Success Cases – Rakes and Kiel Probes for Airfoil Instrumentation

- **Function & Architecture**
  - Sensors assemblies to measure and analyze the critical performance parameters of airfoil (both static and rotating) designs for turbofan turbine stages
- **Main requirements**
  - Type of sensors: pressure, temperature, mass flow and boundary layer.
  - Enabling either many separate readings simultaneously or a simple average of multiple readings
  - Individual measuring elements usually between 4 and 12 kiel heads, either with simple or dual sensor
  - Overall rake length may vary from 50 mm to 600 mm
  - Manufactured in special alloys: Stainless Steel, Ni based, Co based, Ti baed, etc.
- **Product Specificity & Achievements**
  - Completely insensitive to the direction of flow within certain limits, to allow its use in test rigs where the exact flow direction is unknown or varies depending on operating conditions
  - A wide range of the kiel head orientations can be obtained. Yaw and pitch capability depends on rake geometry
  - Specific aeronautical approvals in:
    - Quality Certications UNE-EN 9100 & UNE-EN ISO 9001
    - Electrical Discharge Machining: sinker-EDM, wire-EDM and hole drilling EDM
    - Welding: TIG, MIG-MAG and laser
    - Heat treatments: Quenching and Tempering, Annealing, Precipitation, Stress Relief
    - Non Destructive Testing: Visual Inspection, Liquid Penetrant Inspection and Radiological Inspection
  - Quantities from a few units to several tens
- **Main skills involved & Value Added:**
  - Manufacturing from machined bar or formed and welded sheet, and
  - Drawing upon in additive manufacturing technologies to make complex geometries as a single part
  - Customer Satisfaction regarding:
    - Shorter production times and saving manufacturing costs
    - Less parts counting whilst reducing complex assemblies to a single part