Infrastructure Commission (INFCOM)

Standing Committee on Measurements, Instrumentation and Traceability (SC-MINT)

Expert Team on Quality, Traceability and Calibration (ET-QTC)

# Calibration of Wind Instruments

## Part-3: Requirements for the Laboratory Setup (1)

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# Content

Part 1:

- Introduction to this topic and historical information
- Concepts and definitions

Part 2:

- Methods of measurement

Part 3:

- Requirements for the laboratory setup #1

Part 4:

- Requirements for the laboratory setup #2

Part 5:

- General procedure
- Calibration example #1
- Calibration example #2
- Calibration example #3
- References and links

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# Requirements for the laboratory setup

general requirements

- calibration shall be carried out in a **wind tunnel**, that is suitable for the calibration of anemometers
- all transducers and measuring equipment relevant for the calibration of an anemometer shall be **traceably calibrated**
- pitot-static-tubes, if used, shall have a cylindrical head according to ISO 3966
- flow quality shall be verified
- the repeatability of the calibration shall be verified
- anemometer calibration shall be supported by a thorough assessment of calibration uncertainty performed in accordance with JCGM 100:2008(E)

# Requirements for the laboratory setup

requirements of the wind tunnel

- the presence of the reference shall not substantially affect the flow field in the wind tunnel
- during the measurements, the **reference** and the **device under test (DUT)** are influenced to a certain extent by the blockage and boundary effects
- the blockage area ratio (BR) - defined as the ratio of the projected area of the anemometer (including the mounting system and the rotating rotor) seen in the direction of flow to the total area of the test section - shall not exceed 0.05
- test section should have a height of 1 m
- uniform flow shall be achieved (longitudinal, transversal, vertical)
- the speed of flow shall be uniform to 0.2 % over a period of at least 5 minutes

# Requirements for the laboratory setup

requirements of the wind tunnel

- the flow in the cross section areas, where the anemometer will be located, shall be uniform, stable and constant in time over a period of at least 5 minutes
- the horizontal wind gradient across the anemometer shall be within 0.2 %
- the axial turbulence intensity at position of the anemometer shall be less than 1 %
- reference data shall be collected over a period of 60 seconds with 10 Hz sampling rate
- the wind tunnel calibration factor, which gives the relation between the conditions at the reference measurement position and those at the anemometer position, shall be determined using pitot tubes or LDA
- inter laboratory comparisons shall be carried out

# Requirements for the laboratory setup

instrumentation and calibration set-up requirements

- dedicated external signal conditioning equipment such as frequency to voltage converters, etc. shall be calibrated in isolation from the anemometer, so allowing the anemometers calibration to be derived and reported in isolation from the signal conditioning equipment
- resolution shall be at least 0.2 m/s
- in case of analog voltage instrument care shall be exercised due to low impedances of logging instrument
- only one DUT at time
- mounting tube shall have the same diameter as in the field
- it is recommended that the vertical distance between the anemometer rotor relative to the upper and lower boundaries of the wind tunnel section should not be less than 0.5 m

# Requirements for the laboratory setup

instrumentation and calibration set-up requirements

- perpendicular mounting with max. deviation of 0.1°
- it is important to ensure the anemometer is not significantly influenced by the presence of any reference wind speed equipment
- pitot static tubes shall be positioned in the test section aligned with the mean flow direction with a maximum misalignment of 0.5°
- during calibration, the anemometer output signal shall be examined to ensure that it is not subject to interference or noise

# Requirements for the laboratory setup

types of wind tunnel

open return (Eiffel type)
https://metek.de/de/wp-content/uploads/sites/6/2022/03/Th.-Friedrichs-Windkanal.png

closed return (Göttingen Type)
https://www.b-tu.de/fileadmin/user_upload/b-tu.de/fg-schaltungstechnik/Bilder/Windkanal.jpg

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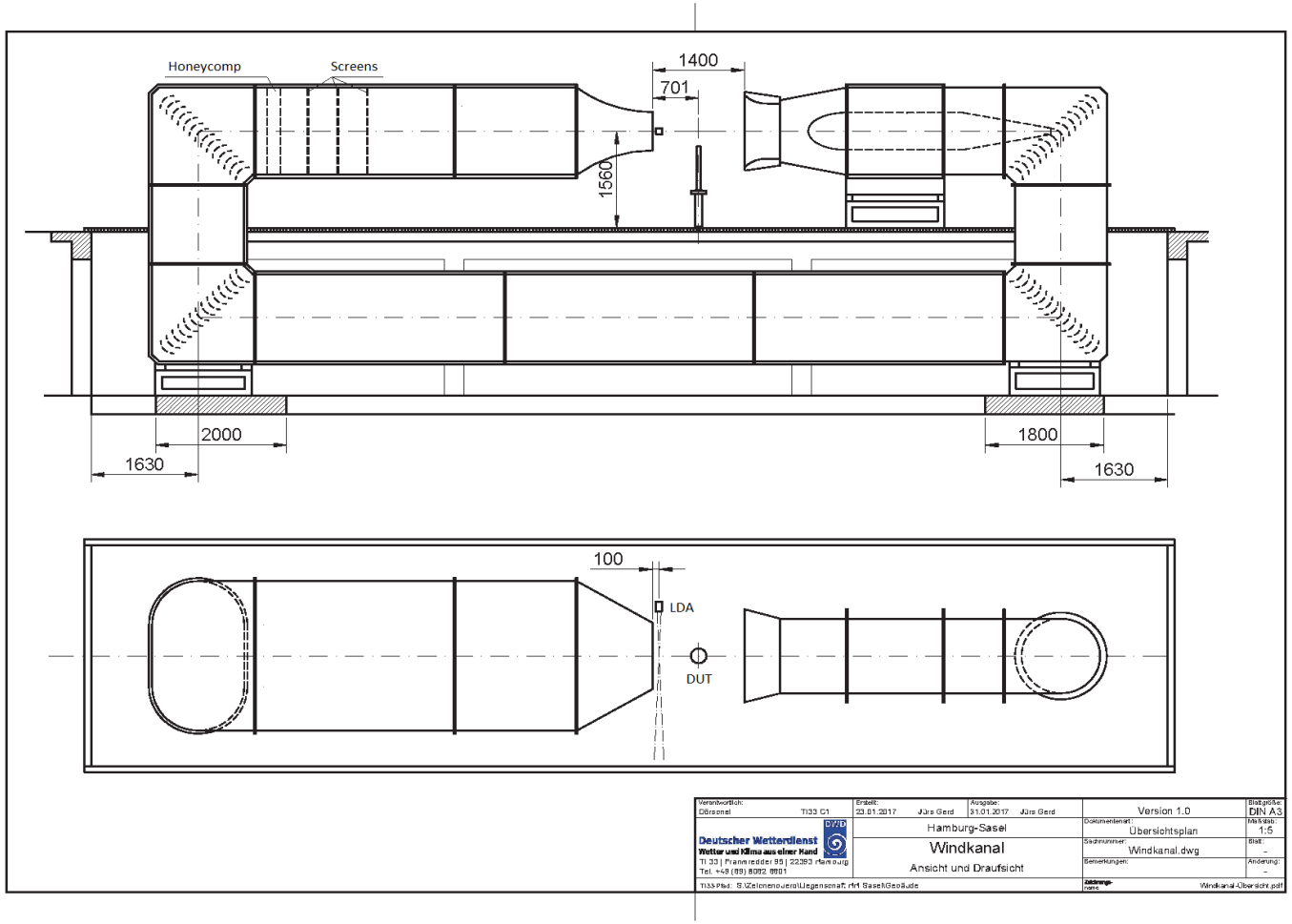
# Requirements for the laboratory setup

DWD’s wind tunnel situated in Hamburg

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# Requirements for the laboratory setup

TSMS’s wind tunnel situated in Ankara

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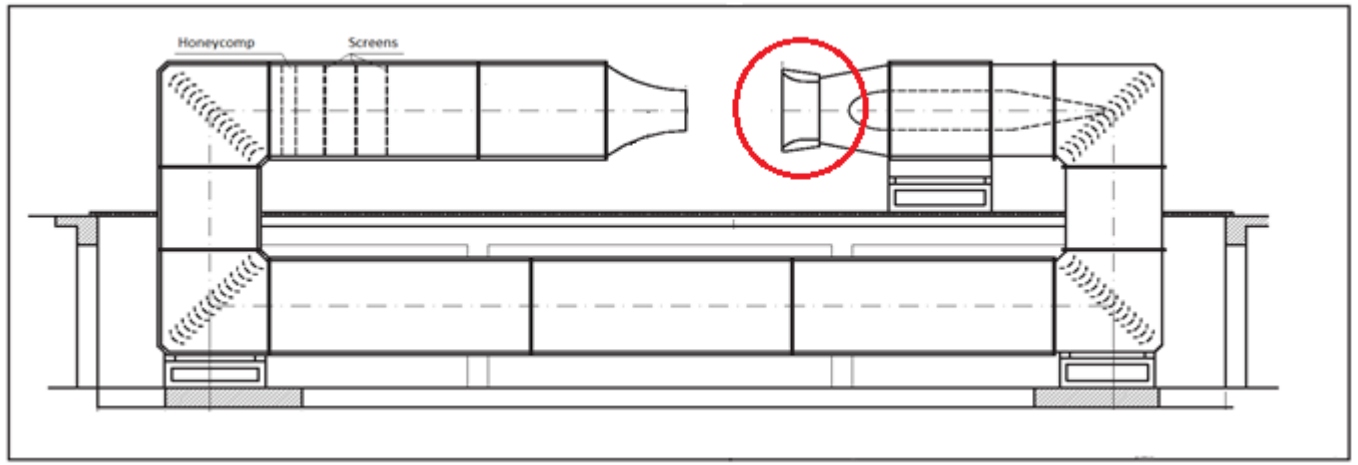
# Requirements for the laboratory setup

basic parts of a wind tunnel

- bell mouth
  - uniform flow
  - it prevents loss of suction

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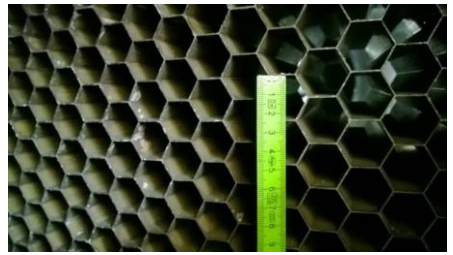
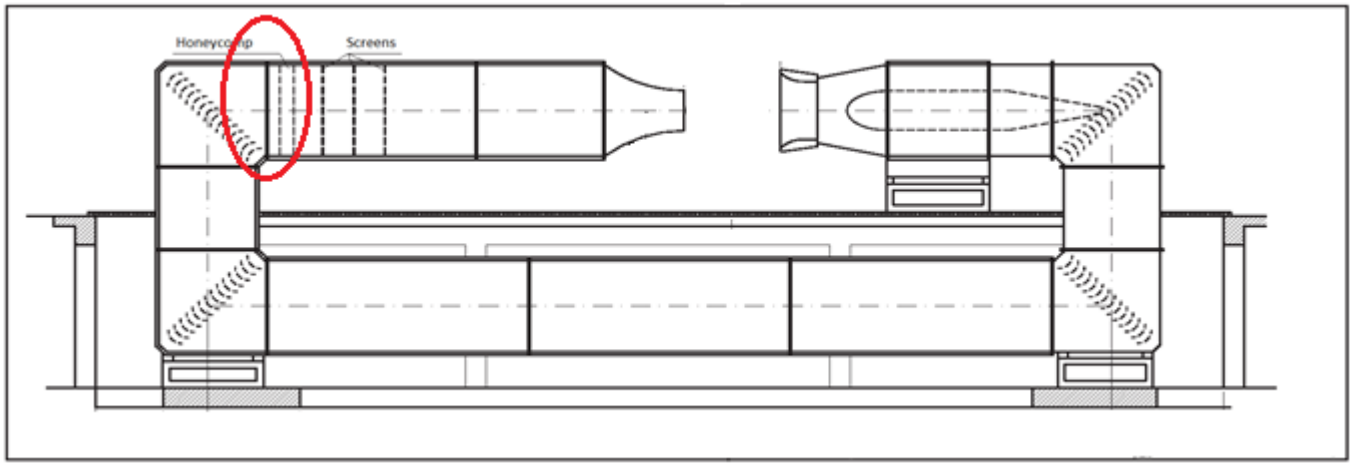
# Requirements for the laboratory setup



basic parts of a wind tunnel

- honeycomb
  - decreases the swirl effect
  - decreases the turbulence effect

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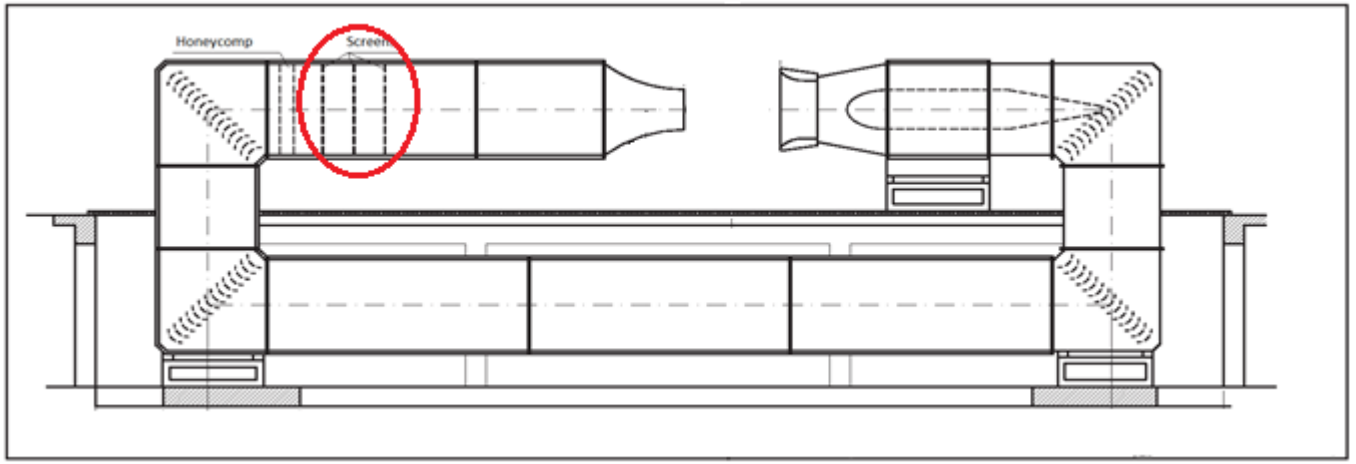
# Requirements for the laboratory setup

basic parts of a wind tunnel

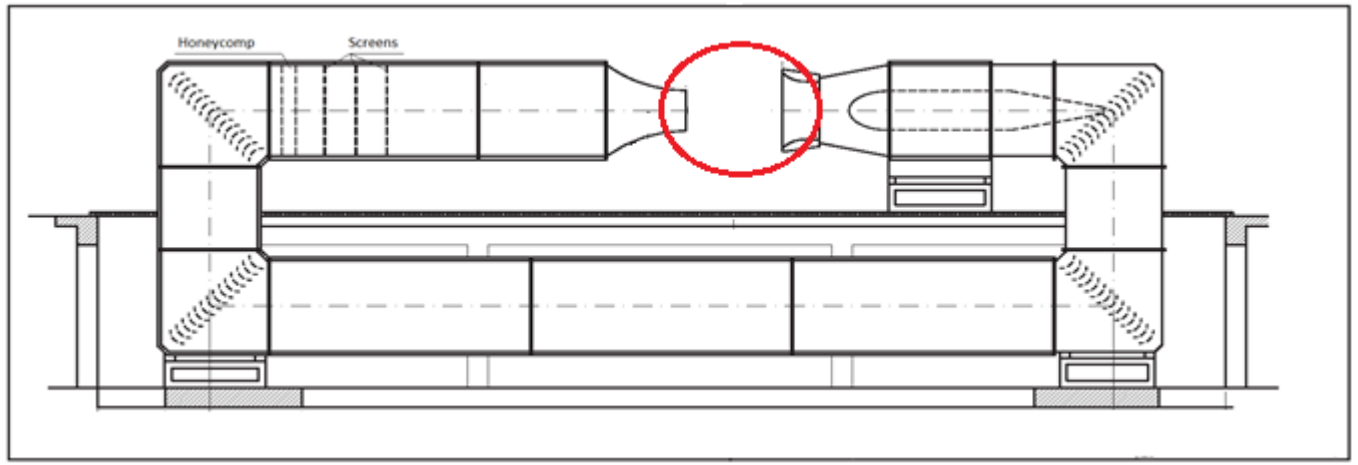
- screens (several mesh sizes)
  - they lead to an overall pressure equalisation by reducing the velocity distribution
  - it will create a hydrodynamic resistance



# Requirements for the laboratory setup

basic parts of a wind tunnel

- test area
- open or closed

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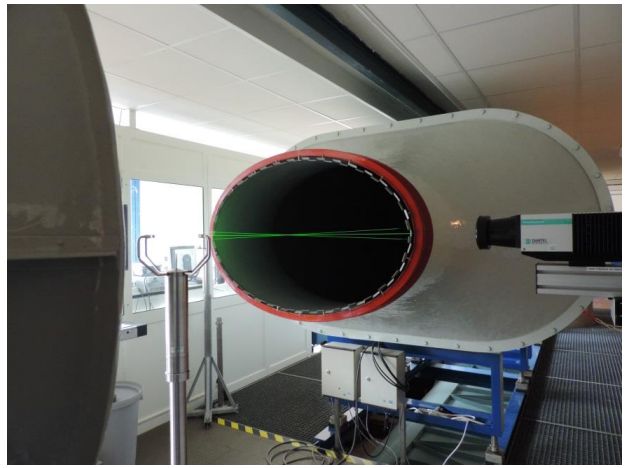
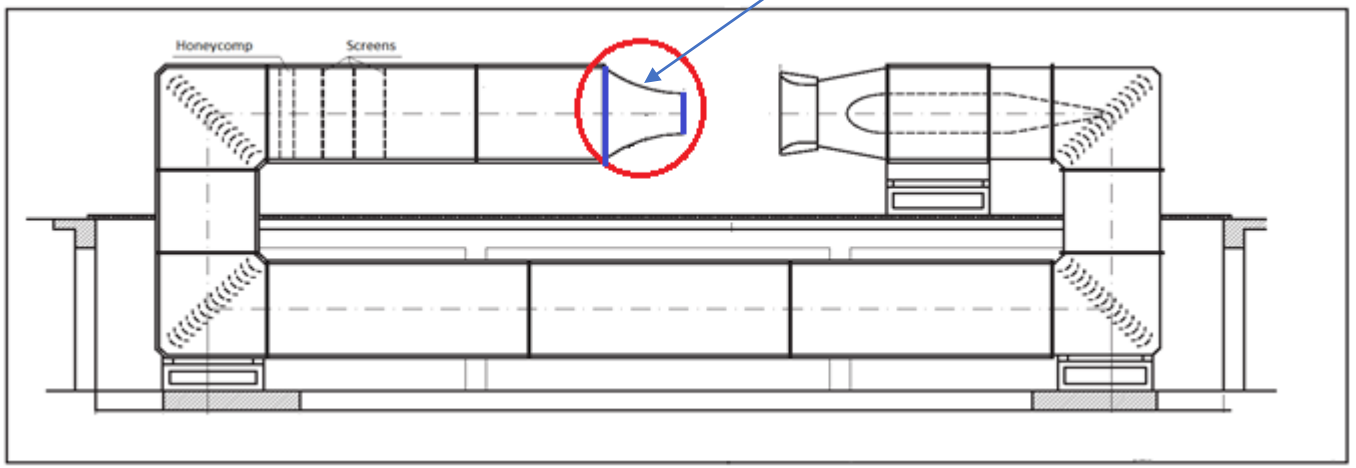
# Requirements for the laboratory setup



basic parts of a wind tunnel

- nozzle
  - reduction of the flow loss evoked by honeycomb and screens
  - reduces the diameter of the flow (contraction) and turbulence
  - homogenises and accelerates the flow

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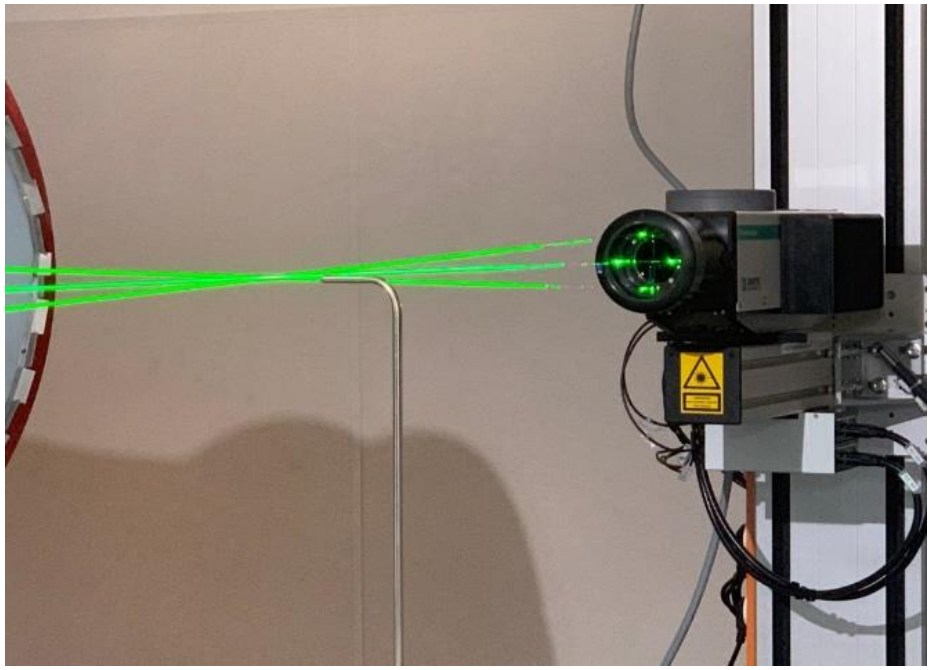
# Requirements for the laboratory setup

reference measurements



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End of Part 3

# Thank you.

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