

# **EXPERIMENTAL AEROELASTICITY AGENDA**

- **Session 1- Background on aeroelasticity and wind tunnels**
- **Session 2 - Wind tunnel facilities**
  - Calibrations and statistical quality control
  - The Transonic Dynamics Tunnel
- **Session 3 - Model design and fabrication**
- **Session 4 - Wind tunnel testing and case studies**
- **Session 5- Active control and smart structure tests**

**WIND TUNNEL CALIBRATION CONSIDERATIONS**

**AND**

**STATISTICAL QUALITY CONTROL**

# FACILITY CALIBRATION CONSIDERATIONS

**What is known and what is important about:**

- **Mach number corrections**
- **Flow angularity**
- **Boundary layer**
- **Turbulence**



# TDT CALIBRATION OBJECTIVES

*Transonic Dynamics Tunnel*

- **Determine R-134a Operational Envelope**
- **Measure Basic TDT Flow Parameters**
- **Quantify Test Section Flow Uniformity and Flow Quality**



# CALIBRATIONS APPROACH

*Transonic Dynamics Tunnel*

- **Verify measurement of primary tunnel parameters**
  - **Stagnation pressure**
  - **Static pressure**
  - **Stagnation temperature**
  - **R134a purity**
- **Mach number distribution**
- **Boundary layer**
- **Flow angularity**
- **Turbulence**



# TDT CONFIGURATION VARIABLES

*Transonic Dynamics Tunnel*

- **Test medium**
- **Slot configuration**
- **Re-entry flaps setting**
- **Pre-rotation vanes setting**



# TDT CALIBRATION TASKS

*Transonic Dynamics Tunnel*

- Measure H and T in settling chamber and P in the plenum
- Using a centerline tube measure P through test section to determine test section Mach number distribution
- Measure P along walls, ceiling, and floor through test section
- Using a flow survey rake with 11 probes measure flow angularity, turbulence, and Mach number distribution at 3 test-section stations to determine flow uniformity and quality
- Using 6 boundary layer rakes measure velocity distributions on sidewalls, floor, and ceiling at 3 test-section stations
- Measure speed of sound to improve accuracy of flow property calculations



# TEST APPARATUSES AND OBJECTIVES

*Transonic Dynamics Tunnel*

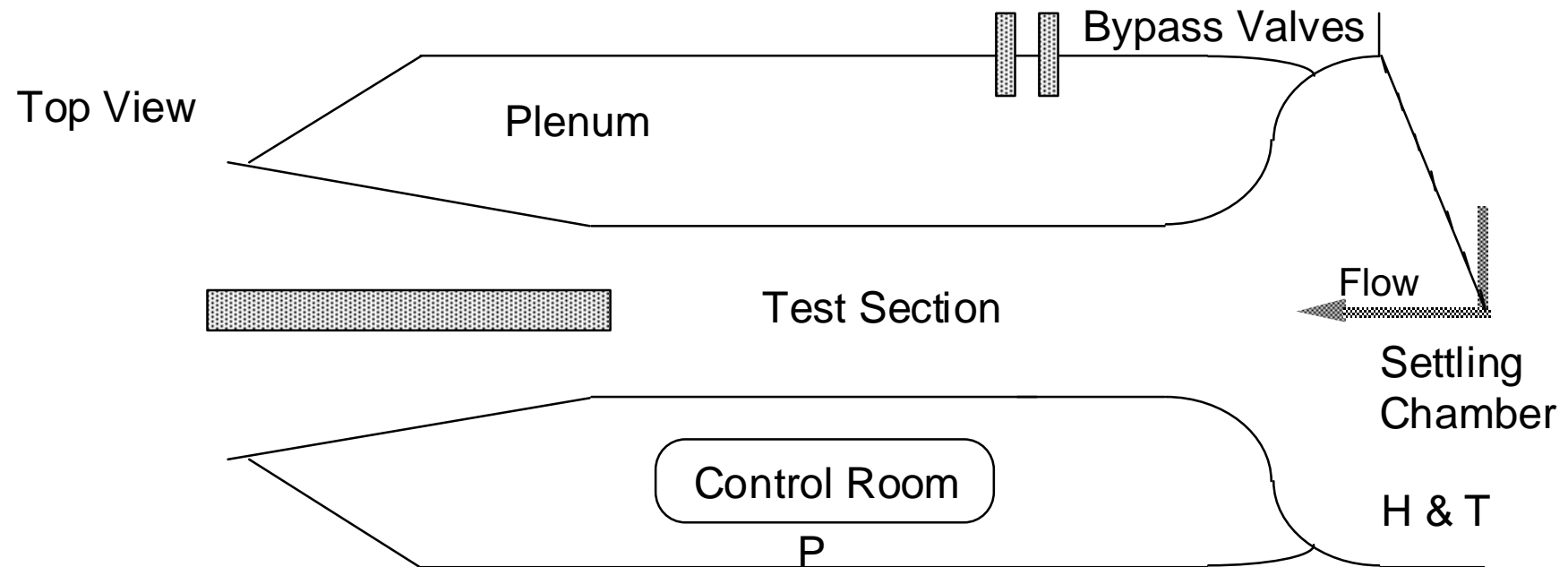
Objective Apparatus	Flow property	Flow quality			
		Mach distribution	Flow angularity	Boundary layer	Turbulence
Centerline tube	?	?			
Survey rake		?	?		?
Sidewall pressures	?	?			?
Boundary layer rakes				?	
Settling cham P & T	?				
Plenum P & T	?				?
Speed of sound device	?				



# PRIMARY FLOW PARAMETERS

*Transonic Dynamics Tunnel*

- Measure H and T in the settling chamber
- Measure P in the plenum
- Obtain multiple H, P, and T measurements to determine proper measurement locations

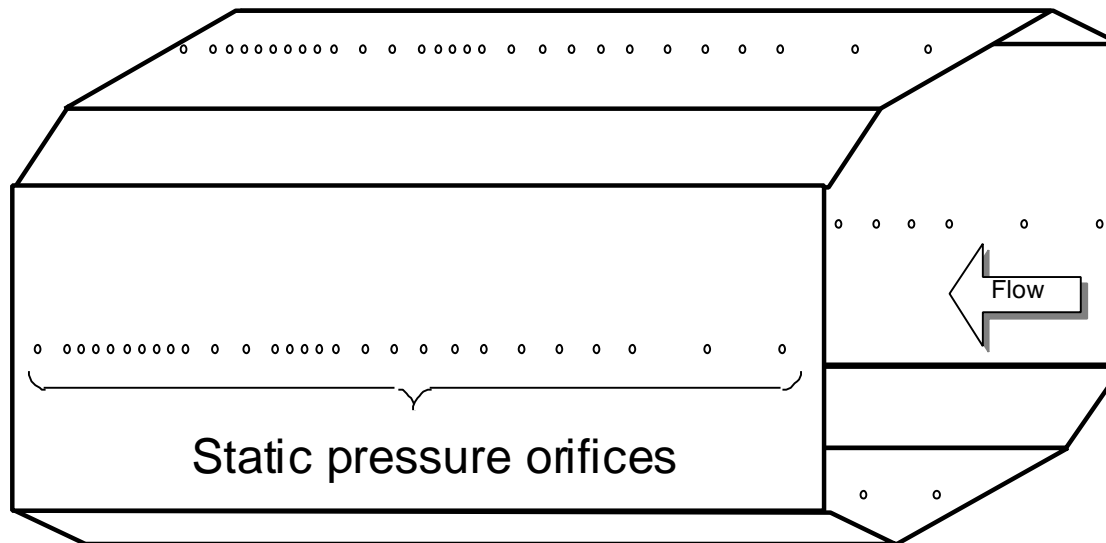




# SIDEWALL STATIC PRESSURES

*Transonic Dynamics Tunnel*

- Measure static pressures along walls, ceiling, and floor through test section
- Determine test section Mach Number distribution



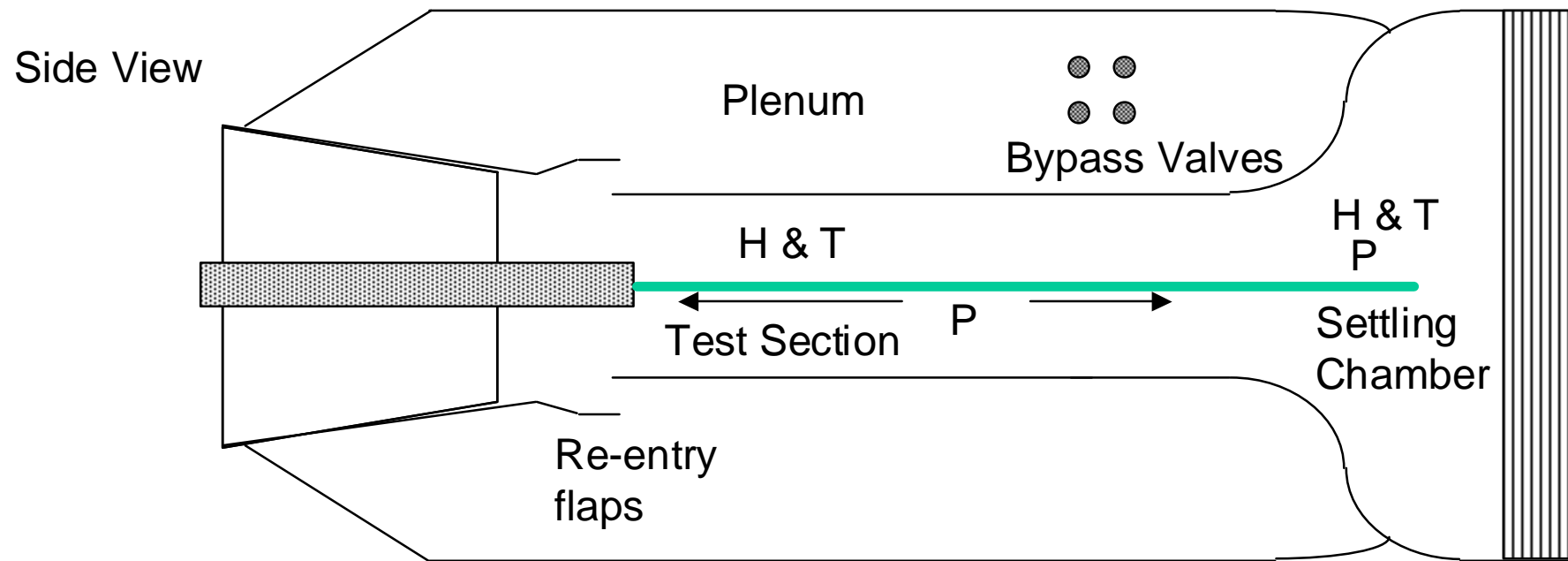
Slots not shown



# CENTERLINE TUBE

*Transonic Dynamics Tunnel*

- Measure static pressures in settling chamber and through test section
- Measure total pressure and temperature in settling chamber and test section
- Determine test section Mach Number and distribution

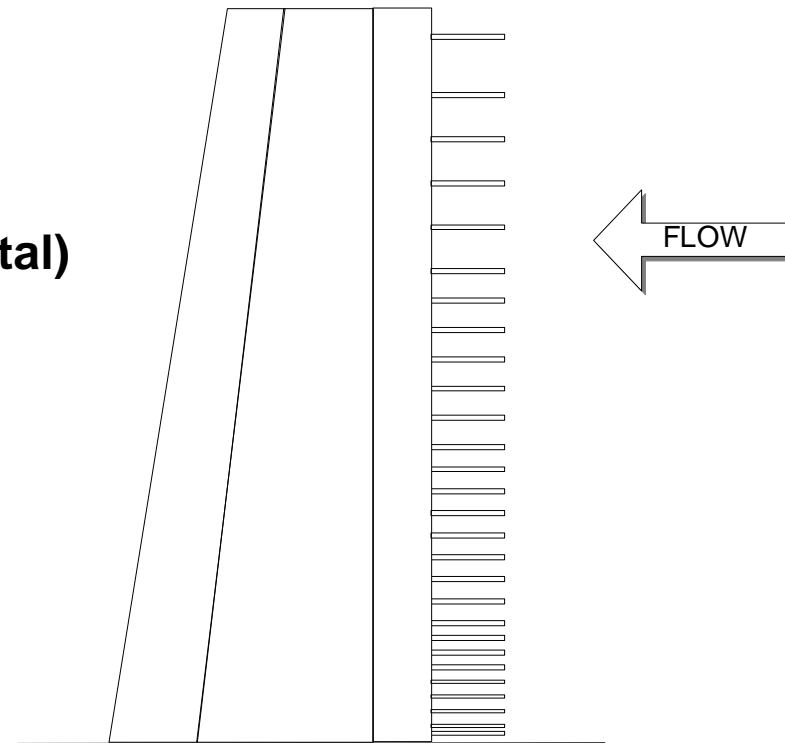




# BOUNDARY LAYER RAKE

*Transonic Dynamics Tunnel*

- **Measure velocity distribution on sidewalls, floor, and ceiling (6 rakes total)**
- **Perform measurements at three test-section stations**

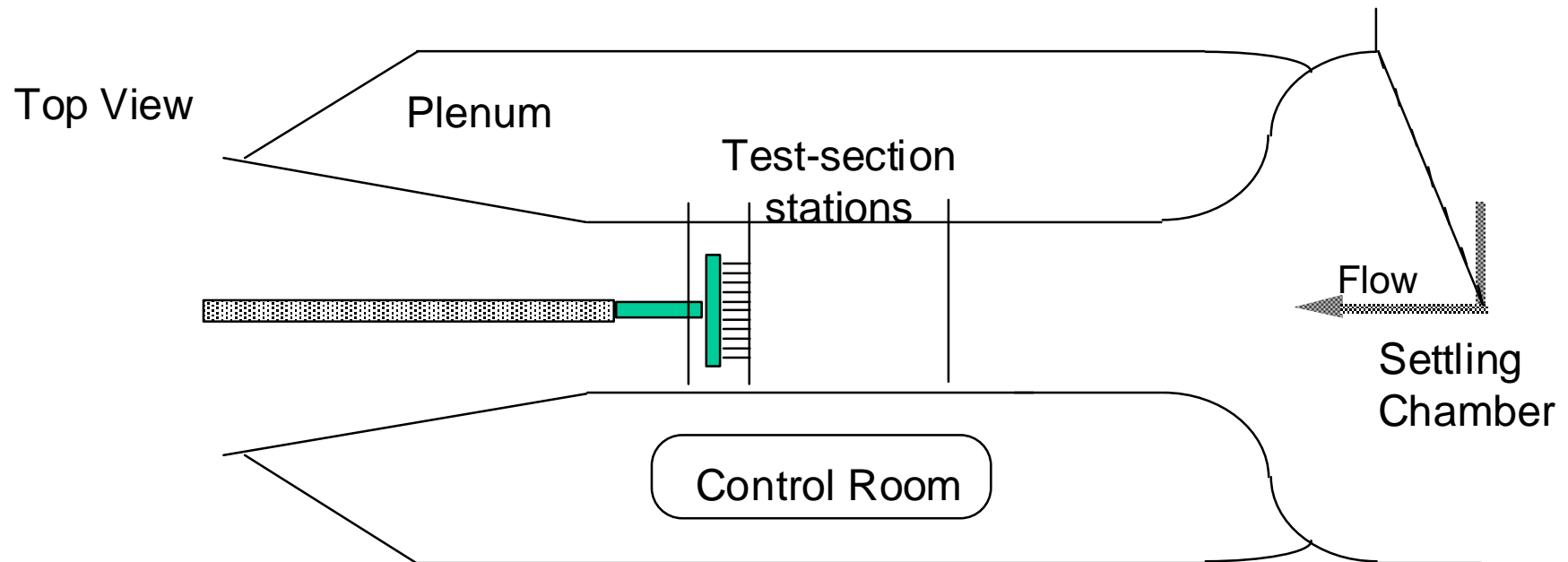




# FLOW SURVEY RAKE

*Transonic Dynamics Tunnel*

- Vertically translating rake, up to 11 measurement probes
- Measure flow angularity, turbulence, and Mach Number distribution in test section
- Perform measurements at three test-section stations to determine flow uniformity and quality

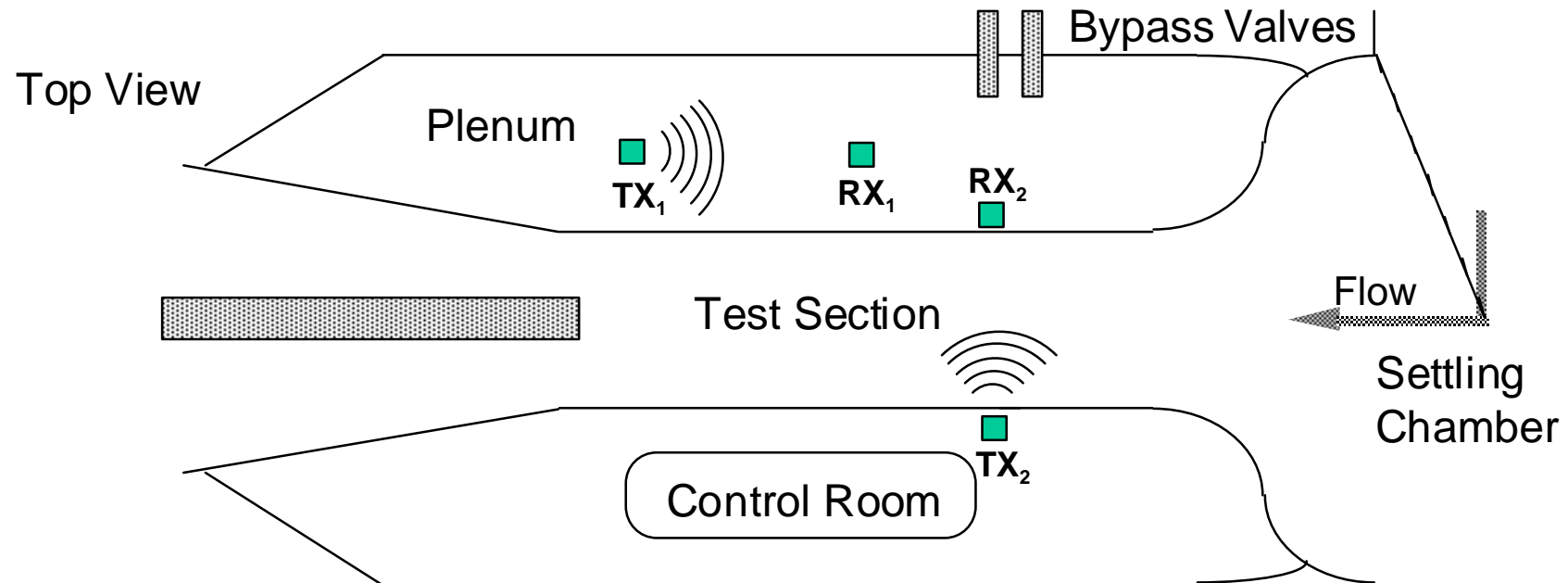




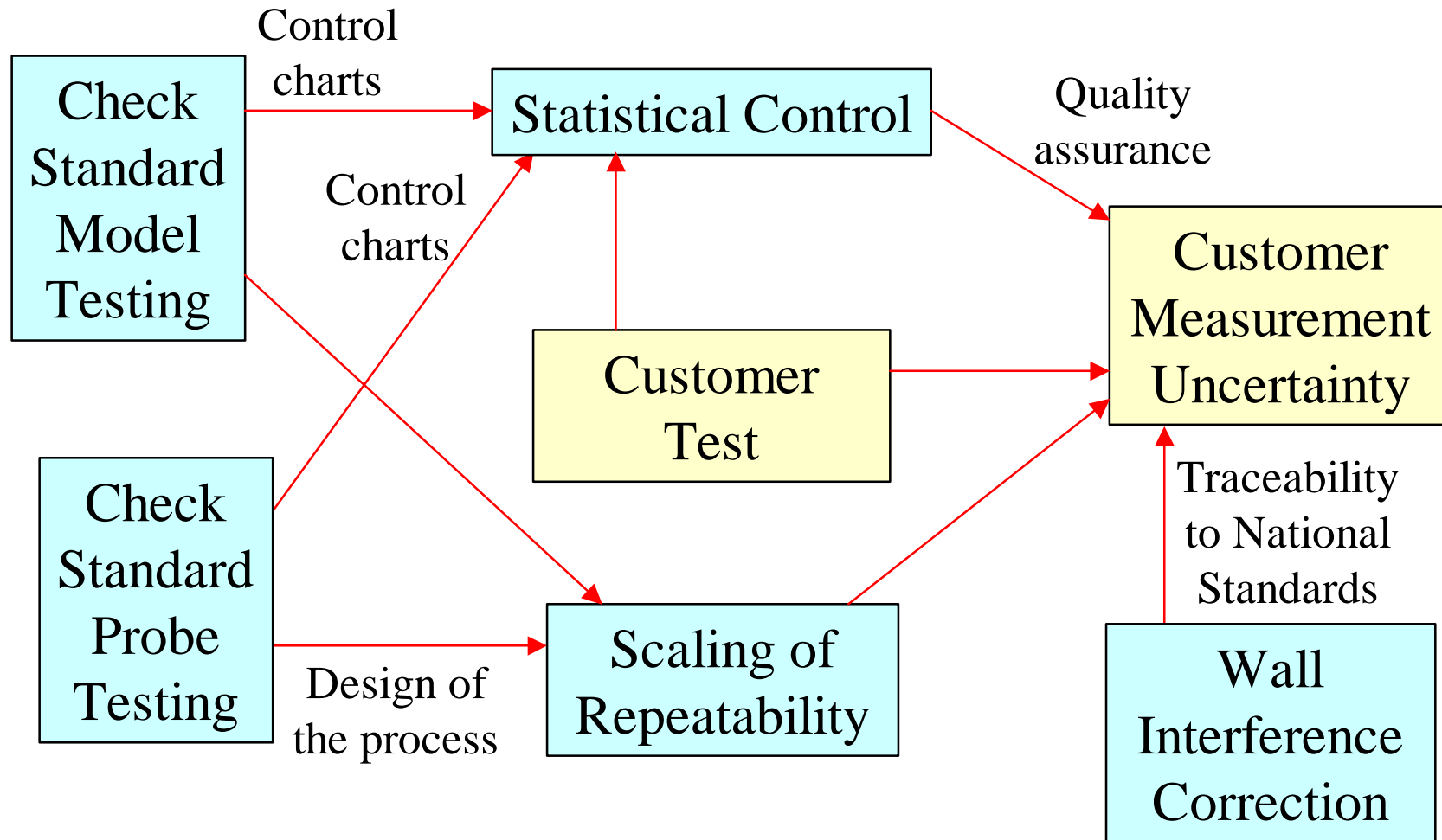
# SPEED OF SOUND

*Transonic Dynamics Tunnel*

- Measure speed of sound of test medium in the plenum and test section
- Use measured speed of sound to improve accuracy of flow property calculations



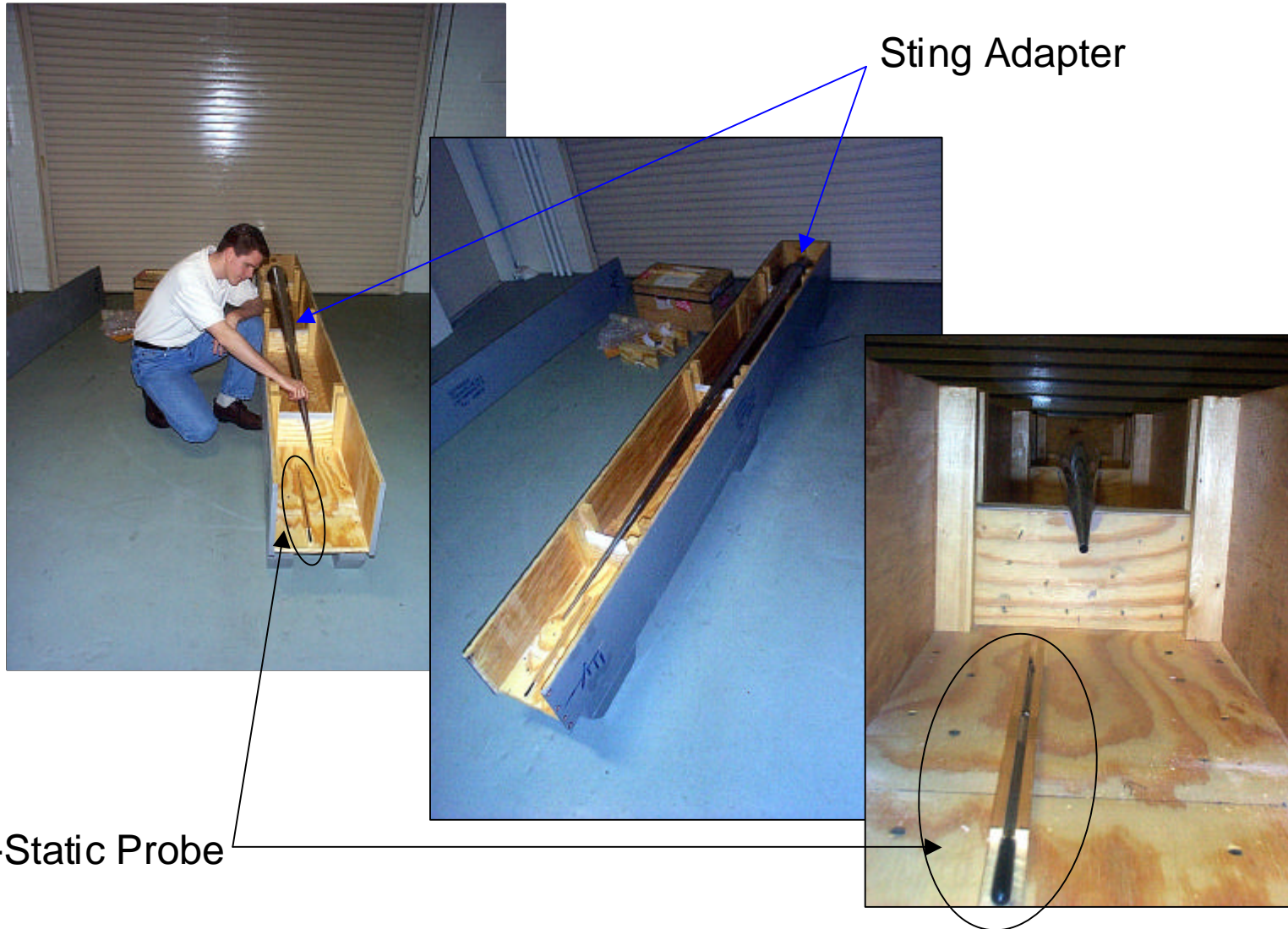
# STATISTICAL QUALITY CONTROL





# PITOT-STATIC PROBE WITH STING ADAPTER

*Transonic Dynamics Tunnel*



Sting Adapter

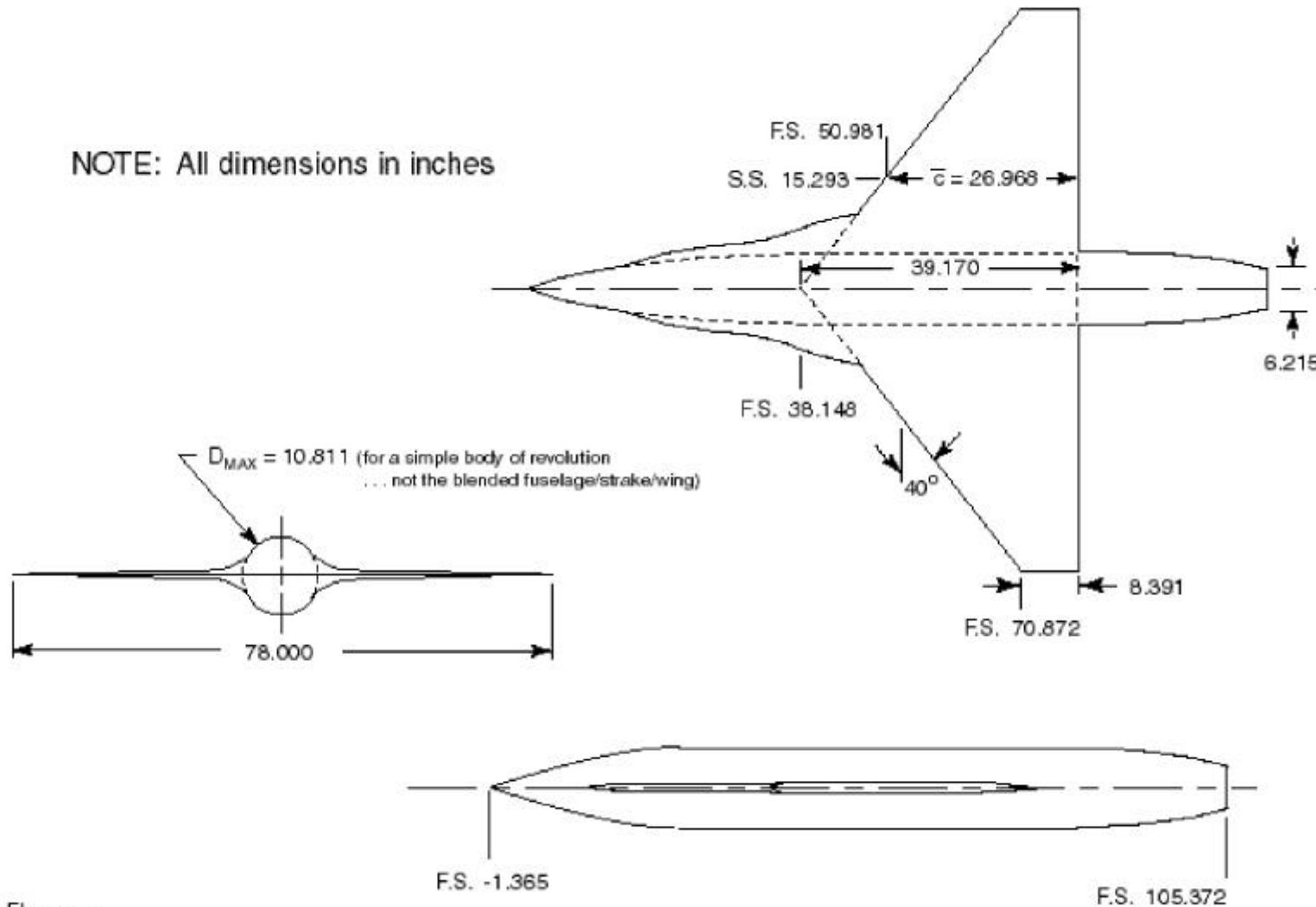
Pitot-Static Probe



# CHECK-STANDARD MODEL CONCEPTUAL DRAWING

*Transonic Dynamics Tunnel*

NOTE: All dimensions in inches





# CHECK-STANDARD MODEL STING ASSEMBLY

*Transonic Dynamics Tunnel*

