



## Engineering Evaluation Report

### Report No. CH327.I.EER.005, Issue 3

#### **Part:**

One Hundred (100) competitor long life CFM56 igniter assemblies P/N 518888-1 / 1374M12P16. See **Table 1** for serial numbers.

#### **Hours of Operation:**

Unknown

#### **Reason for Investigation:**

These igniters were returned by an operator for evaluation.

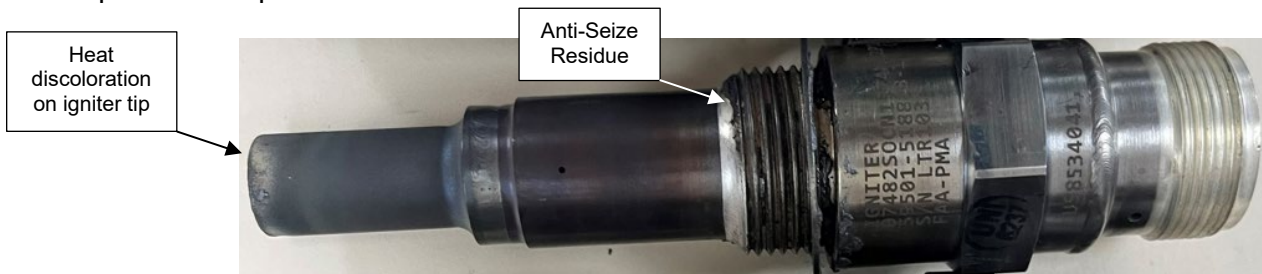
#### **Details of Investigation:**

The one hundred (100) igniter assemblies were visually examined. The following summary presents the results of visual review for each igniter assembly:

#### **VISUAL:**

##### **(As Received)**

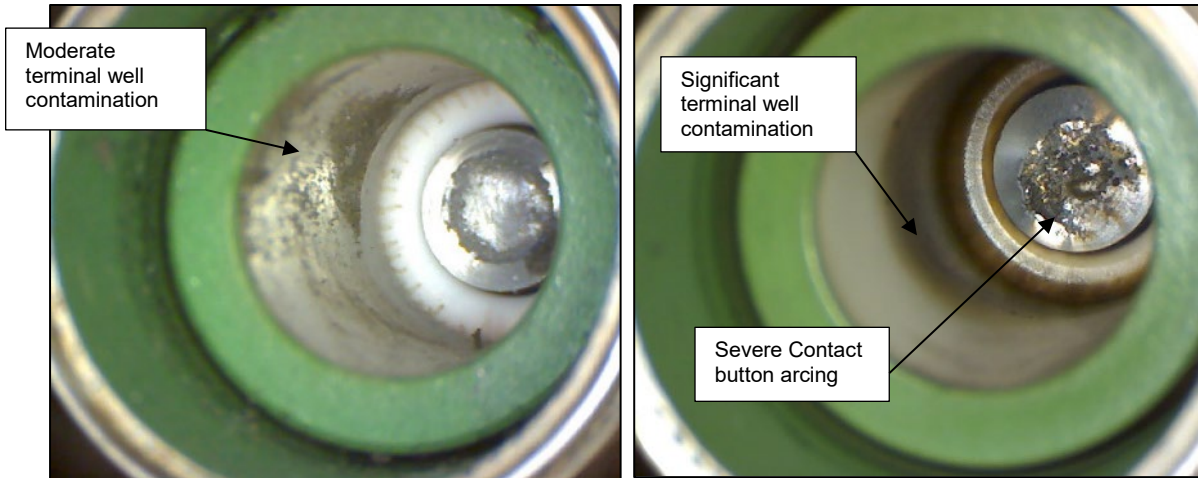
All one hundred (100) igniters had the external appearance for a used igniter. There was normal heat discoloration to the igniter bodies below the installation threads as well as residue of anti-seize compound in the installation threads as can be seen in **Figure 1**. [Appendix A](#), Photograph 1 through Photograph 21 are of all the examined parts. Igniters are labeled from top to bottom in the photo description.



**Figure 1: Typical Competitor Long Life Igniter Visual Examination**

#### **Terminal End Evaluation:**

Approximately 55% of the terminal wells inspected were clean, with the rest exhibiting some level of contamination. Photos below in **Figure 2** and in [Appendix B](#) show the varying levels of contaminants in the population of igniters examined



**Figure 2: Terminal Well Contamination Example**

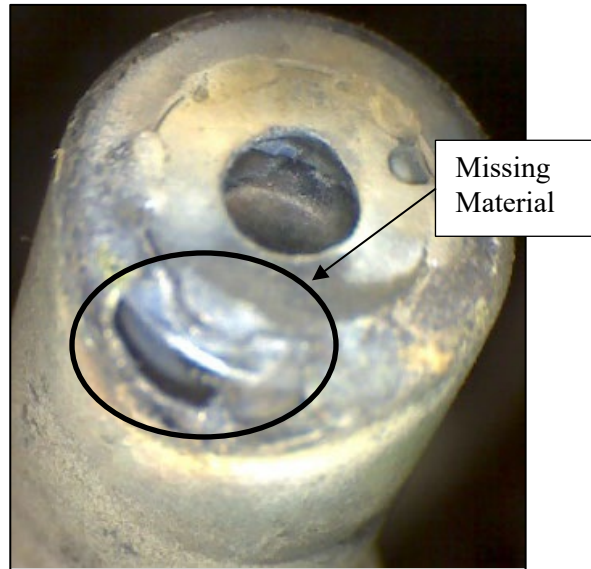
In addition, approximately 31% of the contact buttons show signs of arcing on the button while the remaining units appeared to be clean. An example of this arcing can be found in **Figure 2**. The photos in [Appendix B](#) show the as received condition of all one hundred (100) igniter terminal wells.

**Firing End Tip Evaluation:**

The firing ends of all igniters were visually examined, then measured for wear and abnormalities. A majority of the igniter tips appeared to have normal shell erosion to the I.D with seventeen (17) of the one hundred (100) units having shell I/D's measure over 0.02". However, a couple did exhibit excessive wear as seen in **Figure 3**. In addition to the excessive wear, there were a number of igniters that were missing material to the ground shell, similar to **Figure 4**, while the I.D was still within the normal wear expectation. [Appendix C](#) shows a group of photographs of all the igniter firing ends.



**Figure 3: Excessive Shell Erosion**



**Figure 4: Firing End Shell Missing Material**

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**Figure 5: Igniters SN: LWY978, LYL040, LYA062, and LTY997. Total firing end deterioration with missing parts. See Figures 6-9 below.**



**Figure 6: Igniter SN LYL040**

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Figure 7: Igniter SN LYA062

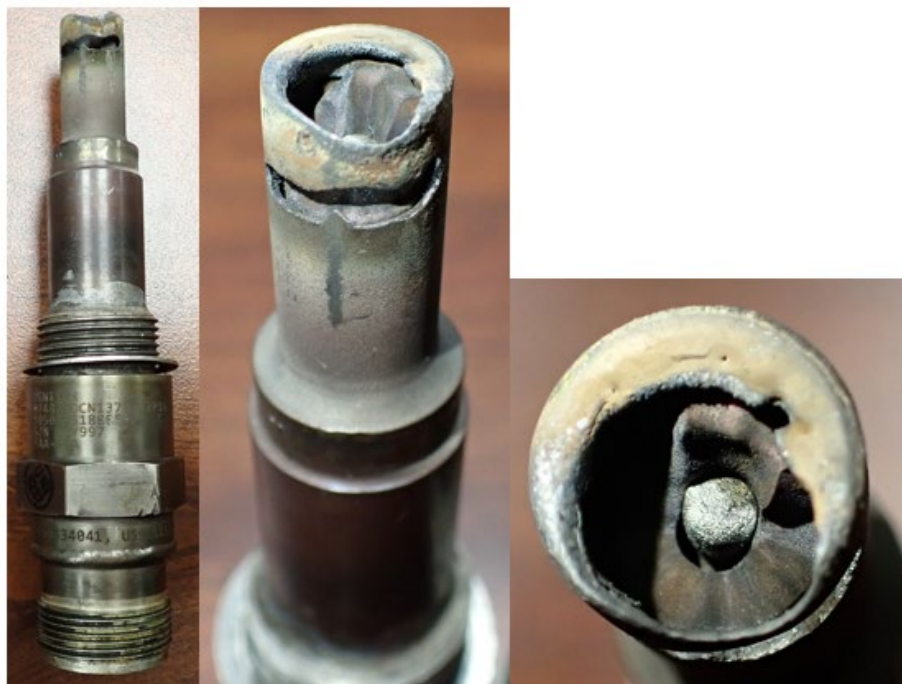


Figure 8: Igniter SN LTY 997

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**Figure 9: Igniter SN LWY978**

The igniter shell O.D's were measured to the  $\varnothing 0.490 - \varnothing 0.500$  specification in addition to the shell I.D and electrode depth measurements. These recordings can be found below in **Table 1**. Of the one hundred (100) units, eleven (11) units measured to be over the  $\varnothing 0.500$  which indicates swelling above the specification limit in these units.

**Table 1: Igniter Wear Measurements**

Igniter Number	Serial Number	Center Electrode Depth (inches)	Ground Electrode Diameter (ID in inches)	Igniter Outside Diameter	Number of Pins
1	LGM502	0.2010	0.1540	0.5010	0
2	LGM516	0.2330	0.1865	0.4980	2
3	LGM518	0.2000	0.1410	0.5050	1
4	LGM529	0.2250	0.1665	0.4955	2.5
5	LJH436	0.1930	0.1500	0.4970	3
6	LJH449	0.1950	0.1400	0.4970	3
7	LJJ595	0.2520	0.1910	0.4960	3
8	LJJ596	0.2020	0.1650	0.4960	2
9	LJJ610	0.2210	0.1530	0.4980	3
10	LJK838	0.2650	0.1770	0.4960	3
11	LJN404	0.2090	0.1710	0.4970	3
12	LJN405	0.1940	0.1400	0.4980	3

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Igniter Number	Serial Number	Center Electrode Depth (inches)	Ground Electrode Diameter (ID in inches)	Igniter Outside Diameter	Number of Pins
13	LJP312	0.1940	0.1410	0.4980	1
14	LJT566	0.1950	0.1410	0.4980	3
15	LJT571	0.2330	0.1520	0.4975	3
16	LJT573	0.1960	0.1465	0.4980	3
17	LJT578	0.2570	0.3115	0.5160	0
18	LJT583	0.2040	0.1530	0.4965	1
19	LJT790	0.2230	0.1890	0.4985	2
20	LLD289	0.2170	0.1990	0.4980	2.5
21	LLE048	0.2270	0.2220	0.4930	1
22	LLE080	0.1980	0.1425	0.5025	2
23	LLE095	0.2340	0.3370	0.5030	0
24	LLE142	0.2380	0.1990	0.4965	2
25	LPH198	0.2230	0.3500 - intact (shell punctured)	0.4965 - intact	0
26	LPY082	0.2140	0.1390	0.4940	3
27	LPY084	0.1980	0.1400	0.4970	1
28	LPY088	0.2030	0.1600	0.4960	3
29	LPY092	0.1990	0.1400	0.4970	3
30	LPY095	0.2010	0.1415	0.4945	0
31	LPY114	0.2050	0.1670	0.4970	3
32	LRE411	0.2340	0.1560	0.4965	3
33	LRE423	0.2035	0.1460	0.4975	3
34	LRE494	0.1970	0.1510	0.5030	0
35	LRF360	0.1960	0.1435	0.4960	1.5
36	LRH697	0.2390	0.1930	0.4940	3
37	LRH702	0.2070	0.1445	0.4960	2
38	LRH710	0.1990	0.1455	0.4945	1
39	LRH716	0.2300	0.1520	0.4960	3
40	LRH779	0.1960	0.1415	0.4965	0
41	LRH894	0.2190	0.2215	0.4980	1
42	LRH921	0.2100	0.1415	0.4975	3
43	LRH945	0.2230	0.1430	0.4960	3
44	LRH954	0.1980	0.1410	0.5030	1.5
45	LRJ186	0.2130	0.3020 - intact (shell punctured)	0.4970 - intact	0
46	LRJ199	0.1950	0.1425	0.4985	3
47	LRJ937	0.2050	0.1610	0.4970	3
48	LRJ978	0.1950	0.1420	0.4965	3

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Igniter Number	Serial Number	Center Electrode Depth (inches)	Ground Electrode Diameter (ID in inches)	Igniter Outside Diameter	Number of Pins
49	LRJ984	0.2070	0.2360	0.5035	2
50	LRK018	0.2110	0.2170	0.4945	3
51	LRK021	0.2260	0.2390	0.4950	2.5
52	LRK024	0.1970	0.1485	0.4970	3
53	LRK038	0.2300	0.1940	0.4970	2.5
54	LRK042	0.2120	0.1540	0.4950	3
55	LRK045	0.1960	0.1445	0.4965	3
56	LRK116	0.2240	0.1780	0.4955	3
57	LRK296	0.1990	0.1410	0.4980	1
58	LRK298	0.2370	0.1860	0.4955	3
59	LRK304	0.1970	0.1500	0.4970	1
60	LRK320	0.2380	0.1520	0.4970	3
61	LRK329	0.2010	0.1840	0.4970	2.5
62	LRK337	0.2260	0.1415	0.4935	3
63	LRK366	0.1970	0.1460	0.4940	0
64	LRK377	0.1980	0.1450	0.4965	0
65	LRK387	0.2230	0.2240	0.4970	1
66	LRL508	0.1990	0.1420	0.4980	2
67	LRL530	0.2080	0.1640	0.4950	3
68	LRL536	0.2060	0.1410	0.4970	0
69	LRL548	0.2370	0.2130	0.4950	2
70	LRL550	0.2010	0.1500	0.4960	0
71	LRL976	0.2430	0.2275	0.4980	1
72	LRL978	0.2000	0.1470	0.4975	3
73	LRM607	0.2010	0.1600	0.4960	3
74	LRR121	0.2110	0.1440	0.4975	3
75	LRW596	0.1950	0.1415	0.4970	3
76	LRW623	0.1980	0.1390	0.4935	3
77	LRW633	0.1980	0.1440	0.4960	3
78	LRW641	0.1970	0.1390	0.4985	3
79	LRW675	0.2110	0.1860	0.4975	3
80	LRW744	0.1955	0.1385	0.4980	3
81	LRW749	0.2030	0.2065	0.4970	2
82	LRW802	0.1950	0.1410	0.4980	3
83	LTC903	0.1950	0.1395	0.4970	3
84	LTC926	0.1950	0.1410	0.5010	1.5
85	LTH778	0.1970	0.1410	0.4980	1
86	LTL150	0.1945	0.1410	0.4980	3

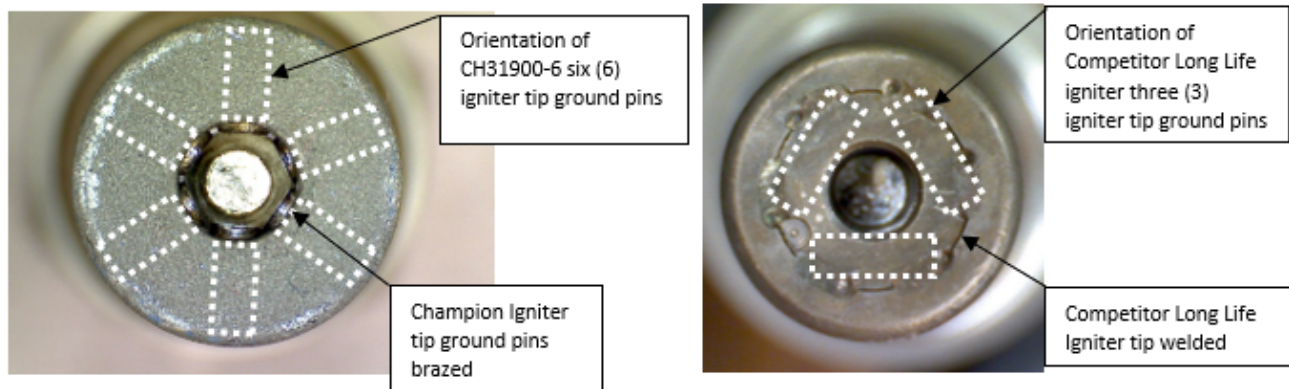
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Igniter Number	Serial Number	Center Electrode Depth (inches)	Ground Electrode Diameter (ID in inches)	Igniter Outside Diameter	Number of Pins
87	LTL164	0.1960	0.1400	0.5010	3
88	LTL170	0.1960	0.1410	0.4985	3
89	LTM261	0.1980	0.1405	0.4980	3
90	LTM508	0.1990	0.1770	0.5120	1
91	LTP278	0.1950	0.1380	0.4950	3
92	LTP343	0.1950	0.1430	0.4970	3
93	LTP355	0.2010	0.1705	0.4960	3
94	LTR079	0.1930	0.1450	0.4970	3
95	LTR103	0.1990	0.1620	0.4975	2.5
96	LTW708	0.1960	0.1400	0.4950	3
97	LWY978	These four (4) Igniters exhibit complete firing end deterioration to the point they are not measurable			
98	LYL040				
99	LYA062				
100	LTY997				

\*Note: Red text indicates out of specification dimension.

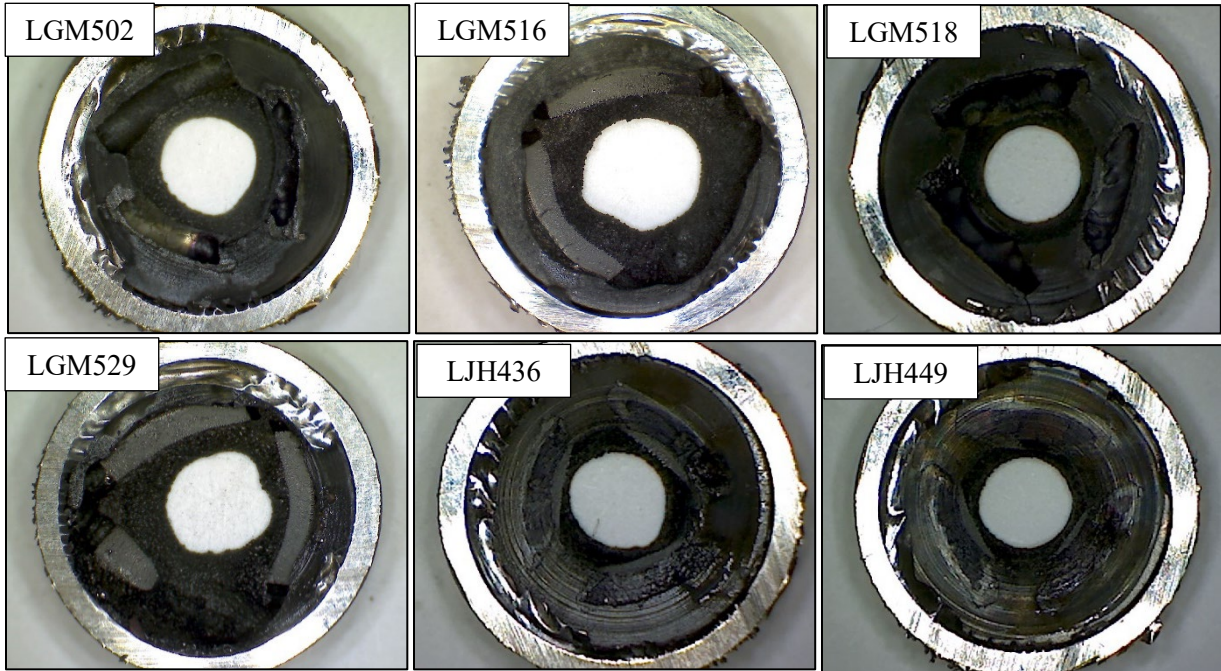
In order to better review the ground pin wear, the firing tip end of each igniter was removed. **Figure 10** below shows the geometry of the Champion and Competitor Long Life igniter firing end tip designs for reference throughout this report. The Champion igniter design utilizes ground pins installed perpendicular to the center electrode equally spaced around the ground shell diameter, which are brazed into the firing end shell. In contrast, the Competitor Long Life 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 10: Champion and Competitor Long Life Igniter Geometry**

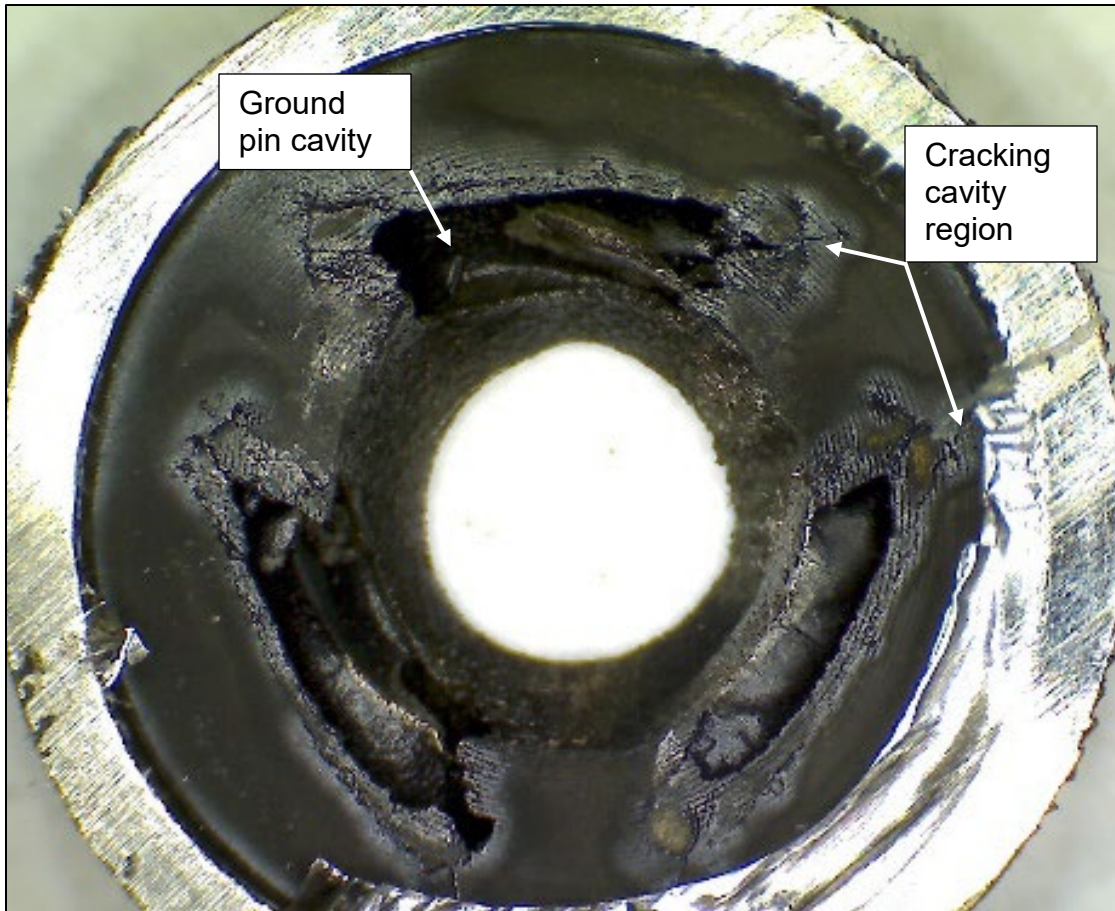
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After evaluating the one hundred (100) Competitor Long Life igniters returned, fifty-two (52) of the igniters appear to have all three ground pins remaining. However, the remaining forty-four (48) igniters appear to have portions of ground pins or entire ground pins missing with sixteen (16) of these units appearing to have all their ground electrode material missing. The pin numbers for each individual igniter are included in **Table 1** above. Pictures of the ground pins are shown below in **Figure 11** and [Appendix D](#).



**Figure 11: Sample pictures of ground pins. See Appendix D for all igniters.**

Upon further investigation of the removed shells, it was observed that some of the igniters also exhibited cracks in the cavity region housing the ground pin electrodes similar to **Figure 12**. This phenomenon has been witnessed before by Champion in previous competitive analysis, CH327.I.EER.004.



**Figure 12: Igniter Tip Internal View**

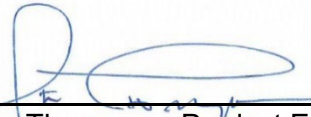
### **Conclusions:**

1. From this analysis, forty-eight (48) of the returned Competitor Long Life igniters exhibit conditions that indicate at least one entire ground pin missing.
2. Because of the cracking and evidence of missing ground pin material, partial or full ground pin liberation into the combustor is likely to have occurred with the Competitor Long Life igniters missing ground pins.
3. Based on observations after removing the igniter firing ends, see [Appendix D](#) and **Figure 12** above, the competitive part does not appear to have a rigid method of retaining the ground pins. This lack of retention could lead to ground pin movement (spinning) in application and eventual liberation from the igniter tip.
4. At least four (4) igniters in this population exhibited complete erosion of the firing end tip with missing pieces presumably liberated into the combustor.



### Signature and Revision Page

Written by  12-16-22  
Chris Meaders, Product Engineer

Approved by  12-16-22  
Stan Thompson, Product Engineering Manager

### REVISIONS

ISSUE NUMBER	CHANGE DESCRIPTION	DATE	BY	APPROVED
1	Original Issue	12/16/22	CDM	SKT
2	Removed Competitor part number	01/24/22	CDM	SKT
3	A. Rewrote, structured and formatted report B. Added Igniters #97-100 and photos C. Added Signature / Revision page D. Added Appendices A-D	03/11/24	SKT	SKT

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### Appendix A: Igniter Photos



**Photograph 1: Serial Numbers  
LGM516 LPY084 LPY092 LRL976 LRK045**



**Photograph 2: Serial Numbers  
LJH436 LRK116 LRK337 LGM529 LRW59**



**Photograph 3: Serial Numbers  
LJJ595 LJJ596 LJT578 LPH198 LRF360**



**Photograph 4: Serial Numbers  
LJK838 LRH716 LRH894 LRK304 LRH702**

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**Photograph 5: Serial Numbers**  
**LJT790 LTH778 LRW749 LTW708 LRJ984**



**Photograph 6: Serial Numbers**  
**LLE095 LTM508 LRK038 LRL978 LPY114**



**Photograph 7: Serial Numbers**  
**LLE142 LRL536 LRK018 LGM518 LJH449**



**Photograph 8: Serial Numbers**  
**LRE411 LRE423 LTR079 LRK296 LTP278**

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**Photograph 9: Serial Numbers  
LRH697 LRH710 LRK366 LRJ186 LRK937**



**Photograph 10: Serial Numbers  
LRH954 LJP312 LPY095 LTP343 LPY082**



**Photograph 11: Serial Numbers  
LRJ199 LRM607 LJT573 LTL150 LRK024**



**Photograph 12: Serial Numbers  
LRK298 LRK320 LRJ978 LRW641 LRK387**

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**Photograph 13: Serial Numbers  
LRK377 LRK021 LRL530 LRL550 LRW80**



**Photograph 14: Serial Numbers  
LRW623 LRK042 LRW633 LJJ610 LRK32**



**Photograph 15: Serial Numbers  
LTC903 LTC926 LLE080 LTR103 LJN405**



**Photograph 16: Serial Numbers  
LTL164 LRR121 LJT566 LJT571 LRH921**

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**Photograph 17: Serial Numbers  
LTM261 LLD289 LJN404 LRE494 LPY088**



**Photograph 18: Serial Numbers  
LTP355 LGM502 LLE048 LRW675 LRW74**



**Photograph 19: Serial Numbers  
LRH779 LRH945 LRL548**



**Photograph 20: Serial Numbers  
LRL508 LTL170 LJT583**

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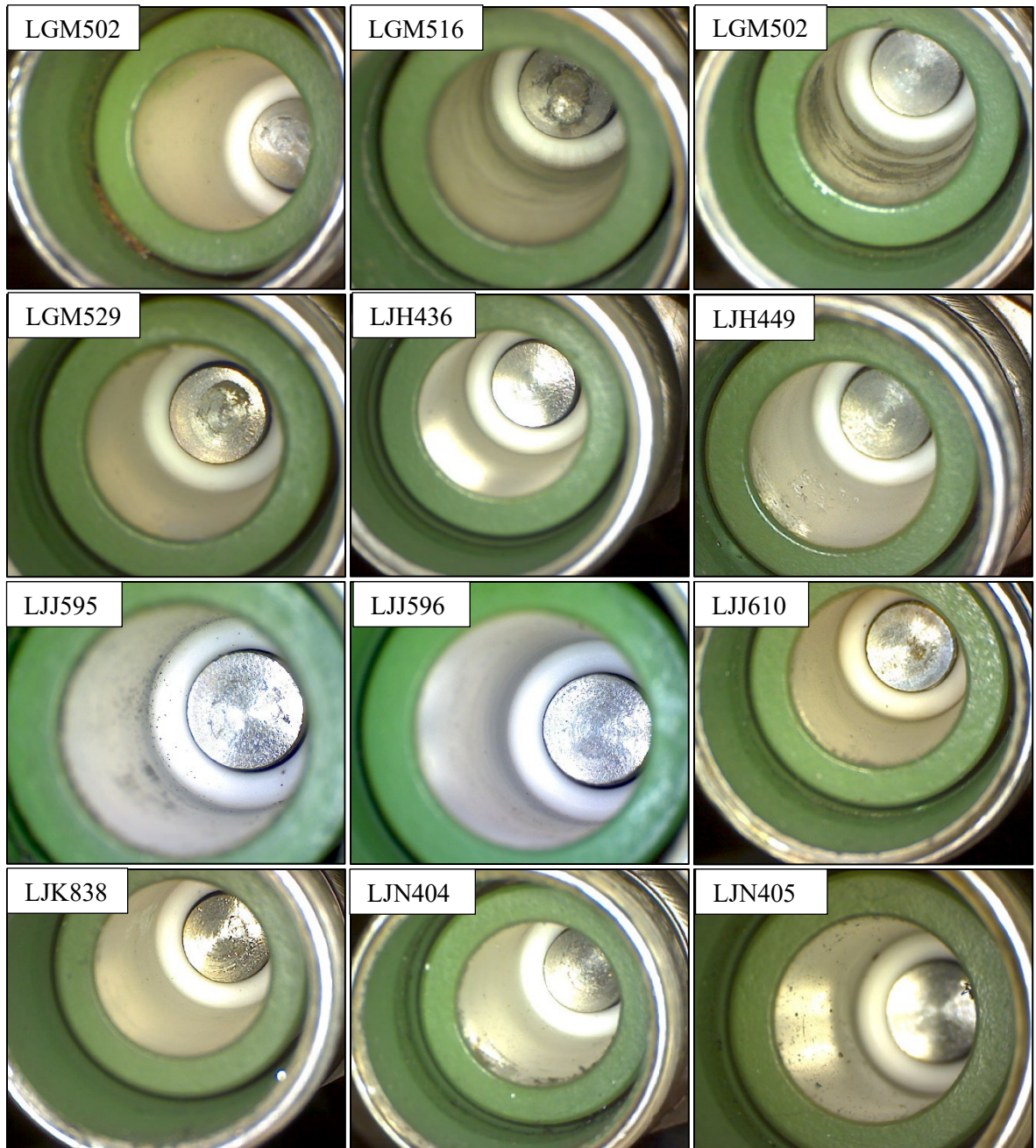


**Photograph 21: Serial Numbers  
LUY978, LYL040, LTA062, LTY997**

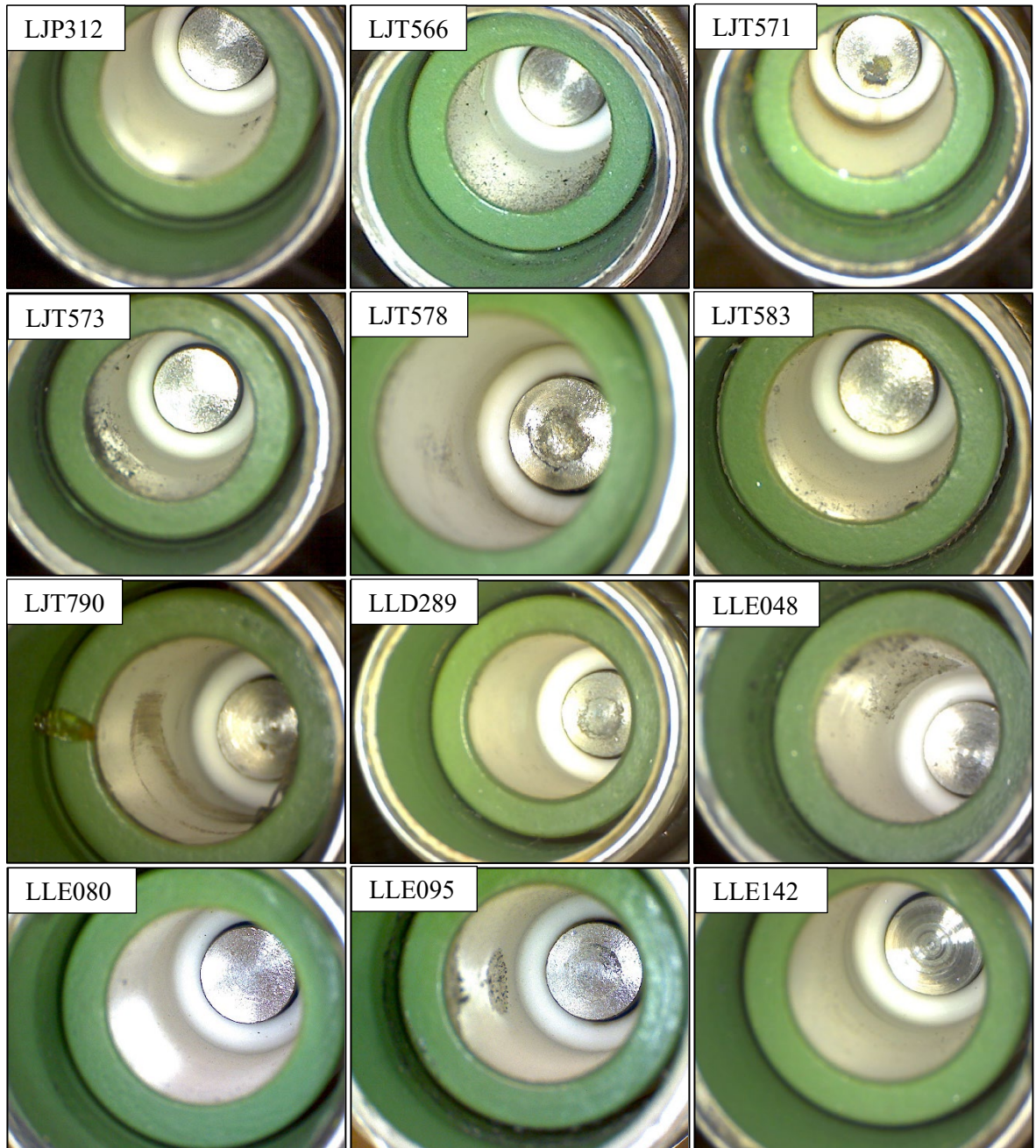
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### Appendix B: Competitor Long Life Igniter Terminal Well Contamination

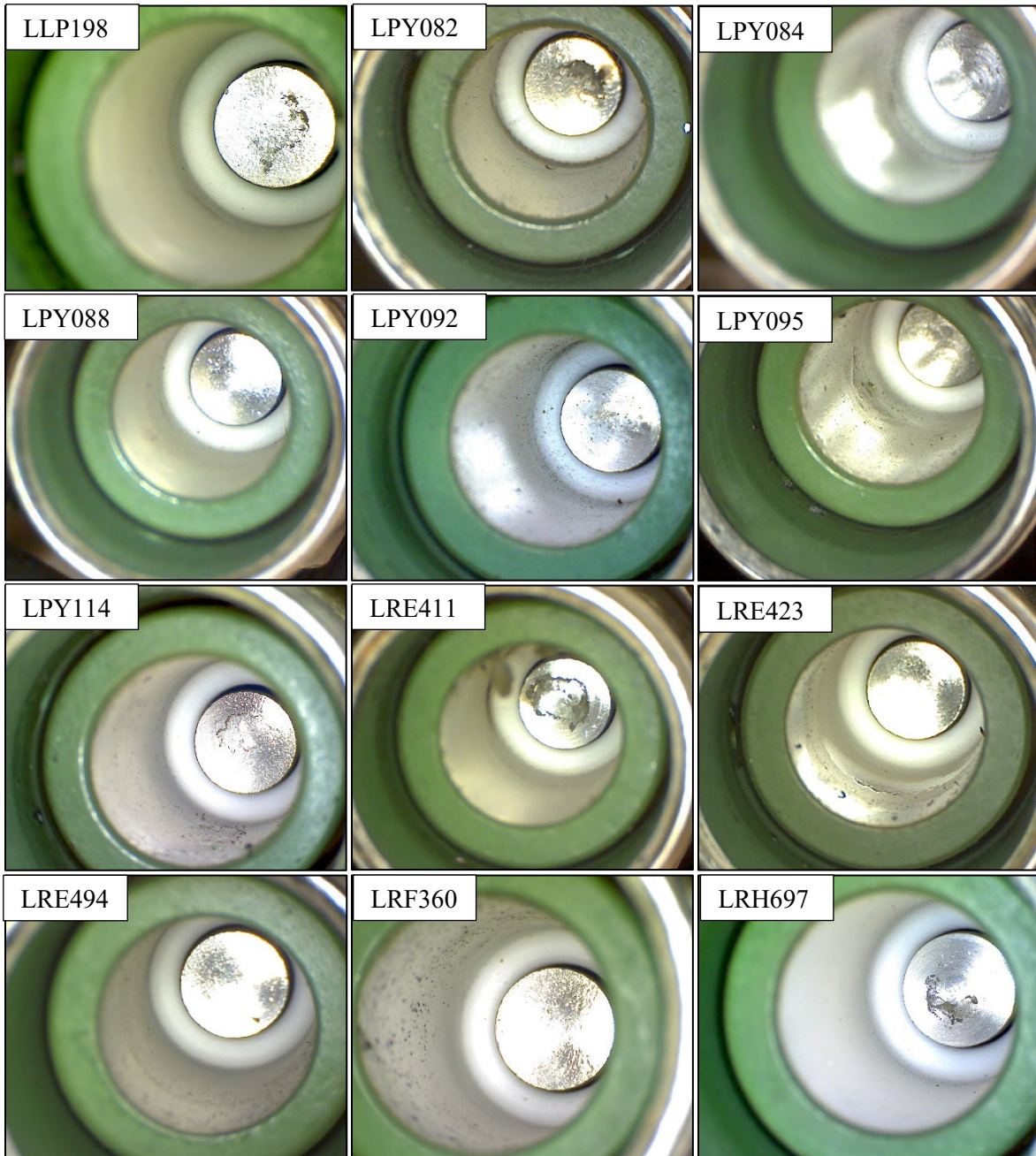


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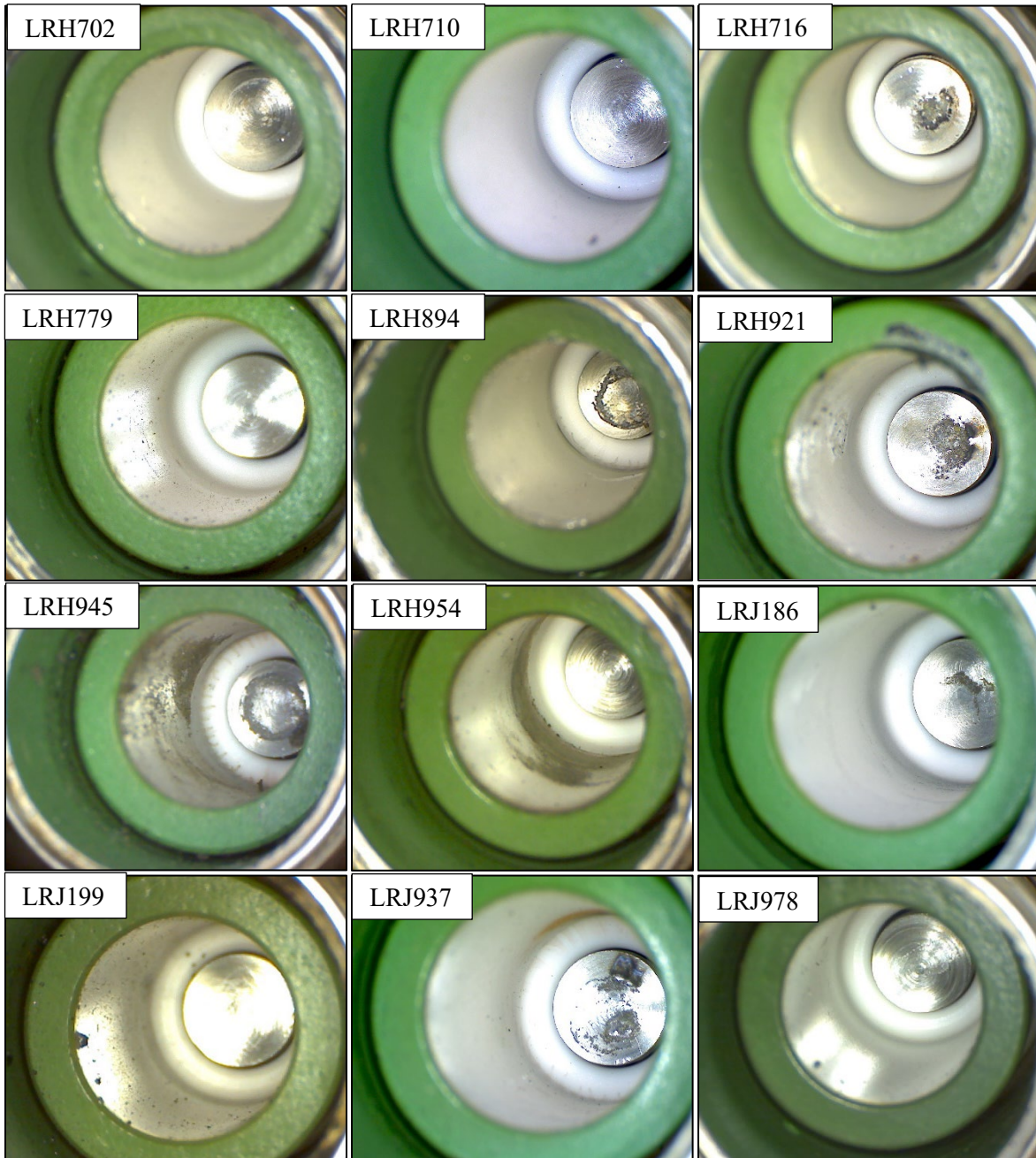
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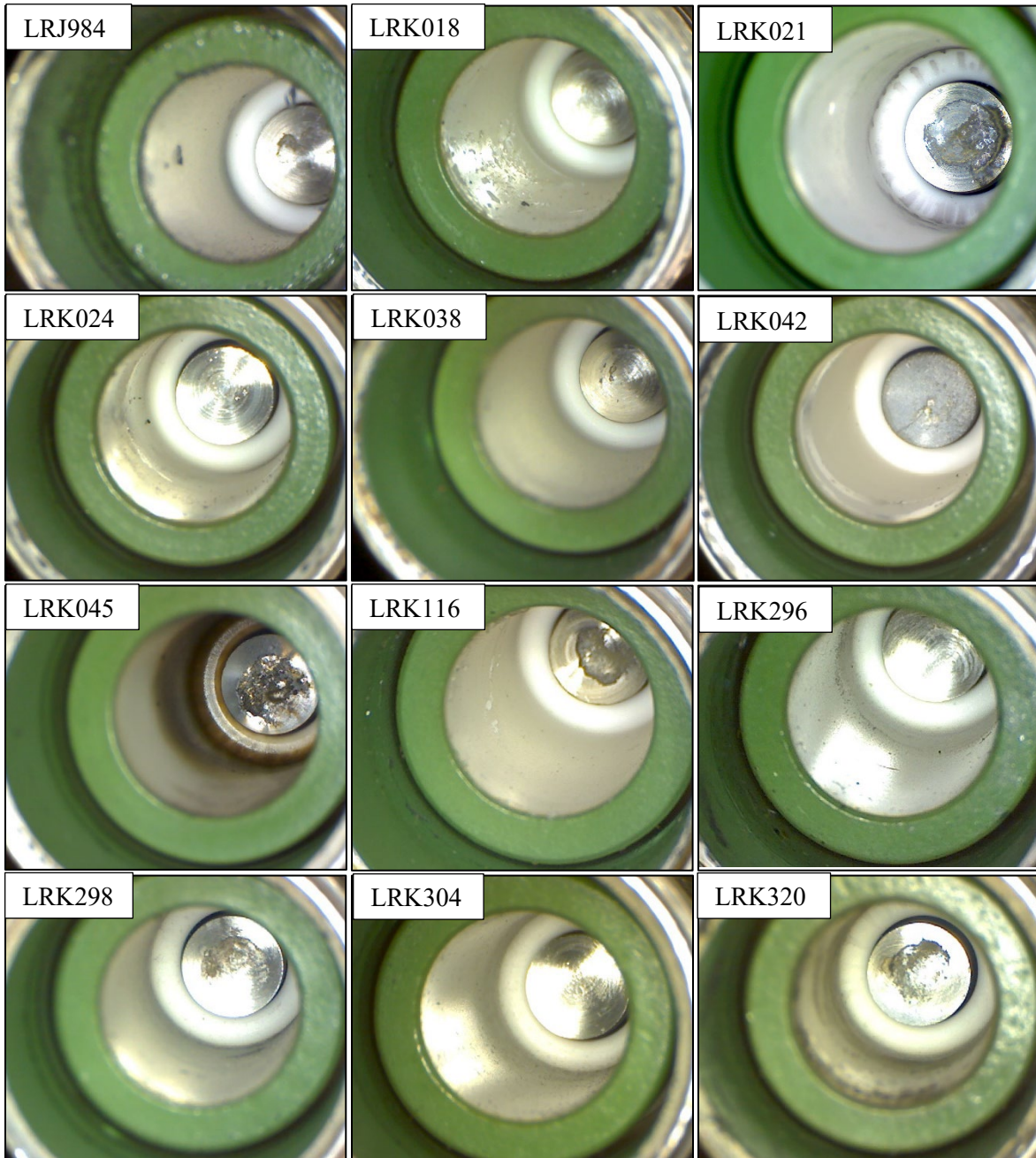


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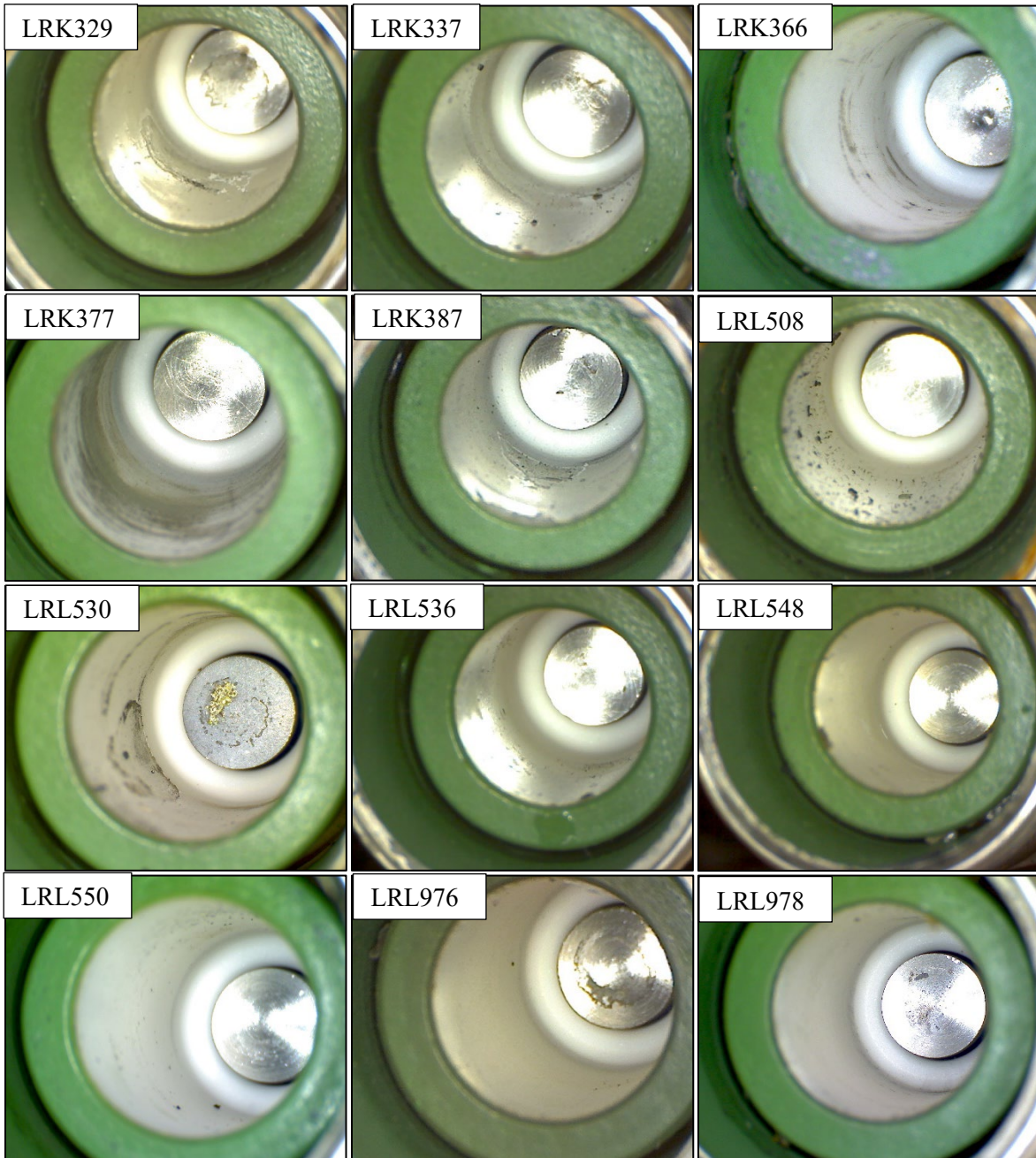


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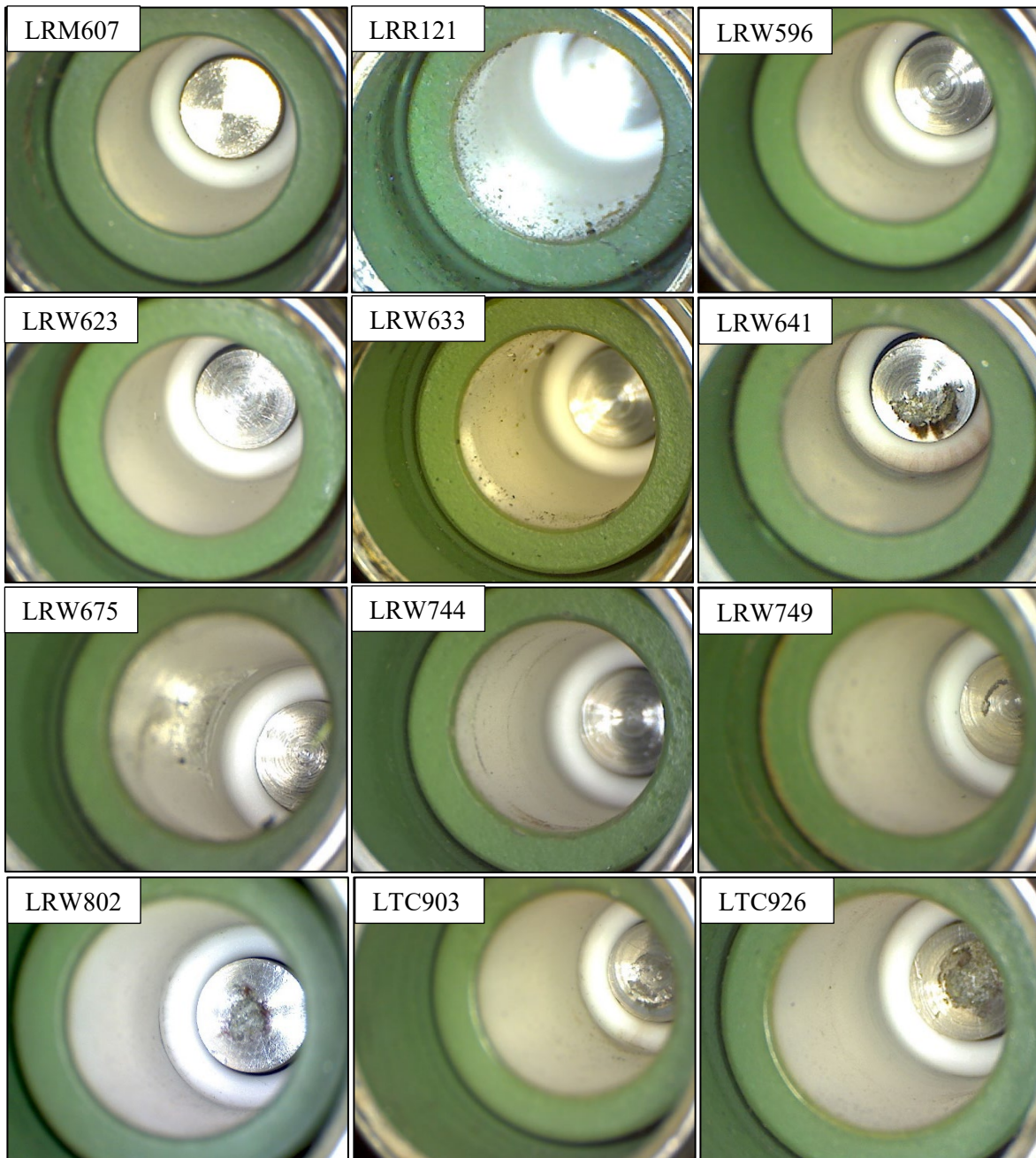
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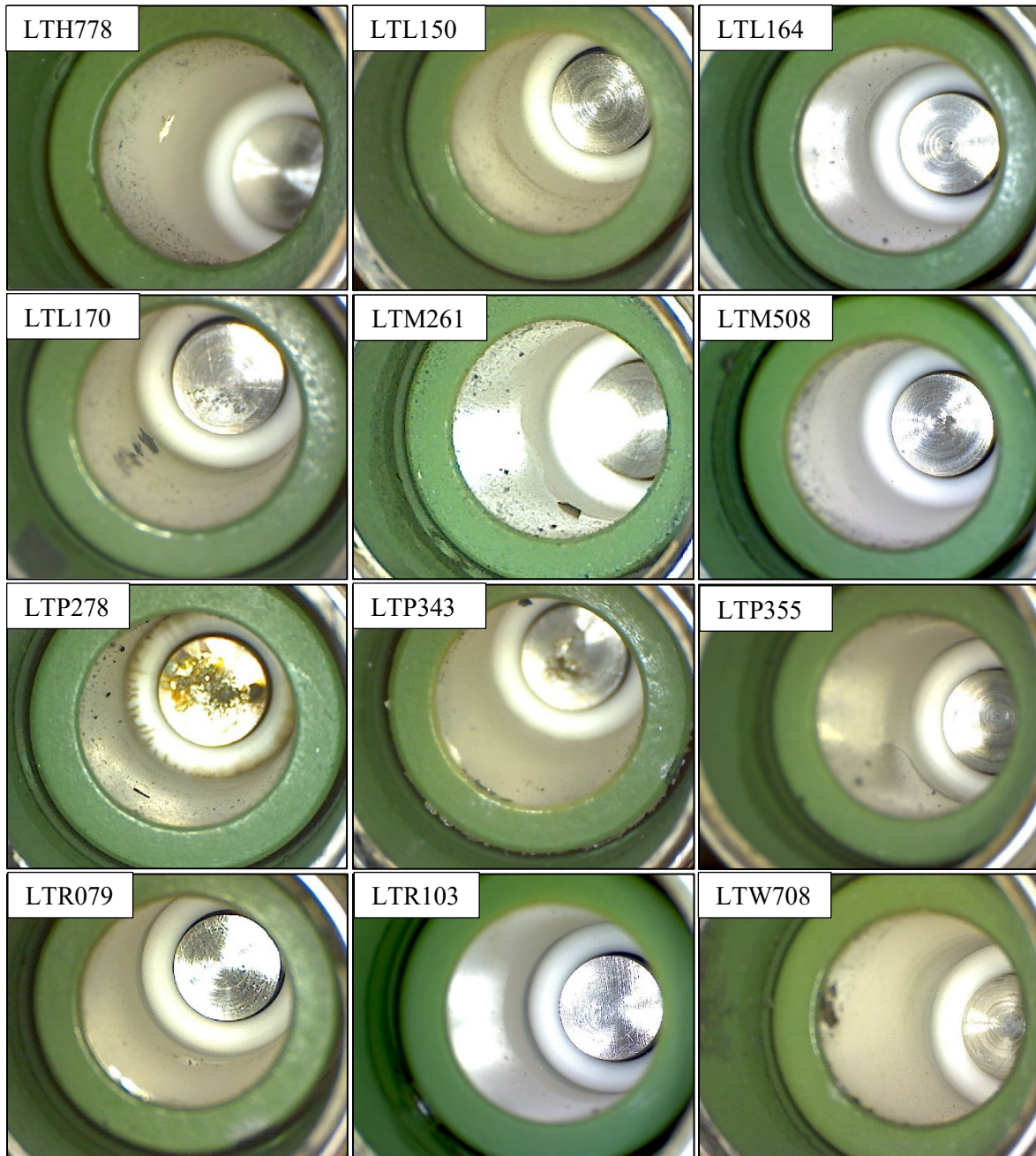


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**Competitor Long Life Igniter Terminal Well Contamination**

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### Appendix C: Competitor Long Life Firing Ends



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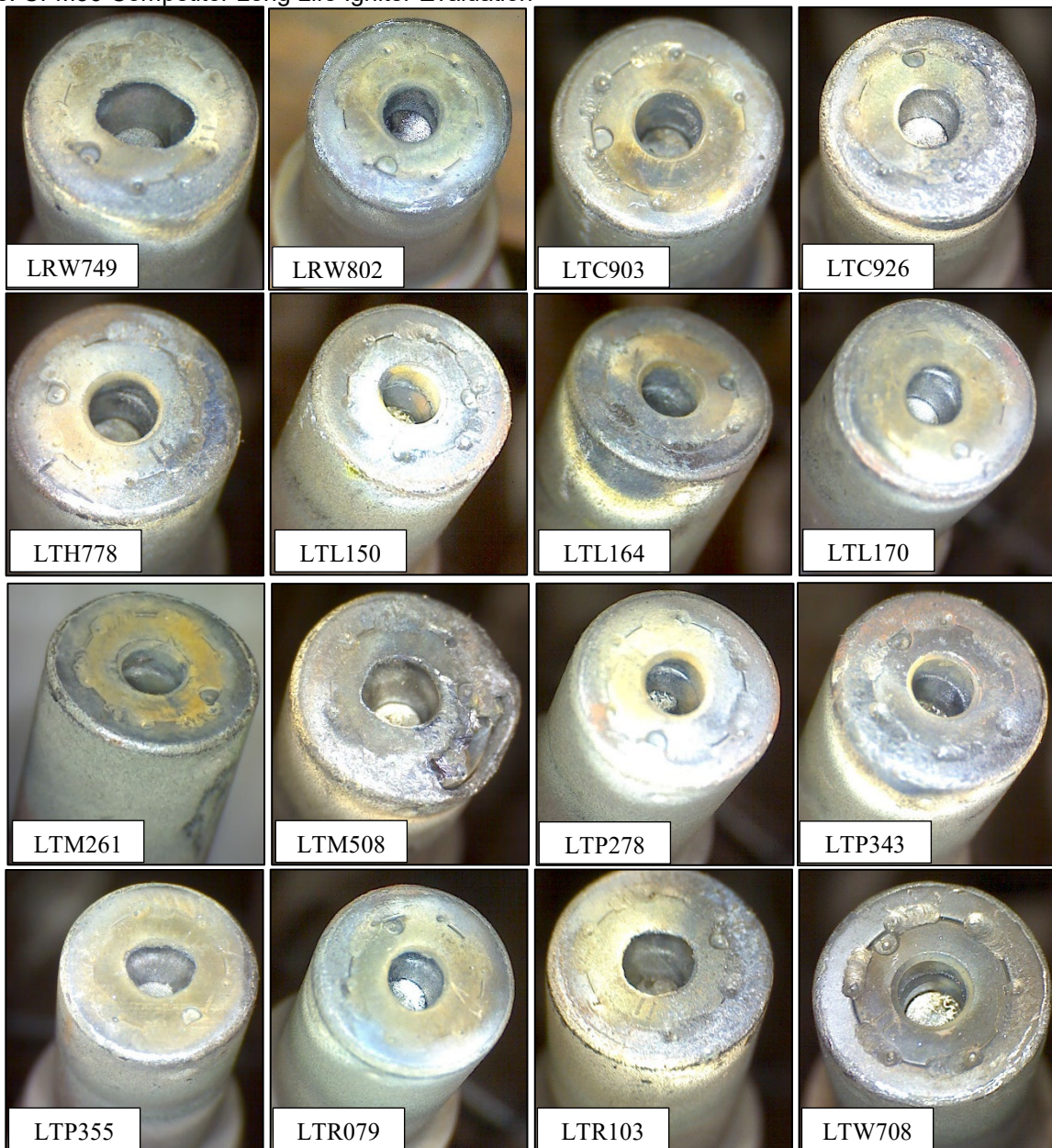
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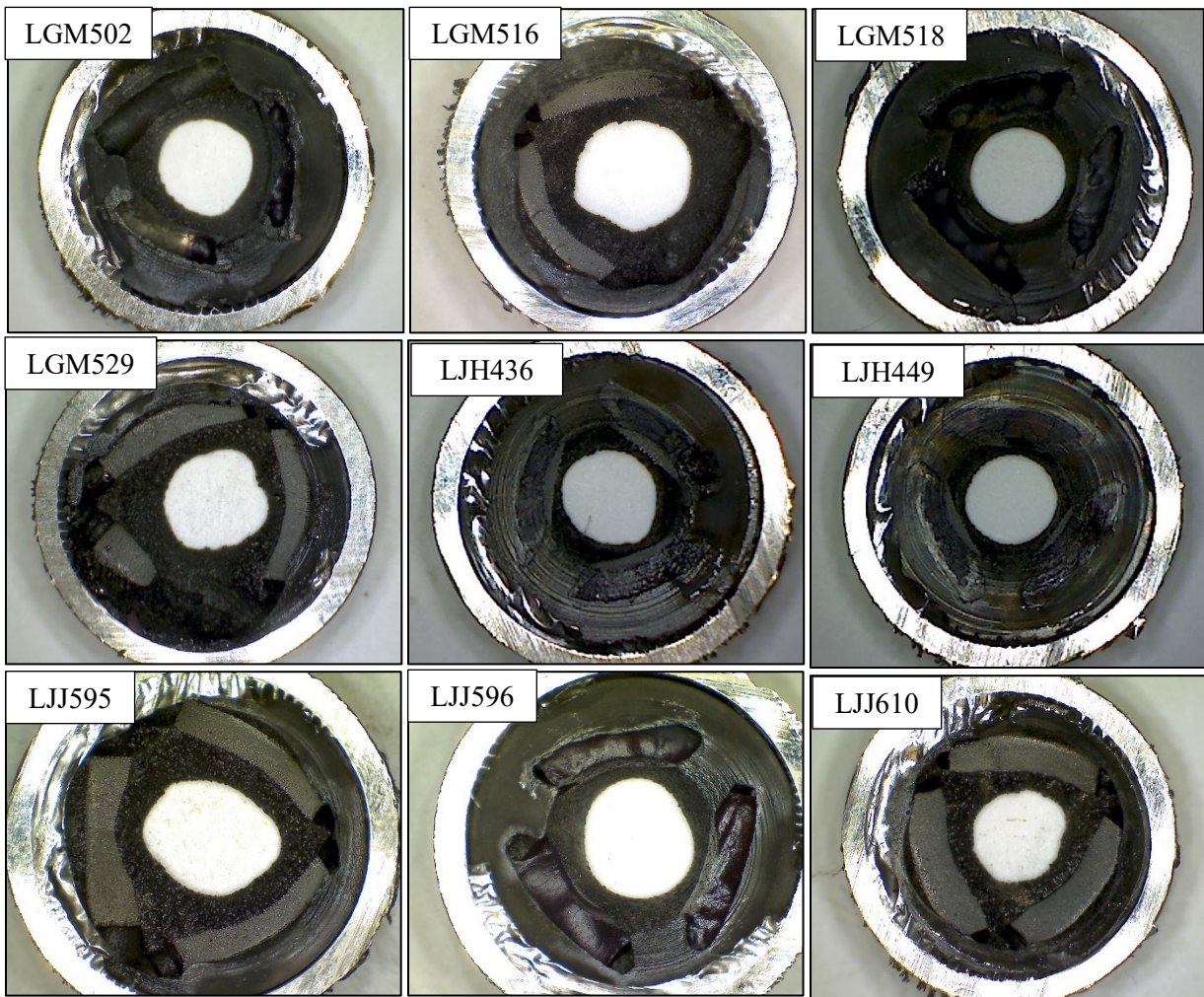




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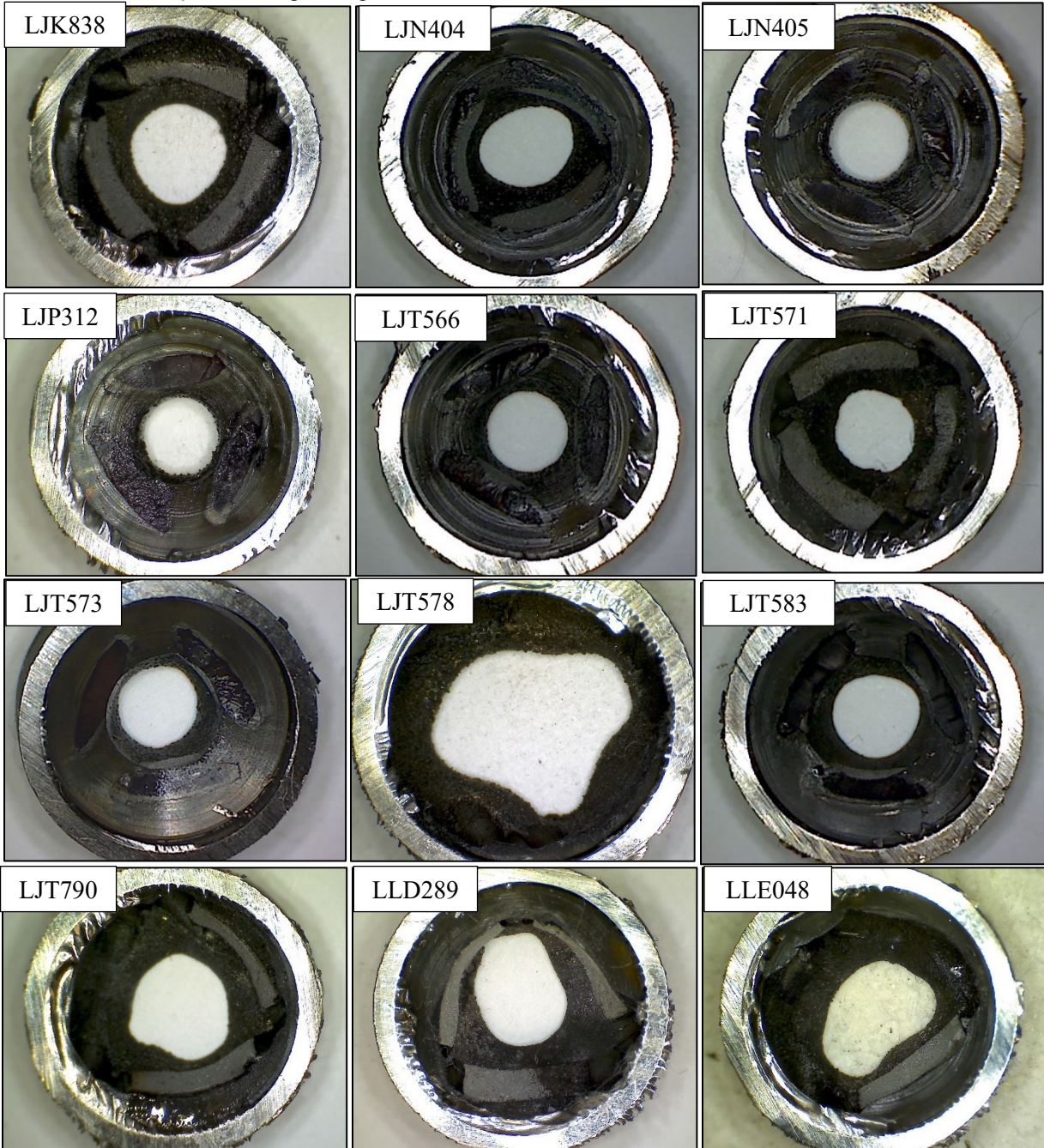


### Appendix D: Competitor Long Life Igniter Pins



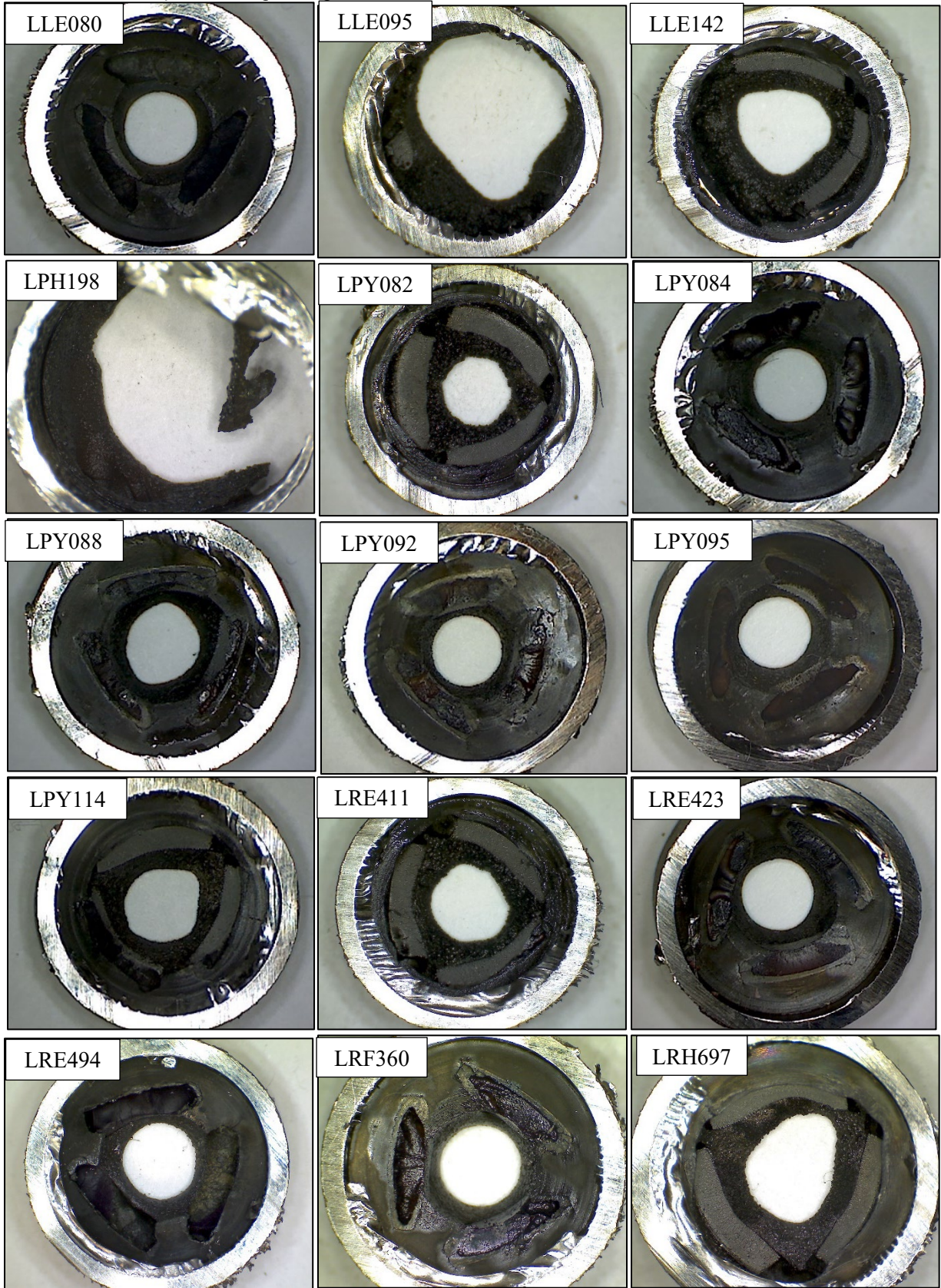
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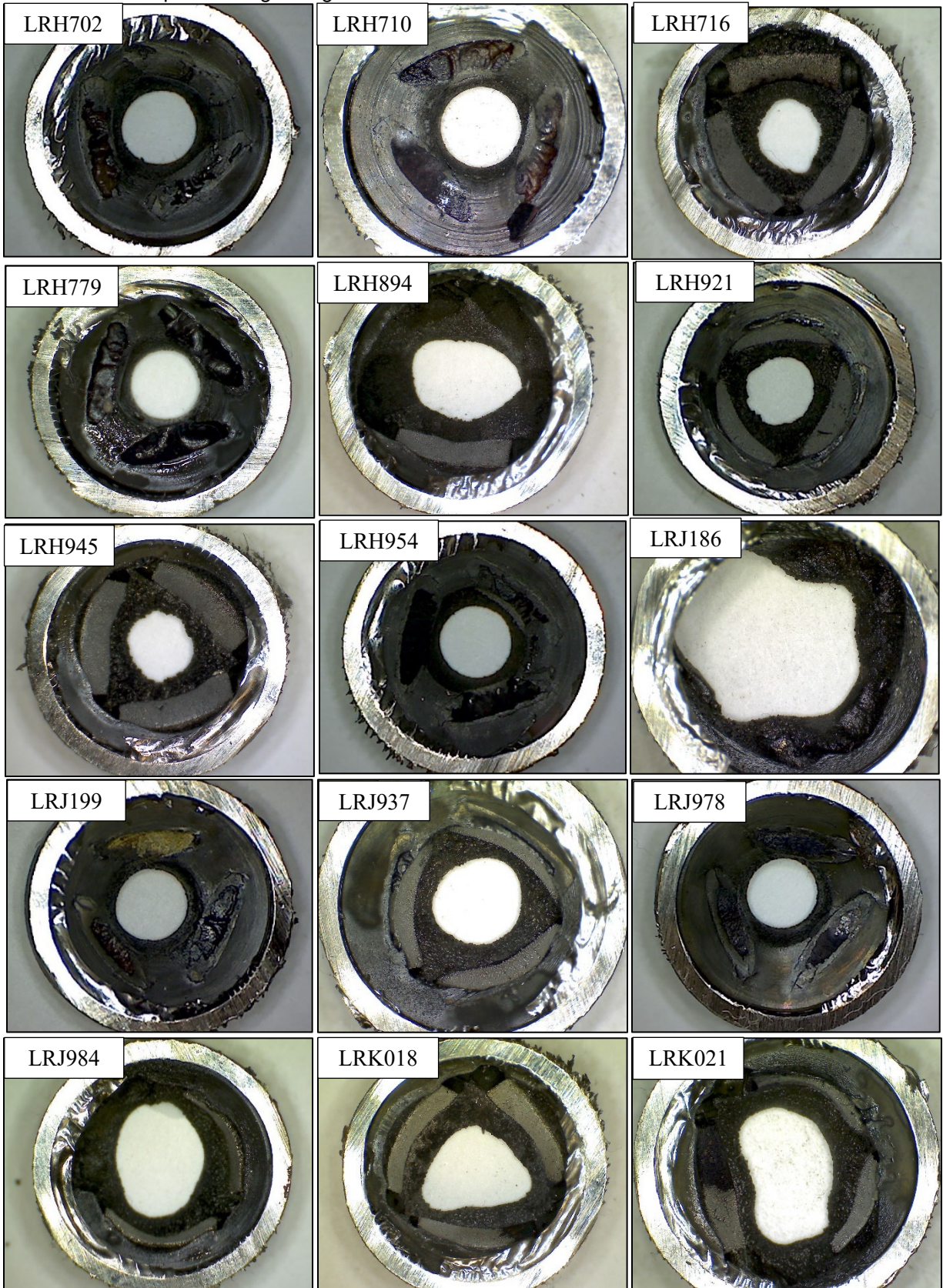
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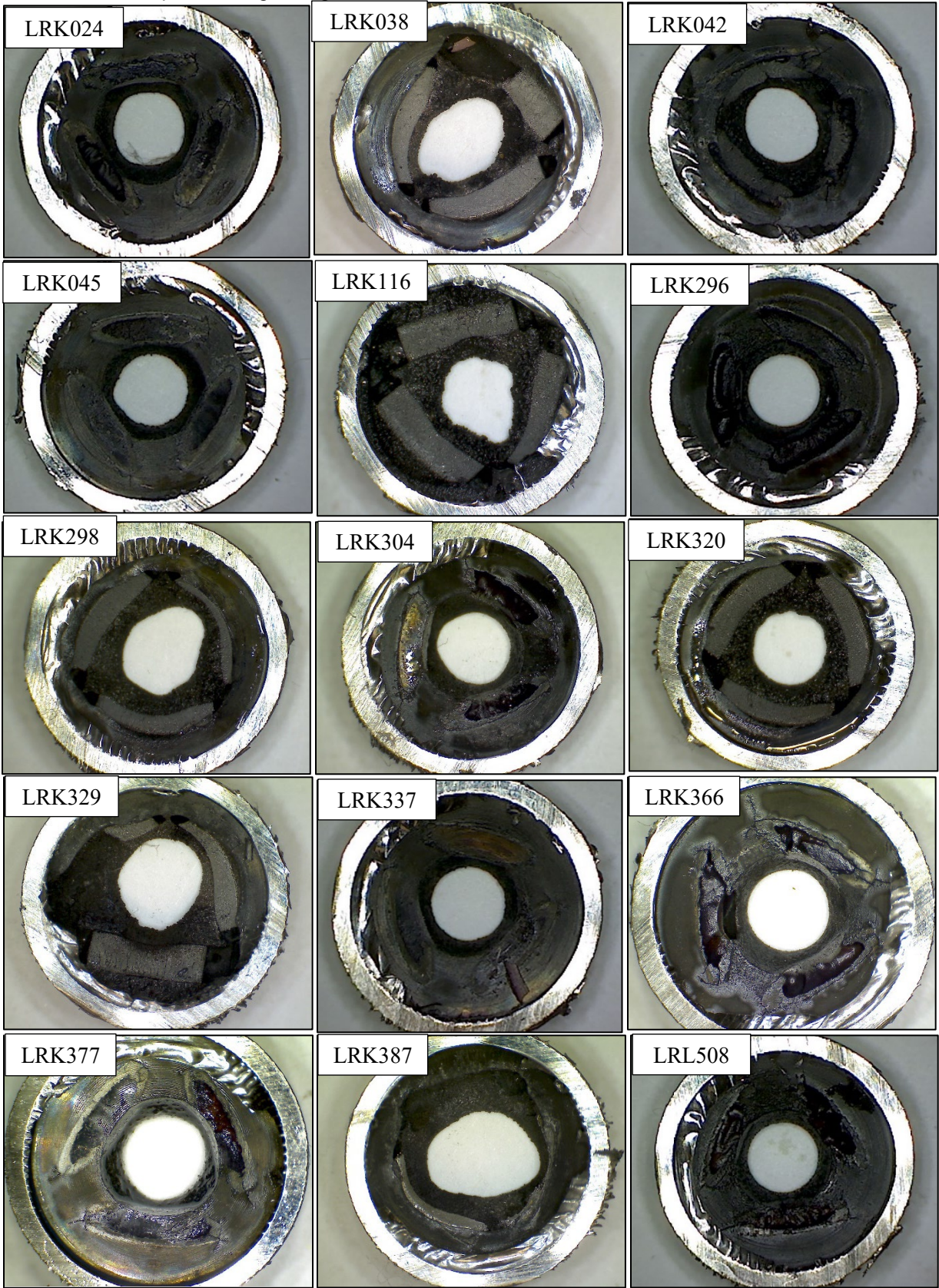
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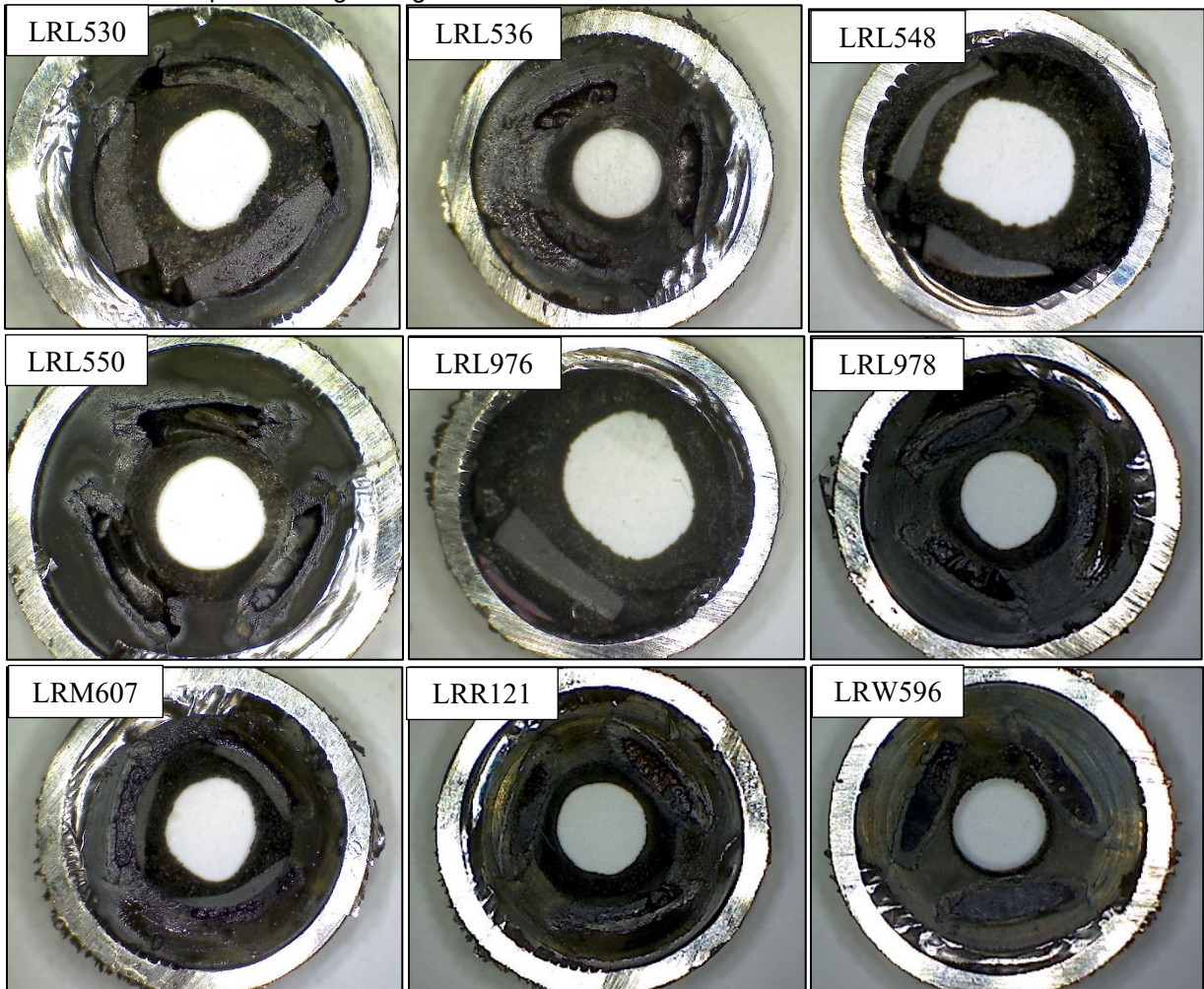
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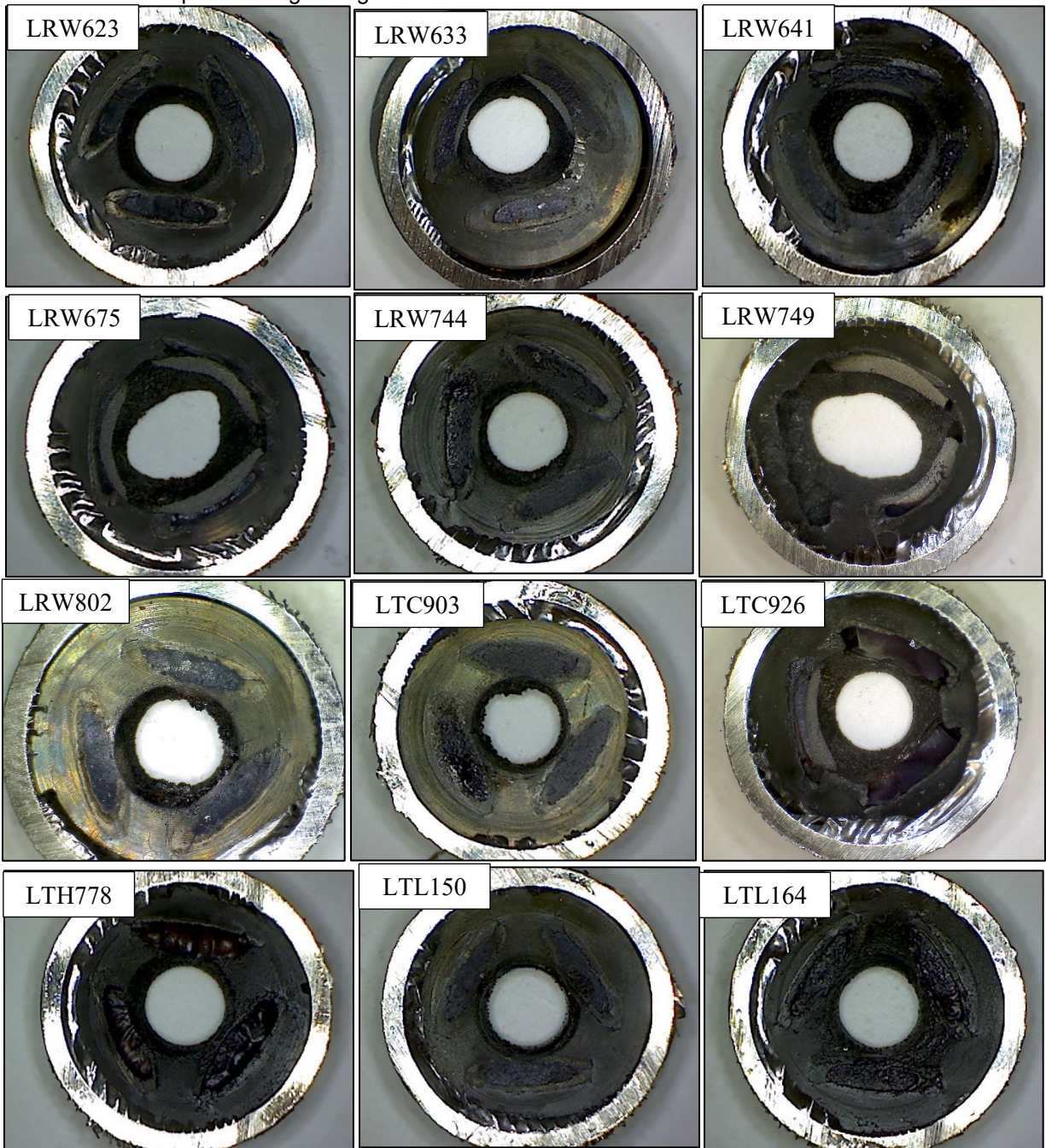
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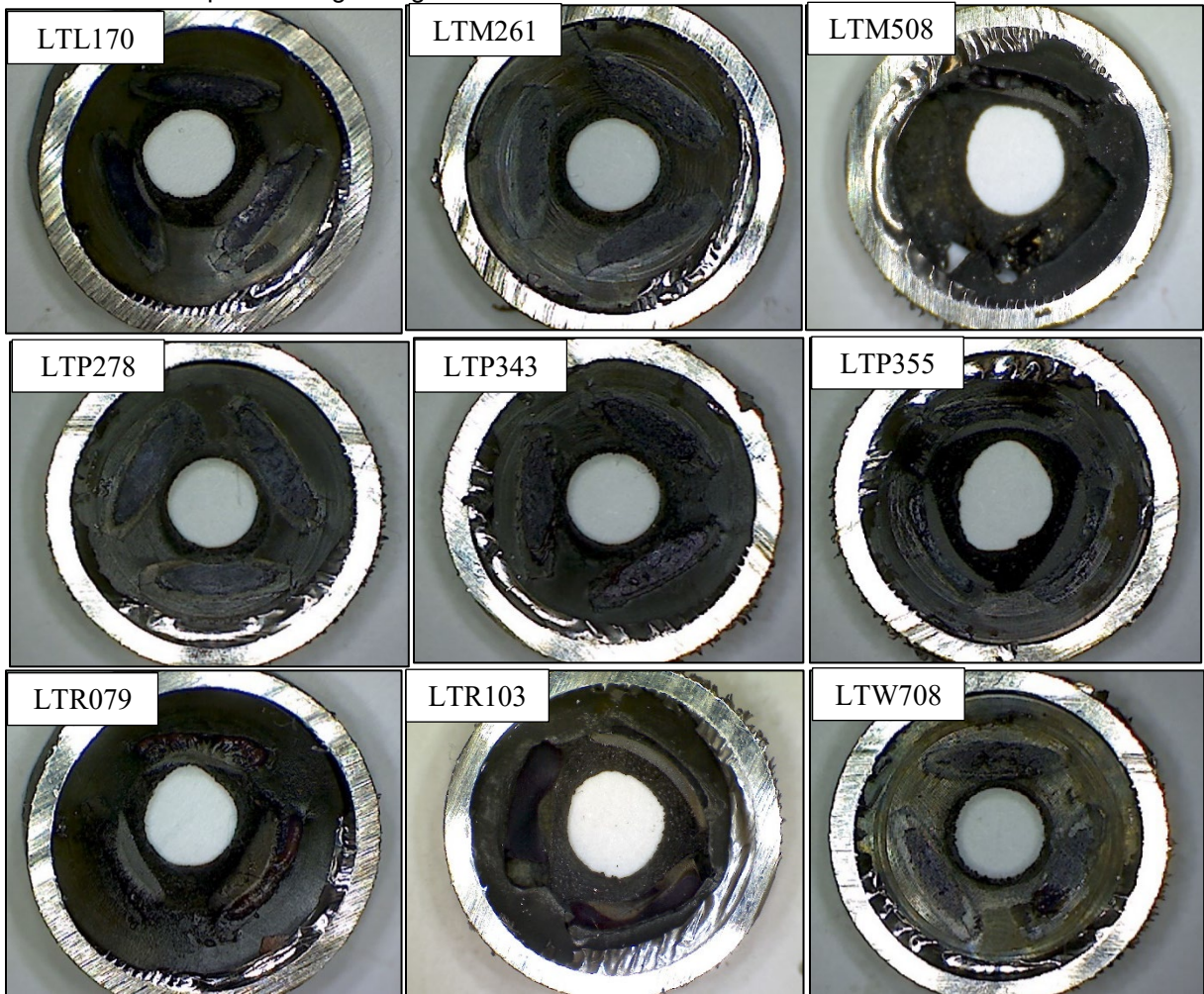
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