

18ECO133T

# Sensors and Transducers

UNIT V

Unit V : Session 2 : SLO 2

# WHAT IS AN ANEMOMETER?

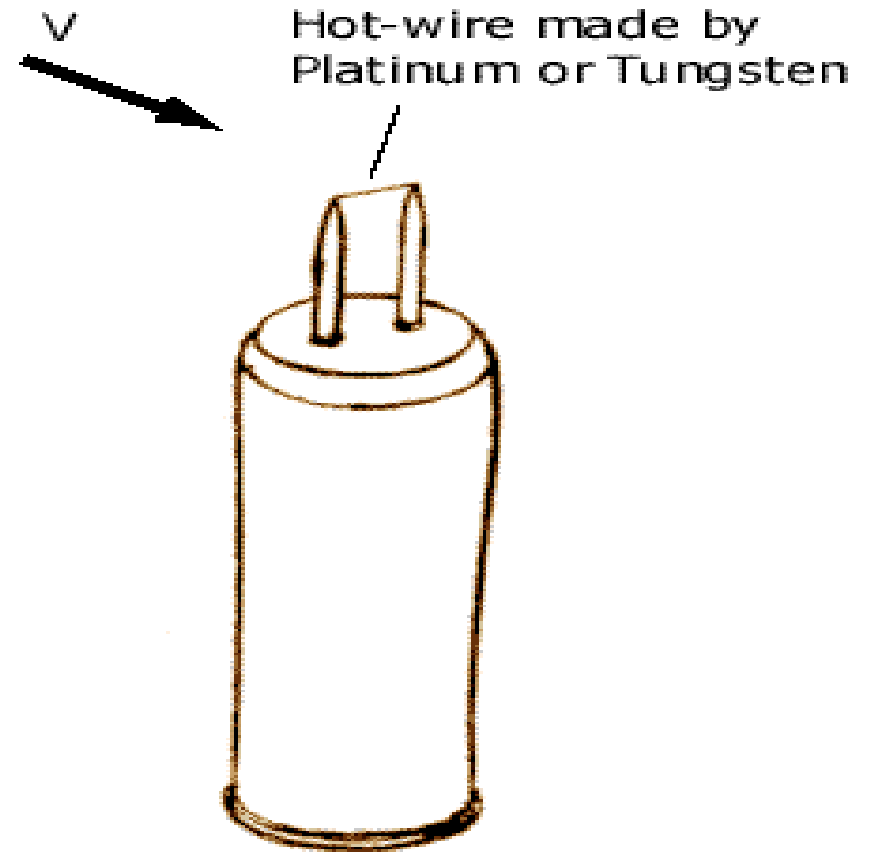
- Anemometer – measures gas speed
- Types
  - rotating cup
  - pitot static tube
  - thermal (hot wire)
    - also performs temperature measurement

# THEORY OF OPERATION

- Energy Balance
- Constant temperature or constant current operation
- Measure change in current or change in temperature
- Correlate  $I$  or  $T_{\text{wire}}$  to gas velocity based on convective H.T. and fluid dynamics

# PROBE

- Tungsten or Platinum filament
  - ~1 mm long
  - 4-10 mm diameter
- Benefits
  - Good spatial resolution
  - Flat frequency response
- Limitations
  - Fragile
  - Requires clean flow
  - Cost (start at \$300-400)

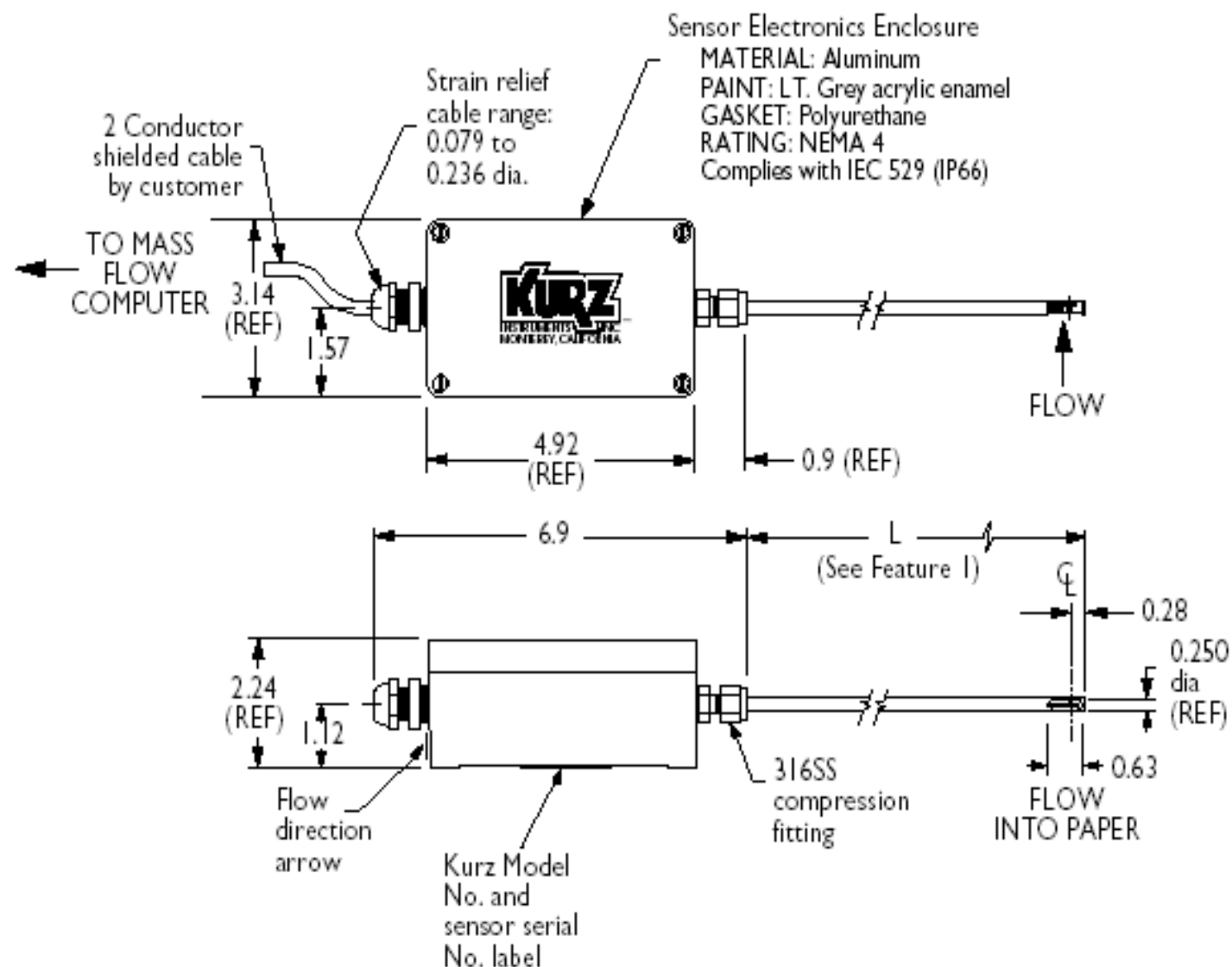


# INTERFACING

- Wide variety of options
  - Devices typically come with some sort of m-controller
  - Depends on application
  - Handheld vs. in-situ
- Most common
  - Serial RS232 – for sampled data collection and control
- Larger selection for industrial sensors
  - Serial RS232, RS485
  - Analog 4-20 mA, 0-10V
  - Profibus, Modbus, etc.

# TYPICAL SPECIFICATIONS

	<b>Handheld/Economy</b>	<b>Industrial Grade</b>
Measurable velocities	0.2-20 m/s	0.2-90 m/s
Operating temp ranges	0-50 °C	-40-200 °C
Velocity Accuracy	± 3% reading	± 1% reading
Time constant	200 ms	100 ms
Interfacing options	Handheld reader, RS232	RS232, RS485, voltage, 4-20 mA, Modbus, Profibus, etc.

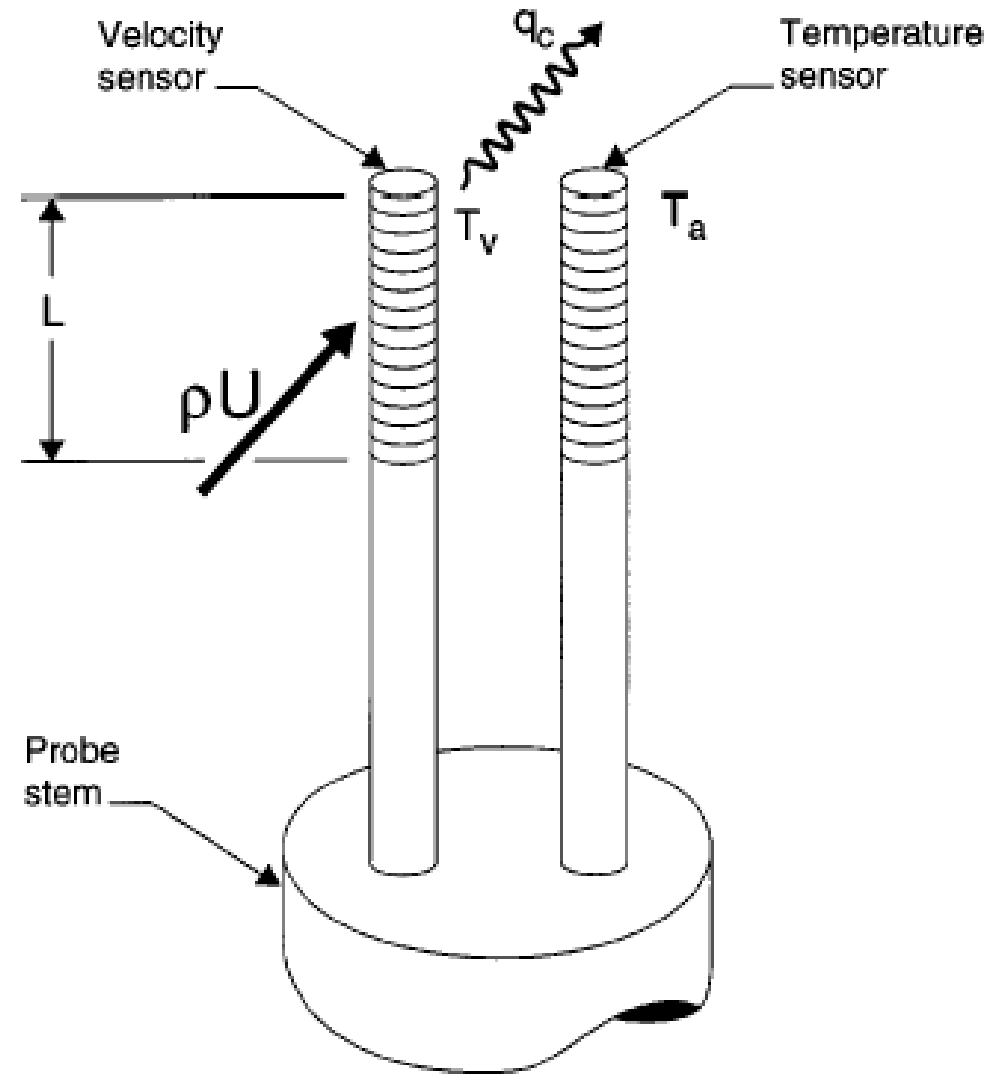


# HOT WIRE ANEMOMETER

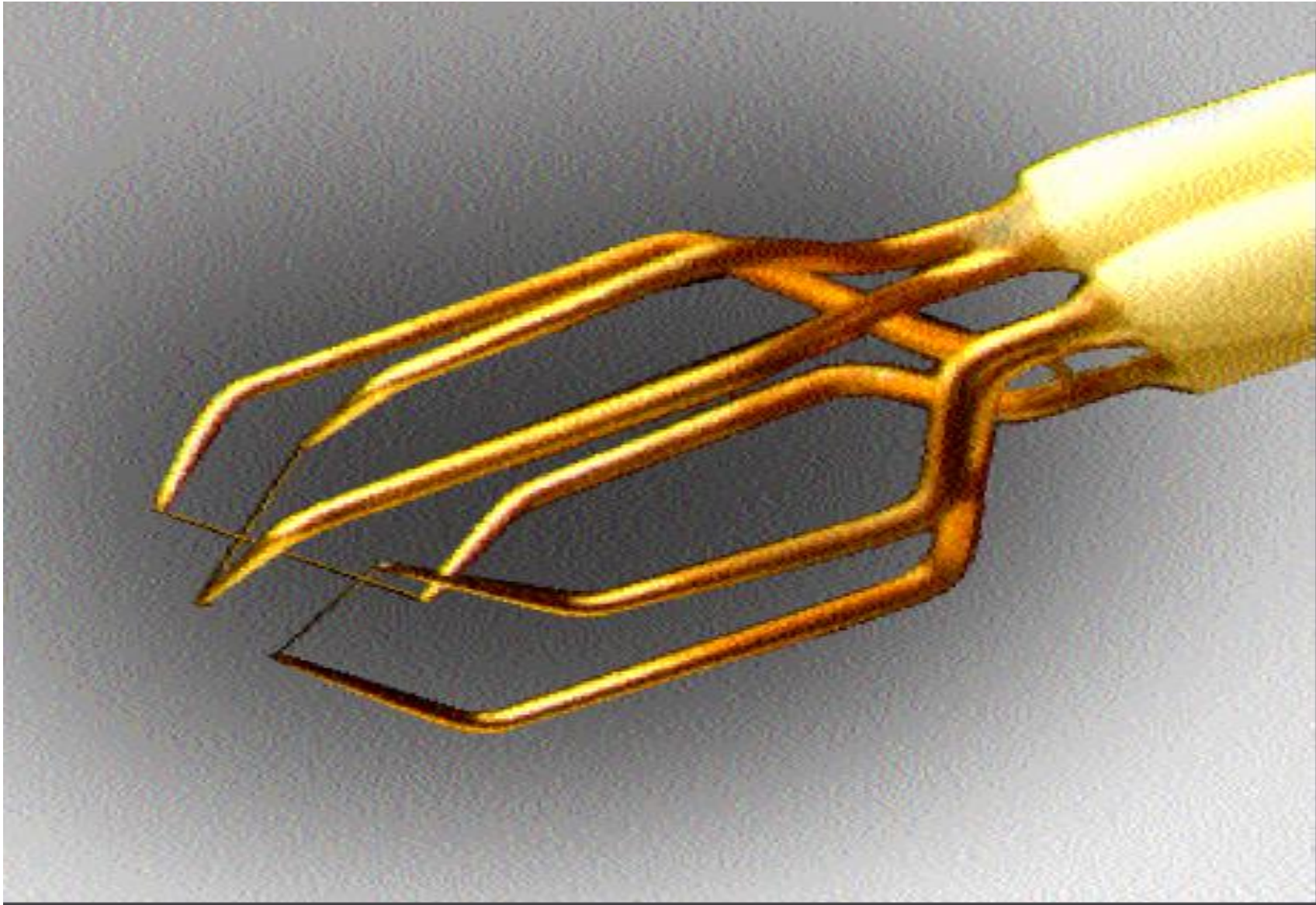
- A thermal anemometer measures the velocity at a point in a flowing fluid — a liquid or a gas.
- A typical industrial thermal anemometer used to monitor velocity in gas flows has two sensors —
- a velocity sensor and a temperature sensor —
- that automatically correct for changes in gas temperature.
- Both sensors are reference-grade platinum resistance temperature detectors (RTDs).
- The electric resistance of RTDs increases as temperature increases.
- For this reason, they are one of the most commonly used sensors for accurate temperature measurements.



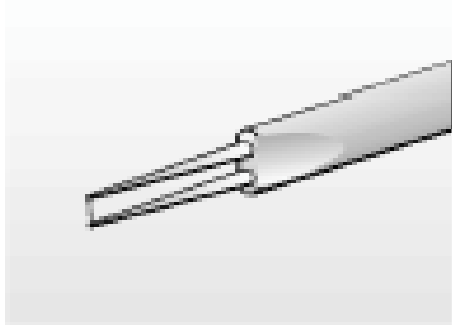
- The electronics circuit passes current through the velocity sensor, thereby heating it to a constant temperature differential ( $T_v - T_a$ ) above the gas temperature  $T_a$  and measures the heat  $q_c$  carried away by the cooler gas as it flows past the sensor.
- Hence, it is called a “constant-temperature thermal anemometer.”



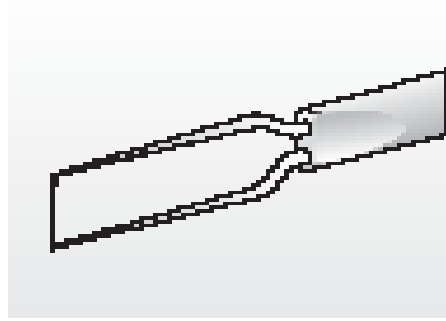
# THREE WIRE ANEMOMETER



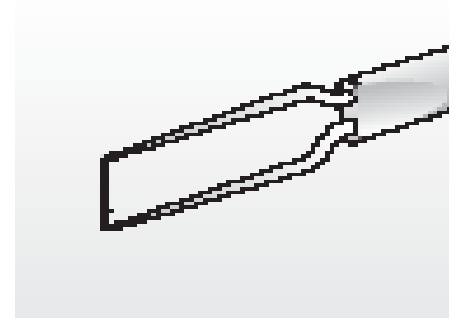
# SENSOR TYPES



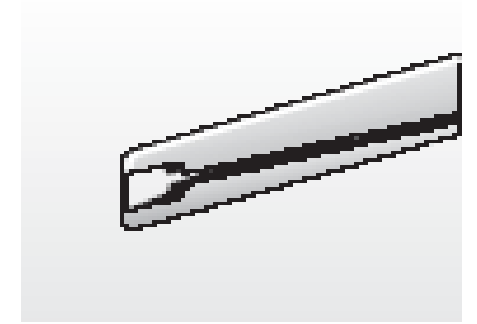
Miniature  
wires



Gold-plated  
wires



Fibre-  
film



Film-sensors

- Wires are normally 5  $\mu\text{m}$  in diameter and 1.2 mm long suspended between two needle-shaped prongs.
- Gold-plated wires have the same active length but are copper- and gold-plated at the ends to a total length of 3 mm long in order to minimise prong interference.

- Fibre-sensors are quartz-fibers, normally 70  $\mu\text{m}$  in diameter and with 1.2 mm active length, covered by a nickel thin-film, which again is protected by a quartz coating.
- Fibre-sensors are mounted on prongs in the same arrays as are wires.
- Film sensors consist of nickel thin-films deposited on the tip of aerodynamically shaped bodies, wedges or cones.