ASSESSMENT OF THE PERFORMANCE OF FLOW MEASUREMENT INSTRUMENTS:
VERIFICATION, CALIBRATION, COMPARISON

Presentation based on the WMO Manual on streamgauging (2010),
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QUALITY ASSURANCE / QUALITY CONTROL

- **To ensure a high level of quality, a gauging must be realized :**
  - By trained field hydrologists
  - Following accepted standards, guides, manuals or protocols
    - Iso Standards
    - WMO guides, manuals and recommendations
    - Internal protocols
  - With equipment in working order
    - Calibrated
    - Checked

- **In this presentation, some recommendations for the most used gauging methods :**
  - Velocity area using mechanical current meters
  - Velocity area using ADCP
  - And some general recommendations for all the methods !

MECHANICAL CURRENT METERS

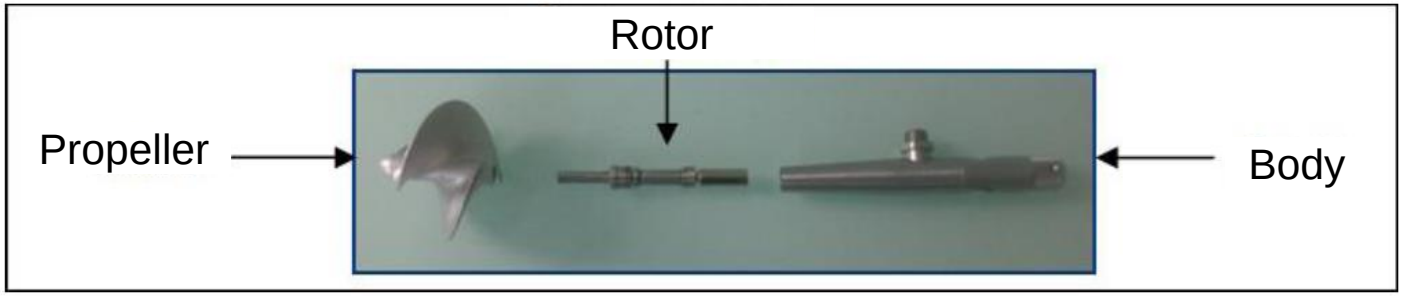
- **Rating / calibrating**
  - Determining the relation between the angular velocity of the rotor and the velocity of the water turning it
  - Standards for calibrating mechanical current meters are described in ISO 3455 (2007)
  - Rating realized in a tow tank :
    - Long water-filled trough
      - Example of Metas (Switzerland) : length of 140 m, width of 4 m and depth of 2.4 m
    - Movable carriage that can run on rails or a track at a constant speed
    - Current meter is suspended from the carriage and moved through the water at a constant speed.
    - → Relating the linear and rotational velocities of the current meter
    - Calibration runs are made at various speeds that can be accurately measured
      - ranging from about 0.1 m/s to about 4 m/s.
    - → equations of rating for an instrument and its holder

Calibration lines	> n	<= n	Velocity v =
Line A	0.0000	3.8980	0.0216 + 0.0605 n
Line B	3.8980	10.0625	0.0407 + 0.0556 n
Line C	10.0625	35.9479	0.0568 + 0.0540 n
	n = Number of impeller revolutions per sec.		v = Velocity in meters per second

DTG

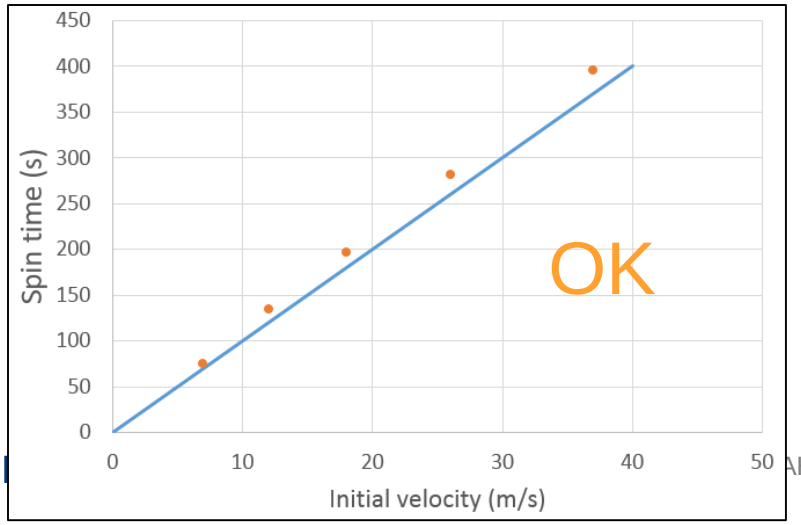
MECHANICAL CURRENT METERS

- **Moving parts → give special attention to the care of the instrument**
  - Before and after each discharge measurement the meter cups, pivot, bearing and shaft should be examined for damage, wear or faulty alignment.
  - Before using the meter its balance on the cable suspension hanger should be checked
  - During measurements the meter should periodically be observed when it is out of the water to be sure that the rotor spins freely.
  - Meters should be cleaned and oiled daily when in use
    - If measurements are made in sediment-laden water, the meter should be cleaned immediately after each measurement.
  - After oiling, the rotor should be spin to make sure that it operates freely
    - If the rotor stops abruptly the cause of the trouble should be sought and corrected before using the meter.



MECHANICAL CURRENT METERS

- **Checking**
  - **Propeller :**
    - Once it is rated, the equation will not change (except if damaged)
    - Visual inspection : if damaged, change the propeller
  - **Rotating axis (rotor) :**
    - Most fragile part of the current meter
    - Hard to inspect visually
    - → Timed spin test :
      - office procedure made under controlled conditions between field trips
      - should also be made when the performance of the meter is suspect and before and after repairs
      - Meter placed on a stable, level surface, no wind currents or drafts that would affect the rotor spin
      - The rotor is given a sharp, forceful spin by hand and a stopwatch is started simultaneously
      - The stopwatch is stopped when the rotor comes to a complete stop
      - Meter should reach a minimum spin time



OTHER CURRENT METERS

- **Acoustic Doppler, electromagnetic**
  - No moving part :
    - Less maintenance
  - Internal Quality tests
    - Included in the instrument's software
  - Checking:
    - In a bucket of water→ V=0
    - Tow tank to validate the measurement on a large range of velocity

ADCP

- **No moving parts**
  - Less maintenance
- **Internal Quality tests**
  - Included in the instrument's software
- **Checking:**
  - Tow tank to validate the measurement on a large range of velocity
  - Beam alignment verification :
    - Travel at a constant cap during about 500m
    - Compare GPS and BT distances

CHECKING

- **Comparison to a reference :**
  - Compare a gauging to a reference discharge
    - Reference discharge = very few uncertainty (< 1%)
    - Hard to realize in natural stream / Possible in flume
- **In situ collaborative interlaboratory experiments**
  - Compare a gauging to the average of a large number of gaugings realized simultaneously
  - The more gaugings, the best !
  - If a measurement is too far from the average (>5%), it is suspicious
  - Can be realized with all the methods