Guide to Sensor Selection

**What cryogen are you using?**

- **Liquid Nitrogen**
  - Platinum 100
  - Also satisfactory:
    - Copper/Constantan Thermocouple,
    - Chromel/Au-0.03% Fe Thermocouple
    - Silicon Diode

- **Liquid Helium (4He)**
  - Is the thermometer in a magnetic field >1 Tesla?
    - Yes
      - Temperature range: 1.4 K - 400 K
        - Cernox or Carbon Ceramic Sensor (CCS)
      - Thermocouples may be suitable in a magnetic field:
        - Chromel/Au-0.03% Fe Thermocouple (>3 K)
        - Chromel/Au-0.07% Fe Thermocouple (>1.5 K)
      - Silicon Diode
    - No
      - Rhodium-iron
      - Also satisfactory:
        - CLTS Copper/Constantan Thermocouple,
        - Chromel/Au-0.03% Fe Thermocouple (>3 K)
        - Chromel/Au-0.07% Fe Thermocouple (>1.5 K)
      - Silicon Diode
Thermometry

- **3\(^{3}\)He**
  - T < 1 K
    - **Rhodium-Iron**
      - Temperature range: 1.4 to 800 K
    - **Capacitance Sensor**
      - Temperature range: 1.4 to 50 K
    - **Miniature Silicon Diode**
      - Temperature range: 1.4 K to 300 K
  - Is the thermometer in a magnetic field > 1 Tesla?
    - Yes
      - Capacitance Sensor combined with Ruthenium Oxide
    - No
      - Ruthenium Oxide

- **3\(^{3}\)He/\(^{4}\)He (dilution refrigerator)**
  - > 50 mK
    - Ruthenium Oxide
  - < 50 mK
    - Nuclear orientation, using Ruthenium Oxide for control
**Recommended Sensor Temperature Ranges**

- **RuO2**
  - Suitable for use in magnetic fields: 50 mK - 4.2 K
  - Not suitable for use in magnetic fields: 3 - 50 mK

- **Capacitance**
  - Suitable for use in magnetic fields: 1.4 - 50 K
  - Not suitable for use in magnetic fields: 1.4 - 800 K

- **Rhodium-iron**
  - Suitable for use in magnetic fields: 1.4 - 377 K
  - Not suitable for use in magnetic fields: 1.4 - 420 K

- **Carbon ceramic**
  - Suitable for use in magnetic fields: 1.4 - 300 K
  - Not suitable for use in magnetic fields: 2 - 300 K

- **Cerno**
  - Suitable for use in magnetic fields: 0.001 - 0.1 K
  - Not suitable for use in magnetic fields: 0.1 - 1 K

- **Silicon diode**
  - Suitable for use in magnetic fields: 0.01 - 1 K
  - Not suitable for use in magnetic fields: 1.4 - 800 K

- **CLTS**
  - Suitable for use in magnetic fields: 2 - 300 K
  - Not suitable for use in magnetic fields: 1.4 - 300 K

- **Chromel/Au-0.03% Fe thermocouple**
  - Suitable for use in magnetic fields: 70 - 900 K
  - Not suitable for use in magnetic fields: 70 - 670 K

- **Platinum**
  - Suitable for use in magnetic fields: 2 - 300 K
  - Not suitable for use in magnetic fields: 1.4 - 50 K

- **Copper / constantan thermocouple**
  - Suitable for use in magnetic fields: 0 - 1 K
  - Not suitable for use in magnetic fields: 0.01 - 0.1 K

- **Copper/ Alumel thermocouple**
  - Suitable for use in magnetic fields: 273 - 1600 K
  - Not suitable for use in magnetic fields: 273 - 1600 K

**Notes**

* Nuclear orientation thermometry is sensitive to external magnetic fields, and the source can be damaged by high fields. See sensor page for details.