Engineering Evaluation Report
Report No. CH327.I.EER.004, Issue 1

Subject: CFM56 Igniter Competitive Evaluation (Champion P/N CH31900-6, GE P/N 1374M13P11 and Unison P/N 518888-1, GE P/N 1374M12P16)

Purpose: To conduct a side-by-side evaluation of Champion's part number CH31900-6 igniter and Unison's part number 518888-1 wear at their firing end tips after removal from fleet use. The result demonstrates that Champion's advanced firing end design delivers proven long life capability due to its desired electrical erosion characteristics of the grounding pins while maintaining its structural integrity.

Scope: This comparison was performed by inspecting the ground pin wear on Champion and Unison igniters by removing the firing end tips, exposing the interior of the firing ends. This evaluation was conducted on fourteen (14) Unison P/N 518888-1 igniters and four (4) Champion CH31900-6 igniters. These igniters were changed out on-condition or during regular service intervals by various operators and the number of in-service mission hours is unknown for each igniter.

Conclusions: The Champion CH31900-6 igniter outperformed the Unison 518888-1 competitive igniter when evaluated after typical in engine service. The Champion design proves to have superior erosion characteristics of the grounding pins in the firing end tip, as can be seen through the presence of all ground pins remaining after the units were removed from service. In comparison, 78% of the Unison 518888-1 units examined exhibited conditions that indicate at least one missing ground pin.

Results:

After the firing tip end of the igniters were removed, the ground pin wear was reviewed. **Figures 1, 2, 3 and 4** below show the geometry of the Champion and Unison igniter firing end tip designs for reference throughout this report. The Champion igniter design utilizes ground pins installed perpendicular to the center electrode equally spaced around the ground shell diameter, which are brazed into the firing end shell. In contrast, the Unison igniter design features ground pins installed in a triangular pattern inside a metallic insert that in turn is welded into the firing end shell.

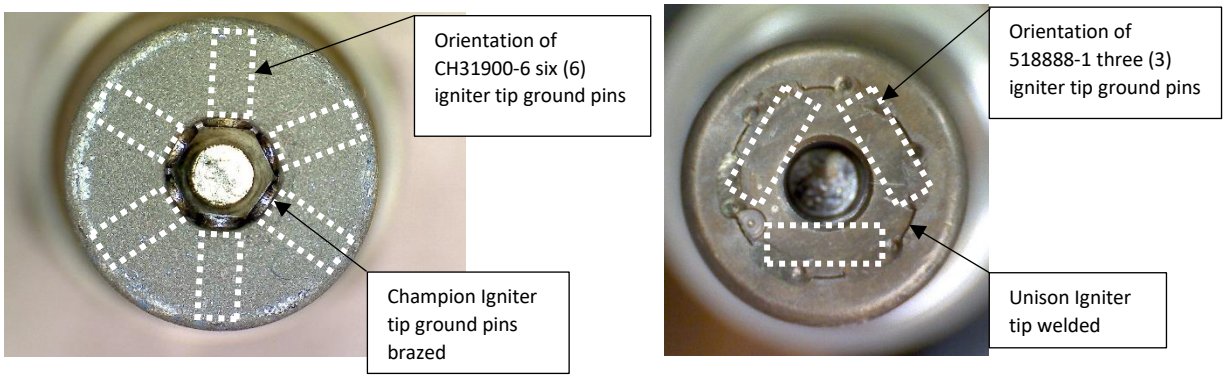

Figure 1 & 2: Champion and Unison Igniter Geometry

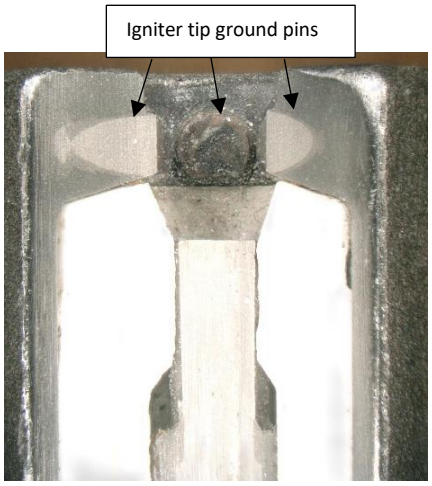

Figure 3: Champion Igniter Geometry

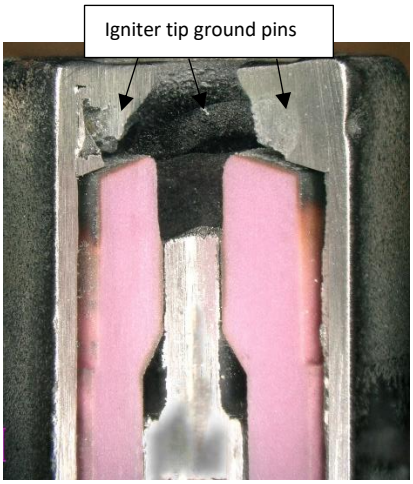

Figure 4: Unison Igniter Geometry

After evaluating the Unison 518888-1 igniters returned from fleet use, three (3) igniters were missing all of their ground pins and eight (8) igniters had either one or two of the three pins missing. Only three (3) of the fourteen (14) Unison igniters evaluated appeared to have all three ground pins intact.

In comparison, the four (4) Champion CH31900-6 igniters evaluated were confirmed to have all six (6) of their ground pins remaining. This is consistent with what we have seen from in service the Champion CH31900-6 igniters through 20+ years of demonstrated performance. **Figure 5 and 6** below show a comparison of the worst case view of the ground pin areas for the Champion and Unison Igniters.

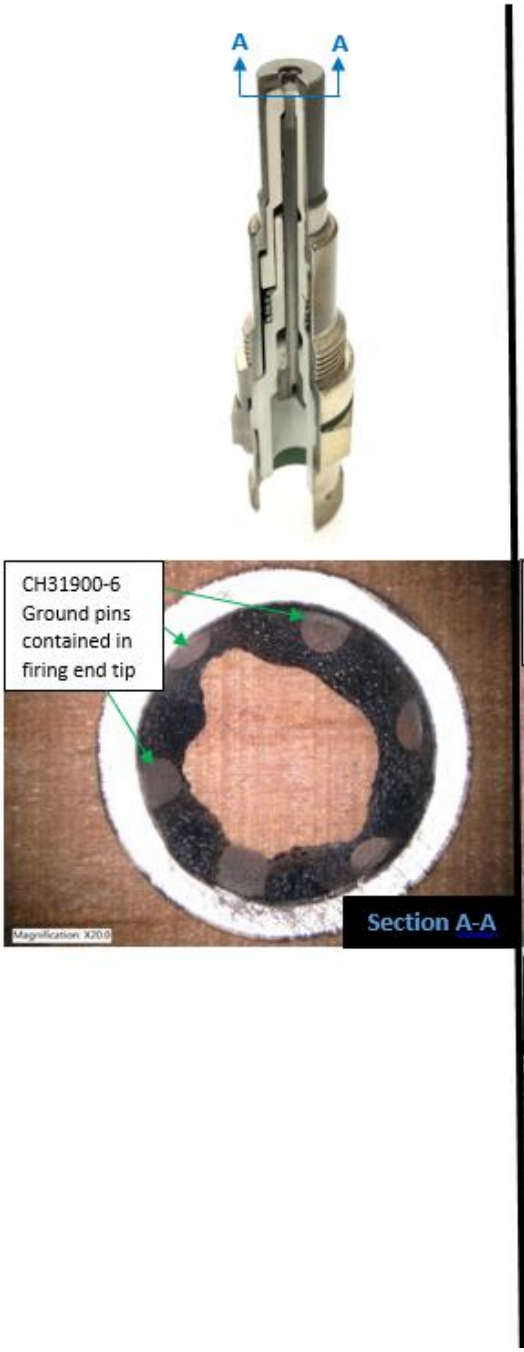

Figure 5: Champion Ground Pin Erosion

Figure 6: Unison Ground Pin Erosion

In addition to missing ground electrodes, it was also observed that the Unison igniters appear to have cracks in the cavity regions housing the ground electrodes in the electrode insert and/or braze region. Examples of cracking from two (2) Unison igniters are shown below in **Figure 7 and 8**.

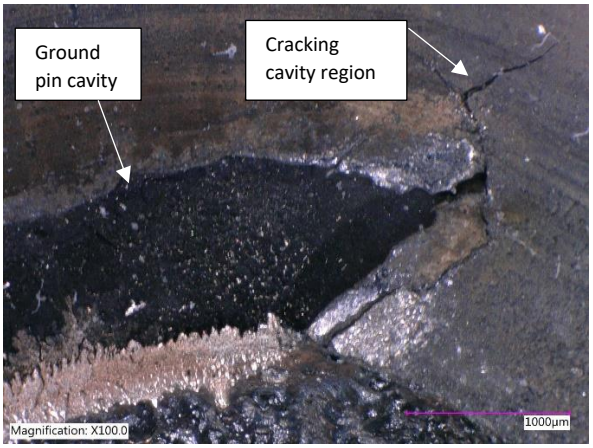

Figure 7: Unison Electrode Cavity Crack

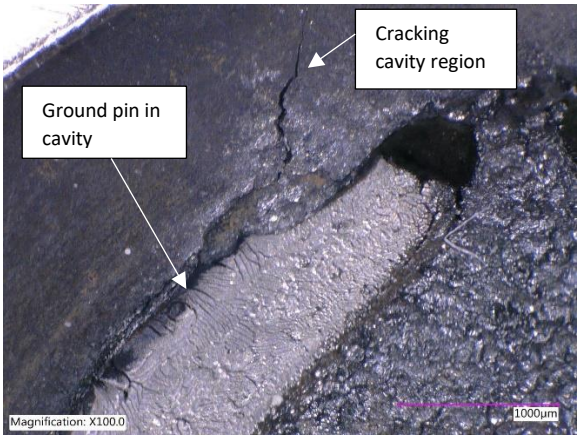

Figure 8: Unison Electrode Cavity Crack (2)

Because of this cracking and evidence of missing ground pin material, partial or full ground pin liberation into the combustor is likely to have occurred with the Unison 518888-1 igniter.

Igniter Spark Life Bench Testing

Bench testing was performed to compare new igniter spark life between the Champion CH31900-6 and the Unison 518888-1 and results support that the Champion CH31900-6 outperforms the Unison 518888-1. In **Figure 9** this spark life testing shows the Champion CH31900-6 provides 2X life for operators that prefer scheduled replacement below .230 center electrode depth. For those operators that wish to extend replacement intervals beyond the depicted green zone, the Champion igniter out performs the Unison igniter retaining pins throughout igniter life. The Unison 518888-1 igniter would increase the risk of FOD as evidenced per the results of the in-service igniters evaluated above.

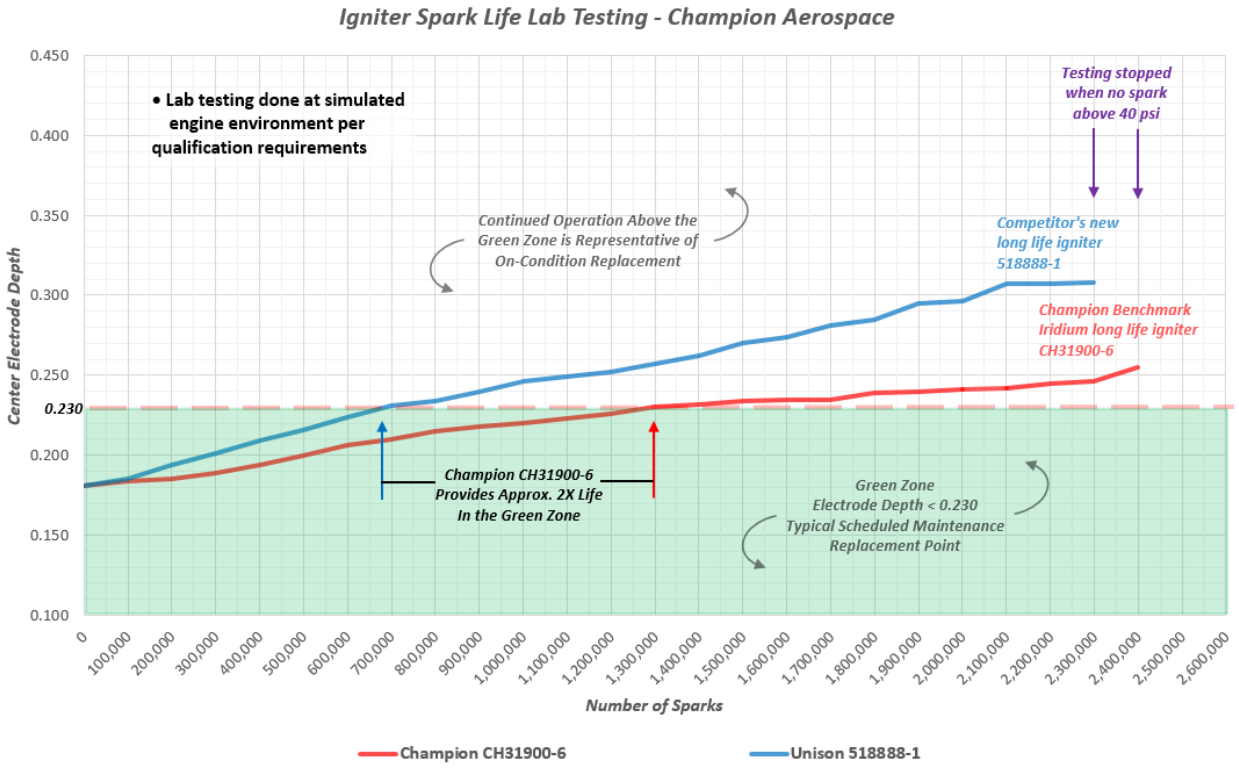

Figure 9: Spark Life Lab Testing

Overall Assessment

The Champion CH31900-6 has been in service providing long life performance for the CFM56 fleet for over twenty (20) years, and this igniter is an evolution of earlier Champion long life igniters for the CFM56 fleet. 34 years after Champion's initial long life igniter Unison has introduced their 1st Long Life Igniter for the CFM56. From the engine operational data and the spark life bench test data provided herein, it is demonstrated the Champion CH31900-6 remains the superior igniter:

- Spark life testing shows the Champion CH31900-6 provides two (2) times the life for operators that prefer scheduled replacement below .230 center electrode depth.
- Igniters removed from in service engines demonstrate the Champion CH31900-6 is a more reliable design, retaining ground electrode pins through to end of life vs the Unison 518888-1 potential for ground pin liberation into the engine gas path.
- Overall spark life of 2.4 million sparks achieved for the Champion CH31900-6 compared to 2.3 million for the Unison 518888-1.

Prepared by:_____ Date: 07APR2022
Christopher Meaders, Product Engineer

Approved by:_____ Date: 07APR2022
Stan Thompson, Product Engineering Manager