SDC and Threat Assessment 11 April 2017

Below you will find wording that attempts to represent the two approaches discussed during the telecom on Thursday, 9 February 2017. These 2 approaches summarized below are presented side-by-side for comparison.

Approach 1 – If the applicant can do a thorough and reliable threat assessment, then SDC becomes optional

Advantages:

- Reduces compliance burden, allows OEMs flexibility of keeping SDC as an internal design requirement, maintains status quo
- More simple, does not force us to come up with standards, which OEMs have had a hard time agreeing upon
- Seemed to be in line with the direction given to us in Florida in December

Approach 2 – If the applicant can do a thorough and reliable threat assessment, SDC is still required, but with lesser requirements (smaller damage size, reduced loads, etc.)

Advantages:

- If no SDC were required, it could send an unintended message to the industry that they can cease continuing their good fail-safe design practices, which could jeopardize safety
- New applicants could claim they have done a thorough and reliable threat assessment and include no level of SDC in their designs if we went with #1
- Could still be some level of flexibility in SDC requirements, by defining a range of requirements, depending on the thoroughness/reliability or even results of threat assessment

Industry proposes the approach 1.

- Text in black is existing text in both the rule and guidance.
- Text in red proposed wording.
- *Text in blue italics is discussion point gathered during Virtual Meeting on 9 February 2017*

Approach 1
25.571 – Damage-tolerance and fatigue evaluations of structure
(a) *General*. An evaluation of the strength, detail design, and fabrication must show that catastrophic failure due to fatigue, ~~corrosion~~ environmental deterioration, manufacturing defects, or accidental damage, will be avoided throughout the operational life of the airplane. This evaluation must be conducted in accordance with the provisions of paragraphs (b) and (e) of this section, except as specified in paragraph (c) of this section, for each part of the structure that

could contribute to a catastrophic failure (such as wing, empennage, control surfaces and their systems, the fuselage, engine mounting, landing gear, and their related primary attachments). For turbojet powered airplanes, those parts that could contribute to a catastrophic failure must also be evaluated under paragraph (d) of this section. In addition, the following apply:
(2) The service history of airplanes of similar structural design, taking due account of differences in operating conditions and procedures, may be used in the evaluations required by this section.
(3) The evaluation may include other considerations that mitigate the extent of a threat assessment
(4) Based on the evaluations required by this section, inspections or other procedures must be established, as necessary, to prevent catastrophic failure, and must be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness required by § 25.1529. The limit of validity of the engineering data that supports the structural maintenance program (hereafter referred to as LOV), stated as a number of total accumulated flight cycles or flight hours or both, established by this section must also be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness required by § 25.1529. Inspection thresholds for the following types of structure must be established based on crack growth analyses and/or tests, assuming the structure contains an initial flaw of the maximum probable size that could exist as a result of manufacturing or service-induced damage: (i) Single load path structure, and (ii) Multiple load path "fail-safe" structure and crack arrest "fail-safe" structure, where it cannot be demonstrated that load path failure, partial failure, or crack arrest will be detected and repaired during normal maintenance, inspection, or operation of an airplane prior to failure of the remaining structure.

Approach 1

Advisory Circular 25.571-1D

6. Damage-Tolerance Evaluation

d. Extent of damage. Each particular design should be assessed to establish appropriate damage criteria in relation to inspectability and damage-extension characteristics. In any damage determination, including those involving multiple cracks, it is possible to establish the extent of the damage in terms of the following parameters.

- Detectablility with the inspection techniques to be used
- The associated, initially detectable crack size,
- The residual-strength capability of the structure, and
- The likely damage-extension rate

This determination should consider the expected stress redistribution under repeated loads expected in service at the expected inspection frequency. Thus, an obvious partial failure could be the extent of damage for the residual strength assessment, provided that fatigue cracks will be detectable at a sufficiently early stage of crack development. The following are examples of partial failures that should be considered in the evaluation:

(1) Detectable skin cracks emanating from the edge of structural openings or cutouts;

(2) A detectable circumferential or longitudinal skin crack in the basic fuselage structure

(3) Complete severance of interior frame elements or stiffeners in addition to a detectable crack in the adjacent skin

(4) A detectable failure of one element of components in which dual construction is used, such as spar caps, window posts, window or door frames, and skin structure.

(5) A detectable fatigue failure in at least the tension portion of the spar web or similar element; and

(6) The detectable failure of a primary attachment, including a control surface hinge and fitting.

k. Threat assessments and other considerations. Other assessments/features may be considered to mitigate the risk of damage resulting in catastrophic structural failure associated with fatigue, environmental deterioration, manufacturing defects, and accidental damage. Such assessments/features may include:

(1) A thorough threat assessment that identifies damage that may occur. A threat assessment should be considered as a key element in the applicant's overall damage tolerance assessment in mitigating the likelihood of catastrophic loss. Based on service history, a thorough threat assessment should reliably address the following factors for similar aircraft operating under similar environments:

(a) Locations of damage,
(b) Sources of damage,
(c) Extent of damage,
(d) Detectability of damage, and
(e) Likelihood of damage

Service history used to support a thorough threat assessment may include the following:

(a) Operator service data, potentially supplemented by test results; and
(b) OEM databases for in-service damage and repairs.

It should be recognized that even for well-established applicants, that they may not have ready access to all of the above data and that the applicability of such data may vary.

(2) The applicant may mitigate the extent of their threat assessment by performing an assessment of Structural Damage Capability (SDC)

	included as a characteristic of the structural design. SDC permits aircraft structure to retain its required residual strength in the presence of large damage. Please refer to the following for additional guidance on SDC: (a) Section xx of this Advisory Circular for metallic structure; and (b) Section yy of AC 20-107C for composite structure