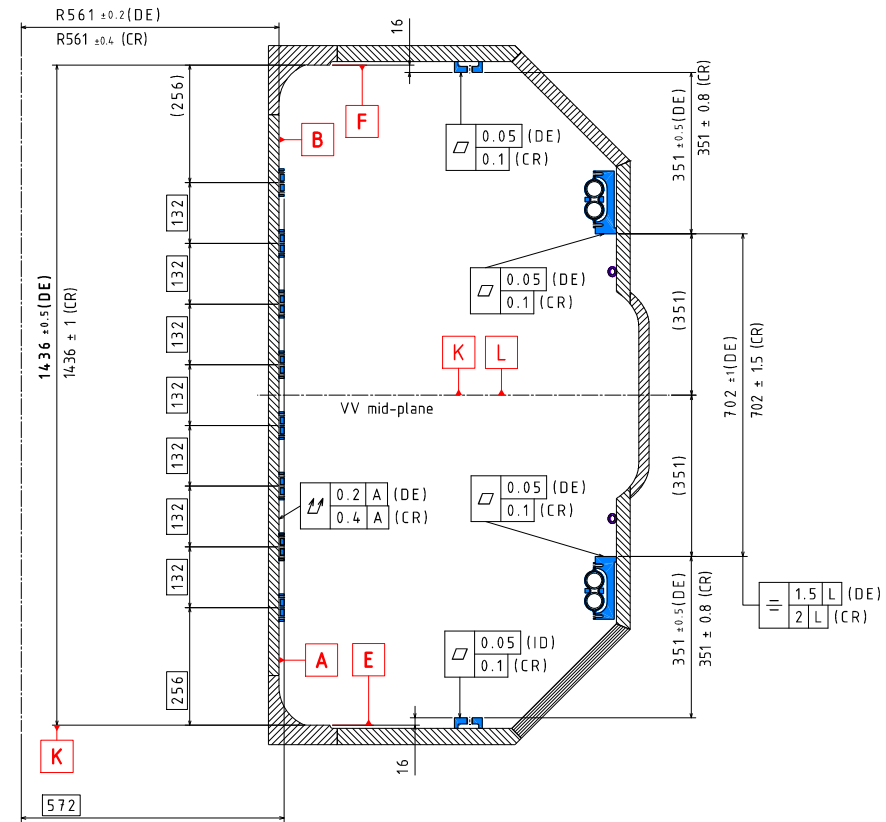
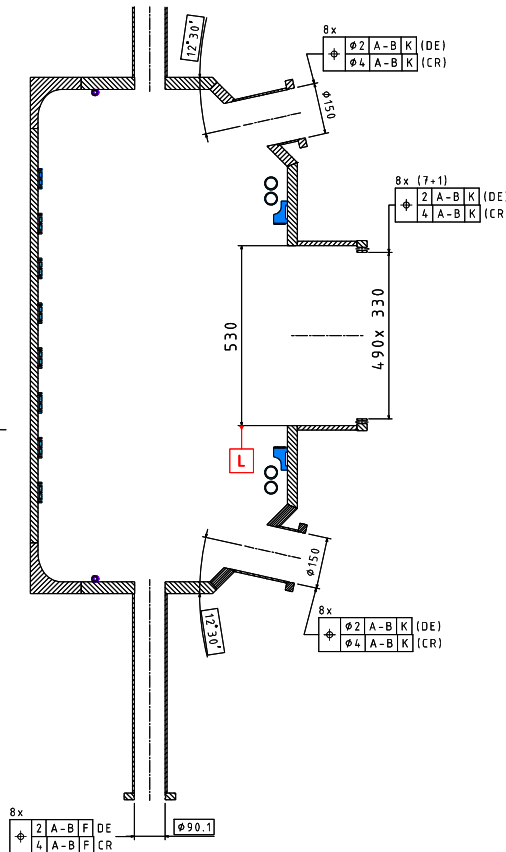
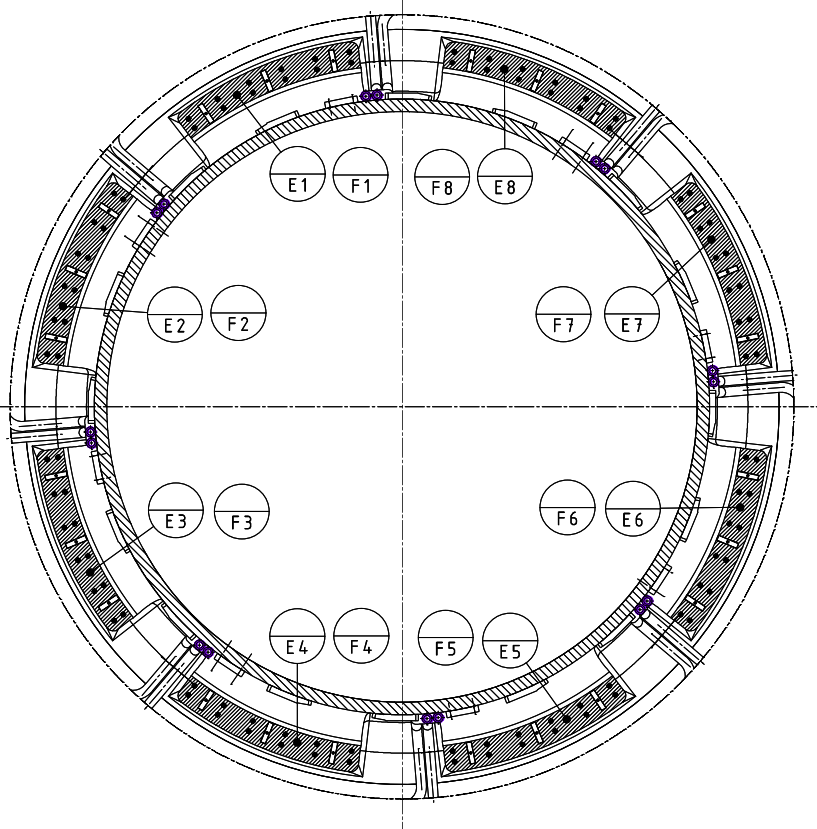
K ... references E and F create a mid-plane reference

U & V... horizontal surfaces of the PSP pads create a reference surface



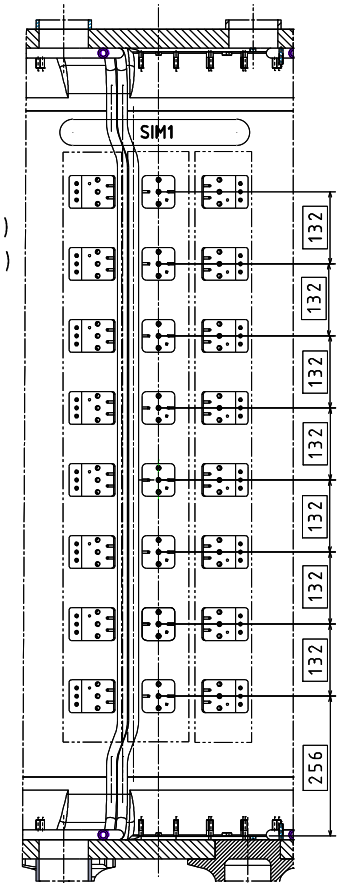
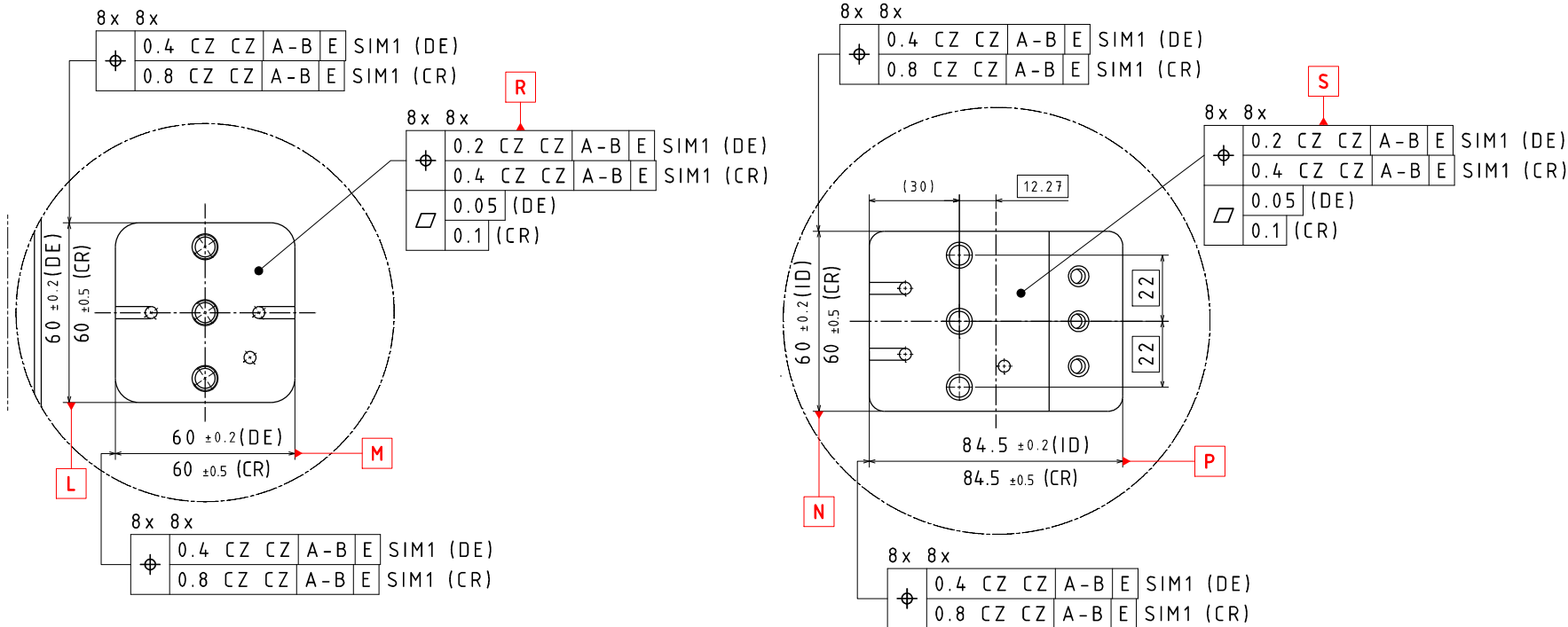
4. VACUUM VESSEL – Preliminary drawing definition

VV BODY + INTERFACES



4. VACUUM VESSEL – Preliminary drawing definition

VV INTERFACES – HFS pads



DATUM FEATURES USED:

L / M ... both create a horizontal / toroidal reference mid-plane of the pad
 N / P ... both create a horizontal / toroidal reference mid-plane of the pad
 R / S ... frontal surface of the pad create a reference

4. VACUUM VESSEL – Preliminary drawing definition

VV INTERFACES – HFS pads and heating tube

