Engine Nacelle Halon Replacement

Federal Aviation Administration

Presented to:	International Aircraft Systems Fire Protection Working Group
By:	Mr. Dave Blake for Douglas Ingerson, Engineer Federal Aviation Administration WJ Hughes Technical Center Fire Safety Team Atlantic City Int'l Airport, NJ USA tel : 609-485-4945 email : Douglas.A.Ingerson@faa.gov
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Presentation Overview

- **Discuss the “MPSe rev03 to rev04” transition**
  - Overview
  - Status
- **Flow visualization, Small-scale wind tunnel (SSWT) activity**

MPSe Rev 03 ➔ 04, Overview

- **Issues driving the test process revision**
  - Terminate the use of halon 1301 in the process
  - Minimize the impact of agent injection on determining the "equivalent" agent quantity

MPSe Rev 03 ➔ 04, Overview
Terminating Halon 1301 Usage

- **Modify halon benchmark process**
  - Use surrogate to replicate halon 1301 fire suppression behavior
  - Surrogate = HFC-125
  - Revise benchmark process

- **Begin characterizing fire threats**
  - Utilize instrumentation in the test article for characterization
  - Benchmark process will likely be dropped in the future

MPSe Rev 03 ➔ 04, Overview
Minimizing the Effect of Injecting Fire Extinguishant

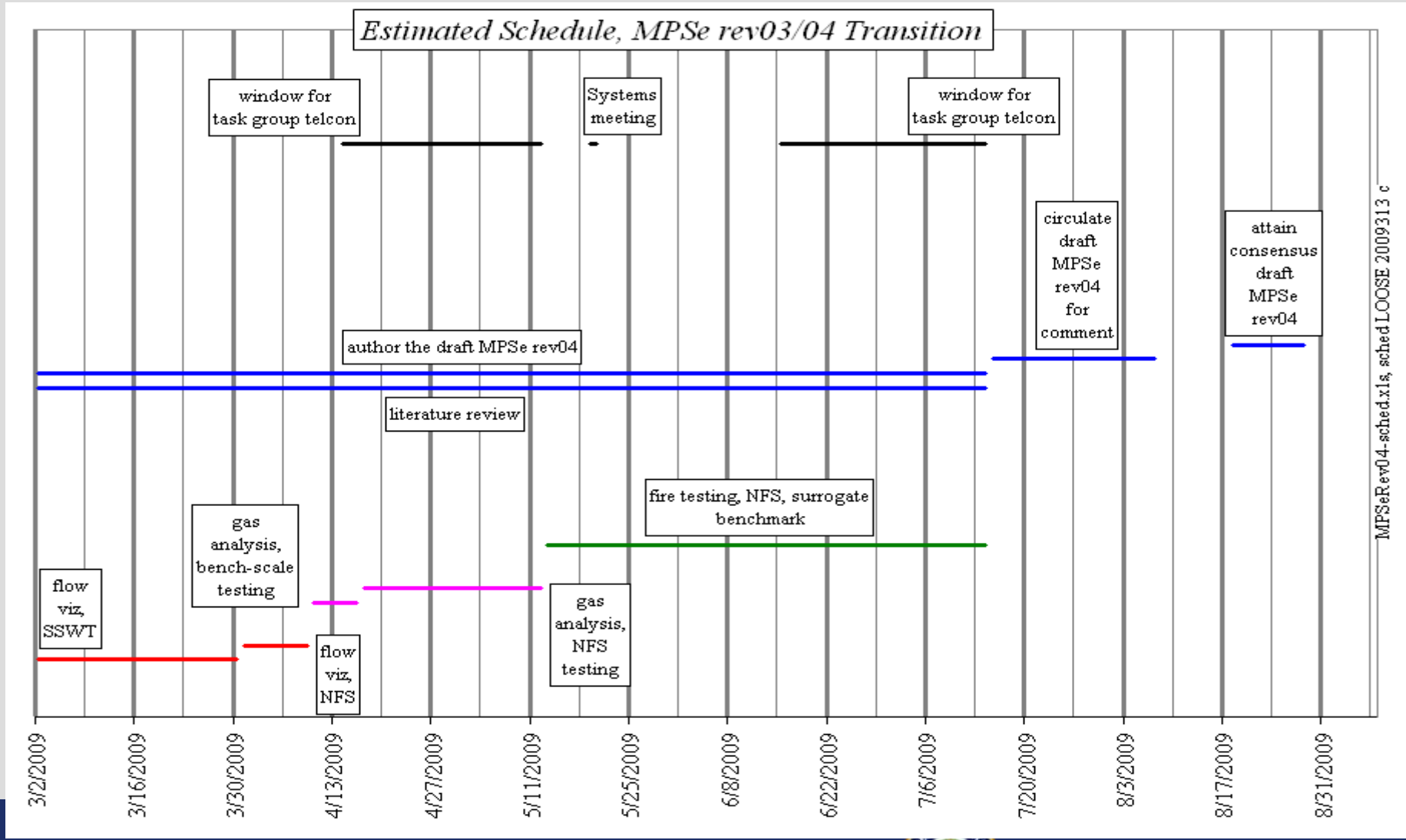
- **Modify test process**
  - Change from an iterative search to a proof-test
    - deliver agent in pre-determined quantity (amount x residence time)
    - predetermined quantity based on accepted bench-scale test
      - based on cup-burner assay
      - agent quantity = (factor-of-safety) x (cup-burner finding)
      - residence time = 0.5 sec
  - Requires preliminary testing to produce the agent distribution in the test article for 2 air flow conditions

MPSe Rev 03 ➔ 04, Overview
Minimizing the Effect of Injecting Fire Extinguishant

- **Review agent measurement method**
  - Conduct flow observations
    - smoke visualization (currently on-going)
      - SSWT & 2 aerodynamic models
      - nacelle fire simulator (NFS)
    - gas distribution behavior in the NFS
  - Revise measurement methods
    - as needed…
    - based on indications from observations & published literature

MPSe Rev 03 ➔ 04, Status

Original Schedule



MPSe Rev 03 ➔ 04, Status

Current Status

- **Flow observations near-complete**
  - Task group telephone conference call expected shortly
    - discuss flow observations
    - late May/early June

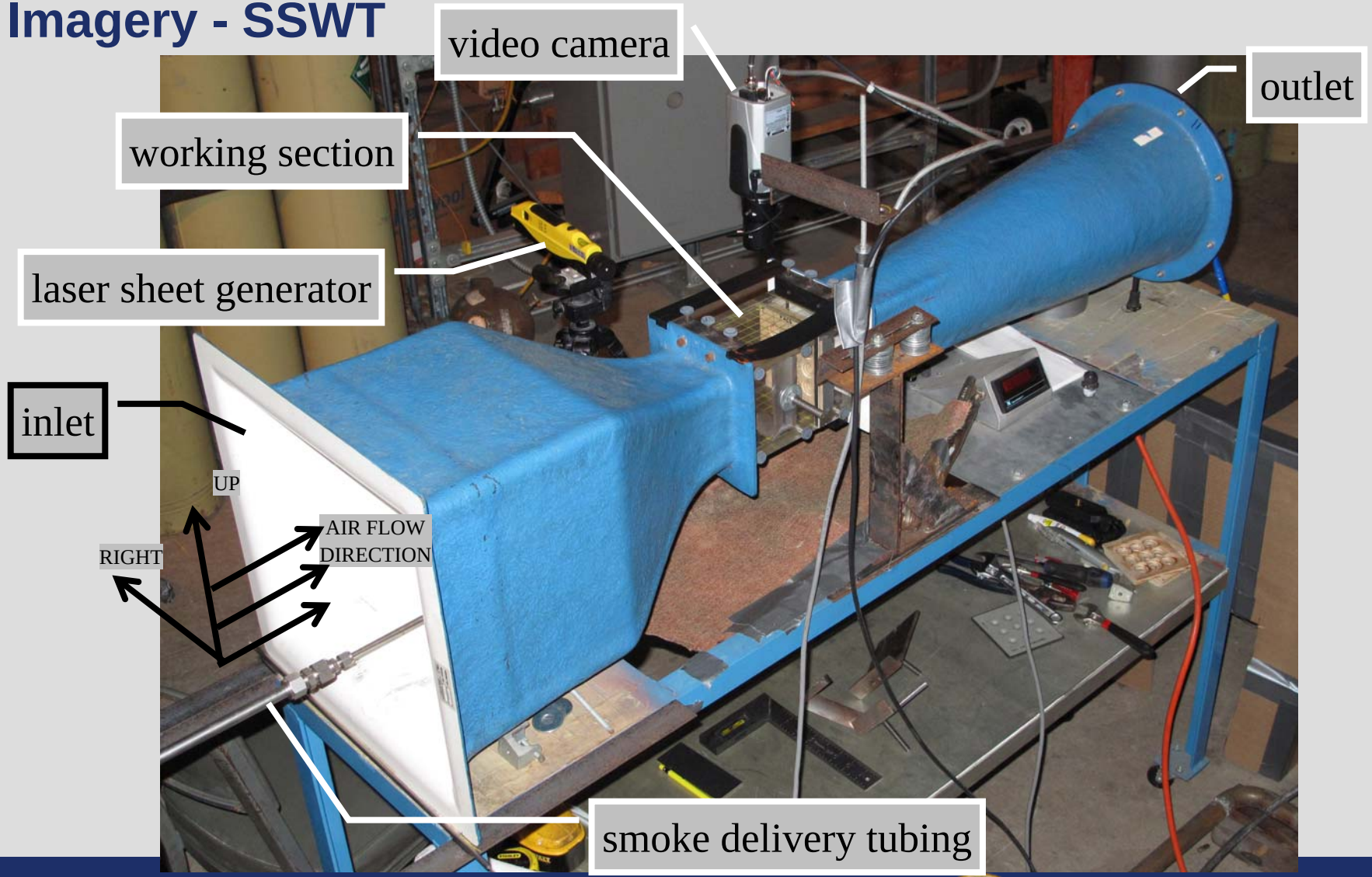
- **Remaining tasks are pending**

Flow visualization, SSWT Activity
Overview

- **Utilizing SSWT to visualize wake regions**
  - Wake regions are related to flame-holders in the NFS
  - Will use indications for placing gas sample points in the NFS
- **SSWT details**
  - Suction tunnel
    - driven by 0-90 VDC motor
    - speeds up to 50 ft/sec (15.2 m/sec)
  - Working section 4 x 4 x 7.5 inches (102 x 102 x 191 mm)
  - Two aerodynamic models; tube array & “fuel pan”
  - Delivering smoke to visualize flow near models
  - Red laser sheet illuminates horizontal planes

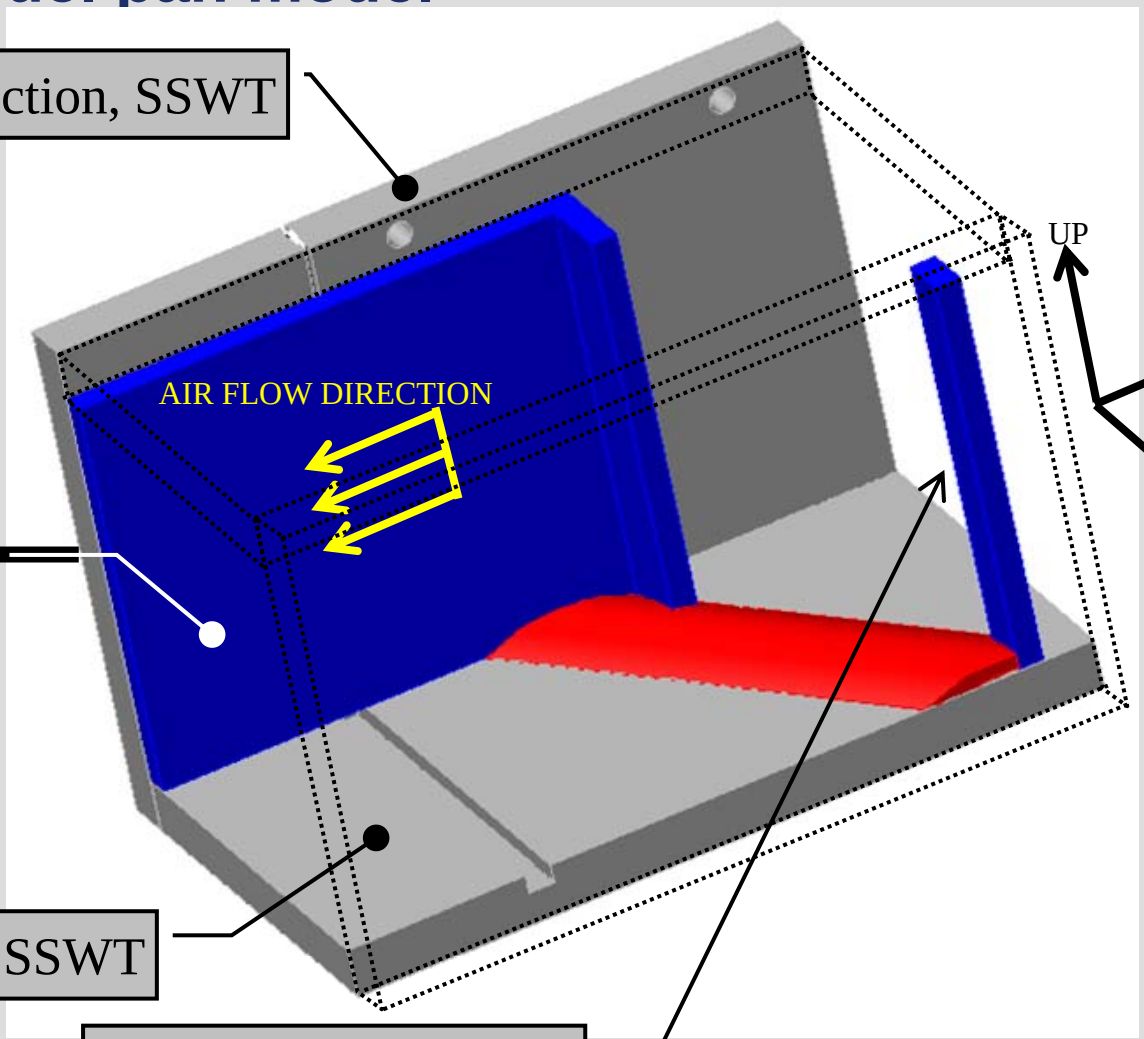
Flow visualization, SSWT Activity

Imagery - SSWT



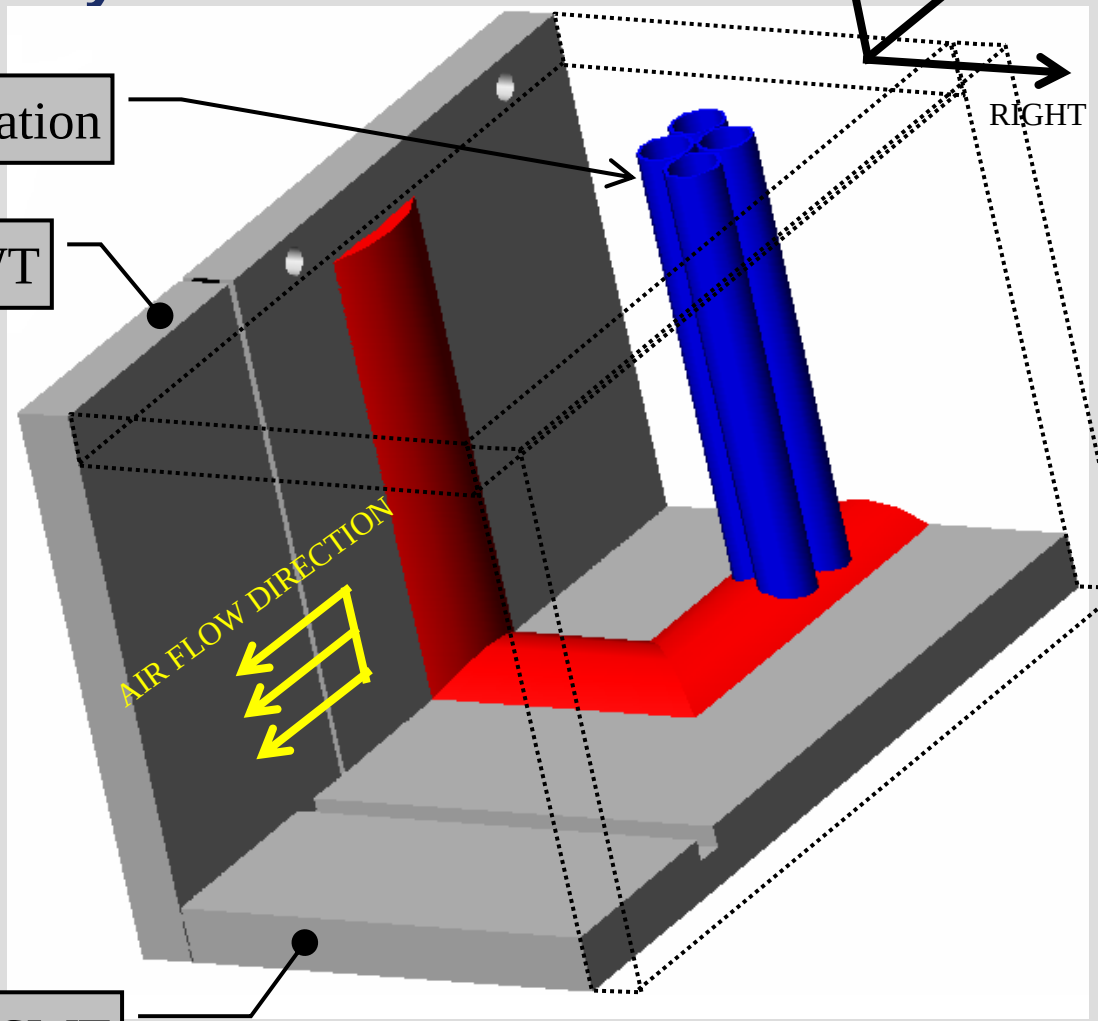
Flow visualization, SSWT Activity

Imagery - SSWT, fuel pan model



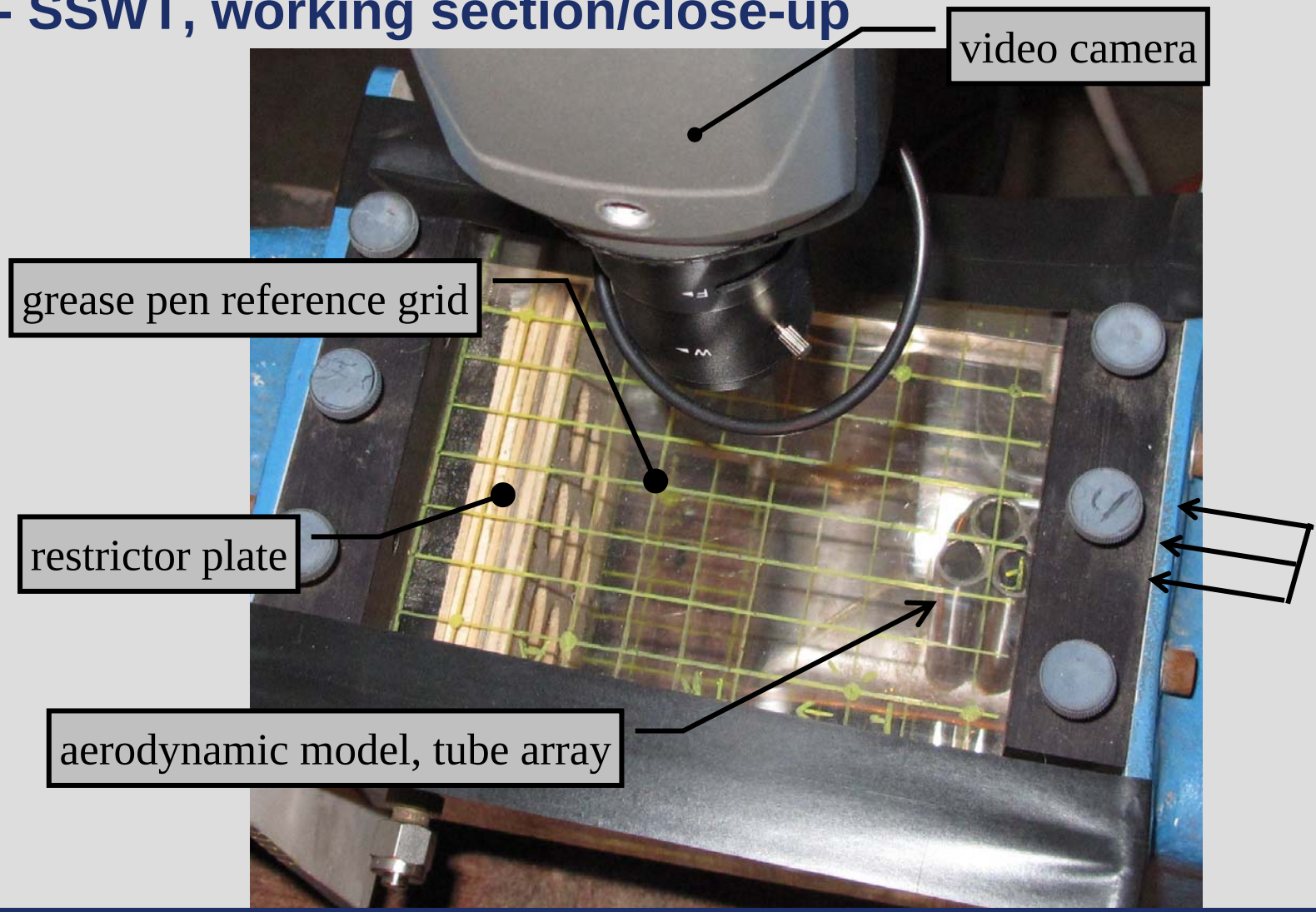
Flow visualization, SSWT Activity

Imagery - SSWT, tube array model



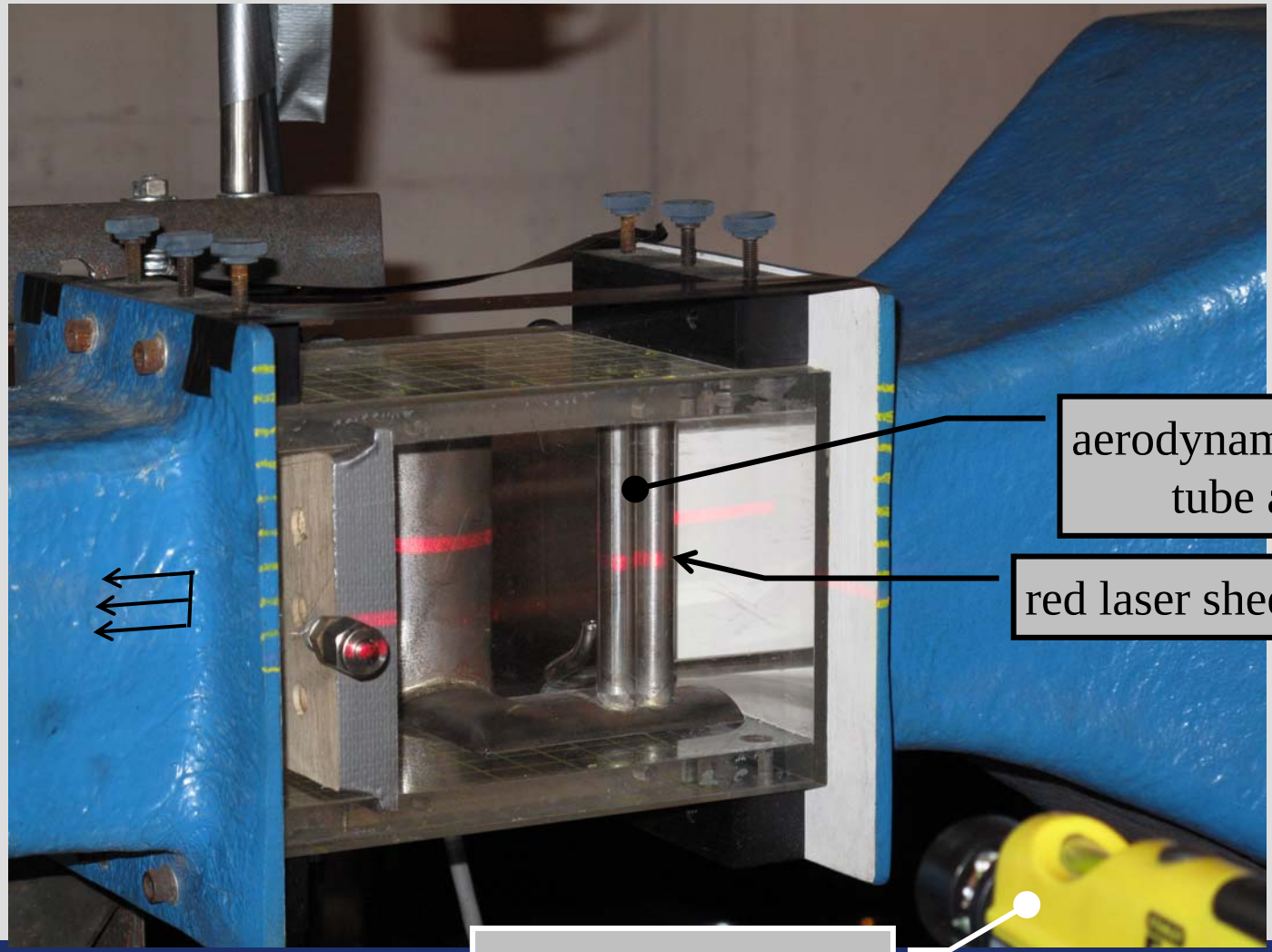
Flow visualization, SSWT Activity

Imagery - SSWT, working section/close-up



Flow visualization, SSWT Activity

Imagery - SSWT, working section/close-up



Flow visualization, SSWT Activity

Imagery - SSWT, set for work

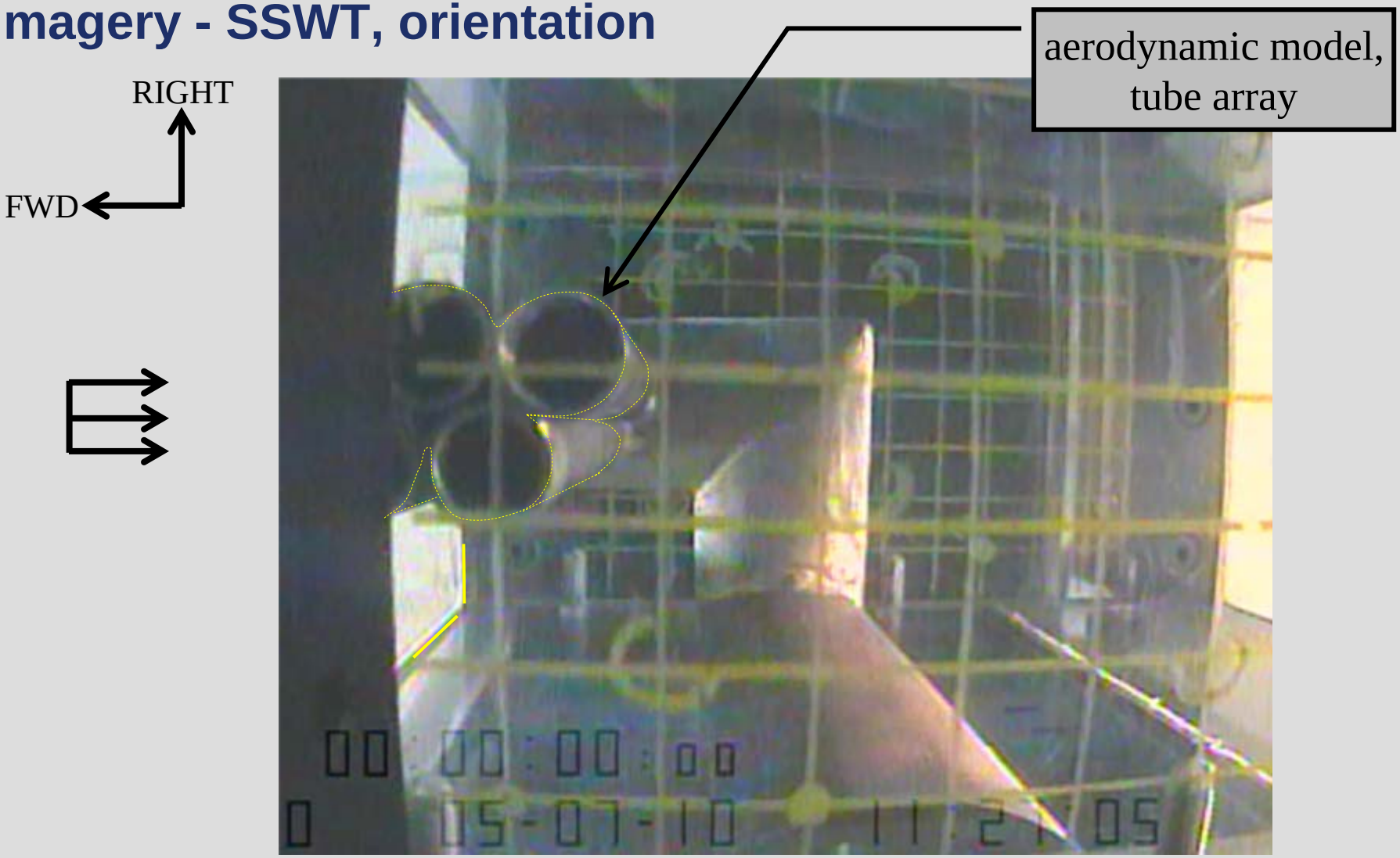
Flow visualization, SSWT Activity

Tests 2009506-18 & -19, smoke visualizations

- **Common characteristics**
  - Air temperature = ~ 64°F (18° C)
  - Calculated air speed = ~ 47 ft/sec (14.3 m/s)
  - Aerodynamic model = tube array
- **Test 2009506-18 (outside wake region)**
  - Smoke delivered through the SSWT inlet forward of model
  - Smoke traversed from right to left (viewed here as top to bottom)
- **Test 2009506-19 (inside wake region)**
  - Smoke delivered to the wake of the model
  - 3 horizontal planes viewed

Flow visualization, SSWT Activity

Imagery - SSWT, orientation



Flow visualization, SSWT Activity

Imagery - SSWT, smoke/inlet delivery, “clear” air/right side

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/inlet delivery, right model boundary

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/inlet delivery, centered

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/inlet delivery, left model boundary

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/inlet delivery, “clear” air/left side

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/wake delivery

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/wake delivery

Flow visualization, SSWT Activity

Imagery - SSWT, smoke/wake smoke delivery

End

- **Acronyms**

  MPSe = Minimum Performance Standard for Civil Aircraft Engine Nacelle & APU Compartments
  APU = Auxiliary Power Unit
  SSWT = small-scale wind tunnel
  NFS = nacelle fire simulator, located at the FAA WJ Hughes Technical Center
  rev = revision
  fwd = forward