Parametric Study Regarding Airflow into OSU Combustion Chamber

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ABSTRACT

The Ohio State University Calorimetry (OSU) test has been used throughout the aircraft industry to determine the heat release of panels used in cabin interiors. The Federal Aviation Administration (FAA) has used these test results to establish regulations limiting how much heat is generated when a panel burns [14CFR25.856(d)]. Naturally a panel that produces either a lower total quantity of heat and/or a lower peak heat is preferred for passenger safety in case of an on-board fire emergency.

It has been noted that there is a significant spread in data acquired among industry labs that use the OSU. A study undertaken by Boeing initially identified sixty nine possible sources of variation in heat release data. The International Fire Test Working Group and FAA have standardized many procedures and equipment, but approximately 50 % of the variation remains unexplained. This can be troubling since a fully accurate baseline in heat output per panel cannot be established.

A review of current OSU specifications shows that certain parameters are not regulated. One example is the incoming airflow's relative humidity, which affects the density of the air headed to the combustion chamber. Consequently, the air density affects the volumetric flow rate, mass flow rate, and the amount of oxygen entering the chamber which may affect how a coupon behaves during combustion.

A parametric study was conducted to capture how much change in air density, volumetric flow rate, oxygen content, and calibration constant there can be using published tolerances. Thousands of iterations were mathematically examined, altering only humidity, ambient pressure, temperature, and differential pressure across an orifice plate. Additionally, what effect these parameters had on the calibration constant was calculated. This numerical analysis focused solely on the aforementioned parameters and is far from painting a complete picture explaining all the variation in data. However, based on this study, there can be as large as a 17 % spread while keeping all parameters within regulations.

There is a cost associated with not having a consistent, repeatable test. Many hours have already been spent by the FAA and industry gathering round robin test data of standard coupons, and several technical groups within Boeing have spent years attempting to standardize the equipment setup, startup procedures, test methodology, and shutdown procedures. If airflow does in fact have a recordable unaccounted effect on heat output, then teams can focus their efforts on calibrating the airflow dynamics which can produce better baseline data that ultimately means the difference between passing or failing a material in design and operation of aircraft.