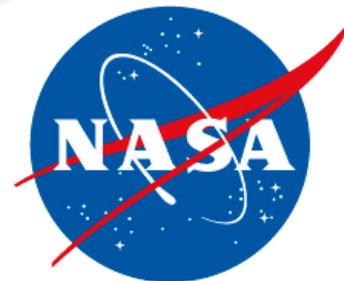


Robust Platinum Resistor Thermometer (PRT) Sensors and Reliable Bonding for Space Missions

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The Need for Robust PRT

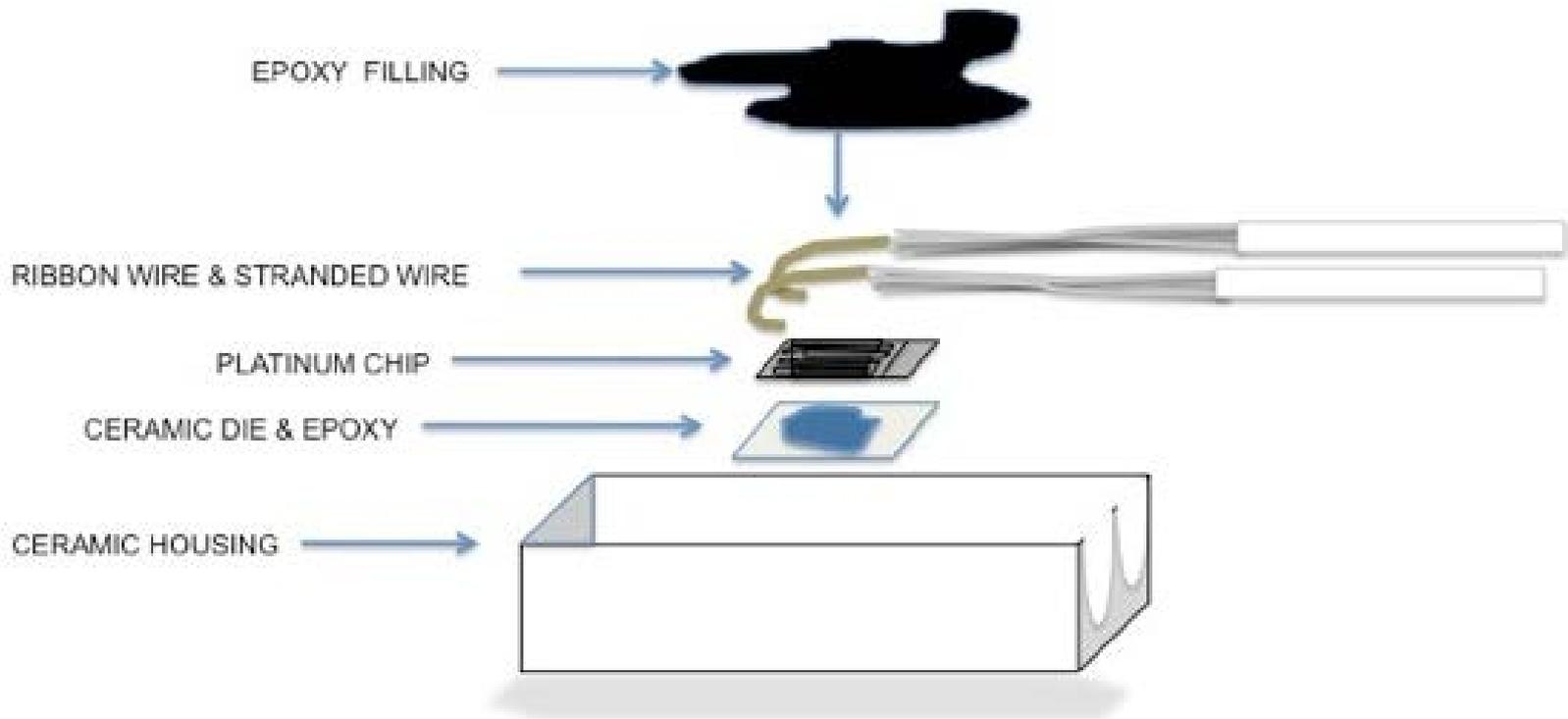
- JPL's PRT implementation and packaging lead to multiple failures:
 - MER, GRAIL, MRO, and others
 - MER Testing
 - Testing showed that this PRT when bonded directly to an Aluminum block with Stycast 2850/24LV or Hysol 9309.3NA was experiencing hard failure (open circuit) within 22 thermal cycles between -110°C to $+110^{\circ}\text{C}$
- Needed a more reliable PRT

Honeywell PRT—HRTS-5760-B-U-0-12

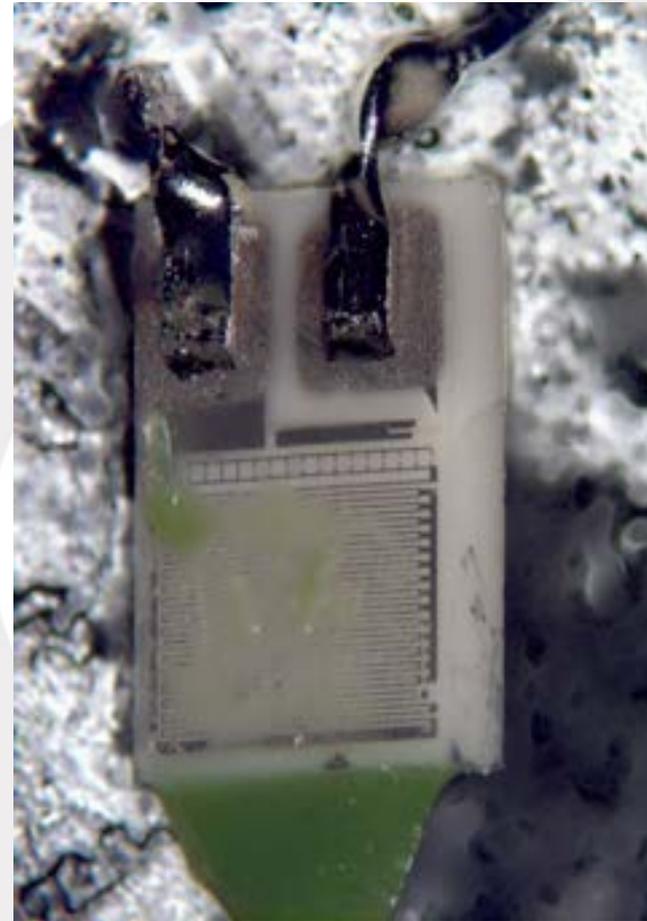
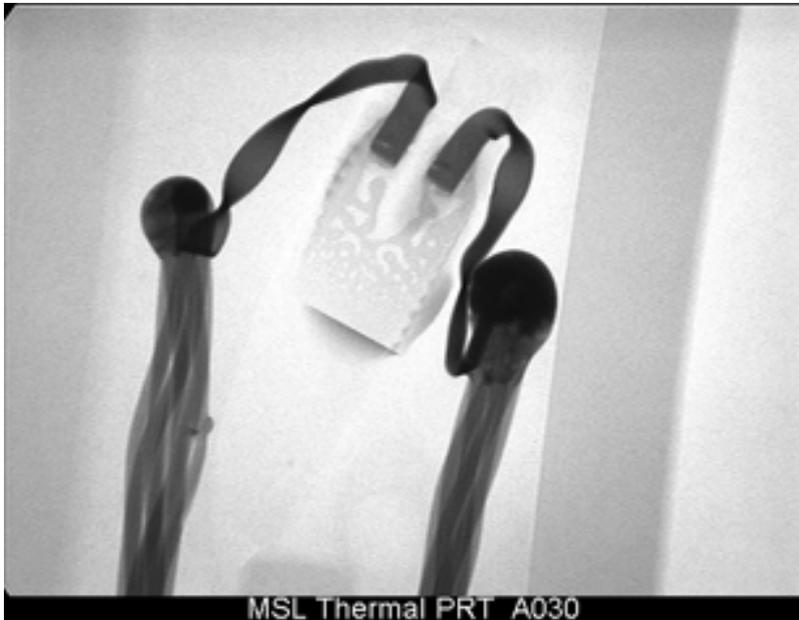
- The Honeywell PRT
 - Etched Platinum Chip—better option than single stranded Pt wire
 - Outer ceramic housing allows for direct surface mounting.
 - Strain relief embedded in the body of the PRT



Honeywell PRT—exploded view

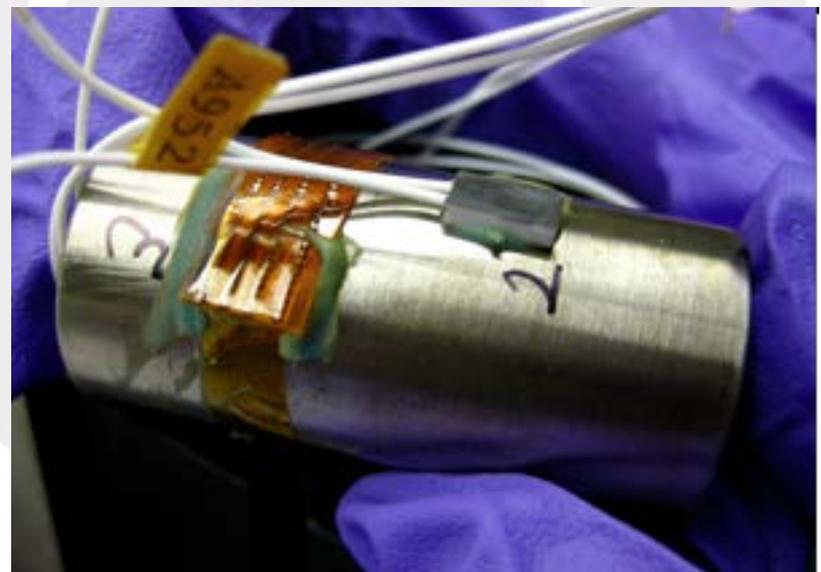


X-Ray & Destructive Part Analysis

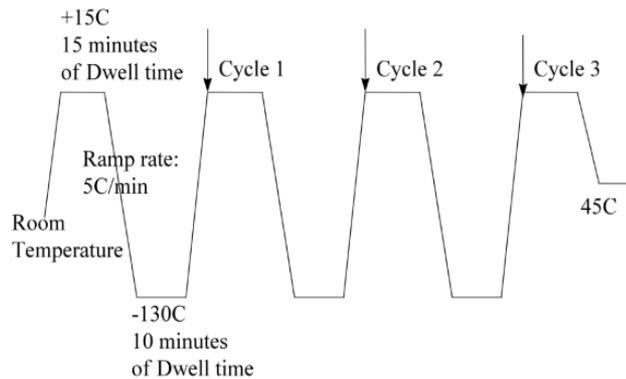


Bonding for Packaging Qualification Test

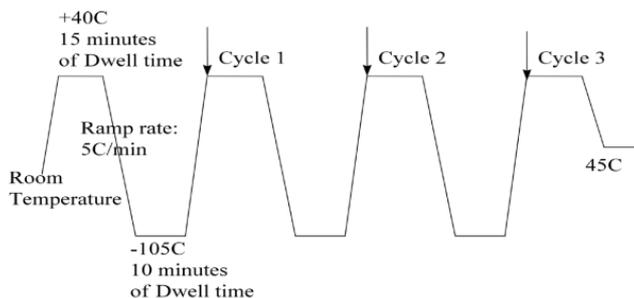
- Used four adhesives:
 - Hysol 9309.3
 - Stycast 28504 24/LV with 3-5 mil beads
 - GE's RTV-566 with 20-mil bonding wire
 - Nusil CV15-2500 with 20-mil bonding wire
 - Hysol 9360 (additional test)
- Used Six Substrates
 - Aluminum, G-10, Stainless Steel, Magnesium, Albemet, & Titanium
 - 78 PRTs



Thermal Cycle Testing



- Mars Science Laboratory: Simulated Martian winter thermal cycles,
 - 600 winter cycles
 - -130°C to +15°C
 - 1410 summer cycles
 - -105°C to +40°C
 - Tested Bonds & PRT package
- Soil Moisture Active/Passive Satellite
 - 520 cycles
 - -135°C to +125°C,
 - 260°C temperature delta
 - Test PRT package only



Electro Static Discharge Testing



- Honeywell Data Sheet indicates the PRT is ESD Sensitive
- With more than 500 PRTs implemented for MSL, restriction was a hindrance
- Passed Machine Model ESD test
- Passed 50 cycles at 800 V shocks
- No Failures

Summary

- PRT construction allows for simple surface mounting.
- JPL mounting and PRT packaging is robust to thermal cycling and useful for space flight applications.
- PRT is not ESD sensitive.



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