

Educational wind tunnel system integrated with a data acquisition system, three-component force/moment balance, 2-axis traverse system and encoders, and experiment modules. All systems shall be integrated and controlled via a supplied computer and a LabVIEW™ software. Delivery and installation is required. Demonstration of similar design and installations must be provided, as well as a list of previous costumers.

The specifications are as follows:

- Wind Tunnel:

- Tunnel shall be made of fiberglass and the test section shall be made of aluminum.
- Test section shall have clear acrylic top and side windows. The top and side windows shall open for installation of models, and means to support a model horizontally in the test section shall be provided (e.g., circular holes in the side windows).
- Test section shall have an integrated yaw table with engraved scale and prepared to accommodate the model positioning system.
- Test section shall be at least 11.5"x11.5"x23" in width, height, and length, respectively.
- Minimum airspeed range in the test section is between 10 mph (4.5 m/s) and 145 mph (65 m/s)
- Turbulence level must be less than 0.3%.
- Tunnel has to be mobile and preferably has four industrial-grade steel casters w/ polyurethane wheels.
- A variable frequency drive motor must be used with a high-efficiency balanced fan/propeller.
- Tunnel design shall incorporate noise reduction.
- Operational manual and documentation must be included.

- Three-Component Force/Moment Balance with a model positioning system:

- Mounts to the test section turntable to allow for manual pitch and yaw control.
- Capable of measuring the normal force, axial force and pitching moment, with values of 25 lb, 10 lb and 50 in-lb for the normal force, axial force and pitching moment, respectively.
- Capable of 90° rotation to read the side force and yawing moment.
  - Capable of manual adjustment of pitch angle range between +/- 30 °, and designed to ensure that models are centered regardless of pitch angle.

- 2-Axis Traverse System and Encoder System: A motorized X-Z traverse system mounts on the ceiling of the test section to support a hot-wire probe support.

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  - Traverse system capable of traversing 12" in the x direction (streamwise) and 12" in the z direction (normal).
  - A ceiling plate with brush sealed slot must be included.
  - Traverse system must operate with two (2) precision stepper motors. Speed in both direction shall be at least 1 in/sec, and the accuracy in both directions shall be 0.003 or better with repeatability of 0.0002 in or better.
  - Stepper drives and controllers must be included and operated via the supplied data acquisition system and LabVIEW™ software.
  - LabVIEW™ traverse software includes data acquisition platform, traverse module (Jog Mode, Single-Point Mode, and Test Matrix Import Mode).
  - Traverse system includes data logger and broadcaster module (Single-Point, Multi-Point, Timed Run, and Continuous Sampling), as well as, plug and play USB communication.
  - Manually configurable limit switches to change the motion range must be included.
  - Encoders: Two encoders must be integrated with the traverse system for positioning feedback. Expected values for resolution, accuracy and repeatability are 0.001 mm, 0.025 mm and 0.001 mm, respectively. Signal from the encoders shall be integrated in the data acquisition system
  - Operational manual and documentation must be included.
- Data Acquisition System: Functions to control the wind tunnel speed, data reading and recording from the force balance and auxiliary transducers for tunnel control and corrections, read high frequency analog signal from 3<sup>rd</sup> party equipment, and control the traverse system. The system includes:
    - National Instrument cDAQ hardware/LabVIEW™ software
    - Desktop computer
    - High precision digital barometer and differential pressure transducer with full scale accuracy of around 0.03%.
    - Temperature and relative humidity readings for density corrections with full scale accuracy 2% for humidity readings, and +/- 0.5 degree Celsius temperature readings
    - All necessary connectors, wires, cabling, tubing
    - Tunnel control module to maintain either fan rpm or tunnel velocity. It requires variable frequency drive, continuous sampling of static ring and a pitot probe, and static inputs for temperature, barometric pressure, and relative humidity
    - Data logger module capable of single run, timed run and continuous data recording, and 10 kHz data acquisition rate. It has a configurable analog voltage inputs for interface with constant temperature anemometry (hot-wire)
    - Broadcaster module capable of streaming all active variable
  - Manometer: At least 24 tubes of 0-14 inches of water scale with fluid reservoir included.

• Experiment Modules: Models to be used in the tunnel for demonstration of basic concepts of aerodynamics and fluid dynamics. Models are designed to mount to the force balance. Models include:

- 2 airplane models (e.g., F-16 and 747). Suggested scale is 1:48
- Aluminum pressure 4-inch cylinder with at least 24 flush-mounted pressure taps along the circumference. Necessary tubing shall be supplied
- Sphere
- Forward cup
- Backward cup
- Flat plate
- Teardrop
- Aluminum pressure wing spanning the entire test section with at least 18 flush-mounted pressure taps. Necessary tubing shall be supplied
- Pitot static tube mounts in the test section window probe port. It has a rounded tip total-pressure tap and 6 static ports.
- Wake rake with at least 18 total-pressure ports. Mounts into test section through the turntable. Ports span at least 1.75 inches and are 2.125 inches in front of the 90° bend. The length shall be 10 inches.