Mitigation of Fatigue and Cracking Damage in F-16 Wing Pylon Cutout Through LPB

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The F-16 Wing Lower Skin Pylon Cutouts are reportedly prone to fatigue cracking in the lip of the cutouts resulting in a serious fatigue debit and reduced damage tolerance life. Inspection and maintenance costs adversely impact readiness and increase the total cost of ownership and operation. This program was developed to establish the LPB process conditions and optimize the production engineering to improve damage tolerance life and enhance fatigue performance of the parts. The end result of this effort will be the implementation of the LPB process into production.

An integrated total solutions approach was used, consisting of the following steps: (1) use of design tools including Lambda's Fatigue Design Diagram (FDD) method and linear elastic fracture mechanics (LEFM) based crack growth analysis, to determine the compressive residual stress field required to achieve an acceptable level of damage tolerance, (2) modification of LPB tools and fixtures to process the component, (3) design of LPB process parameters and the corresponding robotic/pressure codes, (4) measurement of residual stresses (RS) in LPB processed parts, and (5) fatigue testing of actual Wing Lower Skin Mockups to verify the effectiveness of the LPB process. The robustness of the LPB process and production processing bounds were established by finding a range of processing conditions within which RS distributions remain essentially constant, fatigue performance of processed parts show complete mitigation of damage, while the part distortion is kept within manufacturing tolerances. The tool, and the LPB processing parameters are production ready, the next objective is to move the solution to the field, depot or third-party facility.