Superconducting magnet testing:
The art of giving feedback on magnet design

with Franco Mangiarotti
SC magnet testing palette

- Magnet temperature
- Current cycle
- Voltage taps
- External instrumentation

Magnet test at SM18 (CERN)
Mid plane quench limitation

Quench current [kA]

Quench number

- Top coil - outer
- Top coil - inner
- Bottom coil - outer
- Bottom coil - inner
- Joint
- Bottom coil - mid plane

1.9 K
Ramp rate studies: low quench level

![Graph showing ramp rate studies with low quench level.](image)
Early SC $\rightarrow$ normal transition

![Graph showing voltage in the midplane vs. current for two coils at 1.9 K.](image)
High quench propagation velocity

![Graph showing quench propagation velocity vs. current with different Ic reduction levels and measurements at 1.9 K.](image-url)
Last detail: magnet design

Equivalent stress [MPa]

Min. stress

Max. stress

Magnetic field [T]

(i)

(ii)

(iii)

Min. field

Critical Current [kA]

Peak Field (T)

Test - Pressure

1 - 85 MPa

2 - 120 MPa

3 - 80 MPa

4 - 140 MPa

5 - 80 MPa

6 - 150 MPa

7 - 80 MPa
Island in the Wilderness
We believe this magnet has stress concentration in the mid plane, causing a distributed reduction of critical current.
New magnet: no mid plane limit

- Top coil - outer
- Top coil - inner
- Bottom coil - outer
- Bottom coil - inner
- Top coil - mid plane
- Bottom coil - mid plane
- No quench
New magnet: no early SC transition

Magnet design, construction, simulations and measurements by the Magnets, Superconductors and Cryostats group at CERN (TE/MSC) in the frame of the HL-LHC project

For Bob Ross’ paintings