Technical Airworthiness Authority Advisory (TAA Advisory)	
Title	**Installation of Miscellaneous Non-Required Equipment**
TAA Advisory Number	**2006 – 04e-v2**
Effective Date	**29 SEPTEMBER 2006 (REVISED 20 DECEMBER 2013)**
Reference	**TAM Part 2, Chapter 1, Section 3**
OPI / Telephone	**DTAES 3 / 819-939-4810**
RDIMS File	**2182D-1027-812-6 – VOL 1** **#561886 (English)** **#587397(French)**

1. Purpose

1.1 This Technical Airworthiness Authority (TAA) Advisory provides clarification and guidance pertaining to the installation of miscellaneous, non-required electrical, electronic and mission equipment in the Department of National Defence (DND) aircraft.

1.2 This TAA Advisory is not mandatory nor does it constitute a regulation. It describes a means acceptable to the TAA, but is not the only means to demonstrate compliance with the regulation(s). If you elect to use this Advisory, then all the important aspects of it must be followed.

2. Applicability

2.1 The TAA Advisory is applicable to organizations involved with the certification of miscellaneous, non-required equipment in military aircraft, which have a basis of certification derived from the Federal Aviation Regulations (FAR). This TAA Advisory is not applicable to systems or equipment, which provide flight essential functions or information required for safe flight and landing of the aircraft. Although portions of this material is applicable to the certification of military armament/weapon/stores systems, this TAA Advisory is not intended to address the certification requirements associated with the safe carriage, jettison and release of energetic material.

3. Related Material

3.1 Definitions:

a. Non-required equipment: Those equipment whose function is not required (essential) for the safe flight and landing of the aircraft. The installation and operation of this equipment must not have an adverse affect on the correct operation of the other required aircraft equipment.

b. Energetic Material: Refers to the explosives and pyrotechnic material contained in military weapons/stores associated equipment, (e.g. torpedoes, bombs, sonobuoys, flares, etc.).

c. Fail-safe: Fail-safe is defined as the design feature of a part, unit or equipment that allows the item to fail only into a non-hazardous mode.

3.2 Regulatory References

3.2.1 FAR Advisory Circulars (AC):

a. FAA AC 20.152 - Design Assurance Guidance for Airborne Electronic Hardware;

b. FAA AC 23.1309 - Equipment, Systems, and Installations in Part 23 Airplanes;

c. FAA AC 25.10 - Guidance for Installation of Miscellaneous, Non-required Electrical Equipment;

d. FAA AC 25.1309-1 - System Design Analysis; and

e. FAA AC 29.2C Section 1309 - Certification of Transport Category Rotorcraft.

3.2.2 Industry Documents:

a. Radio Technical Commission for Aeronautics (RTCA) document DO-160, Environmental Conditions and Test Procedures for Airborne Equipment;

b. ARP 4754–Certification Considerations for Highly-Integrated or Complex Aircraft Systems;

c. ARP 4761–Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment;

d. RTCA DO-178B-Software Considerations in Airborne Systems and Equipment Certification;

e. RTCA DO-254; and

f. SAE AS50881 Wiring Aerospace Vehicle.

3.2.3 Government Documents:

a. MIL-STD-704E–Electrical;

b. MIL-STD-810F–Environmental;

c. MIL-STD-461E / MIL-STD-464A – EMI/EMC/EME;

d. MIL-HDBK-5400 General Guidelines for Electronic Equipment, Airborne;

e. MIL-HDBK-454A Safety Design Criteria-Personnel Hazards; and

f. MIL-STD-1472E Human Engineering.

3.2.4. Related sections of FARs, which may apply to installations of miscellaneous non-required equipment, are provided in Annex 1 for rotorcraft and Annex 2 for fixed wing aircraft. As military mission equipment covers a wide range of equipment types and functions the listings in the Annexs are not to be considered all-inclusive. Each installation must be considered on a case by case basis and applicable FAR requirements assessed as necessary to ensure safe flight and landing of the aircraft.

4. Discussion

4.1 Although mission equipment installed in a DND aircraft may not be essential for the safe operation of the aircraft, all of the systems and equipment installed on a DND aircraft must be certified to demonstrate the safe carriage and operation of the equipment. Examples of miscellaneous, non-required electrical/electronic equipment installed on civil aircraft include video projection systems, in-flight entertainment systems, telephones, galley equipment, aerial cameras and logo lights. In addition to the equipments found in civil aircraft, military aircraft may be fitted with a wide-range of mission equipment. Examples of mission equipment include, Tactical Radars, Tactical Computers/Displays, Tactical Communication Systems and Self-protection Systems (RWR, Flare/Chaff, IR and RF Jammers).

4.1.1 Although the functioning of these military mission equipment may be essential for the aircraft to perform its military mission and perhaps survival in a military threat environment, during peace-time training and operations these equipment are defined as ‘non-essential’ or not required for the aircraft to safely take-off, fly and land.

4.1.2 An important factor in military non-required equipment is the interaction with the flight crew, which unlike civilian non-required equipment must be considered in the assessment and certification of military mission equipment. Military mission equipment may provide a display of tactical data to the flight crew, which could conflict with primary flight data leading to hazardous misleading information. Mission equipment may provide tactical alerts, which must be reconciled with the Advisory Caution and Warning System on the aircraft. Operation and control of mission equipment may require input of the flight crew, which must be assessed from an overall cockpit crew workload perspective. In

addition the responses of the flight crew from the out of mission equipment must be assessed from a safe flight and landing perspective. In some cases, conflicts will occur between mission performance and safety requirements, which can only be reconciled through detailed standard operating procedures for the mission equipment and proper training of the flight crew.

4.1.3 This TAA Advisory provides guidelines in the crashworthiness, structural, electrical, and EMI areas sufficient to substantiate the installation of the components themselves; however, it does not address concerns such as the approval of hydraulic/plumbing systems, fire containment and stowage capacities which may be applicable to the units as a whole. Annex 3 provides more detailed procedures, which may be considered necessary where heavy electrical loads and higher temperatures are involved in the equipment installations.

4.2 Acceptable Means of Compliance.

4.2.1 Functions and Installation. As described in Section 1301 of the applicable FAR, each item of installed equipment must be installed according to the limitations specified for that equipment. This section of the FARs also requires that the equipment function properly when installed. However, certification of non-required equipment does not require a demonstration of equipment function unless the equipment has a function or mode where it is possible for that equipment to create a hazard to the safe flight and operation of the aircraft.

4.2.2 The means to address the usual fire, electrical and electromagnetic interference hazards associated with the installation and operation of miscellaneous electrical equipment are provided in this advisory. However, some military mission equipments may have operating modes, which, if a malfunction or failure were to occur, would constitute a hazard to the aircraft. Examples of such hazards include the following:

a. Rescue Hoist - Uncommanded Guillotine;

b. Rescue Hoist - Payout of rescue cable;

c. Dipping Sonar Submersible Unit - Cable Runaway;

d. Dipping Sonar Submersible Unit - Uncommanded Guillotine;

e. Dipping Sonar Submersible Unit - Unable to raise;

f. Weapon or Store - Inadvertent Release; and

g. Weapon or Store - Inability to Jettison.

4.2.3 System Safety - Hazard Assessment. Where an item of equipment has a failure mode(s), which could result in a hazard to the aircraft, compliance with FAR 29.1309(b) must be demonstrated. Accordingly, non-required equipments and systems must be designed to prevent hazards to the aircraft in the event of a malfunction or failure. As described in the associated Advisory Circular for Section 1309 of the applicable FAR the Functional Hazard Assessment (FHA) methodology provided in SAE ARP 4761 must be used to identify hazardous conditions and determine their criticality level. Based on the criticality level indicated by the FHA, safety objectives or Development Assurance Levels (DAL) must be determined. The methodology provided in SAE ARP 4754 must be used to identify the appropriate development assurance levels. The ARP 4761 System Safety Assessment (SSA) methodology must be used to demonstrate that the resulting equipment design and installation satisfies the required development assurance levels.

4.2.4 Within complex electronic systems, functions may be allocated to the software or hardware elements of the system. The System Safety Process identifies the appropriate DAL level. RTCA DO-178B is the standard and means to be used to demonstrate that the required Development Assurance Level has been met for software and RTCA DO-254 for hardware.

4.2.5 In the case of an airplane design or design alteration limited to the installation of miscellaneous, non-required equipment, an acceptable means of compliance with the applicable airworthiness regulations is as follows:

a. The installation must be able to withstand the flight, ground, and emergency landing conditions without failures. This may be demonstrated by tests or analyses;

b. The flammability requirements of the applicable FAR should be met for materials used in non-electrical components, or materials external to a metal enclosure (which will contain a fire) used for electrical components;

c. For all the flammability tests, there must be a TAA-approved test plan, conformity of test specimens and witnessing of the test by a TAA-approved Finding Authority. A TAA-approved Finding Authority must verify that the article or product being tested conforms to approved data or processes or material specifications.

d. Wire added to the airplane must have self-extinguishing insulation equal to or better than that originally approved under the airplane type certificate, unless it is inside an enclosure, which is sufficiently airtight, that internal-combustion cannot be sustained;

e. Electrical equipment and wiring installations must meet the applicable requirements listed in paragraph 3.2.4 of this advisory. An adequate electrical load analysis should be performed for the electrical equipment, taking into account load shedding, if provided. Except where obviously impractical, components should be housed in metal enclosures which either will contain an internal fire, or are sufficiently airtight that internal combustion cannot be sustained. Equipment safety grounds should be separate from electrical circuit grounds. Circuit protective devices should be provided such that a fault in the non-required system does not cause a failure of a required system;

f. Electromagnetic Interference (EMI) tests, if required, must have been performed on the subject equipment in accordance with RTCA DO-160B, Environmental Conditions and Test Procedures for Airborne Equipment, or equivalent requirements approved by the TAA. Tests performed in accordance with RTCA DO-160B, paragraph 21.0 are Conducted Radio Frequency (RF) Interference and Radiated RF Interference tests, both are done to the category "I" level, unless it can be shown that the equipment location can justify a lower level. In addition, the evaluation should include a cockpit EMI survey with the subject equipment in operation, as in paragraph 4.7 (l)(4) of this Advisory;

g. Wires and wire bundles should be identified in accordance with AC 43.13-1A, Acceptable Methods, Techniques and Practices, Aircraft Inspection and Repairs or SAE AS 50881;

h. Equipment incorporating a Cathode Ray Tube (CRT) should meet minimum X-ray radiation requirements of the applicable Canadian Health and Welfare publications or TAA-approved equivalent requirements. Installations that have been modified by removing shielding material from or around the CRT should be retested to the above requirements;

i. Because of the possibility of airplane decompression, a means must be provided for either the automatic removal of power from all components containing a CRT or the installation of a barometric switch for each component using a CRT. Unless the high voltage circuits and components have been shown to be free of arcing under appropriate environmental tests specified in RTCA DO-160, or equivalent tests receiving prior approval by the TAA;

j. Impact and implosion protection for a CRT should be verified in accordance with Underwriter's Laboratories document UL 1418 dated May 5, 1976 (formerly 492.8), paragraphs 13.2 and 14.5, or later Underwriter’s Laboratories revisions or TAA-approved equivalent requirements. Underwriter's Laboratories labels that certify compliance with the above is attached to most U.S. and foreign manufactured CRT based appliances;

k. Verification by test, where testing (ground or flight) is used as a means of demonstrating compliance to any of the BoC requirements, then the testing must be accomplished in accordance with a TAA-approved test plan. A TAA-approved Finding Authority must witness the test;

l. The interference tests for installed equipment should be performed in accordance with the following:

(1) Equipment Installation. The equipment should be installed in accordance with manufacturer's installation instructions. Visually inspect all the installed equipment to determine that industry standard workmanship and engineering practices were used. Verify that all mechanical and electrical connections have been properly made and that the equipment has been located and installed in accordance with the manufacturer's recommendations. The wire insulation temperature rating should also be considered;

(2) Power Input. Unless otherwise specified, tests should be conducted with the equipment powered by the airplane's electrical power generating system;

(3) Associated Equipment or Systems. Unless otherwise specified, all electrically operated equipment and systems on the airplane must be on and operating before conducting interference tests;

(4) Interference Effects. The effects on interference should be evaluated as follows:

(a) The equipment shall not be the source of harmful conducted or radiated interference or adversely affect other equipment or systems installed in the airplane;

(b) With the equipment energized on the ground, individually operate other electrically operated equipment and systems on the airplane to determine that no significant conducted or radiated interference exists. Evaluate all reasonable combinations of control settings and operating modes. Operate communications and navigation equipment on at least one low, mid and high-band frequency. Make note of systems or modes of operation that should also be evaluated during flight; and

(c) For airplane equipment and systems that can be checked only in flight, determine that no operationally significant conducted or radiated interference exists. Evaluate all reasonable combinations of control settings and operating modes. Operate communications and navigation equipment on at least one low, mid and high-band frequency.

m. Electromagnetic compatibility problems, which develop after installation of this equipment, may result from such factors as design characteristics of previously installed systems or equipment, and the physical installation itself. It is not intended that the equipment manufacturer should design for all installation environments. The installing facility will be responsible for resolving any incompatibility between this equipment and previously installed equipment in the airplane. The various factors contributing to the incompatibility should be considered. Special attention should be given to assure that the added systems do not affect the reliability of a flight essential system.

Note

Ground EMI tests have consistently been found adequate for follow-on approvals of like or identical equipment types, irrespective of the aircraft model used for the initial approval. Radio frequency transmission devices, such as wireless telephones, should also be tested with respect to their transmission frequencies and harmonics.

ANNEX 1
TO TAA ADVISORY 2006-04e
DATED 29 SEPTEMBER 2006

Applicable FAR Requirements Installation of Miscellaneous Non-required Equipment on Rotorcraft

Item	FAR 29	Subject
1	29.301	Loads
2	29.303	Factor of safety
3	29.305	Strength and deformation
4	29.307	Proof of structure
5	29.333	Flight envelope
6	29.471	Ground Loads, General
7	29.561	Emergency Landing Conditions, General
8	29.853	Compartment Interiors
9	29.1301	Function and installation
10	29.1309	Equipment, systems, and installation
11	29.1351	Electrical systems and equipment
12	29.1353	Electrical equipment and installations
13	29.1357	Circuit protective devices
14	29.1359	Electrical system fire and smoke protection
15	29.1431	Electronic equipment
16	29.1581	Flight Manual
17	Annex A to Part 29	Instructions for Continued Airworthiness
18	29.610	Lightning and static electricity protection
19	29.143	Controllability and manoeuvrability
20	Annex C to Part 29	Icing Certification
21	29.631	Bird Strike

ANNEX 2
TO TAA ADVISORY 2006-04e
DATED 29 SEPTEMBER 2006

Applicable FAR Requirements Installation of Miscellaneous Non-required Equipment on Fixed Wing Aircraft.

Item	FAR 25	Subject
Basic Requirements		
1	25.301	Loads
2	25.303	Factor of safety
3	25.305	Strength and deformation
4	25.307	Proof of structure
5	25.333	Flight envelope
6	25.471	Ground Loads, General
7	25.561	Emergency Landing Conditions, General
8	25.853	Compartment Interiors
9	25.1301	Function and installation
10	25.1309	Equipment, systems, and installation
11	25.1351	Electrical systems and equipment
12	25.1353	Electrical equipment and installations
13	25.1357	Circuit protective devices
14	25.1359	Electrical system fire and smoke protection
15	25.1431	Electronic equipment
16	25.1581	Flight Manual
17	Annex A to Part 25	Instructions for Continued Airworthiness
18	25.143	Controllability and manoeuvrability
19	Annex C to Part 25	Icing Certification
20	25.629	Aeroelastic Stability requirements
21	25.631	Bird Strike

ANNEX 3
TO TAA ADVISORY 2006-04e
DATED 29 SEPTEMBER 2006

Installation of Miscellaneous Non-required Equipment

1. Electrical Loads Analysis:
   a. Determine that required electrical power is available to power non-required equipment;
   b. Considering the additional mission equipment loads, the electrical power sources must be able to supply power to the essential loads after failure of:
      (1) Any one engine on two-engine aircraft; and
      (2) Any two engine on three-or-more-engine aircraft.
   c. To comply with the applicable requirements for the essential power source, heavy non-required equipment loads must be either automatically or manually reduced under a monitoring procedure to prevent or suppress overloading.
2. Wiring Instructions:
   a. Review Circuit Analysis to determine:
      (1) The wire size and circuit breaker rating is compatible with the electrical load;
      (2) On 3-phase AC power systems, the load distribution is divided evenly among the phases; and
      (3) The electrical connections are in accordance with the manufacturer's instructions.
   b. Determine that the wire used has:
      (1) Self-extinguishing insulation;
      (2) Insulation types, suitable for expected environmental temperature conditions; and
      (3) Proper identification.
   c. Determine that components used have:
      (1) Proper identification;
      (2) Proper electrical rating for application;
      (3) Proper environmental rating (heat, moisture, vibration, mechanical shock, etc.); and
      (4) Quality of hardware suitable for the application.
3. Installation Requirements:
   a. Wire Mechanical Protection:
      (1) Ensure that wire support clamps are of the proper quantity and in the proper location;
      (2) Provide grommets for wire feed-through holes (except metal parts also require support clamps); and
      (3) Ensure that power feeder cables comply with the applicable FAR requirement (i.e. FAR 25.1359 or 29.1359).
   b. Protection from Fluids and Condensation:

(1) Ensure that electrical equipment and terminals are protected from lint, dripping fluids and condensation;

(2) Ensure that connectors are provided with wire drip loops to prevent fluid drainage into connector or equipment; and

(3) Ensure that conduits and sleeving upper ends are sealed to prevent fluid from entering. Also, ensure that drain holes are provided to prevent moisture entrapment.

c. Grounding and Bonding:

(1) Ensure that safety-grounding paths of metal portions of non-required equipment are direct to airframe;

(2) Ensure that electrical circuit return is electrically bonded to airplane structure separately from the safety ground;

(3) Ensure that metallic water lines and faucets are safety grounded to the airplane structure;

(4) Ensure that ground studs are built-up using proper methods; and

(5) Ensure that separate ground studs are used for AC and DC circuits.

d. Human Engineering - Hazard Protection Considerations:

(1) Personnel hazards shall be minimized through compliance with MIL-STD-1472, Section 5.13 (Hazards and Safety);

(2) The aircraft installation design for all electronic equipment shall provide fail-safe features for the safety of personnel during the installation, operation, maintenance and repair or interchanging of a complete equipment assembly or component parts thereof;

(3) Equipment power switches shall be so selected and located that accidental contact by personnel will not place equipment in operation;

(4) Thermal Contact Hazards:

(a) At an ambient temperature of 25°C, the operating temperature of control panels and operating controls will not exceed 49°C; and

(b) Exposed parts, other than control panels and operating controls, subject to contact by operating personnel, will not exceed 60°C.

(5) The aircraft installation design shall incorporate methods to protect personnel from inadvertent contact with voltages capable of producing shock hazards;

(6) The design of equipment will incorporate methods to protect personnel from accidental contact with voltages in excess of 30-volt root mean square (RMS) or DC during normal operation of the equipment;

(7) All contacts, terminals and like devices having voltages between 70 and 500 volts RMS or DC with respect to ground shall be guarded from accidental contact by personnel if such points are exposed to contact during direct support or operator maintenance;

(8) Assemblies operating at potentials in excess of 500 volts shall be completely enclosed from the reminder of the assembly and equipped with non-by passable interlocks;

(9) High voltage circuits and capacitors will be provided with discharging devices unless they discharge to 30 volts or less within two seconds after the power is removed from the equipment;

(10) Electrical connectors shall be selected to ensure that the operator/maintainer is not exposed to electrical shock or burns when normal disconnect methods are used. Exposed pin contacts shall not be energized (hot) after being disconnected from the socket contacts;

(11) Materials will be chosen with due consideration for operator, equipment and environmental safety;

(12) Highly toxic materials are defined as materials that produce corrosive r deleterious fumes or produce gases that combine with the atmosphere to form an acid or corrosive alkali. Highly toxic materials shall not be used in fabrication, maintenance, or support of the aircraft installation design. The aircraft installation design shall not contain any of the following materials:

(a) Liquid mercury;

(b) Mercury salts;

(c) Mercury vapour (except for trace amounts used in cold cathode fluorescent lamps in the proposed design);

(d) Any part that has been exposed to mercury contamination;

(e) Poly-vinyl chloride (PVC) (except the use of poly-vinyl chloride (PVC) film in capacitors in the proposed design);

(f) Asbestos and asbestos composite materials;

(g) Uranium and depleted uranium;

(h) Lead, (except in batteries and the use of lead in wire harness terminations and circuit card assembly soldered components in the proposed design);

(i) Beryllium; (except the use of beryllium alloys as part of an electrical/electronic assembly)

(j) Magnesium and magnesium alloys; and

(k) Carcinogenic substances and processes, including cadmium compounds (except the use in cadmium plating and alodining of parts).

(13) Explosive and other dangerous materials shall not be used. The materials that liberate gases, which combine with the atmosphere to form an acid or corrosive alkali, shall not be used. The materials that liberate toxic or corrosive fumes shall not be used. The materials that liberate gases, which may produce an explosive atmosphere, shall not be used;

(14) Equipment incorporating heaters should have over-temperature protection;

(15) Equipment incorporating fluid heaters should have over-temperature protection and pressure safety valves with overflow provisions;

(16) Storage compartments should pass the fire containment test per FAR 29.853(e);

(17) Storage compartments should not be subject to excessive temperatures;

(18) Lighting system ballast failures must not provide hazardous quantities of smoke. High temperature ballast failures can be prevented by internal fusible links: and

(19) Electromagnetic Interference Considerations. Interference tests should include the activation of relays, rectifiers and inverters as applicable;