



Advancing Structural Simulation to drive Innovative Sustainment Technologies: ASSIST

Military Transport Aircraft Crack Growth Prediction Challenge:

Welcome to the Military Transport Aircraft Crack Growth Prediction Challenge. This document describes the key information required to participate in this challenge. In this case a series of wide plate panel tests were designed by DST and tested within its Fatigue and Fracture Laboratory in support of a recent full-scale fatigue test program.

Structural Configuration

This initial phase of the challenge is based upon a simple centre cracked (or middle tension type) wide plate coupon which is representative of a typical military transport aircraft lower wing surface material (including temper and thickness).

Material: Al 7075-T7351 Bare Plate

Surface Preparation: As per bare plate. No special surface preparation procedure has been undertaken.

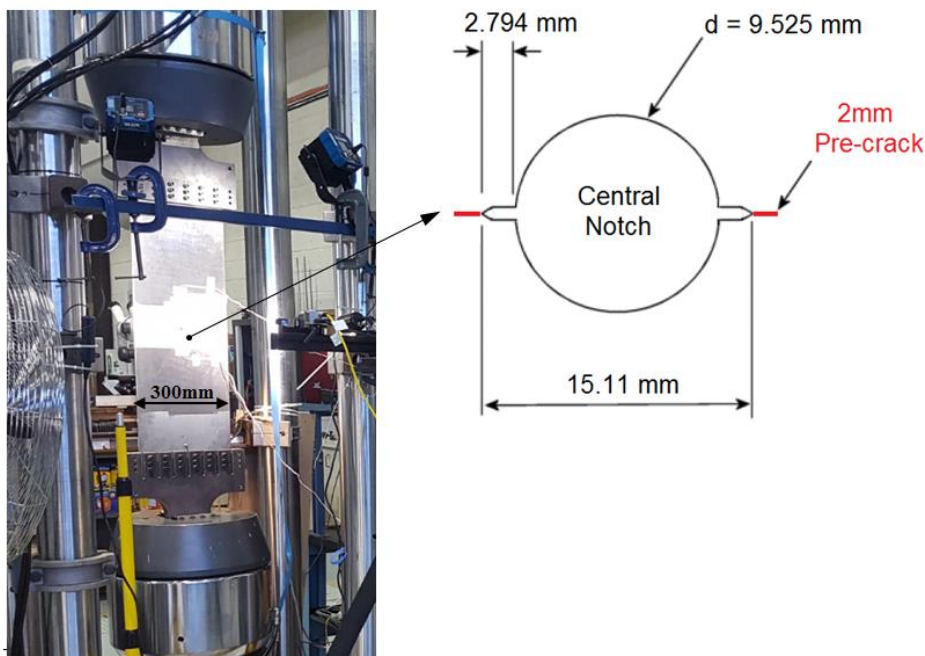


Figure 1: Military Transport Aircraft Challenge: Wide Panel Test and Notch Geometry

Coupon Geometry: The plate is nominally 6.8 mm thick and 300 mm wide. Details regarding the initiating notch are shown in Figure 1 along with a photo of the panel in the 2 Mega Newton test machine.

Pre-cracking: Prior to application of spectrum loading a constant amplitude loading sequence¹ was applied to nucleate and grow quasi-symmetric cracks from the wire cut notches either side of the central hole. These pre-cracks were each grown to a length of approximately 2 mm producing an effective starting crack length (tip to tip) of nominally 19.1 mm.

Loading

The test spectrum provided (see section on Attachments) is an operationally measured military transport aircraft lower wing surface spectrum and is representative of a specific period of operational flying containing 520,550 turning points (or load lines). The maximum far field (or gross) stress is 150.6 MPa (corresponding to a maximum panel test load of 307 kN). Due to the configuration of the wide long panel (and absence of buckling guides), the compressive content within the spectrum has been clipped to -6.9 MPa. Note that the sequence has been normalised with respect to the maximum spectrum stress. A time history representation of the normalised peak-valley sequence is presented in Figure 2 (including an additional detailed view of the initial 450 turning points).

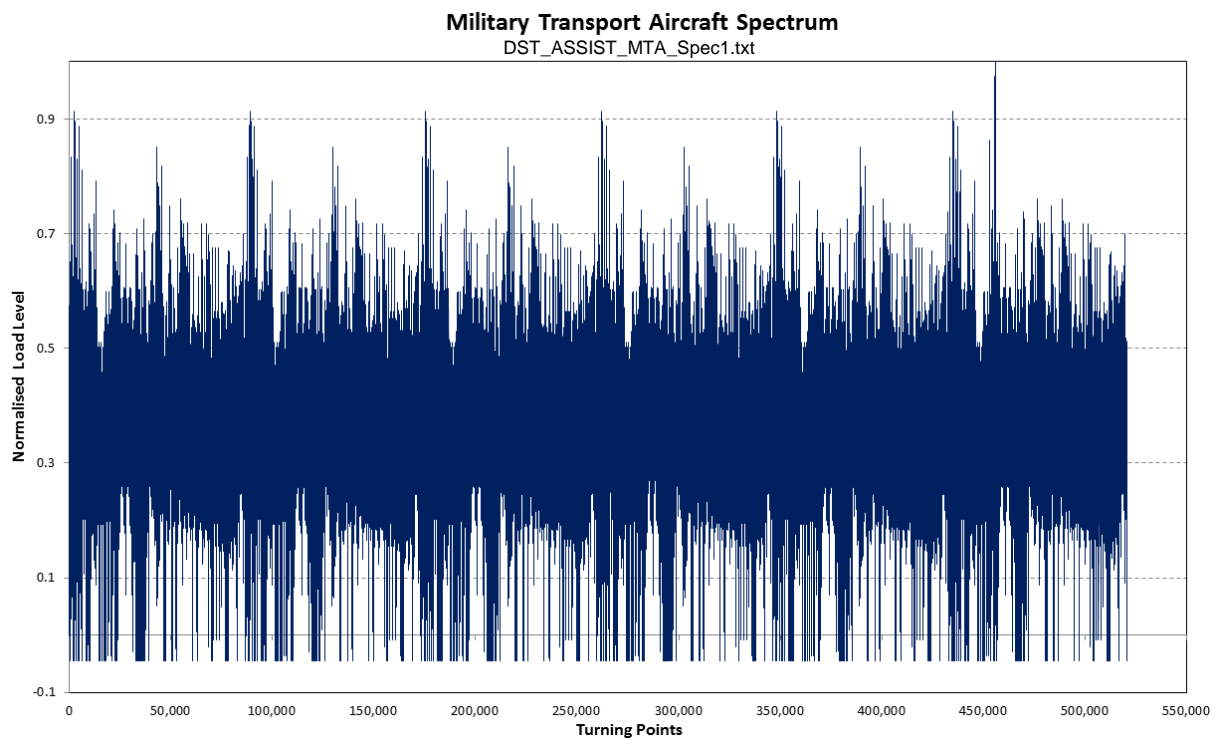


Figure 2: Military Transport Aircraft Spectrum

¹ Sharp pre-crack produced by cycling with constant amplitude load equal to 70% of the peak spectrum load value (at a maximum $R = 0.1$) until the pre-cracks reach a length of 1.0 mm on each side of the notch. Load shedding is then undertaken (i.e. drop from 70% peak load to 60% peak load) as the pre-crack grows out from 1mm to 2mm each side of the notch in order to reduce plasticity effects at the crack tip.

Approved for Public Release

Challenge Details

With the notched test specimens supporting this challenge containing existing pre-cracks, this ASSIST challenge is aimed at predicting the crack growth life, commencing from a nominal initiating length (19.1 mm) to final failure. Challenge participants are requested to submit their results to DST or onto the GovTEAMS portal no later than 1st Aug 2019.

DST will seek your permission prior to further use, with wider publication in a suitable conference or journal paper desirable. Entrants will be credited, though individual results can be de-identified prior to publication.

Participants should provide DST with details of their analysis inputs and assumptions and crack growth versus spectrum block predictions (including crack growth rate and final failure length prediction). Where possible details regarding tools and methods used for crack growth and spectrum manipulation are also encouraged to be shared. Following the 1st Aug 2019 deadline for submission of challenge predictions, DST will release the experimental results via the ASSIST portal on GovTEAMS.

Attachments

The data required to support this challenge is the applicable normalised (tab delimited peak-valley) military transport aircraft loading spectrum presented below.

Filename

DST_ASSIST_MTA_Spec1.txt