Flight 115 Pressure Measurement Corrections

Summary

The primary static pressure measurement for the UH–60A failed or was inoperative on Flight 115 of the Airloads Program. Derived parameters within the TRENDS data base, such as pressure ratio, density ratio, advance ratio, weight coefficient, and power coefficient, depend upon this pressure measurement and, therefore, have been in error since the installation of the flight data in the TRENDS data base. The equations used for data reduction have now been modified and the ship's system static pressure measurement has replaced the failed boom measurement for this flight.

Boom Static Pressure Measurement Failure

The aircraft static pressure was measured on a special-purpose test boom, installed on the UH–60A for the Airloads Program, as well as with the normal ship's system. The measurements were assigned the item codes H001 for the boom measurement and H002 for the ship's system measurement. The measurement units are in-Hg. Using the MINMAX option in TRENDS, average values of item codes can be plotted by counter number for the duration of a flight. The H001 and H002 measurements for Flight 116 are shown in Fig. 1. For this flight, as the aircraft is initially flown to a higher altitude, the measured pressures are seen to drop. Most of the counters on this flight were diving turns and this results in a sawtooth pattern in the pressure measurement as the aircraft loses altitude in each maneuver and, generally after four counters, is required to climb back up to the maneuver altitude. Both H001 and H002 were functioning normally on this flight and show good agreement. The standard deviation of the difference, for all counters, is 0.071 in-Hg for Flight 116. In terms of the pressure ratio, δ, the standard deviation of the differences is about 0.25%.

The measured static pressures on Flight 115 are shown in Fig. 2 and it is clear that there is a large discrepancy between the two measurements. From this figure, it appears that the boom pressure measurement was inoperative on this flight. Both static pressure, P_s, and dynamic pressure, q, were measured with both the boom system and the ship's system. The dynamic pressure is the difference between the measured total or stagnation pressure and the measured static pressure and, for the UH–60A, is expressed in in-Hg as

$$q = P_t - P_s \tag{1}$$

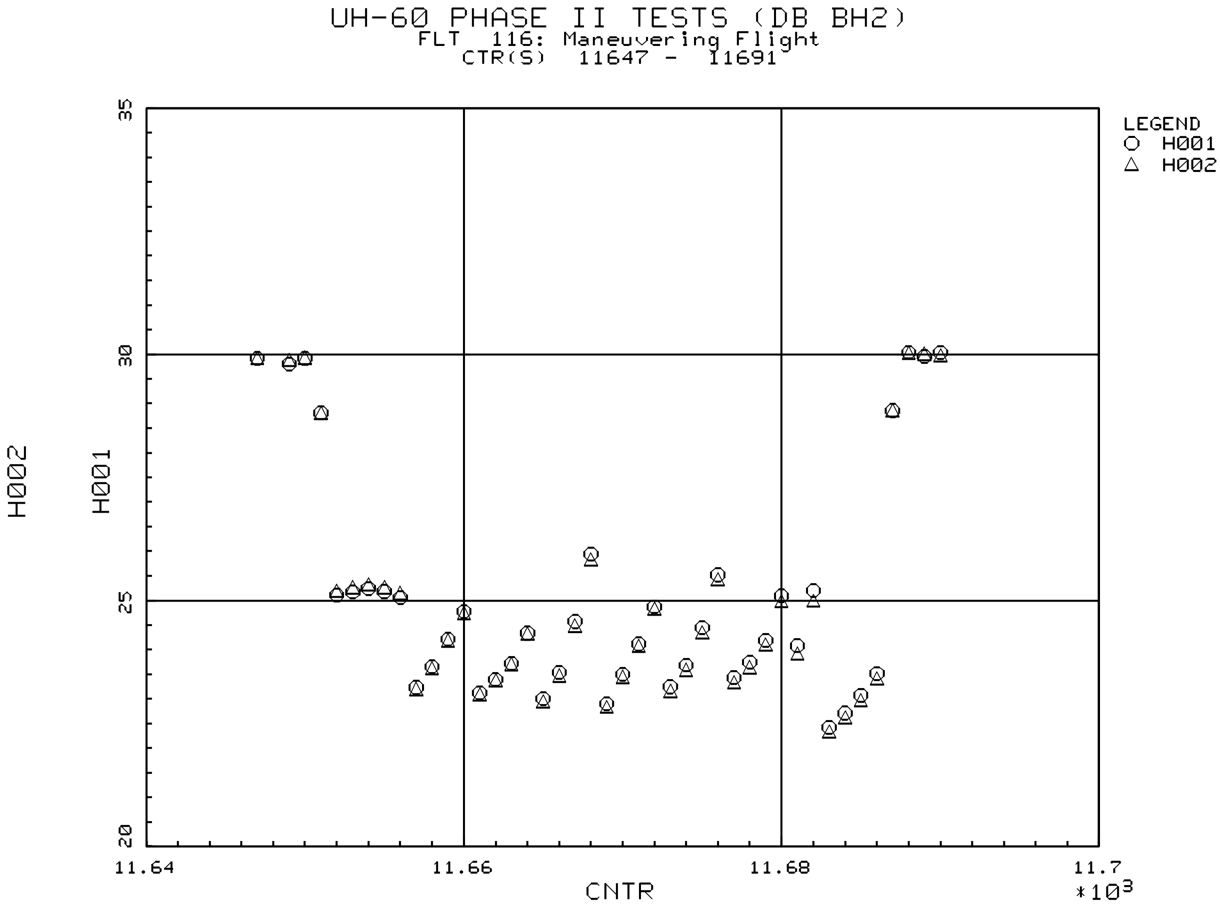

Figure 1. Comparison of boom system static pressure measurement, H001, and ship's system pressure measurement, H001, for Flight 116.

Separate measurements are obtained for the static pressure (H001 and H002) and dynamic pressure (V001 and V002). If the H001 failure for Flight 115 was because of a problem with the test boom pitot static system, then the dynamic pressure measurement, V001, would also be erroneous. A comparison of V001 and V002 for this flight shows both parameters behaving normally. Thus, the boom static pressure measurement (H001) failure occurred between the pitot static system and the data package and the dynamic pressure (V001) was not affected.

The calculation of pressure, temperature, density, and airspeed is discussed in Occasional Note 2000-01. The data reduction equations are used to calculate the various properties for the boom and ship's systems separately. However, when the calculations are complete, IF statements are used to determine which system is to be used as the primary reference for subsequent calculations such as for advance ratio, weight coefficient, and power coefficient. Previously, the boom system was used as the primary reference for all calculations in TRENDS. To correct for the H001 failure on Flight 115, new IF statements have been added that set the ship's system as the primary reference for all parameters that depend upon a pressure measurement. In addition, statistical parameters stored separately in TRENDS have now been recomputed.

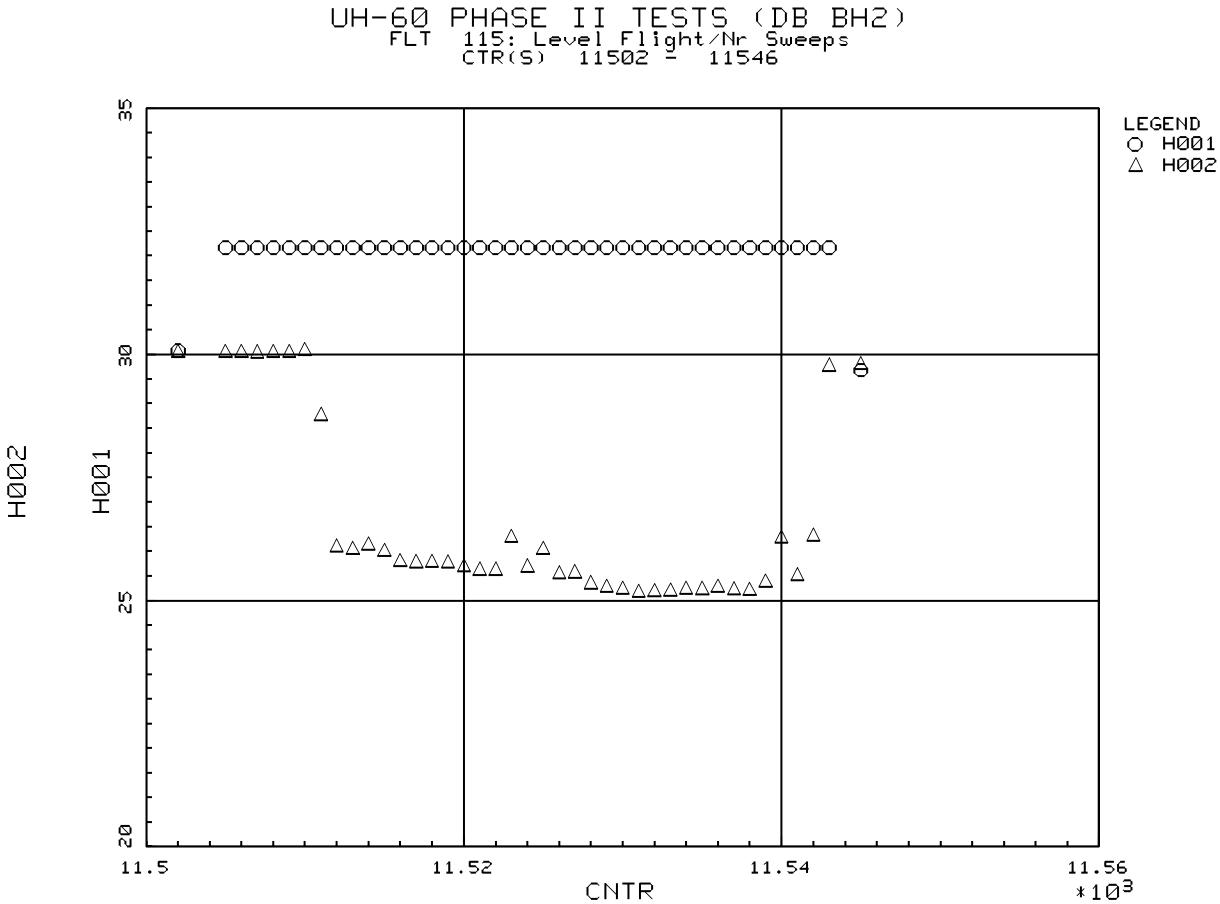

Figure 2. Comparison of boom system static pressure measurement, H001, and ship's system pressure measurement, H001, for Flight 115.

Conclusions

The UH–60A test aircraft flown at NASA Ames Research Center during the Airloads Program during 1993 and 1994 used two independent systems to measure pressure: a special-purpose test boom installed on the aircraft for the duration of the Airloads Program, and the normal ship's system. The data reduction equations used in the TRENDS data base calculate pressure, density, and airspeed separately for the two independent systems. The boom system is defined as the primary reference for the calculation of derived parameters such as pressure ratio, density ratio, advance ratio, weight coefficient, and power coefficient.

An examination of pressure data from Flight 115 has shown that the boom pressure system failed or was inoperative for this flight and, therefore, derived parameters that depend upon the boom pressure measurement as a primary reference are in error and have been so since the installation of the data base. As of the date of this Occasional Note, the data reduction equations have been changed so that the primary pressure reference for Flight 115 is the ship's system measurement, H002. An examination of the boom dynamic pressure measurement, V001, shows that this measurement was not affected by the H001 failure and no changes in the reduction equations are required. The statistical derived parameters that are stored separately in the TRENDS data base and that depend upon H001 have been recalculated for Flight 115 and now depend upon H002.

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September 12, 2000