

## **The matter of aircraft structure corrosion damage classification**

The difference of corrosion damage levels classification in regulation documents of EASA and State Aviation Administration of Ukraine that can have an impact on safety was founded and analyzed. It was proposed ways to harmonized technological instruction according to EASA standards.

Corrosion is a time dependent failure mechanism that occurs as a result of chemical or electrochemical degradation of metal. Aircraft structures generally are affected by corrosion that could lead to catastrophic consequences especially in combination with fatigue damages. Well known Boeing 737 of Aloha Airlines accident shown level of corrosion dangerous.

To maintain the required level of safety during aircraft long time operation the Corrosion Prevention and Control Program (CPCP) was developed and implemented. The main task is to control corrosion such that the load carrying capability of an aircraft structure is not degraded below a level necessary to maintain airworthiness. CPCP contains a definition of corrosion levels - parameters for determining severity of corrosion problem. This approach was introduced in different airworthiness regulation documents and implemented for majority of modern aircraft maintenance programs. For other aircraft that are out of CPCP maintenance approach (e.g. old aircraft built in USSR) National Aviation Authorities could issue special documents to carried out corrosion control activities.

State Aviation Administration of Ukraine has developed technological instruction № ЕД-07-10 [1] for aircraft whose operational documentation haven't requirements for document management of corrosion conditions and/or aircraft structural repair cards. The instruction is used during evaluation of the implementation of the corrosion damage detection and repairing actions for aircraft technical condition controlling.

In this article attention will be given to the definition of corrosion levels difference between technological instruction and the Airworthiness Authority regulations EASA AMC20-20 Continuing Structural Integrity Programme [2].

According to paragraph ЕД-07-10 next levels of corrosion are used:

**Level 1** is surface corrosion, the reduction of the cross-section (thickness) of the structural element does not exceed allowable limits (the total depth of blended-out for all previous checks in the control area is taken into account);

**Level 2** is corrosion exceeding the allowable limit; replacement for first category parts is required, repairing of the defect is carried out in accordance with the repair and operational documentation;

**Level 3** is a corrosive damage, the nature of which may affect the safe operation of the aircraft, the repairing of the defect can be carried out only in agreement with the developer.

According to EASA AMC20-20 :

**Level 1 Corrosion.** Level 1 corrosion is:

(1) Corrosion, occurring between successive corrosion inspection tasks that is local and can be reworked or blended out within the allowable limit; or

(2) Corrosion damage that is local and exceeds the allowable limit, but can be attributed to an event not typical of operator's usage of other aircraft in the same fleet (e.g. mercury spill); or

(3) Operator experience has demonstrated only light corrosion between each successive corrosion inspection task inspection; and, the latest corrosion inspection task results in rework or blend out that exceeds the allowable limit.

**Level 2 Corrosion.** Level 2 corrosion is that corrosion occurring between any two successive corrosion inspections task that requires a single rework or blend out which exceeds the allowable limit. Or, corrosion occurring between successive inspections that is widespread and requires a single blend-out approaching allowable rework limits. i.e. it is not light corrosion as provided for in Level 1, definition (3). A finding of Level 2 corrosion requires repair, reinforcement, or complete or partial replacement of the applicable structure.

**Level 3 Corrosion.** Level 3 corrosion is that corrosion occurring during the first or subsequent accomplishments of a corrosion inspection task that the operator determines to be an urgent airworthiness concern.

For better understanding of corrosion levels classification problem additionally few definitions of corrosion must be given:

**Light corrosion** is corrosion damage so slight that removal and blend-out over multiple repeat intervals may be accomplished before material loss exceeds the allowable limit.

**Local corrosion** is corrosion of a skin or web (wing, fuselage, empennage or strut) that does not exceed one frame, stringer, or stiffener bay. Local corrosion is typically limited to a single frame, chord, stringer or stiffener, or corrosion of more than one frame, chord, stringer or stiffener where no corrosion exists on two adjacent members on each side of the corroded member (fig.1 a).

**Widespread corrosion** is corrosion of two or more adjacent skin or web bays (a web bay is defined by frame, stringer or stiffener spacing). Or, widespread corrosion is corrosion of two or more adjacent frames, chords, stringers, or stiffeners. Or, widespread corrosion is corrosion of a frame, chord, stringer, or stiffener and an adjacent skin or web bay (fig.1 b).

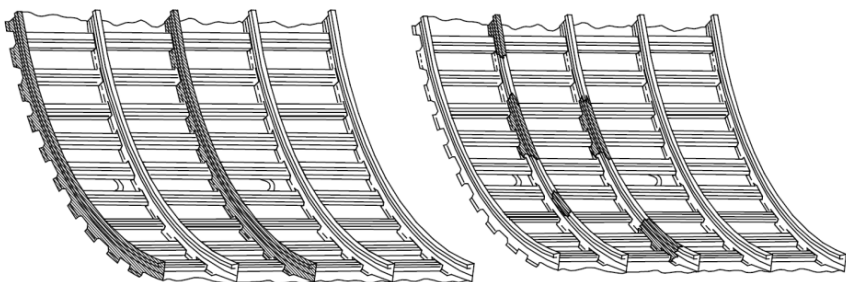


Fig.1. Examples of local (a) and widespread corrosion (b) [2]

From a comparison of corrosion levels definitions it can be concluded next difference in definitions of corrosion (table).

Table

Corrosion levels definitions analyses

Difference		Discussion
AMC-20-20	ЕД-07-10	
Term "Local corrosion"	Term "Surface corrosion"	Surface corrosion could attack two or more adjacent structure elements and must be identify as widespread corrosion and classify as Level 2 if single blend-out approaching allowable rework limits. Instead it was classified as Level 1. <b>Result:</b> Wrong corrosion level classification. Loosening of CPCP regulations <b>Proposition:</b> change term " Surface corrosion" on "Local corrosion"
Corrosion can be attributed to an not typical event	<i>has no counterpart</i>	In case of not typical event corrosion damage must be classify as Level 2. <b>Result:</b> Wrong corrosion level classification. Corrosion prevention and control tasks will be recognized as inefficient <b>Proposition:</b> to broaden the interpretation of the Level 1 corrosion term
Light corrosion between corrosion task inspection and the latest inspection results in blend out that exceeds the allowable limit	<i>has no counterpart</i>	History and type of corrosion damages are not taken into account and damage must be classify as Level 2. <b>Result:</b> Wrong corrosion level classification. Corrosion prevention and control tasks will be recognized as inefficient. <b>Proposition:</b> to broaden the interpretation of the Level 1 corrosion term

## **Conclusion**

Comparison of EASA AMC20-20 Continuing Structural Integrity Programme and State Aviation Administration of Ukraine technological instruction № ЕД-07-10 shown significant difference in corrosion Level 1 classification. To avoid some of the issues with corrosion levels classification the changes in definitions of Level 1 corrosion were proposed.

## **References**

1. [Electronic source] Technological instruction № ЕД-07-10: improvement actions for controlling of the technical condition of aircraft during their operation – Access mode: URL: <http://avia.gov.ua/wp-content/uploads/2017/02/ED-07-10.pdf>
2. [Electronic source] AMC20-20 Continuing Structural Integrity Programme – Access mode: URL: <https://www.easa.europa.eu/certification-specifications/amc-20-general-acceptable-means-compliance-airworthiness-products-parts>