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COAXIAL INPUT RF LOADS

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RF Group Cross-Training Session

January 30, 2009

Presentation Outline

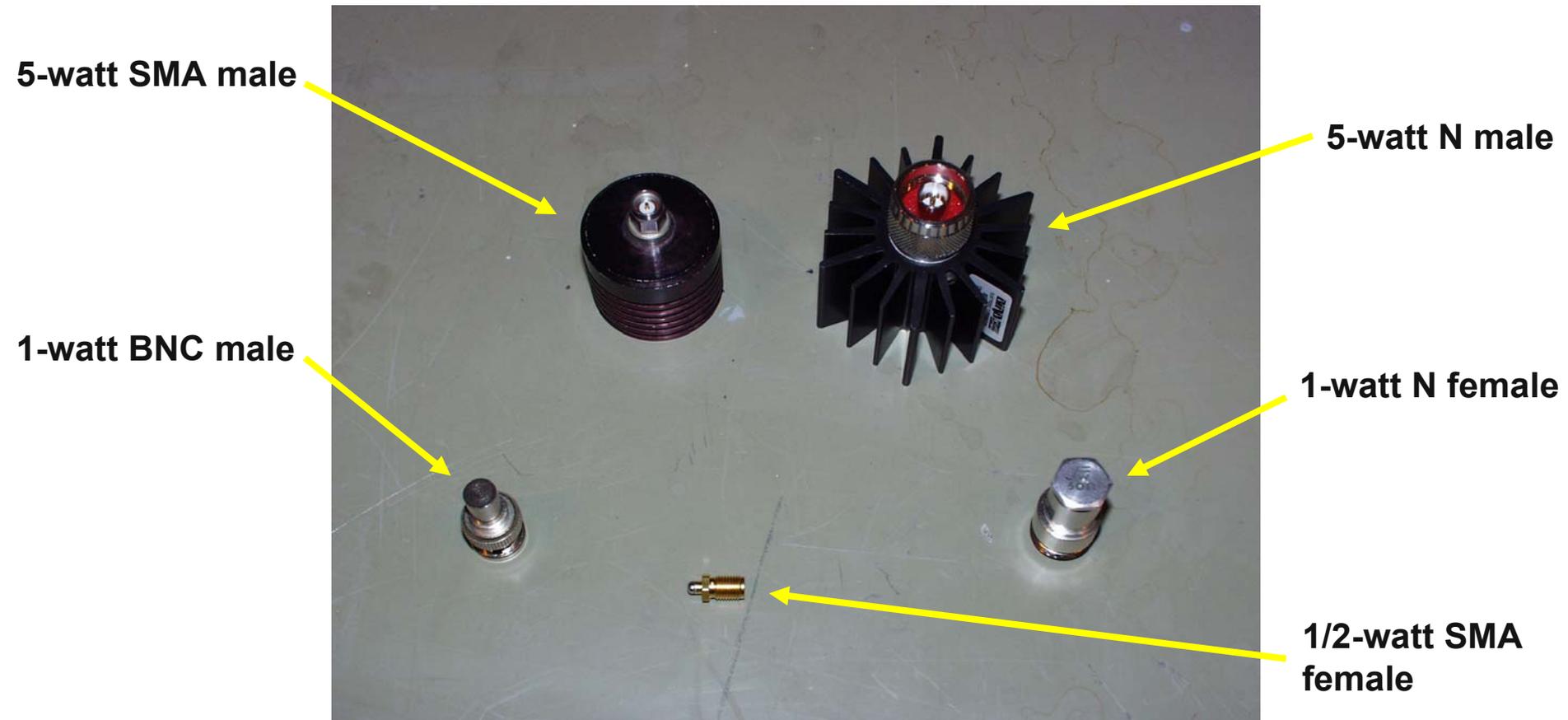
1. Description of RF load types.
2. Details on Altronic Research Water-Cooled RF Loads.
3. Details on “CERN” 300kW Water Loads
4. Load Replacement Procedure
5. Conclusion

RF Load Types

- RF load designs are determined by *impedance*, *power handling capability*, *cooling method*, and *frequency range*:
 - Power handling capability: 1-watt, 10-20 watt, 100-300 watt, or many kilowatts
 - Impedance is typically 50 ohms unless otherwise stated
 - Quality of match can vary from good (typical for “loads”) to excellent (typical for precision “terminations”)
 - Cooling method could be ambient air, forced air, closed-system oil conduction to air fins, forced water, etc.....it depends on the power levels involved
 - A “broadband” rf load will represent a 50-ohm match with low VSWR over a specified frequency range, but some loads are designed to be a good match at only one frequency

Low Power RF Loads

- Average power dissipation typically ranges from ½-watt to 5 watts, with various connector options.
- Power is dissipated in resistive material thermally bonded to a heat sink. → *will read 50Ω with a dc ohmmeter*



Moderate Power RF Loads

- Power is dissipated in a resistive material bonded thermally to an air-cooled heat sink or immersed in oil that is air-cooled by fins.

→ *Will read 50Ω with a dc ohmmeter*



100W air-cooled



200W air-cooled



300-watt oil/air cooled

Beryllium Oxide Warning!

- **Some loads use BeO ceramic internally as a dielectric material because of its low rf loss and excellent thermal properties.**

→ **If the load case is breached or you disassemble the load, do not touch the BeO ceramic material.**

→ **Do not abrade the BeO material, or ingest dust from abraded BeO.**

→ **In some cases, BeO ceramics are intentionally colored pink for identification.**



Moderate Power RF Loads

- 50kW load used as a television transmitter dummy load

→ *3-1/8" EIA coaxial flange input*

→ *Forced-air cooling with circulating coolant -- oil, or glycol-water mixture passed through an internal heat exchanger cooled by fans*

→ *Will read 50 Ω with a dc ohmmeter*

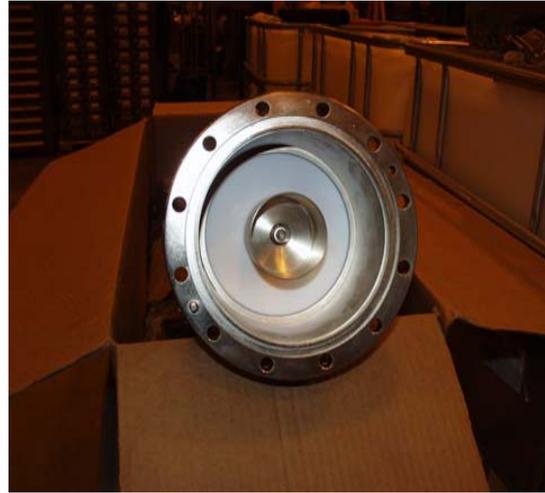


Altronic Research Water-Cooled Loads

- **Broadband rf loads with EIA coaxial flange terminations:**



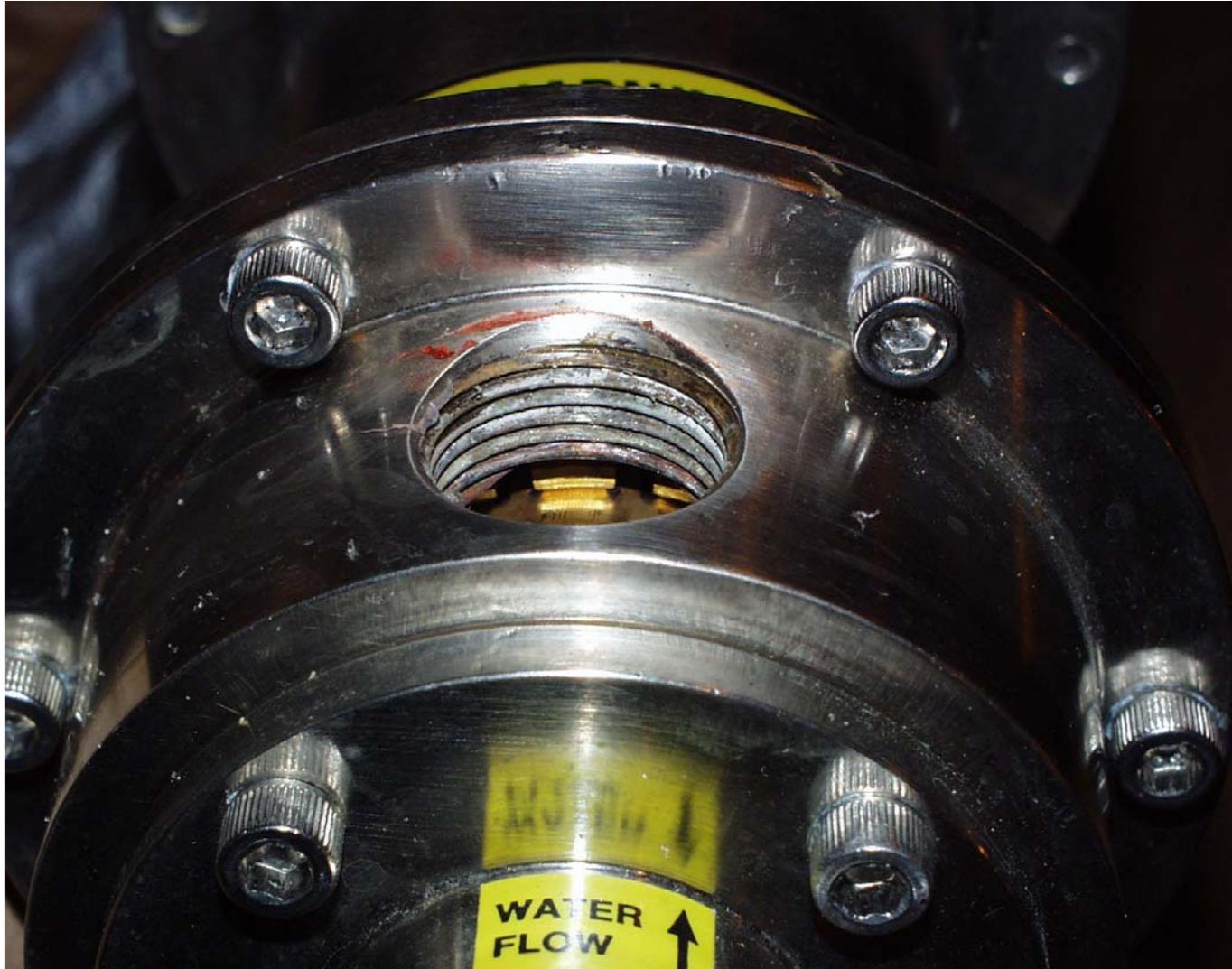
200kW with 6-1/8" EIA flange



5kW with 1-5/8" EIA flange

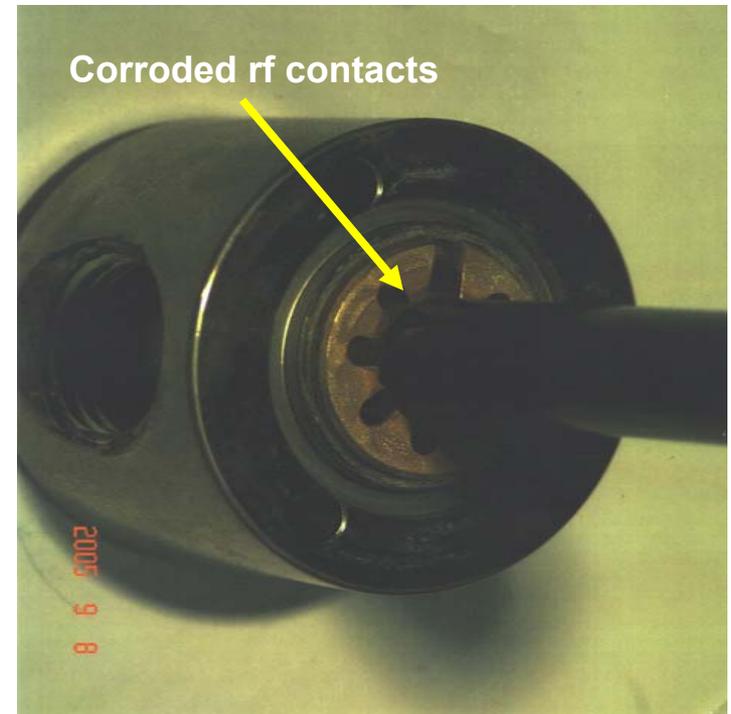
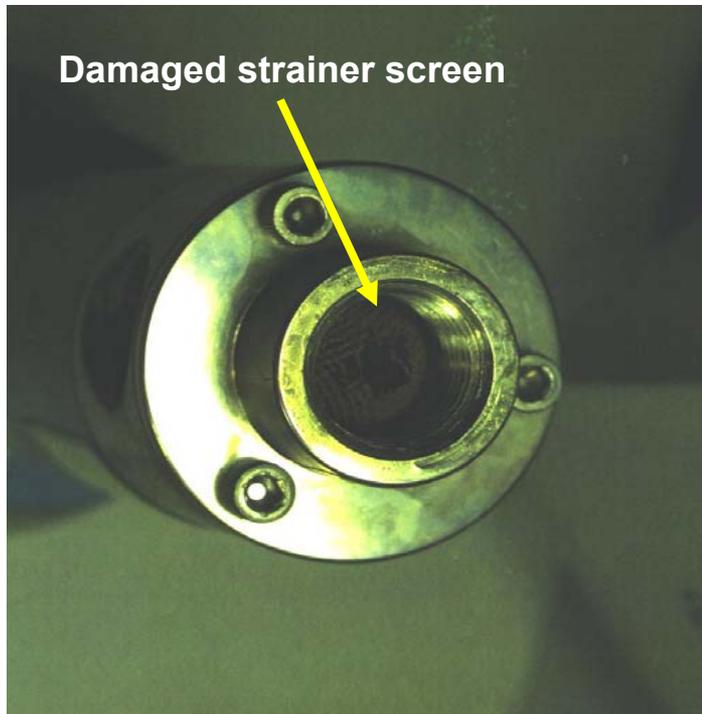
Altronic Research Water-Cooled Loads

- *View of rear rf contacts to resistor tube on a 200kW load:*



DI Water Effects on Altronic Research Water-Cooled Loads

- Corrosive effects of high-purity DI water causes erosion of rf contacts by dissolving the metallic contact parts and de-plating the resistor – *which will result in arcing at high power!*
→ three-year maximum service life between rebuilds in our systems



CERN 300kW Water Loads

- Shorted coaxial line with DI water in dielectric region
 - RF power is dissipated in the cooling water itself
 - **NARROW BAND** – only a good match at 352 MHz!
 - Load impedance is approximately 10 ohms – a coaxial transformer (tapered center conductor) is used to correct input impedance to 50 ohms → reads 0Ω with a dc ohmmeter!
 - Very rugged.....but can fail due to arcing at the transformer if input power exceeds 300kW.



Transformer coaxial section and center conductor



Water weep holes in transformer section

Care and Feeding of Coaxial RF Loads

- **Follow guidelines in RF Technical Note on rf load replacement:**
 - **CCWP required!**
 - **All 352-MHz rf stations must be off and LOTO before load is removed!**
 - **17.5 ft-lbs torque on flange bolts!**
 - **Sniff flange for rf leaks after replacement!**



NOTE: Minimum flow on 200kW loads is 19 GPM!

Altronic Research 200kW Water-Cooled Loads

The result of operating full input power *with no coolant flow* and *no functioning interlocks!*

**OPERATION WITHOUT COOLANT FLOW
WILL RESULT IN INSTANTANEOUS LOAD FAILURE**



Care and Feeding of Coaxial RF Loads

- ***In horizontal mounting, orient the load so that weep holes face the floor as best as possible:***

