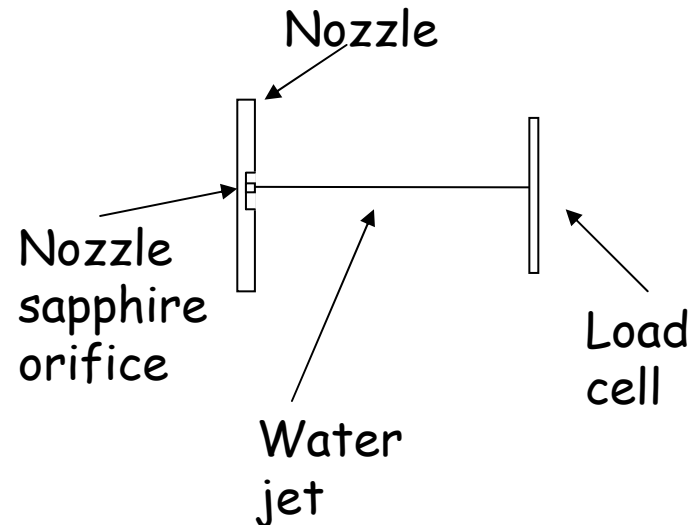


# HPR: water jet force measurement

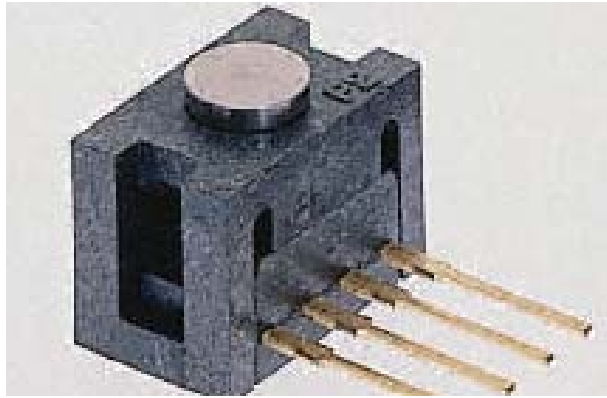
Experimental set up: in the HPR system a load cell is installed. Distance between the cell and the nozzle is the same as the one for the equator of TTF cavity.

Water jet parameters during the test:

Orifice diameter: 0.55 mm  
Throughput: from 0 to 1.7 l/min  
Pump pressure: up to 120 bar



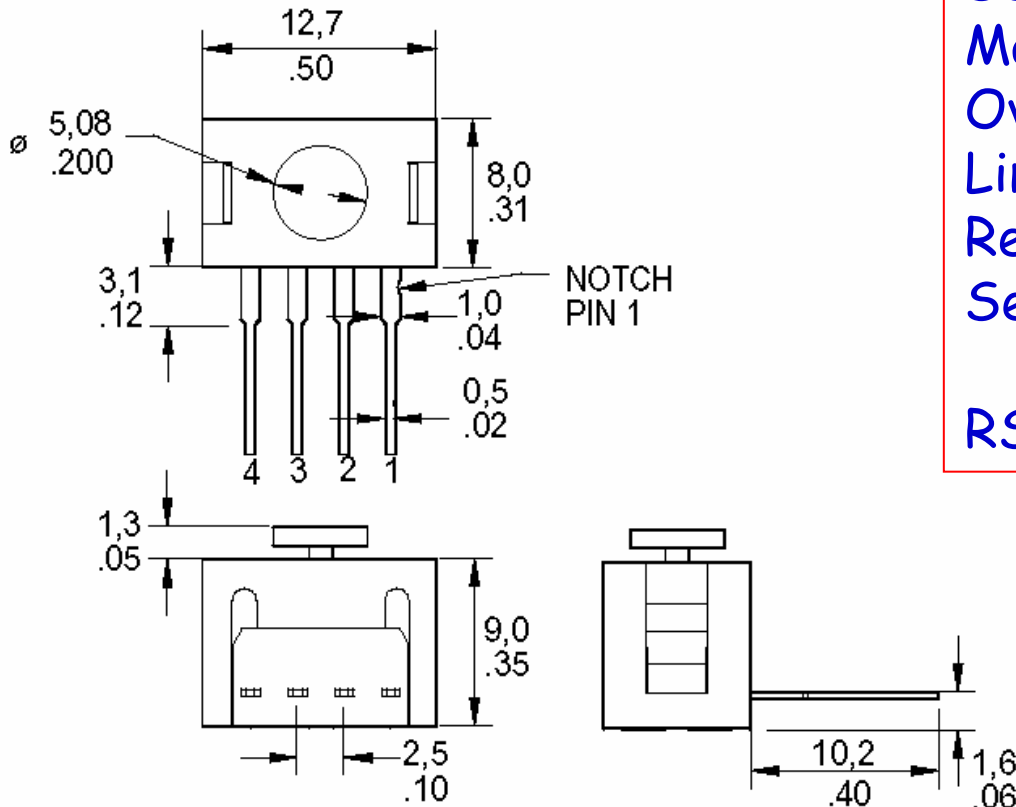
# Force sensor: miniaturized load cell



Sensor: Honeywell FSG-15N1A

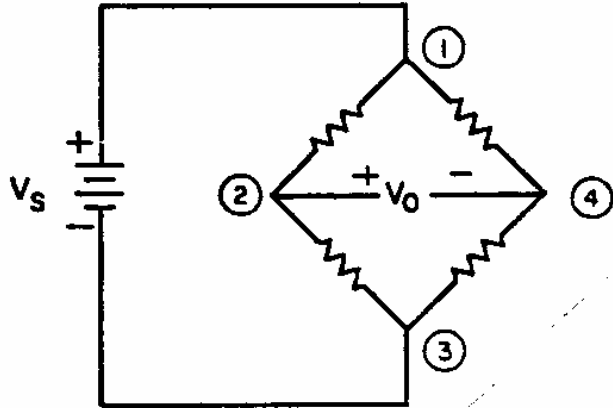
Sensor: Silicon piezoresistor  
Sensitivity (@10 V): 24 mV/N  
Max load: 15 N  
Overforce max: 55 N  
Linearity: 0.5 % read.  
Reproducibility: 0.2 % read.  
Sensor deflection: < 30  $\mu\text{m}$

RS catalog: 235-6210



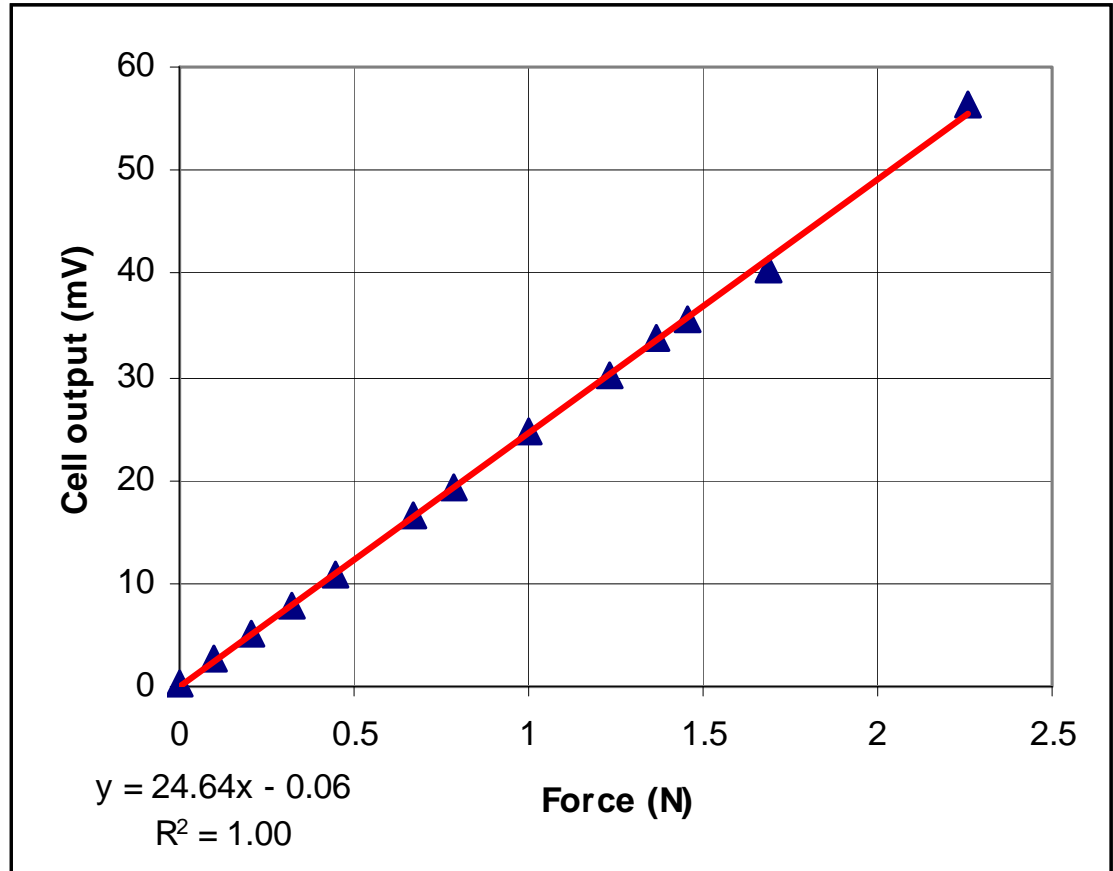
# Reading system and calibration

## EXCITATION SCHEMATIC



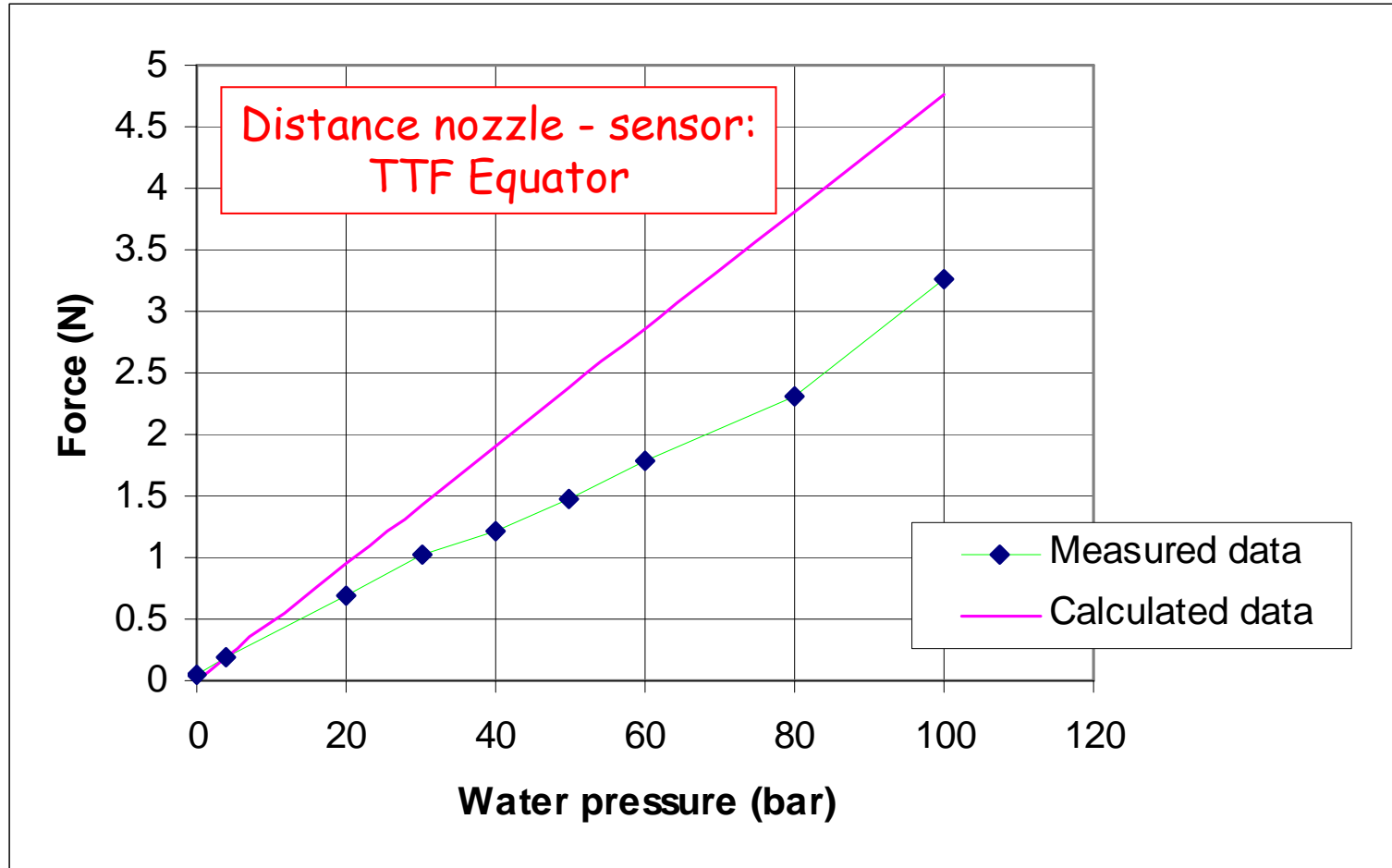
## FS SERIES CIRCUIT

- 1. Circled numbers refer to sensor terminals (pins). Pin 1 is designated with a notch.
- Pin 1 = Supply  $V_s$  (+)
- Pin 2 = Output, (+)
- Pin 3 = Ground, (-)
- Pin 4 = Output, (-)



Reading System: Solartron digital multimeter, 6  $\frac{1}{2}$  digits

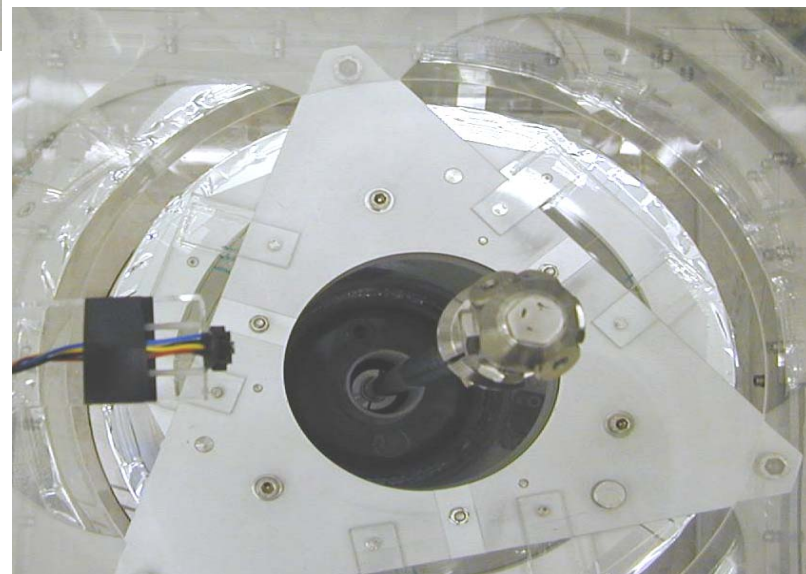
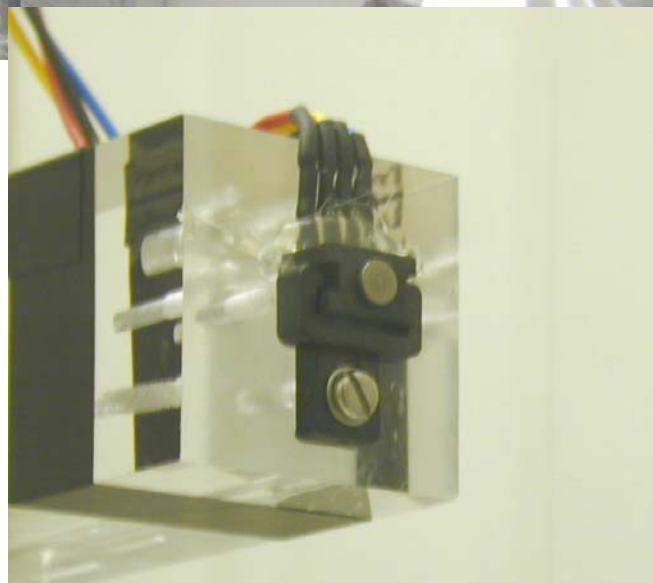
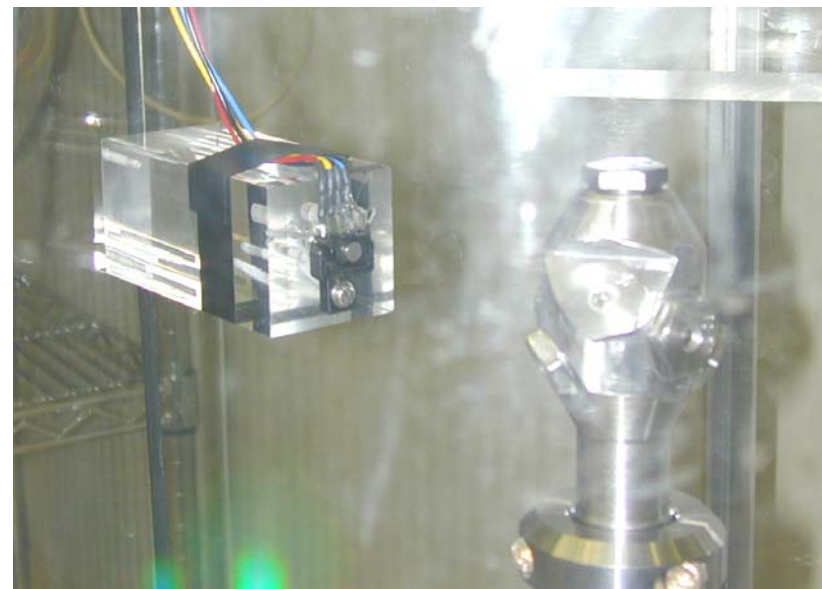
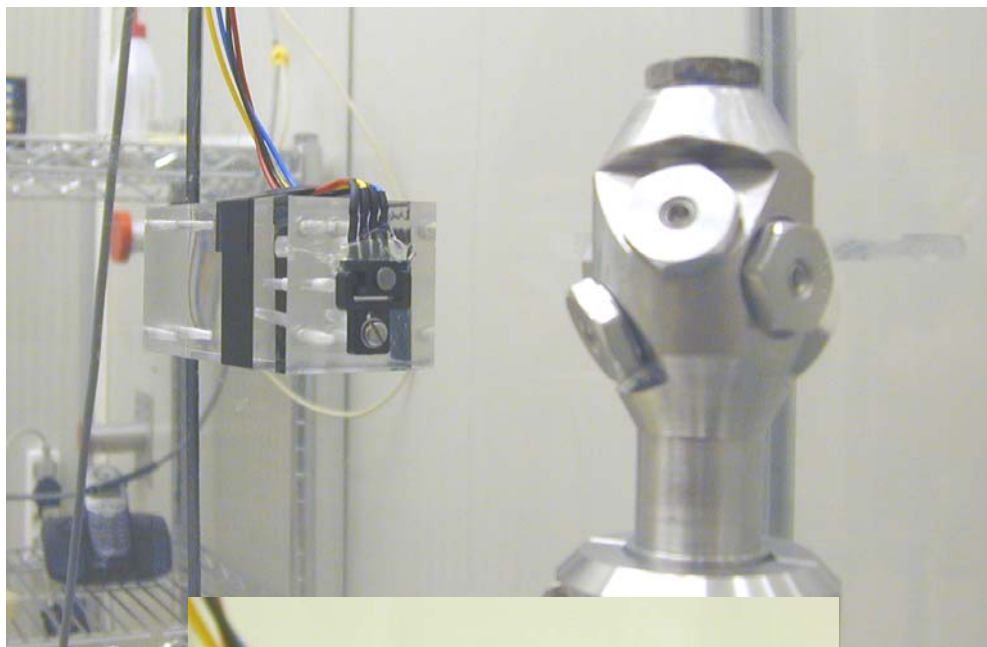
# Very preliminary data



Data are calculated as the water will lose all the energy in the impact and no energy was lost during the flight from the nozzle

$$F = 2 \cdot A_N \cdot (P_{\text{pump}} - P_{\text{Atm}})$$

# The force sensor in the HPR



# What can be done in the future?

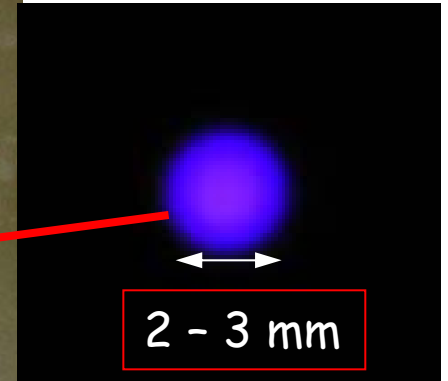
Do more reliable measurements, avoiding HPR head vibrations.

Measure of the force during system rotation: jet profiling is possible? (signal deconvolution ?)

System can be easily transferred to other labs to make comparison of the water jet characteristics.



# Pictures in the light and in the dark



Luminescence +  
OZONE  
?

