

**DEPARTMENT OF CIVIL AVIATION
MALAYSIA
AIRWORTHINESS NOTICE**

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ELECTRICAL CABLE FAILURE

1. In a well documented occurrence, damage to the insulation of electrical cables, caused by defective circuit identification printing, was a contributory factor to a significant aircraft system electrical fault in flight. The incorrect application of hot stamp printing resulted in excessive penetration of insulation and a group of individual cable damage sites coincided physically in a loom. Fluid from a leaking toilet waste system contaminated the cables in the damaged area and severe electrical arcing occurred which was of sufficient intensity to rupture the damaged cables and also others in close proximity.
2. Study of pertinent factors has indicated that in addition to avoiding damage to cables during installation, modification or repair activity, there is a need for vigilance in the following areas:-
 - (a) Fluid contamination of electrical equipment is obviously to be avoided but it is particularly necessary to appreciate that certain contaminants, notably that from toilet waste systems (which is saline) and fluids which contain sugar, such as sweetened drinks can induce electrical tracking of degraded electrical cables and unsealed electrical components.
 - (b) Cable looms are particularly vulnerable to liquid contamination because they can provide a drainage path. Care should be taken to route cables away from known areas of possible leakage but, should contamination occur, cable looms must be thoroughly cleaned and dried and any unsealed electrical items removed to workshops for examination.
 - (c) In areas where it is not possible to provide segregation between electrical cables and pipes which carry fluid, it is good design practice to keep pipe joints to an unavoidable minimum. The fitment of drip shields or drained enclosures to joints in liquid waste system is recommended.
 - (d) The DCA will pay additional attention to the quality control of hot printing applied by cable users and will expect to see appropriate testing of cables after printing. The preferred method of ensuring that the insulation of printed cable has not been degraded is to employ a. High Voltage Test using one of the systems defined in the British Standards BS G.230 Test 16. Continuous testing is not required provided an adequate sample is tested whenever any machine setting is altered, including changes of alpha numeric characters.
 - (e) It is important to note that hot stamp printing may only be applied on to cable types and sizes which have been certified as capable of accepting such marking. Cable manufacturers whose products have approval under BCAR Section A. Chapter A3-3 procedures are able to give appropriate guidance on a Declaration of design and Performance (DPP) and they will be able to advise on suitable test and inspection methods.
3. It has been further reported that certain types of widely used cable insulations are susceptible to "arc track" when seriously abused in service. The failure detailed in paragraph 1 related to a wet 'arc tracking condition and designers of installations should be aware that in addition of the factors noted in paragraph 2, it is recommended that cable selection should include evaluation of "wet-arc tracking" characteristics. BS G.230 defines test conditions for aircraft electrical cables and Test 42 provides a test regime which facilitates comparison between cable types. Cable manufacturers are evaluating their existing products using Test 42 criteria and in consequence some new cable constructions have been developed.
4. A failure mode which has been established by laboratory testing and widely canvassed, is that of 'dry arc tracking', which is a secondary failure condition resulting from the short circuiting of cables. The primary aim of the testing was to explore "battle damage" failure but it may be postulated that cable to cable abrasion or other 'cut through' faults can permit intense local heating at power levels which are well within the short term no-trip characteristic of the associated electrical protection. In such conditions some insulation materials can form a conducting char and if this extends to cables not involved in the original fault a 'cascade' failure may develop. The DCA, CAA and other agencies are seeking to establish if this failure mechanism has any relevance to civil aircraft beyond placing further emphasis on the need for good design, installation and maintenance of electrical interconnect systems.
5. Personnel engaged in servicing of aircraft are reminded that the discovery of a potentially hazardous failure condition during maintenance or fault finding may well justify the raising of a Mandatory Occurrence Report (MOR) in the context of this Notice, any disruptive failure of electrical cables would warrant such a report. Physical evidence should be retained for investigation.