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G100UL and xG100UL DETONATION TEST RESULTS

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FAA Project Numbers: ST06669WI-E (was ST13515AT-E) and ST06671WI-E.

ABSTRACT
14 CFR §33.47 Detonation test

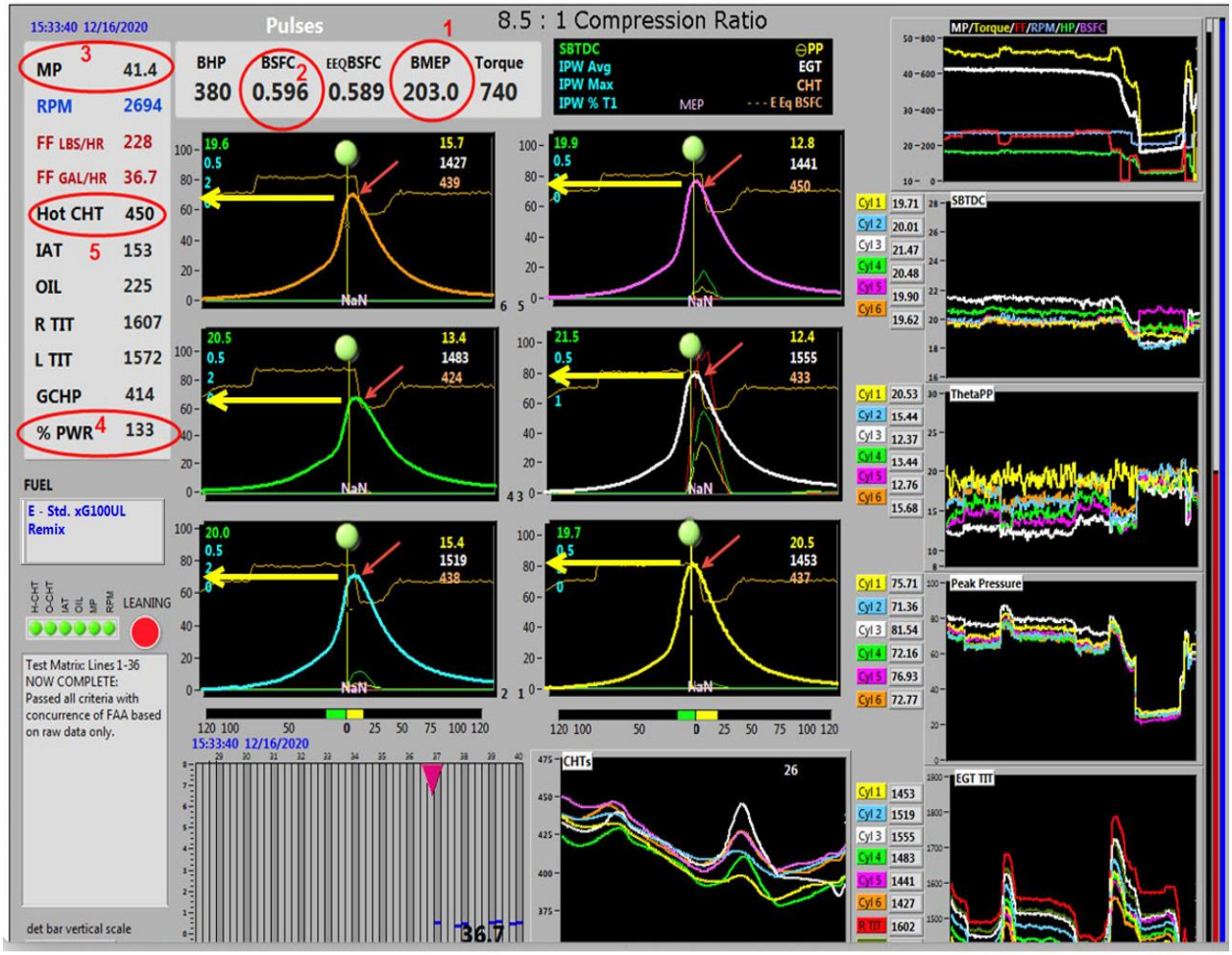
This report details the results of the successful detonation testing of unleaded high octane G100UL and xG100UL fuel chemistries when operated on a high compression, turbonormalized engine. The engine configuration was purposefully selected to enable the unleaded fuel chemistries to be simultaneously tested on both a high compression and a turbocharged engine in one test. In addition, the manifold pressure and horsepower were purposefully increased so that the BMEP of the test engine would exceed that of any other high compression engine and be comparable to all turbocharged engines now in operation in the general aviation fleet.

The two unleaded fuel chemistries are included in the scope of the referenced pending project numbers for inclusion in one or more AML STCs to allow the use of these unleaded aviation gasolines as a functional drop-in replacement for ASTM D910 100 Low Lead aviation gasoline. As the central aspect of the testing described in this report, these two fuel chemistries were directly compared to a conforming D910 100LL for their detonation characteristics.

There were more than two dozen back-to-back engine mixture sweep comparisons between D910 100LL and the GxG100UL fuel chemistries. In every instance, and at every combination of manifold pressure, RPM, & fuel flow, the unleaded fuel chemistries were observed to be an improvement compared to the D910 100LL.

The detonation testing was conducted at the GAMI Engine Test Facility, in conformity with an FAA approved Detonation Test Plan. The FAA observed the testing in Ada, Oklahoma on December 15 & 16, 2020.

Note: G100UL™ and xG100UL™ are trademarks of General Aviation Modifications, Inc.



(1) BMEP = 203 PSI; (2) The BSFC was 0.596 lb/hr/hp, which is approximately 15-18% leaner than a normal full rich mixture and, therefore, conforms to the lean-down requirements for full power detonation testing set forth in 14 CFR 33.47; (3) The Manifold Pressure (41.4" Hg.) was ~11.4" more than the OEM limit for this engine; (4) The 380 BHP, corrected to ISA Std. Conditions **(~414 BHP)** was ~ **133% of the OEM certified horsepower** (310 BHP); (5) The hottest CHT was 450° F (Redline = 460° F). A review of the six engine combustion pressure traces reveals that there was zero evidence of any detonation, nor even any combustion instability, much less any higher levels of detonation that would have still been deemed to be acceptable for certification (see the six red arrows in the image). The peak internal cylinder combustion pressures are at levels of 70 to 80 BAR (see yellow arrows), which is 20-25% higher than the peak internal cylinder pressures that would be observed during normal operation of this engine at its OEM/FAA approved maximum BHP.

Figure 7. Data demonstrating operation of a high compression turbocharged engine at extremely high power settings at limiting certification conditions. This data point **(Condition A3)** was optional, to be addressed at the conclusion of the testing. This data is consistent with the ASTM D909 laboratory data for the GxG100UL fuel chemistries which typically returns values for "Performance Numbers" substantially greater than the historic "purple gas" used in the piston airliners with a MON/PN number of 115/145. The measured "Performance Number" (aka the "Rich Rating") of the GxG100UL fuel chemistries has never been measured less than 150, and is normally so high that the existing D909 laboratory report sometimes simply states the value as "in excess of 160".