

# **ARA experimental test facilities**

### **NWTF Tunnel Managers Forum**

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# 1 ARA Transonic Wind TWT (TWT)

Test section	2.74m wide x 2.44m high (9ft x 8ft).
Four porous walls	22% maximum porosity.
Mach number	0 to 1.4
Stagnation pressure	0.8 to 1.2 atmospheres (standard is 1 atmosphere)
Reynolds number	3.5 to 16.7 million/m

The Transonic Wind Tunnel (TWT) has several support systems for a wide range of test types:

- Rear single sting support, basic incidence range -10° to +40°, ±180° roll range
- High incidence offset roll system, up to 70° incidence
- Twin Sting Rig for rear fuselage testing
- Underfloor balance support for semi-span model testing
- 2-dimensional wing testing support (±180° incidence range)
- High-pressure air-feed system for full-span and semi-span testing
- Captive Trajectory System for full 6-degree of freedom store release trajectory testing
- Gust Rig for impulse load and alleviation assessment

### 1 ARA Transonic Wind TWT (TWT)









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#### Force and moment testing:

- Multiple 6 component sting balances
  - 2.25" MK36 TASK
  - ARA 53mm
  - ARA 3"
- Underfloor half cart balances (5 component)

#### Pressures:

- PSI 64 15psid ESP modules
- 64/32 25psid DTC modules
- 102CH unsteady DAQ for Kulites (100kHz)

### Optical:

- Pressure-Sensitive Paint
  - Steady (LPSP, BPSP)
  - Unsteady (DPSP)
- Particle Image Velocimetry
- Model Deformation Measurement (DIC)

#### Other support capabilities:

- HP air (10, 250bar)
- Traversable wake rake
- CTS rig (TSR)



### 2 ARA Z4 Tunnel



- Z4 is a 1/12 scale version of the TWT (1":1')
- Primarily now used for technique development
- Ejector driven (10bar) closed return vented circuit
- M < 1.1
- Multiple wall configurations, porous, windows etc

#### Pressures:

- PSI 64 15psid ESP modules
- 16CH unsteady DAQ for Kulites (80kHz)

#### <u>Optical:</u>

- Pressure-Sensitive Paint
  - Steady (LPSP, BPSP)
  - Unsteady (DPSP)
- Particle Image Velocimetry

## 3 ARA Mach Simulation Tank (MST)

- The Mach Simulation Tank (MST) is used for mass-flow and thrust/drag calibration of through-flow nacelles (TFN), turbine-powered simulator (TPS) nacelles, ducted models and nozzle systems.
- Facility is used to support propulsion testing in the Transonic Wind Tunnel (TWT) but is also available for stand-alone tests.

#### Facility Capabilities

- Simulated Mach number range from zero up to 1.3
- High precision thrust measurement with a 1300N (292lbf) axial force capacity
- High precision mass flow measurement with a binary array of critical flow venturis
- High pressure air delivered by two servo-controlled high pressure airlines with pressures up to 69bar (1000psi)



## 4 ARA Propulsion Test House/HP Air facility (PTH)

- Large Scale Powered Test Cell
- This test cell is used for model assembly, systems installation and initial dynamics trial runs prior to installation in the Transonic Wind Tunnel (TWT).

#### **Facility Capabilities**

- Two controllable high pressure air supplies for air motors
- High voltage power supplies for electric motors pictured motor is 447kW (600hp)
- Reinforced control room equipped with all the required data acquisition and health monitoring systems
- Check-out facility for complex TWT models







### 5 ARA Balance Calibration/Gauging

- ARA designs and manufactures balances
- Main model balances with load capacities of up to 17,800N
- Small store balances with load capacities of 30N
- ARA also offers a calibration service for customer supplied balances.
- All the balance calibration equipment is traceable to UK national standards.



#### Technical Capabilities

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- Standard equipment used to perform dead weight loadings in the calibration frame, which incorporates pitch and roll levelling mechanisms.
- A balance calibration matrix produced from a full set of interactive calibrating load cycles, including first and second order interaction terms.
- For a typical civil aircraft drag model balance, the achieved resolution of ±0.11N (±0.025lbf) in axial force components and ±0.60N (±0.135lbf) in normal force components in static calibration is equivalent to  $\Delta$ CA = 0.000014 and  $\Delta$ CN = 0.000075 for a typical qS of 8000N (1800lbf).







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