# TSB Recommendation A01-03

## Material flammability test requirements for aircraft wiring

The Transportation Safety Board of Canada recommends that a certification test regime be mandated that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition.

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| Air transportation safety investigation report | A98H0003 |
| Date the recommendation was issued | 28 August 2001 |
| Date of the latest response | May 2019 |
| Date of the latest assessment | March 2023 |
| Rating of the latest response | Fully Satisfactory |
| File status | Closed |

### Summary of the occurrence

On 02 September 1998, Swissair Flight 111, a McDonnell Douglas MD-11 aircraft, departed John F. Kennedy Airport in New York, New York, en route to Geneva, Switzerland. Approximately one hour after take-off, the crew diverted the flight to Halifax, Nova Scotia, because of smoke in the cockpit. While the aircraft was manoeuvring in preparation for landing in Halifax, it struck the water near Peggy's Cove, Nova Scotia, fatally injuring all 229 occupants on board. The investigation revealed that the flight crew had lost control of the aircraft as a result of a fire in the aircraft's ceiling area, forward and aft of the cockpit bulkhead.

On 28 August 2001, the Board released interim safety recommendations as part of its investigation (A98H0003) into this occurrence.

### Rationale for the recommendation

Irrespective of efforts to design, install and maintain an aircraft's wiring system to a high standard, deficiencies with wires will likely persist and present the potential for wire failures. While all wires will arc under certain circumstances, the dynamics of how a particular wire fails during an arcing event is highly dependent on the composition of the wire insulation.

Understanding the dynamics of how a wire will fail under realistic conditions would be valuable, given the known consequences of the failure of an energized wire. While the Federal Aviation Administration (FAA) endorses several failure tests (for example, the dry arc tracking test procedure), it does not require any failure tests as a basis for wire certification.

The Board believes that, given the incidence of aircraft wire failures and their role as potential ignition sources, the absence of a certification requirement that measures a wire's failure characteristics, and that specifies performance standards under realistic operating conditions, constitutes a risk.

Therefore, the Board recommended that

> a certification test regime be mandated that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition.
>
> **TSB Recommendation A01-03**

## Previous responses and assessments

### November 2001: response from Transport Canada

In its response of 08 November 2001, Transport Canada (TC) states that it agrees that evaluation of aircraft wiring should be based on realistic operating conditions. The Canadian Airworthiness Manual 525.1357 specifies the protection required against aircraft wiring faults and 525.1351(b) (4) requires the electrical system to be tested to ensure that transients due to electrical faults will not create a fire hazard.

The FAA has advised TC that it concurs with this recommendation and that the FAA has initiated a project to revise the standards for wiring performance and test requirements. The FAA Wire Systems Harmonization Working Group will identify requirements for wire system safety and the assessment methodology will include common mode analysis, safety zonal analysis and specific risk analysis. The FAA is also evaluating the requirement for the installation of arc fault circuit breakers to reduce the chance of ignition from an electrical fault.

TC is also participating in a FAA Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) that has identified a wire system certification requirement as a task to be studied in cooperation with industry and other airworthiness authorities. TC will take action after ATSRAC recommendations are made and an approach is adopted by airworthiness authorities for current operating aircraft and future certification programs.

TC will continue to cooperate in these research activities associated with aircraft electrical wire failure characteristics and will introduce, in harmonization with other airworthiness authorities, the appropriate changes to certification test requirements and standards that are required.

### March 2002: TSB assessment of the response (Satisfactory Intent)

In its response of 08 November 2001, TC states that it agrees that evaluation of aircraft wiring should be based on realistic operating conditions. However, TC falls short of endorsing the need for a certification test regime that evaluates aircraft electrical wire failure characteristics. In its response, TC references two sections of the Canadian Airworthiness Manual dealing with requirements for circuit protective devices and "transients" within electrical generating systems. As the recommendation deals with the adequacy of material flammability certification requirements for aircraft wire, it is uncertain why TC is referencing regulations that deal with overload protection.

According to TC, the FAA concurs with the recommendation and has initiated a project, under FAA's Wire Systems Harmonization Working Group, to revise the standards for wiring performance and test requirements. TC also advises that it is participating in the FAA's ATSRAC's task to study a wire system certification requirement.

These preliminary actions are considered an appropriate "first step" and the response is considered as **Satisfactory Intent**.

### December 2005: response from Transport Canada

In its update of active recommendations dated 14 December 2005, TC indicated that an update to Recommendation A01-03 was not available due to scheduling conflicts for some Swissair recommendation team members. Furthermore, TC indicated that an update will follow as soon as team members can meet and draft updates.

### July 2006: TSB assessment of the response (Satisfactory Intent)

Actions taken by the FAA have focused on re-organizing wiring-related Federal Aviation Regulations (FARs), on 05 February 2002, issuing a "wiring" policy letter, and conducting research and development on material flammability standards for wire insulation. Although TC's activity update of 14 December 2005 did not include any information regarding Recommendation A01-03, it is the Board's understanding that TC remains committed to its 08 November 01 response, which, if fully implemented, will reduce the safety deficiency described in Recommendation A01-03.

Therefore, the assessment remains at **Satisfactory Intent**.

### February 2007: response from Transport Canada

TC's response advises that it has initiated Canadian-specific rulemaking activities which will disposition into the Canadian regulatory framework the findings of FAA's Aging Transport Systems Rulemaking Advisory Committee. TC states that its rulemaking will include new Design Approval Holder requirements, specifically for type certificate and supplemental type certificate holders. These requirements would reference technical standards to ensure that an acceptable level of safety is maintained for the affected aeroplanes. TC's response does not

make reference to any initiative that would mandate a certification test regime for electrical wire as suggested in Recommendation A01-03.

### July 2007: TSB assessment of the response (Satisfactory in Part)

Although TC's response outlines its initiative with respect to the Aging Transport Systems Rulemaking Advisory Committee findings; however, the risks remain with respect to the lack a certification test regime for aircraft electrical wire failure characteristics as identified in Recommendation A01-03. The planned action will reduce but not substantially reduce or eliminate the deficiency.

Therefore, the assessment is changed to **Satisfactory in Part**.

### March 2008: response from Transport Canada

In its response of 6 March 2008, TC reviews the various initiatives undertaken to ensure that aircraft wiring systems are designed, maintained and modified for continuing operational safety. The results of these activities are now being considered for inclusion into the CARs to parallel the FAA's Aging Airplane Program.

### August 2008: TSB assessment of the response (Satisfactory in Part)

TC's response outlines its initiative with respect to the CARAC's Ageing Aeroplane Transport Systems Rulemaking Advisory Committee findings; however, the risks remain with respect to the lack of a certification test regime for aircraft electrical wire failure characteristics as identified in Recommendation A01-03. The planned action will reduce but not substantially reduce or eliminate the deficiency.

Therefore, the assessment remains as **Satisfactory in Part**.

### February 2010: response from Transport Canada

In its latest response, TC states that a Notice of Proposed Amendment (NPA) 2008-013, effective 11 May 2009, amends Part V - Airworthiness Manual Chapter 525 for transport category aeroplanes. Specifically, these amendments establish a new sub-chapter H - Electrical Wiring Interconnection Systems (EWIS) which provides comprehensive certification requirements including assessment of EWIS failure scenarios and consequential effects to other systems.

### July 2010: TSB assessment of the response (Satisfactory in Part)

The proposed amendments to Airworthiness Manual Chapter 525 do not specifically address the lack of a certification test regime for the evaluation of electrical wire failure characteristics as identified in Recommendation A01-03. Additionally, the response contains no definitive indication as to whether or not TC intends any future regulatory change that would require such a test regime. Therefore, the risks remain with respect to the lack of a certification test

regime for aircraft electrical wire failure characteristics. The action as stated in the response will reduce but not substantially reduce or eliminate the deficiency.

Therefore, the assessment remains as **Satisfactory in Part**.

### January 2011: response from Transport Canada

TC's latest update indicates that the completion of rulemaking on EWIS for Design Approval Document Holders is the number two priority on its Aircraft Certification Standards Domestic Regulation agenda. This activity would complete the rulemaking that amended Part V - Airworthiness Manual Chapter 525 for transport category aeroplanes in May 2009 which provided "flammability test requirements for wiring". An NPA is to be presented at the Canadian Aviation Regulation Advisory Council (CARAC) Technical Committee meeting in spring 2012.

### March 2011: TSB assessment of the response (Satisfactory in Part)

The flammability test requirements in TC's May 2009 amendments to Part V - Airworthiness Manual Chapter 525 appear to refer to flammability standards related to the EWIS itself rather than a certification test regime for the wires. These amendments do not establish a certification requirement that measures a wire's failure characteristics, and specifies performance standards under realistic operating conditions as stated in the preamble to Recommendation A01-03.

Other than to state that its next rulemaking activity will address EWIS requirements for Design Approval Document Holders, no information was provided about the content of the future NPA activity. Consequently, it is impossible to assess whether or not the NPA will mitigate the risks identified in Recommendation A01-03.

The risks remain with respect to the lack of a certification test regime for aircraft electrical wire failure characteristics. The action as stated in the response will reduce but not substantially reduce or eliminate the deficiency.

Therefore, the assessment remains as **Satisfactory in Part**.

### May and September 2011, March 2012: response from Transport Canada

#### May 2011 input

Transport Canada is continuing to pursue completion of the Aging Airplane Program – Continued Airworthiness and Safety Improvement (CASI) which includes completing rulemaking on Electrical Wiring Interconnection Systems (EWIS) for Design Approval Document Holders. Transport Canada plans to present an NPA to the CARAC Technical Committee in 2012.

**September 2011 update**

TC to provide clarification to the TSB in regards to the existence of flammability tests TC requires for wiring.

**March 2012 update**

On 28 March 2012, TC submitted an update stating the following:

> Continued work is planned for the fiscal year 2012/2013 in order to investigate possibilities to establish a certification test regime that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition.

### March 2012: TSB assessment of the response (Satisfactory in Part)

TC has indicated that continued work is planned for the fiscal year 2012–13 in order to investigate possibilities to establish a certification test regime that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition.

Therefore, the risks remain with respect to the lack of a certification test regime for aircraft electrical wire failure characteristics. The action as stated in the response will reduce but not substantially reduce or eliminate the deficiency.

The response is considered **Satisfactory in Part**.

### December 2012: response from Transport Canada

The issue of aging aircraft systems, including electrical wiring interconnection systems (EWIS), affects operators, maintenance organizations, design approval holders and competent authorities. It is applicable to all aircraft types and to both new aircraft designs and to the existing fleet.

As such, an integrated and holistic approach to addressing the safety concerns associated with transport airplane wiring, to characterize its propensity to become an ignition source and the flammability characteristics of wire insulation material has been the subject of industry and authority safety initiatives over the past decade. Transport Canada participated in many of the working groups formed under the FAA lead Aging Transport Systems Rulemaking Advisory Committee (ATSRAC). ATSRAC was tasked to "propose such revisions to the Federal Aviation Regulations and associated guidance material as may be appropriate to ensure that non-structural systems in transport airplanes are designed, maintained, and modified in a manner that ensures their continuing operational safety throughout the service life of the airplanes."

The recommendations of ATSRAC are now implemented in the FAA's Enhanced Airworthiness Program for Airplane Systems (EAPAS) rulemaking. Transport Canada has implemented a significant portion of the ATSRAC recommendations, especially the portions relating to

requiring design approval holders of certain transport category airplanes to develop and make available instructions for continued airworthiness (ICA) for the EWIS using the MSG-3 v2005.1 (or later version) enhanced zonal analysis procedure (EZAP). Operators of those applicable airplanes would incorporate those EWIS (EZAP) ICA into their maintenance or inspection programs, where these programs are updated annually in Canada pursuant to Part VI of the CARs.

As part of an ongoing communication campaign, Transport Canada recently published an ASL article on the above subject for consideration by design applicants for modifications and repairs to transport category aeroplanes: http://www.tc.gc.ca/eng/civilaviation/publications/tp185-6202.htm#fuel.

In consideration of fire risk associated with EWIS (including wiring) failures, there has been a two-prong approach. First, in regard to the flammability of the wiring insulation itself, TCCA has, with the FAA and industry, participated in the development of a test regime and criteria that realistically replicate in-service conditions. The subject regime, which is based on ignition / fire propagation under radiant heat conditions (as has been implemented to the flammability testing of thermal/acoustic insulation), has been validated against medium-scale test results and shown to effectively segregate between fire-worthy and non-fire-worthy wiring insulation types.

Second, through improved wiring maintenance and inspection practices, wiring is no longer considered to be a “fit and forget” installation. Rather, periodic visual and some detailed inspections of the wiring are conducted along with a new “clean and protect as you go” philosophy, as well as removing local combustible material that may be ignited by an electrical arc. With these methodologies, potential wiring degradation and fire hazards are identified and rectified in a more timely manner. The aim is to reduce the propensity for a fire to spread even if a wire failure were to result in an arc ignition source. The combined approach of attempting to reduce wire failures and removing combustible material is intended to provide a holistic solution to the scenario that was described in the Swiss Air 111 accident report.

Continued work is planned for the fiscal year 2012–13 and later years to fully implement all recommendations from ATSRAC and to harmonize with the EAPAS requirements, to the extent practicable. Again, it should be noted that elements of EAPAS are already codified in the CARs and standards. The regulatory development work will lead to proposals to address gaps that exist between the latest FAA final rules and current TCCA requirements.

### March 2013: TSB assessment of the response (Satisfactory in Part)

TC’s latest response provides a review of aircraft wiring-related actions planned or taken since receipt of Recommendation A01-03. As the Board has previously noted, most of these actions do not directly address the safety deficiency identified in Recommendation A01-03. Therefore, since 2005, the Board has assessed these cumulative efforts as Satisfactory in Part as these actions would not substantially reduce the safety deficiency associated with Recommendation A01-03.

Conversely, TC's 28 March 2012 response was exceptional in that it identified an initiative that dealt directly with the safety deficiency as stated in Recommendation A01-03:

Continued work is planned for the fiscal year 2012–13 in order to investigate possibilities to establish a certification test regime that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition.

The Board was encouraged by this promised activity as it would, if successfully implemented, lead to the establishment of a certification test regime that evaluates aircraft electrical wire failure characteristics. Unfortunately, TC's latest update has failed to inform the Board of TC's activities with respect to this initiative. While the Board is disappointed with this lack of information, it remains confident that TC is intent on accomplishing this work. Additionally, the TSB expects to be advised of both TC's findings and TC's next step to deal with the safety deficiency as identified in Recommendation A01-03.

Therefore, the risks remain with respect to the lack of a certification test regime for aircraft electrical wire failure characteristics. The action as stated in the response will reduce but not substantially reduce or eliminate the deficiency.

The response is considered **Satisfactory in Part**.

### November 2013: response from Transport Canada

As reported previously, Transport Canada addressed the issue with respect to newly designed aircraft by amending Chapter 525 of the Airworthiness Manual. Change 525-26, effective May 11, 2009, included new airworthiness (certification) requirements for Electrical Wiring Interconnection Systems (EWIS), which were adopted from FAR Amendment 25-123. These amendments established comprehensive certification requirements including assessment of EWIS failure scenarios and consequential effects to other systems.

Continued work is planned to:

- implement recommendations from Aging Transport Systems Rulemaking Advisory Committee (ATSRAC);
- harmonize with FAR Part 26 EAPAS-EWIS requirements, to the extent practicable;
- develop proposals to address gaps that exist between FAA final rules and current Transport Canada Civil Aviation requirements.

### April 2014: TSB assessment of the response (unable to assess)

Transport Canada's current response implies that it has addressed the issue identified in Recommendation A01-03 by its implementation of Chapter 525 Airworthiness Manual Change 525-16 (incorrectly identified as 525-26 in TC's response). While 525-16 adopts aircraft wiring-related requirements published by the FAA in FAR Amendment 25-123, it does not mandate that aircraft electrical wire undergo a certification test regime to determine its failure characteristics as stated in Recommendation A01-03.

Likewise, as neither the ATSRAC recommendations nor the FAR Part 26 EAPAS-EWIS requirements establish a certification test regime for aircraft wire, as described in Recommendation A01-03, the continued wire-related work related to these activities would appear to do little to mitigate this specific risk.

As the response lacks details, it is impossible to determine whether or not TC's proposals to address gaps between FAA final rules and current Transport Canada Civil Aviation requirements are, in any way, related to its 13 December 2012 declared intention to act as follows:

Continued work is planned for the fiscal year 2012–13 in order to investigate possibilities to establish a certification test regime that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition.

The Board accepts that improvements to wire-related regulations and maintenance practices will have a positive impact on the continuing airworthiness of an aircraft's electrical wire system.

The Board requires specific information about the status of this project. As TC's latest response contains no new information that would enable the Board to make a meaningful assessment as to whether the safety deficiency, as stated in Recommendation A01-03, will be reduced or eliminated, the response is rated as **Unable to Assess**.

### January 2015: response from Transport Canada

Transport Canada agrees with the intent of the recommendation and has pursued a two-pronged approach to meet the intent of recommendation A01-03.

First, methodologies and new best practices have been developed to help assure the continued fire-safety of wiring in-service. Second, an improved certification wiring flammability test regime has been developed that may better represent in-service conditions.

This two-prong approach has the goal of reducing wire failures, as well as to remove combustible material, and is intended to provide a holistic solution to the safety intent of recommendation A01-03.

Given the complex nature of this issue, Transport Canada would appreciate the opportunity to brief the Board to more fully elaborate on the department's response to this recommendation.

### March 2015: TSB assessment of the response (unable to assess)

Transport Canada's response provides no new information that would enlighten the Board as to what, if any, progress has been made to establish a certification test regime to mitigate the risks associated with the deficiency as described in Recommendation A01-03.

In the past, the Board has noted positive changes with respect to the organization and harmonization of aircraft wire-related regulations and improvements to the continuing airworthiness requirements of an aircraft's electrical wire interconnect system. However, the status quo remains, in that present certification test requirements only measure the capacity of an electrical wire to propagate a flame and not its propensity to fail, under realistic operating conditions, and initiate a fire.

As with its April 2014 reassessment, the Board is unable to make a meaningful assessment whether the safety deficiency associated with Recommendation A01-03 will be reduced or eliminated; the response is rated as **Unable to Assess**.

### November 2015: response from Transport Canada

Transport Canada (TC) agrees with the intent of the recommendation and has pursued a two-pronged approach to meet the intent of Recommendation A01-03.

In January 2015, TC offered to brief the Board on this complex issue, but the briefing has not been staged. TC still believes that this complex technical issue is best understood in a face-to-face discussion, and requests an opportunity to brief the Board to more fully elaborate on the department's response to this recommendation.

### March 2016: TSB assessment of the response (unable to assess)

Transport Canada's latest response reiterates the position that, in order to mitigate the risks associated with Recommendation A01-03, its two-pronged approach would suffice. As described in previous assessments, the Board understands that an improved wire insulation flammability test regime and electrical wiring interconnection systems maintenance practices would enhance the continued airworthiness of installed wiring. Unfortunately, this approach, as described in previous updates, does not satisfy the need for a mandated certification test regime that would evaluate aircraft electrical wire failures as called for in Recommendation A01-03.

As with its April 2015 assessment, the Board is unable to make a meaningful assessment as to whether the safety deficiency associated with Recommendation A01-03 will be reduced or eliminated. Therefore, the response rating remains **Unable to Assess.**

### January 2017: response from Transport Canada

The certification test regime for aircraft electrical wire is complex. TC, as detailed in previous updates, considers this recommendation satisfied. TC renews its offer to brief the Board and their staff on the initiatives implemented to address the safety deficiency underlying this recommendation.

### March 2017: TSB assessment of the response (unable to assess)

TC's response provides no new information that would inform the Board as to why it has not advocated for the development of a certification test regime for aircraft electrical wire. Instead,

TC considers that its two-pronged approach has sufficiently mitigate the risks associated with the safety deficiency identified in Recommendation A01-03. While the Board understands that the two-pronged approach is designed to ensure the continued fire-safety of in-service wiring, it does not view this as a substitute for an aircraft wire certification test that quantifies a wire's propensity to fail under realistic operating conditions. Stating that the complexity of the solution precludes clarification in writing, TC proposes to explain its position directly to the Board.

In the interim, the Board is unable to make a meaningful assessment as to whether the risks associated with the safety deficiency identified in Recommendation A01-03 are reduced or eliminated.

Therefore, the response to Recommendation A01-03 is assessed as **Unable to Assess.**

## Latest response and assessment

### May 2019: response from Transport Canada

TC agrees with the intent of the recommendation.[1]

In January 2015, following the reassessment of TC' s response as Unable to Assess, TC requested an opportunity to brief the Board to fully elaborate on the Department's response to this recommendation as this is a complex technical issue that is best explained through a face-to-face discussion. To date, TC's offer to brief the Board is outstanding.

### March 2023: TSB assessment of the response (Fully Satisfactory)

In its response, Transport Canada (TC) indicated that it agrees with the intent of the recommendation.

Since the publication of Recommendation A01-03, a number of actions have been taken by TC and the United States Federal Aviation Administration (FAA) to address the safety deficiency identified in this recommendation, regarding mandating a certification test regime that evaluates aircraft electrical wire failure characteristics under realistic operating conditions and against specified performance criteria, with the goal of mitigating the risk of ignition. These actions include the following:

- Shortly after the issuance of Recommendation A01-03, the FAA launched the Aging Transport Systems Rulemaking Advisory Committee (ATSRAC), in which TC participated. This committee was tasked to "propose revisions to the *Federal Aviation Regulations* and associated guidance material as may be appropriate to ensure that non-structural systems in transport airplanes are designed, maintained, and modified in a

[1] All responses are those of the stakeholders to the TSB in written communications and are reproduced in full. The TSB corrects typographical errors in the material it reproduces without indication but uses brackets [ ] to show other changes or to show that part of the response was omitted because it was not pertinent.

manner that ensures their continuing operational safety throughout the service life of the airplanes."

- In 2009, TC amended Part V - *Airworthiness Manual* Chapter 525 for transport category aeroplanes, establishing a new Sub-chapter H: Electrical Wiring Interconnection Systems (EWIS), which provides comprehensive certification requirements, including assessment of EWIS failure scenarios and consequential effects to other systems.
- In 2012, the FAA had implemented ATSRAC's recommendations in its Enhanced Airworthiness Program for Airplane Systems rulemaking. TC had also implemented a significant portion of the ATSRAC recommendations, especially the portions relating to requiring design approval holders of certain transport category airplanes to develop and make available instructions for continued airworthiness for the EWIS using the MSG-3 v2005.1 (or later version) enhanced zonal analysis procedure.
- In 2012, TC published an article in the *Aviation Safety Letter*, Issue 1/2012, entitled "Fuel Tank Safety and Electrical Wiring Interconnection Systems – Considerations for Transport Airplane Modification and Repair Design."
- In consideration of fire risk associated with EWIS failures, over the last decade, TC undertook a two-prong approach:
    - Improved wire insulation flammability test regime - TC, the FAA, and industry participated in the development of a test regime and criteria that realistically replicated in-service conditions regarding the flammability of wiring insulation. The subject regime, which is based on ignition/fire propagation under radiant heat conditions (as has been implemented to the flammability testing of thermal/acoustic insulation), has been validated against medium-scale test results and shown to effectively segregate between fire-worthy and non-fire-worthy wiring insulation types.
    - EWIS systems maintenance practices - Wiring maintenance and inspection practices have been improved to enable the identification and rectification of potential wiring degradation and fire hazards in a timely manner. As indicated in TC's update in December 2012, wiring is no longer to be considered to be a "fit and forget" installation. Periodic visual and detailed inspections of the wiring are conducted along with a "clean-and-protect-as-you-go" philosophy, as well as removing local combustible material that may be ignited by an electrical arc.

The Board believes that the actions taken by TC and the FAA have effectively addressed the risks identified in Recommendation A01-03. In addition, the Board acknowledges that similar actions have been adopted by the European Union Aviation Safety Agency (EASA). Of note, EASA issued the following three *Easy Access Rules for Acceptable Means of Compliance (AMC) for Airworthiness of Products, Parts and Appliances*: AMC 20-21 – Programme to Enhance Aeroplane Electrical Wiring Interconnection System (EWIS) Maintenance, AMC 20-22 – EWIS Training Programme, and AMC 20-23 – Development of Electrical Standard Wiring Practices documentation. These AMCs are based on the recommendations submitted to the FAA by ATSRAC, as well as relevant FAA regulations and advisory circulars.

Therefore, the Board considers the response to Recommendation A01-03 to be **Fully Satisfactory.**

## File status

This deficiency file is **Closed**.