6.3.4 Fuel system components

The temperatures of the fuel system components should also be evaluated considering the failure of the bonding straps.

6.3.5 Pneumatic system

Pneumatic system temperatures need to be evaluated for the effects of duct ruptures impinging on the external tank surface. Radiant and conducted heat transfer associated with the tank and components affecting tank wall temperatures should also be considered (see the previous discussion of spaces adjacent to fuel tanks).

6.3.6 Electrical defects and arcing

Electrical defects that generate excessive heat, and arcing at the electrical connections to the pump housing or within the connector.

6.3.7 Submerged heat exchangers

Submerged heat exchangers and supply tubing operating under conditions of maximum heat rejection to the fuel. This should include failures in any systems outside the fuel tank that could result in heat exchanger or supply tubing surface temperatures exceeding 204 °C (400 °F).

6.3.8 Failed or aged seals

6.3.8.1 Spraying of fuel in the tank from any pressurised fuel source may cause electrostatic charging of the components in the fuel tank. In addition, the use of sealant in connectors that is not compatible with the fuel may allow leakage into the connector and the possibility of a fire near the connector.

6.3.8.2 Fuel line couplings

Ageing of seals may result in hardening of the seal material and leakage and spraying of fuel within the fuel tank; therefore, fuel line coupling designs should be evaluated and a design life should be established for all seals that are shown to age and allow leakage that can cause unacceptable electrostatic charging of components.

6.3.9 Fuel pump cooling flow

Fuel used for the cooling of fuel pumps may be sprayed from the fuel pump. Fuel pump cooling flow should not be sprayed into the fuel tank vapour space for the same reason as stated in 6.3.8 for the spraying of fuel. Means should be provided to distribute the discharged cooling fuel into the fuel tank at or near the bottom of the fuel tank.

6.3.10 Explosion-proof electrical connector sealant and seals

Electrical connections to fuel pumps are typically located either inside or outside the fuel tank in areas of the aeroplane where the presence of flammable fuel vapour should be assumed because no secondary sealing of fuel is provided. Fuel leakage and corrosion at electrical connectors located outside the fuel tank has allowed the presence of both flammable vapour and electrical arcing at connectors, resulting in fires. In other applications, arcing has occurred at the pump connections inside the fuel tanks, requiring the installation of appropriately sized steel shields to prevent arcing through the connector or pump housing into the fuel tank or areas where flammable vapour could exist.

6.3.11 Arcing at the pump electrical connections

Wear, corrosion, manufacturing variability (e.g. tolerances), connector distortion and seal damage from ice, and bent pins in the connector are examples of failures that have caused high resistance or shorting and arcing in electrical connectors. Based upon historical data showing that these and other failure modes listed previously in this AMC have occurred in fuel pump connectors, arcing in the connectors is a foreseeable failure. Each of these single or cascading failure modes should be included in the FMEA. The high current loads present during pump start-up and operation exacerbate arcing in the connector. The size and duration of the arcing event should be established based upon the fuel pump electrical circuit protection features. Arcing at the pump electrical connections, and the resultant damage to the pump connector, housing, and explosion-proof features due to intermittent, and maximum energy, arcing events should be assumed. If fuel is present on the backside of the connector, failures resulting in fuel leakage in conjunction with arcing in the connector should be assumed if the fuel leak is a latent failure or is the result of a cascading failure. The design of traditional fuel pumps has resulted in the need to install AFCB or GFI protection features to address foreseeable failures and limit the energy release during an arcing event to prevent an ignition source from occurring. The pump connector should be shown to contain any resultant arcing or fire and to maintain all surface temperatures below the auto-ignition temperature of the fuel. Component manufacturer maintenance records and qualification test results should be reviewed as part of the safety analysis process to establish that any sealants and materials in the connector are compatible with the operating environment and to determine whether a design life or periodic inspections for the pump connector are needed.

7 AIRWORTHINESS LIMITATIONS FOR THE FUEL TANK SYSTEM

7.1 CS-25 Appendix H, paragraph H25.4(a)(2) requires that each mandatory replacement time, inspection interval, related inspection procedure, and all the CDCCLs approved under CS 25.981 for the fuel tank system, be included in the Airworthiness Limitations Section of the ICA.

7.2 Critical design configuration control limitations include any information necessary to maintain those design features that were defined in the original type design as being needed to preclude the development of ignition sources. This information is essential to ensure that maintenance, repairs, or alterations do not unintentionally violate the integrity of the original fuel tank system type design. The original design approval holder should define a method to ensure that this essential information will be evident to those that may perform and approve repairs and alterations. Visual means to alert the maintenance crew should be placed in areas of the aeroplane where inappropriate actions may degrade the integrity of the design configuration. In addition, this information should be communicated by statements in the appropriate manuals, such as wiring diagram manuals.

7.2.1 CDCCLs may include any maintenance procedure that could result in a failure, malfunction, or defect endangering the safe operation of the aeroplane, if not performed properly or if improper parts or materials are used. This information is essential to ensure that maintenance, repairs, or alterations do not unintentionally violate the integrity of the original type design of the fuel tank system.

7.2.2 CDCCLs are intended to identify only the critical features of a design that must be maintained. CDCCLs have no intervals; they establish configuration limitations to maintain and to protect the 'critical design features' identified in the CDCCLs. CDCCLs can also include requirements to install placards on the aeroplane with information about the critical features. For example, certain components of a fuel pump (or all the components) may include critical features that are identified as CDCCLs. These critical features must be identified in the Airworthiness Limitations Section of the ICA and should also be identified in the component maintenance manual (CMM) as CDCCLs to provide awareness to maintenance and repair facilities.

7.2.3 Certain CDCCLs apply to elements of fuel system components. As such, maintenance of those critical features may be covered in a CMM. When Airworthiness Limitations need to call out aspects of CMMs, it is a best practice to limit the CDCCL-controlled content to only those maintenance tasks directly impacting a CDCCL feature, rather than requiring the complete CMM to be a CDCCL.

7.3 Any fuel tank system components that are determined to require periodic maintenance, inspection, or overhaul to maintain the integrity of the system or maintain protective features incorporated to preclude a catastrophic fuel tank ignition event must be defined and included in the Airworthiness Limitations Section of the ICA. An inspection Airworthiness Limitation has a specific task and interval (such as 10 years). The inspection interval should be established based on the standard practices defined in AMC 25.1309 for the evaluation of component failures. The inspection could also be required following maintenance to verify that a CDCCL feature is maintained. Examples of inspection Airworthiness Limitations include the following:

7.3.1 Ageing fuel line coupling seals/o-rings

In certain instances, the materials used in fuel line couplings may lose flexibility and harden with age. Under pressurised operation, the seal may allow fuel leakage. This will allow spraying of fuel in the tanks or other areas of the aeroplane where spraying fuel could create a fire hazard. Repetitive inspections, functional checks, or mandatory replacement intervals may be required to prevent leakage.

Note: While not related to compliance with CS 25.981, the hazards associated with the ageing of fuel coupling O-rings, resulting in air entering fuel lines during suction feed operation, should also be addressed when developing the fuel system maintenance program.

7.3.2 Wear of pump bushings, bearings, and seals

Wearing of pump bushings, bearings, and seals may significantly affect the performance of fuel pumps and degrade the features necessary to maintain the explosive-proof qualification. In most cases, these failure conditions are latent; therefore, incorporation of other fail-safe features, as discussed earlier in this AMC, should be considered. If fail-safe features, such as the installation of feeder tanks that are filled using ejector pumps, are incorporated, the functioning of those features would need to be ensured by indications or periodic functional tests. The installation of fuel level sensors in the feeder tanks would provide continuous monitoring of the function. Another means could be the installation of flow indicators in the flow line of the ejector pump that can be viewed by maintenance personnel, and a mandatory periodic inspection of this function is one example of a method of a mandatory maintenance action.

7.3.3 Fuel pump electrical power protective features

If a failure of an AFCB or GFI protective feature and/or a thermal fuse (closed) is latent and this feature is needed to maintain the fail-safe features, periodic checks would likely be needed. The inspection interval, and the need for built-in test features with indications of failures, should be established through the safety analysis process and should consider the factors described in paragraph A.3.4.3 of Appendix A to this AMC.

7.3.4 Transient suppression/energy limiting devices

If a failure of the device is latent and this feature is needed to maintain the fail-safe features, periodic checks will likely be needed.

7.3.5 Wire shield grounding

Component grounds and wires will likely require inspections and measurements to determine whether they are properly grounded.

7.3.6 Fuel tank access panel/door seals

Maintenance tasks should adequately provide procedures for inspections and checks of access panels and door seals.

7.3.7 Corrosion, wear, and damage to fuel pump connectors

Maintenance tasks should provide adequate procedures for inspecting and checking fuel pump connectors for wear, corrosion, and damage.

7.3.8 Integrity of the fuel pump electrical supply conduit

Maintenance tasks should provide adequate procedures for inspecting the integrity of the structure, sealing, drain holes, and bends of the electrical supply conduit to the fuel pump.

7.4 Maintainability of design and procedures

Maintainability, both in the design and procedures (i.e. the master minimum equipment list, aeroplane maintenance manual, etc.), should be verified by the applicant. This should include, as a minimum, verification that the system and procedures support the safety analysis assumptions and are tolerant to the anticipated human errors.

7.5 Incorporation by reference into Airworthiness Limitations

7.5.1 Where the words 'in accordance with' or 'per' are used in the Airworthiness Limitations, the procedures in the referenced document must be followed to ensure that the critical design feature is maintained. Any changes to these procedures require approval by EASA before they can be used.

7.5.2 Where the words 'refer to' are used in the Airworthiness Limitations, the procedures in the referenced document represent one method of complying with the Airworthiness Limitation. An accepted alternative procedure may be developed by the operator in accordance with its procedures in its maintenance program/manual. Prior approval by EASA is not required for this action.

7.6 Visible identification of CDCCLs

7.6.1 CS 25.981(d) establishes a requirement for visibly identifying the critical features of a design that are located in certain areas. The DAH should define a method of ensuring that this essential information will be communicated with statements in the appropriate manuals, such as wiring diagram manuals, so it will be evident to those who perform and approve such repairs and alterations, and it will be identified as a CDCCL.

7.6.2 An example of a CDCCL that would result in a requirement for visible means would be maintaining wire separation between the FQIS wiring and other high-power electrical circuits where the separation of the wiring was determined to be a CDCCL. Acceptable methods of providing visible means would include colour coding and labelling the wiring. For retrofits of markings onto existing wiring, the placement of identification tabs at specific intervals along the wiring would be acceptable. Standardisation within the industry of the colour coding of the wiring used for the fuel tank system would assist maintenance personnel in the functional identification of wiring. It is recommended to use pink coloured wiring as a standard for fuel tank system wiring.

Appendix A. Certification of Arc Fault Circuit Breakers (AFCBs) or Ground Fault Interrupters (GFIs)

A.1 PURPOSE

This Appendix provides guidelines for the certification of AFCB or GFI devices that have been shown to be practical means to protect the circuits of electric-motor fuel pumps and other fuel tank components that use higher than intrinsically safe electrical power (for example, motor-operated valves).

A.2 BACKGROUND

A.2.1 Service experience has shown that failures in the power supply circuit of a fuel pump, discussed in the body of this AMC, can result in ignition sources and, therefore, must be assumed as a foreseeable failure condition. Traditional thermal circuit breakers are sized to prevent nuisance trips during fuel pump transient power demands and have not tripped when intermittent electrical arcs occurred. Intermittent arcing can erode metallic barriers such as conduits, electrical connectors, and the pump housing, resulting in a loss of the integrity of the explosion-proof features, or creating ignition sources outside in areas adjacent to the fuel tank. Addressing the failure modes discussed in this AMC has resulted in the need to provide fast-acting GFI or AFCBs in traditional fuel pump electrical circuits in order to show compliance with CS 25.981.

A.2.2 AFCBs have been used as a practical means to protect against arcing in the power circuits of fuel pump motors powered by either alternating current or direct current. SAE International has issued two aerospace standards for AFCBs, one for alternating current circuits and one for direct current circuits. (See paragraph B.3 of Appendix B of this AMC).

A.2.3 Fuel pump housings and metallic conduits are grounded to the airframe, and any arcing to the cavity wall or conduit creates a ground fault. Therefore, GFIs have been used in AC pump power circuits as a practical means to ensure that power is quickly disconnected from the fuel pump in the event of a ground fault in the pump or the associated power wiring.

A.3 CERTIFICATION GUIDELINES

One acceptable means for the applicant to show compliance with the applicable regulations is to demonstrate, through design, review, analysis, and test, that the AFCB or GFI performs as intended under any foreseeable operating conditions and addresses the following guidance:

A.3.1 Fault detection trip levels

A.3.1.1 The applicant should show that the AFCB or GFI can distinguish between actual fault events and events characteristic of the normal aeroplane pump start-up operating loads and environmental conditions. Laboratory testing and/or aeroplane ground/flight testing should be performed to show the 'intended function' of the AFCB or GFI. The test methods chosen should reproduce the most common types of arcing in fuel pumps that occur in an aeroplane environment due to ground or arc faults. The AFCB or GFI should be designed to prevent nuisance tripping due to normal aeroplane electrical loads and electrical bus switching, and to operate continuously with the normal and abnormal aeroplane electrical bus switching characteristics associated with the master minimum equipment list dispatch relief configurations.

A.3.1.2 Installation of the AFCB or GFI should not result in an appreciable increase in the loss of the fuel pump function. A reliability requirement of the order of 100 000 hours mean time between failures may be satisfactory, but the applicant should show that a failure of the AFCB or GFI does not result in an appreciable increase in the occurrence of failures that result in the loss of fuel pump function.

A.3.1.3 Sufficient laboratory testing and aeroplane testing should be conducted to show the AFCB or GFI nuisance trip performance, including tests for lightning, HIRF, and electromagnetic compatibility. In addition, sufficient laboratory testing should be conducted to show that the AFCB or GFI trips before arcing in the fuel pump can lead to the ignition of fuel vapour in the fuel tank.

A.3.1.4 A means should be provided to latch the AFCB or GFI in a state that removes power from the fuel pump motor in the event that a ground fault has been detected, until the AFCB or GFI is reset. A trip of a single AFCB or GFI should not be reset until the reason for the trip has been determined and repaired, or until it has been determined that no ground fault exists. Intermittent arcing can cause tripping of circuit protection devices resulting from failures that are difficult to isolate during maintenance actions. Single trip events may be attributed to a nuisance fault. However, maintenance instructions should include notes that state that repeated tripping of devices indicates that an intermittent fault exists, and the circuit should not be energised until the fault is isolated and repaired.

A.3.2 Software

Inadvertent operation of multiple AFCB or GFI devices has the potential to affect the continued operation of more than one engine, a condition that EASA considers to be hazardous. The software used by the AFCB or GFI devices should be developed and verified in accordance with the latest version of AMC 20-115.

A.3.3 Airborne electronic hardware

Application-specific integrated and complex circuits used by the AFCB or GFI devices should be developed and tested in accordance with the latest version of AMC 20-152.

A.3.4 System safety assessment

A.3.4.1 AFCB or GFI devices may be installed in circuits that perform essential or critical functions, and/or their performance could impact the safety of flight. The applicant should perform an installation SSA in accordance with CS 25.901(c), 25.981(a) and (d), and 25.1309. The SSA should include a functional hazard assessment to determine the effects of failures of the AFCB or GFI devices on the safety of the aeroplane and to verify that the design limits the probability of undesirable failure conditions to acceptable levels. In addition, the applicant should address the potential for possible common cause trips due to hardware/software errors and common cause trips due to environmental conditions such as HIRF (CS 25.1317), lightning (CS 25.954 and 25.1316), and electromagnetic interference (CS 25.1301, and 25.1353(a)).

A.3.4.2 A failure to provide fuel pump power due to the unintended activation of multiple AFCB or GFI devices has the potential to affect the continued operation of more than one engine. A circuit-protective device failure, cascading failure, or common cause failure that affects multiple engines would be non-compliant with CS 25.903(b) if it prevents the continued operation of the remaining engines, or requires immediate crew action to prevent a multiple engine power loss.

A.3.4.3 A failure of an AFCB or GFI device to detect an arc or ground fault condition in a fuel pump circuit can contribute to a catastrophic failure condition. Assuming that the loss of the explosion-proof features of the pump (examples discussed in paragraph A.2.1) or arcing at the electrical connector could result from a single failure, EASA considers the undetected failure of an AFCB or GFI alone, which prevents its detection of or response to an arc or ground fault, to be a hazardous failure condition. The probability of a loss of arc or ground fault protection should either be shown to be extremely remote (if latent, consistent with the requirement of CS 25.981(a)(3)) or annunciated to the flight crew prior to flight. If failures of the AFCB or GFI can contribute to hazardous or catastrophic failure conditions, the safety assessment should analyse the common cause failures or design errors that could result in these conditions and verify that appropriate protection to prevent them is provided. Due to the nature of AFCB and GFI devices, special attention should be given to protection from lightning, EMI, and HIRF.

A.3.4.4 As discussed in Section A.3.7 below, means should be provided for the flight crew to reset the AFCB or GFI in the event that more than one fuel pump AFCB or GFI trips simultaneously in flight.

A.3.4.5 Further, the applicant should show by design, analysis, and fault insertion testing, if applicable, the validity of failure analysis assumptions, and show that the probability of the failure of AFCB or GFI to detect the existence of a ground or arc fault condition and remove power from a pump is extremely remote (10^{-7} or less) when combined with a single failure as assumed in Section A.3.4.3. In order to show this, AFCB and GFI installations have typically required an automatic built-in test feature that verifies the AFCB or GFI is operational before applying power to the fuel pump prior to each flight (see Section 5.3.3 of this AMC).

A.3.5 Power and ground requirements

AFCBs or GFIs are active devices and they require power to function. The applicant should show that the AFCB or GFI power and ground connections are implemented such that all the aeroplane's load margins are sufficient and that proper circuit protection or other methods are used to protect the AFCB or GFI power and ground wiring. The applicant should also show that there are no hazards to maintenance or flight crews due to possible hot shorts to electrical panels containing AFCBs or GFIs. In addition, if the installation of AFCBs or GFIs involves the direct replacement of devices on a given electrical panel, the applicant should show that there is adequate power/heat dissipation and ensure a safe touch temperature.

A.3.6 Built-in test

AFCB and GFI devices should incorporate the built-in test and annunciation features needed to meet the reliability requirements for showing compliance with CS 25.981(a)(3). For example, if a single or cascading failure in the fuel pump electrical circuit can result in an ignition source, a circuit protection feature failure rate less than extremely remote (1×10^{-7}) would be required in order to comply with CS 25.981. Traditional protective devices without built-in tests and annunciations of failures have not been shown to achieve this level of reliability. Applicants should consider installing multiple protective devices in series or providing built-in tests with annunciation.

A.3.7 Troubleshooting procedures

A.3.7.1 Because AFCBs or GFIs are capable of detecting ground paths on pumps and aeroplane wiring that may not be detected by visual inspection, the applicant should define the operational and maintenance philosophies and the methodology associated with an AFCB or GFI trip that does not rely solely on visual inspections. The applicant should show how the maintenance procedures would be able to safely distinguish and diagnose an AFCB or GFI trip and a nuisance trip without causing a fuel tank explosion. Operational instructions and maintenance procedures should be provided to prevent the resetting of tripped AFCBs or GFIs until it can be assured that resetting an AFCB or GFI will not cause the occurrence of a fuel tank explosion. Human factors should be taken into account to minimise the possibility of human errors during aeroplane operation and maintenance.

A.3.7.2 If multiple boost pumps are protected with AFCB or GFI devices such that the continued operation of multiple engines could be affected, there should be a means for the flight crew to reset tripped AFCB or GFI devices in flight. A loss of fuel pump capability due to inadvertent tripping in some fuel tanks could result in a loss of the fuel reserves needed to complete an extended operations (ETOPS) flight or a safe diversion. To prevent causing an ignition source, the applicable aeroplane flight manual should contain a limitation against the reset of a single AFCB or GFI. However, in order to address common cause inadvertent tripping, procedures should be provided for resetting AFCB or GFI devices when multiple AFCBs or GFIs have tripped simultaneously in flight.

A.3.8 Hardware qualification

Environmental testing — including thermal, shock and vibration, humidity, fluid susceptibility, altitude, decompression, fungus, waterproof, salt spray, and explosion-proof testing — should be performed in accordance with EUROCAE ED-14G/RTCA DO-160G or equivalent standards. The applicant should define an insulation, dielectric, and electrical grounding and bonding standard acceptable to EASA for the AFCBs or GFIs. Appropriate test categories in each section of EUROCAE ED-14G/RTCA DO-160G should be chosen based on the AFCB or GFI installation environment defined for the specific aeroplane. Particular attention should be given to the normal and abnormal power input tests outlined in Section 16 of EUROCAE ED-14G/RTCA DO-160G. A system with AFCBs or GFIs installed must comply with CS 25.954 and CS 25.1316 for lightning protection, CS 25.1301 and CS 25.1353(a) for electromagnetic compatibility, and CS 25.1317 for HIRF.

A.3.9 Aeroplane tests

The applicant should show by ground tests, flight tests, or both that all the AFCBs or GFIs remain armed during both normal and abnormal electrical power bus and load switching as described in paragraph A.3.1.1 of this AMC, and are not adversely affected by the operation of other aeroplane systems. The aeroplane tests should also show that neither the AFCBs nor the GFIs would produce electromagnetic interference that would affect other aeroplane systems.

A.3.10 Instructions for Continued Airworthiness (ICA)

A.3.10.1 The applicant must submit the ICAs required by CS 25.1529 in order to provide the necessary procedures to service and maintain AFCB or GFI installations. As required by Appendix H to CS-25, H25.4, the Airworthiness Limitations Section of the ICA must include each mandatory replacement time, inspection interval, related inspection procedure, and all the critical design configuration control limitations (CDCCLs) approved under CS 25.981 for the AFCB or GFI installation. Inspection intervals determined from the safety analysis should be included for the detection of latent failures that would prevent the AFCBs or GFIs from tripping during a ground or arc fault event.

A.3.10.2 AFCBs or GFIs used for showing compliance with the CS 25.981 requirements for preventing ignition sources are typically CDCCLs in these installations. As required by CS 25.981(d), the applicant must provide visible means of identifying the AFCB or GFI as a CDCCL and should provide design features to minimise the inadvertent substitution of an AFCB or GFI with a non-AFCB or GFI device.

A.3.11 Aeroplane flight manual limitations

The aeroplane flight manual limitations section should address any limitations related to the intended function of the AFCBs or GFIs and any self-test features of the AFCB or GFI design.

Appendix B. Related Documents

B.1 EUROCAE Documents

— EUROCAE ED-14G Change 1 ‘Environmental Conditions and Test Procedures for Airborne Equipment’, dated January 2015.

— EUROCAE ED-79A ‘Guidelines for development of civil aircraft and systems’, dated December 2010.

— EUROCAE ED-107A ‘Guide to Certification of Aircraft in a High Intensity Radiated Field (HIRF) Environment’, dated July 2010.

B.2 RTCA Documents

— RTCA DO-160G, ‘Environmental Conditions and Test Procedures for Airborne Equipment’, 6 December 2010.

B.3 SAE International Documents

— AIR1662A, 'Minimization of Electrostatic Hazards in Aircraft Fuel Systems', dated August 2013.

— ARP4404C, 'Aircraft Electrical Installations' (guidance document for design of aerospace vehicle electrical systems).

— ARP4754A, 'Certification Considerations for Highly Integrated or Complex Aircraft Systems', dated December 2010.

— ARP4761, 'Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment', dated December 1996.

— ARP5583A, 'Guide to Certification of Aircraft in a High Intensity Radiated Field (HIRF) Environment', dated June 2010.

— AS50881F, 'Wiring Aerospace Vehicle' (procurement document used to specify aerospace wiring; replaces MIL-W-5088), dated May 2015.

— AS5692A, 'ARC Fault Circuit Breaker (AFCB), Aircraft, Trip-Free Single Phase and Three Phase 115 VAC, 400 Hz - Constant Frequency', dated December 2009.

— AS6019, 'ARC Fault Circuit Breaker (AFCB), Aircraft, Trip-Free 28 VDC', dated June 2012.

B.4 Military Specifications

MIL-STD-810H, Environmental Engineering Considerations and Laboratory Tests, dated January 2019.

B.5 Other Industry Documents

— Air Force Aero Propulsion Laboratory Technical Report AFAPL-TR-75-70, Summary of Ignition Properties of Jet Fuels and Other Aircraft Combustible Fluids, dated September 1975, http://www.dtic.mil/get-tr-doc/pdf?AD=ADA021320.

— ASTM D2155-12, Standard Test Method for Determination of Fire Resistance of Aircraft Hydraulic Fluids by Autoignition Temperature.

— ASTM D4865, Standard Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems, August 2009.

— ASTM E659-15, Standard Test Method for Autoignition Temperature of Chemicals, ASTM International.

— NASA Report NASA/TM-2000-210077, Some Notes on Sparks and Ignition of Fuels, dated March 2000, https://ntrs.nasa.gov/search.jsp?R=20000053468.

— National Fire Protection Association NFPA 77, Recommended Practice on Static Electricity, latest edition, http://www.nfpa.org.

— Underwriters Laboratories Inc., UL 913, Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, III, Division 1, Hazardous (Classified) Locations, dated 31 July 2006, https://standardscatalog.ul.com/standards/en/standard_913_8.

Appendix C. Definitions

C.1 ARC FAULT CIRCUIT BREAKER (AFCB)

A device that provides thermal circuit breaker protection, detects electrical arcing faults, and interrupts electrical power to the fault. (See paragraph B.3 of this AMC for the SAE standards for alternating current and direct current AFCBs.)