Week 2 Demo

(Thermometry)

Harrison chapter 5
Brock chapter 4
WMO-8 Chapter 2

Tim Chui

Weekly Schedule

Day	Monday	Wednesday	Friday
Type	Lecture	Demo	Lab
Purpose	• Introduction of learning goals • Theoretical knowledge of instruments • "Formal" instruction	• Review of learning goals • Hands-on intro of instruments • "Informal" instruction	• Realization of learning goals • Hands-on application of instruments • "Self-taught" instruction

Learning Goals (from Monday's lecture)

	By the end of today's class, you should be able to:
1	List 5 or more types of thermometers, and describe how they work and how you use them.
2	Calculate and plot thermometer response (voltage, resistance, size, etc.) vs. temperature
3	Describe the advantages, disadvantages, and typical errors of each type of thermometer.
4	Select the appropriate thermometer and associated infrastructure (e.g., screens) for any measurement program.
5	Convert between different temperature units.
6	Explain the reasons for using radiation shields.

Demo Worksheet

Demo - Comparison of temperature sensors
Worksheet by Dr. Rosie Howard
Edited by Tim Chui
Date of demo: 15 January 2020

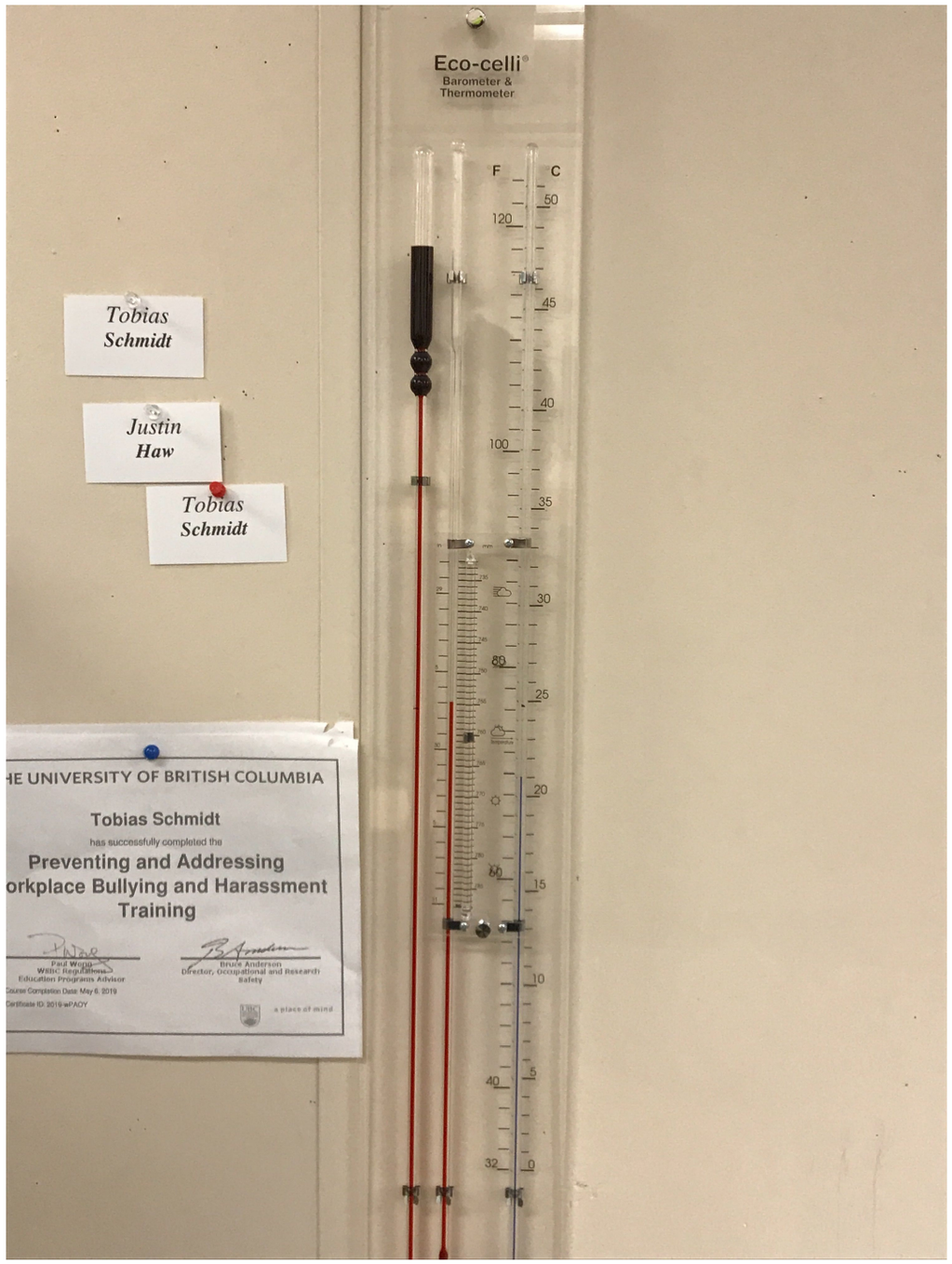
	Instrument	What is it made of?	Principle	Details	Use/applications	Anecdotes
1	**Liquid crystal thermometer**	Liquid crystals	Liquid crystals are heat sensitive Colour changes when temperature changes	Monitors heat flow due to conduction, convection, and radiation Safer than glass thermometer though not as accurate	Medical/aquariums/home-brewing	
2	**Bimetallic strip thermometer**	Two metals e.g. iron and brass		Each metal must have different coefficient of linear expansion so it responds differently to heat One end fixed, other end is pointer to scale	Simple domestic thermometers/thermostats	
3	**Liquid-in-glass thermometer**		Volume expansion as response to temperature change		Traditional domestic thermometers Medical Calibrating other temperature sensors	
4	**Type T thermocouple**	Copper-constantan, two dissimilar metals		Inherently a differential temperature sensor Sensitivity: ~43 μV/°C	Widely used across scientific applications Meteorology field studies: e.g. air temperature	Rosie used these to measure temperature inside datalogger/power enclosures
5	**Type E thermocouple**	Chromel-constantan		Sensitivity: ~68 μV/°C		Rosie used these to measure the temperature at the snow-ground interface
6	**Type K thermocouple**			Sensitivity: ~41 μV/°C	Most common/inexpensive type	
7	**Platinum resistance temperature detector**	Platinum	Electrical resistance changes with temperature		Commonly used for air temperature measurements	Rosie used two of these at Whistler site (2-m and 10-m heights)
8	**Thermistor**		Resistance varies with temperature	Nonlinear, usually has negative temperature slope Despite nonlinearity, popular because they	Commonly used for air temperature measurements	
9	**Sonic temperature sensor**	Sonic anemometer (mostly aluminium)	Uses speed of sound, knowing distance between transducers and signal travel time		Sophisticated instrument used in field research e.g. eddy covariance methods or sub-zero temperatures	Rosie used this at Whistler site (but for 3-D wind speed/direction). We will hear more about that in week 12.
10	**Radiation shield**	Thermoplastic plates		Still allow ambient air to pass over sensor	Should always be used for air temperature measurements	Chris used these on a controlled burn. Turns out, they can melt!
11	**Aspirated radiation shield**	Thermoplastic plates	As above, plus fan pulls air over sensor to maintain high convective heat transfer (offset radiative or conductive heat transfer)	Better than non-aspirated		Rosie used one aspirated and one unaspirated. Unaspirated because needed small/light equipment that wouldn't easily accumulate snow on platform suspended over ski run.

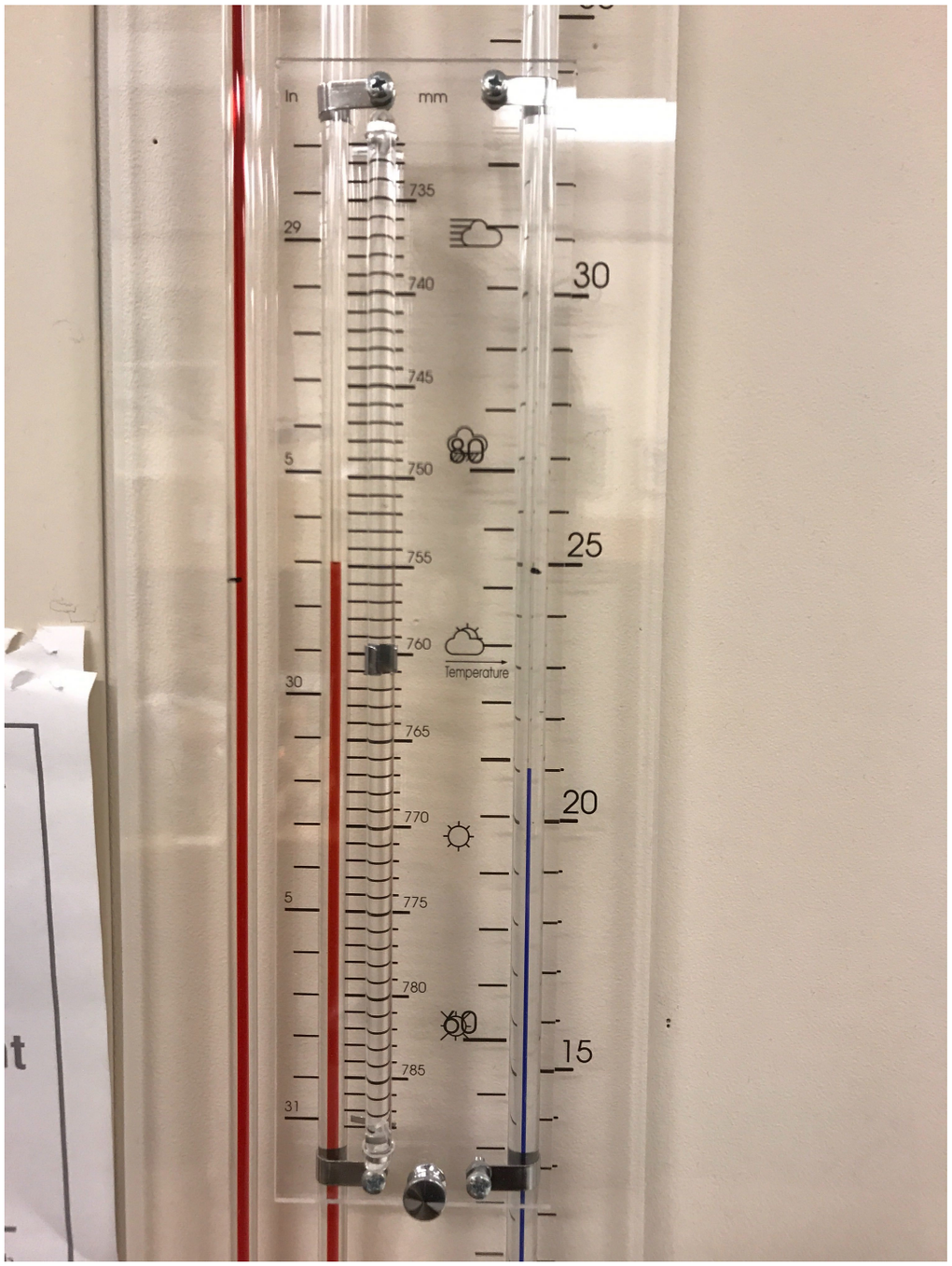
Liquid Crystal Thermometer

Bimetallic Strip Thermometer

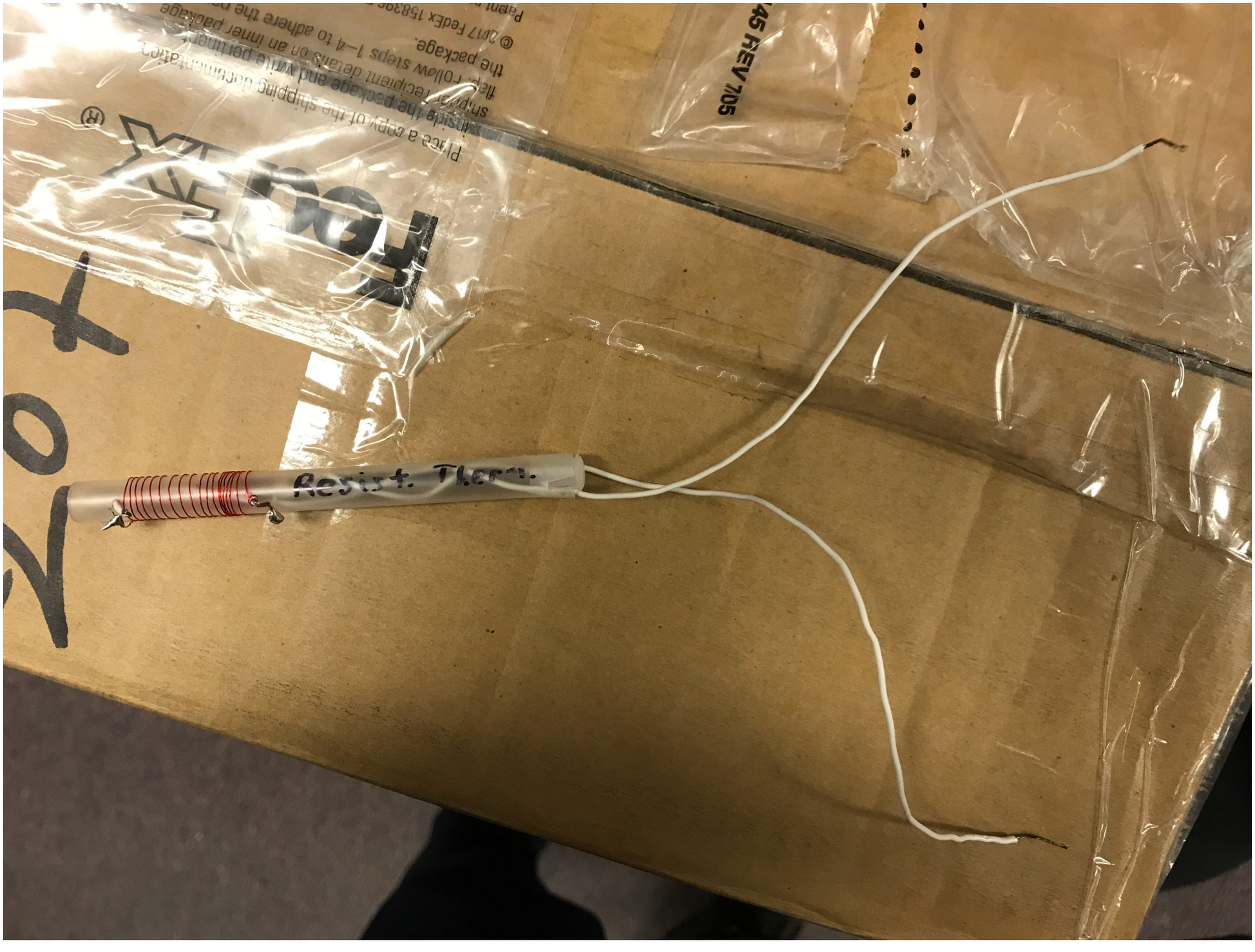
Bimetallic Strip Thermometer

Liquid-in-Glass Thermometer



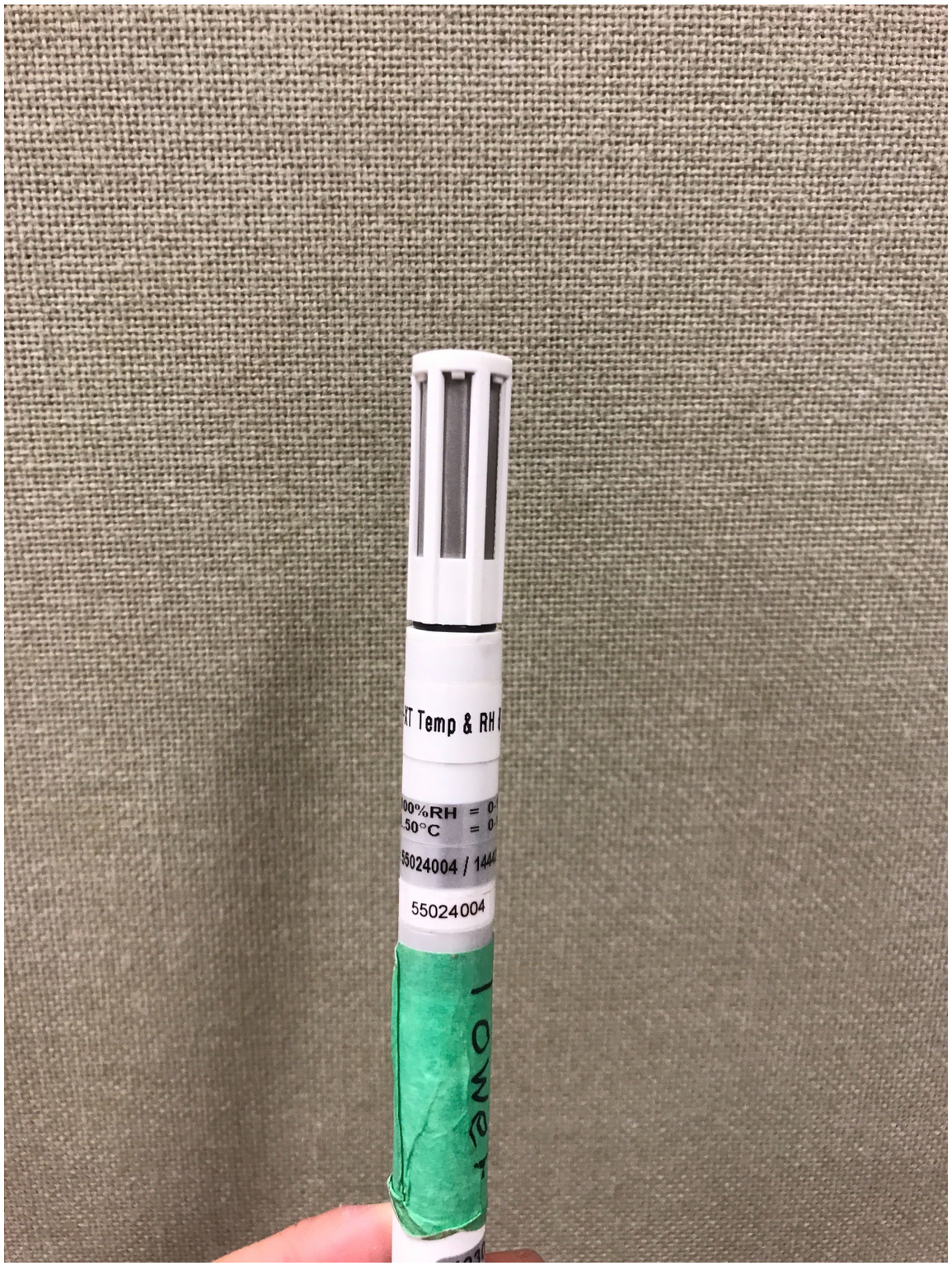


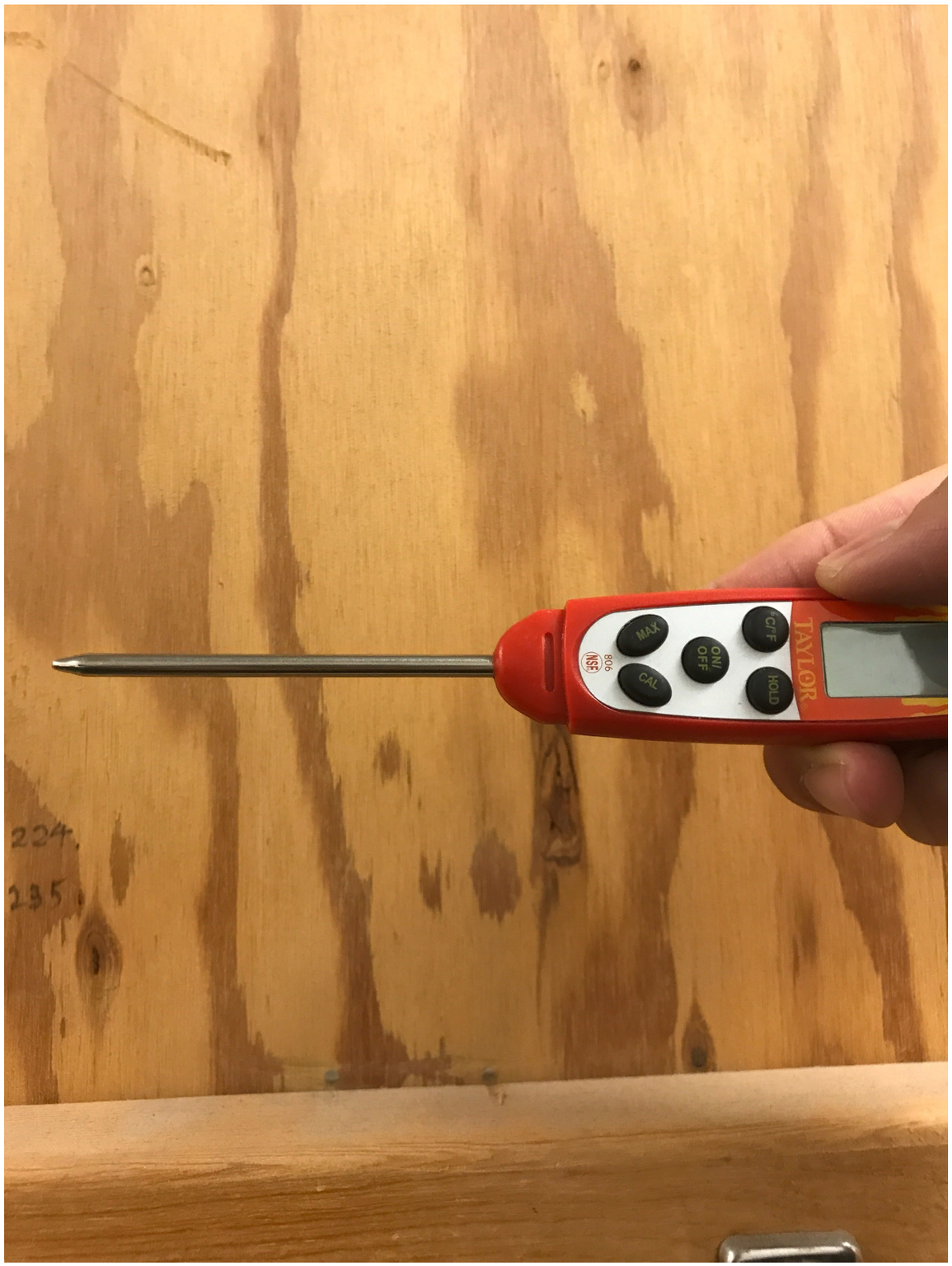
Platinum Resistance Temperature Detector



Thermistor

Thermistor

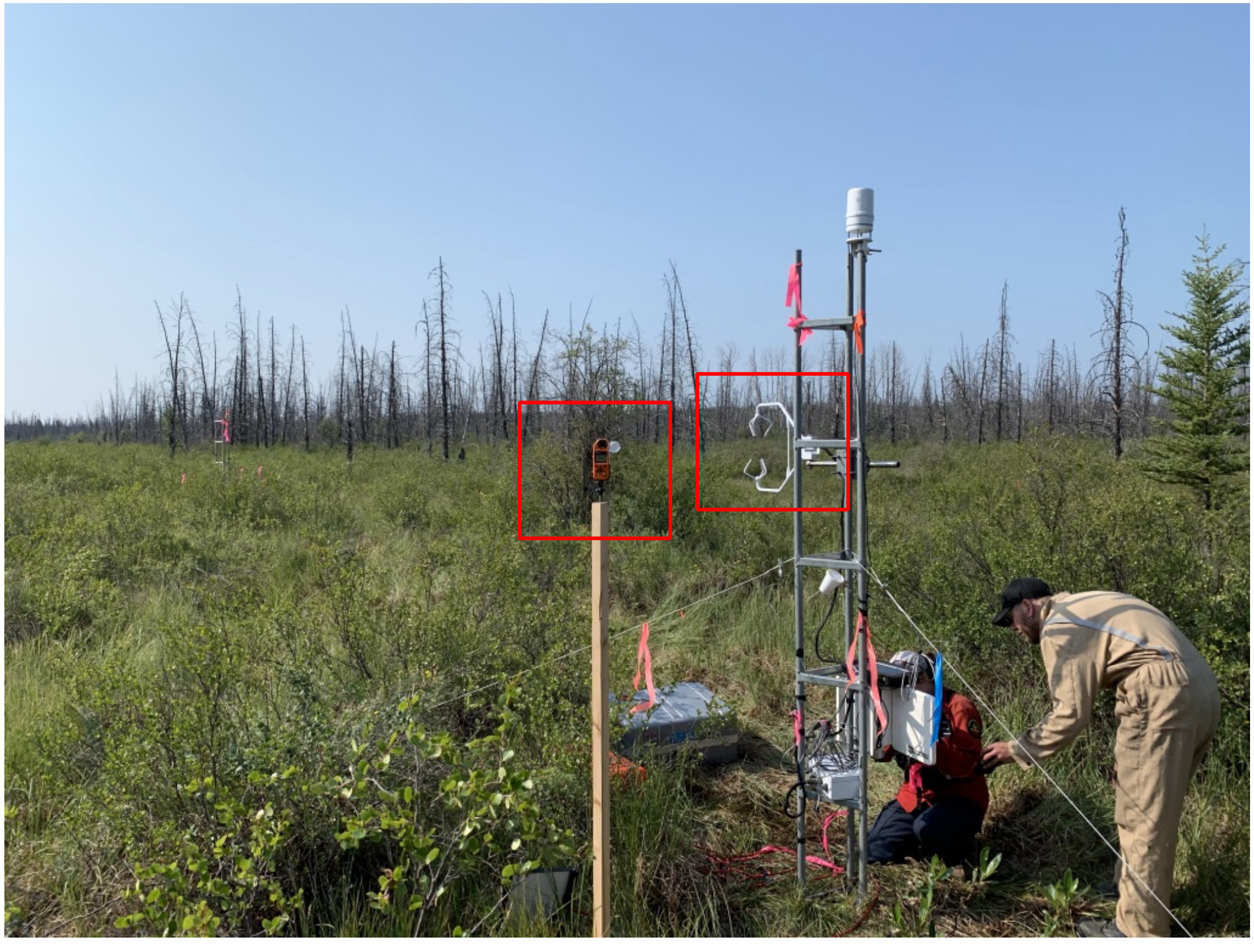

XT Temp & RH
55024004
55024004


MAX
CAL
ON/OFF
°C/°F
HOLD
TAYLOR
NSF
224
285

Sonic Temperature Detector

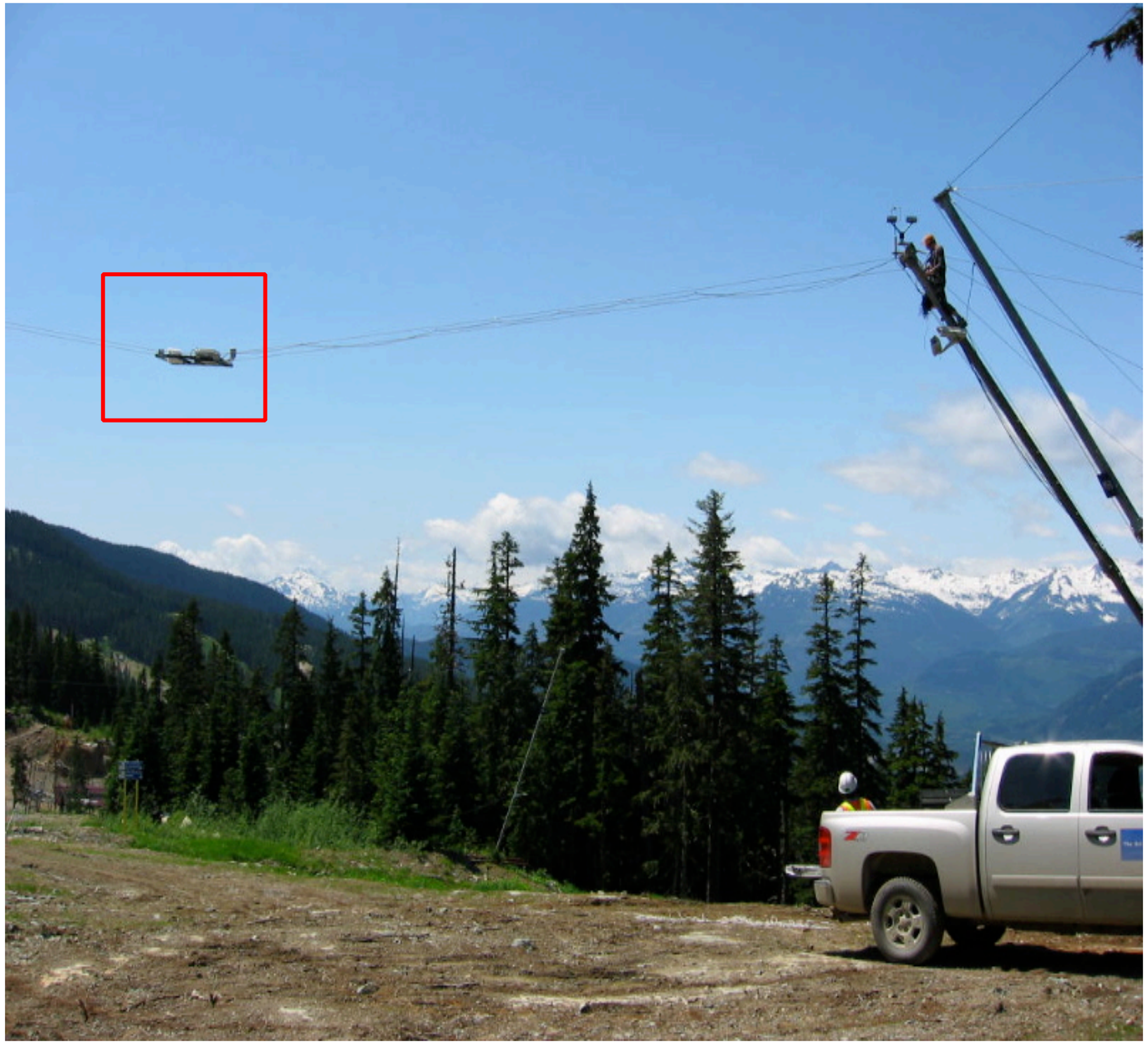
Sonic Temperature Detector

Sonic Temperature Detector



Radiation Shield

Radiation Shield



Radiation Shield

Thermocouple