

# Aerodynamic Design and Computational Analysis of Yaw Sphere for Subsonic Wind Tunnel Calibration

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## Abstract

Flow analysis is considered to be the most crucial procedure in aerodynamics. Analysis of flow and its parameters over any object has to be done with considering aerodynamic loading acting over it. In the field of aerodynamics, wind tunnel test setup is used for flow analysis. The wind tunnel test section should always afford a laminar and uniform flow to provide exact results during flow parameter determination. But attaining cent percent laminar flow inside a wind tunnel test section is practically not possible. Hence there is an immense requirement of performing calibration before starting any research experiments in a wind tunnel. It is to be noted that wind tunnel calibration is done with ultimate care to avoid any error in the analysis. Generally a pitot-static probe is used to calibrate subsonic wind tunnel. But the pitot-static tube has many limitations like single point data sensing. Hence a new efficient and compact instrument has to be developed for the calibration of wind tunnels. In this paper, a yaw sphere is designed and analyzed to perform the calibration of a subsonic wind tunnel.

## Keywords

Internet of Things, Any Paradigm, Smart Objects, Computational Analysis, Aerodynamics

## Introduction

Wind tunnels are apparatus that distribute stream of air flowing under controlled conditions. Wind tunnels are divided as low-speed, high-speed and special-purpose tunnels. Those tunnels working with a test-section speed less than 180 meter per second are Low-speed wind tunnels. Wind tunnels are further divided as open-circuit and closed-circuit tunnels. Inertia and viscosity are the main factors prompting tunnel performance in low-speed wind tunnels. In low-speed wind tunnels, the effect of compressibility is insignificant. Dynamic pressure, flow direction, static pressure, total pressure, temperature, and turbulence level are the major parameters that characterize low speed tunnel. In other words, calibration of low-speed wind tunnel instruments involve the determination of flow angularity in the test-section and turbulence level. The wind tunnel calibration is done in order to ensure the uniformity in the flow. Calibration of the wind tunnel plays a vital role in wind tunnel operation. Uniformity in the flow has to be maintained throughout the cross section. At the test-section when it is free from any model, the flow should possess a straight path in the direction of stream lines corresponding to axis of tunnel. Therefore, before starting any test to perform in the wind tunnel, confirming the direction of flow with tunnel axis is important. Hence, to measure angularity of flow in the subsonic wind test section, a Yaw sphere has been designed and analysed in this paper