**Reynolds Number for a Multi-Surfaced Sphere and Turbulence Intensity in a Wind Tunnel**

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**Introduction**

Turbulence intensity is the variation of the velocity in respect to a static or reference value. It measures how much the velocity of the air fluctuates over time. For wind tunnels, the turbulence intensity from the tunnel itself should be as low as possible to mitigate any interference in data collection. Unwanted turbulence in a wind tunnel can largely cause inaccurate data during experiments. For this experiment, a smooth and rough sphere were placed on a force-balance system to determine the Reynolds number drop off region and to determine the turbulence intensity of the wind tunnel. This experiment is useful because it shows the difference in drag profiles between smooth and rough surfaces as well as verifying that the wind tunnel had minimal turbulent effect on the data.

**Results and Discussion**

The experiment was performed in the ERAU closed-loop research wind tunnel. A smooth sphere measuring 8.57 inches in diameter was placed in the wind tunnel test section attached to a force-balance. The force-balance system measured the drag force of the sphere during the experiment.

Diagram

Description automatically generatedThe sphere was subjected to a range of free stream velocities ranging from 30ft/s to 200ft/s. The exact speeds used can be found in figure. By using the reference area, dynamic pressure, and drag force, the drag coefficient for each velocity can be found by rearranging the drag equation and solving for the coefficient of drag:

**Figure 1.** Schematic of Sphere in Test Section

(1)

|  |  |
| --- | --- |
| Velocity (ft/s) | CD |
| 30 | 0.387448 |
| 40 | 0.385337 |
| 50 | 0.387957 |
| 60 | 0.378993 |
| 70 | 0.349827 |
| 75 | 0.293038 |
| 80 | 0.249747 |
| 90 | 0.125494 |
| 100 | 0.129580 |
| 110 | 0.127975 |
| 120 | 0.124577 |
| 130 | 0.127796 |
| 140 | 0.134935 |
| 150 | 0.134502 |
| 175 | 0.133738 |
| 200 | 0.136937 |

**Table 1.** List of velocities and the corresponding drag coefficient for the smooth sphere.

Plotting this against the Reynolds number for the smooth sphere yields a