
Wind Tunnels Classifications

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Part I

Classification

Wind tunnels generally falls into one of these 3 Categories:

- Aeronautical Wind Tunnels
 - High R_e Tunnels which are divided into:
 - * Pressurized Tunnels: test gases are pressurised to increase the Reynolds number.
 - * Heavy Gas Tunnels: : Heavier gases like freon are used as test gases. NASA Langley tunnel is an example.
 - * Cryogenic Tunnels: gases are cooled down to increase the R_e . The European transonic tunnel is an example.
 - * High-altitude Tunnels: these are designed to test the effects of shock waves in near vacuum.
 - V/STOL Tunnels
 - Spin Tunnels
- Automobile Tunnels
 - External flow tunnels are used to study the external flow through the chassis
 - Climatic tunnels are used to evaluate the performance of door systems, braking systems, etc. under various climatic effects.
- Aeroacoustic Tunnels

our main focus here is definitely the Aeronautical wind tunnels.

there are also another classification as it was mentioned in the LAB tutorial and that is by speed:

- Subsonic ($M < 0.8$)
- Transonic ($0.8 < M < 1.2$)
- Supersonic ($1.2 < M < 5$)
- Hypersonic ($M > 5$)

there is also another classification by air pressure

- atmospheric
- Variable-density

Part II

Types

in the LAB tutorial we talked about 2 types of tunnels the open & the closed one adding 2 more types to that we can classify them in 4 types:

- Closed-type
- Open-type
- Blowdown (used for supersonic testing)
- Shock Tube (used for hypersonic testing)

	Closed-type	Open-type
Advantges	-low operation cost & a quiet operation	-Low build cost
	-Better flow quality	-better for propulsion and smoke visualzation
Disadvantges	-High build cost	-flow quality isn't always good
	-not good for propulsion and smoke visualzation	-High operation cost &a lot of noise
	- higher temps. than open tunnels	

	Blowdown
Advantges	-High Mach Number
	-Lower construction and operating costs.
	-Superior design for propulsion and smoke visualization
Disadvantges	-In need for pressure regulator valves.
	-Noisy operation.

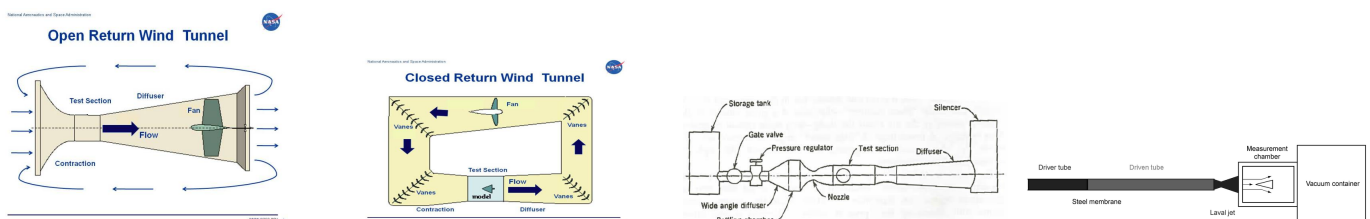


Figure 1: Open wind tunnel vs Close wind tunnel vs Blowdown vs Shock Tube

Refreneces

- https://www.researchgate.net/figure/Schematic-of-a-shock-tube-as-wind-tunnel_fig1_251734637
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- <https://www.slideshare.net/jrgsg17/wind-tunnel>
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