



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

**Subject: Guidance for Selecting Chemical
Agents and Processes for Depainting
and General Cleaning of Aircraft
and Aviation Products**

**Date: 9/25/98
Initiated by: AFS-340**

**AC No: 43-205
Change:**

1. PURPOSE. This Advisory Circular (AC) contains guidance (test methods, acceptance criteria, and process changes) for qualifying alternative chemical agents and/or processes used in depainting or general cleaning of aviation products. Like all AC material, this AC in itself is not mandatory, and does not constitute a regulation. It is issued to describe an acceptable means, but not the only means, for selecting and testing alternatives to chemical agents and/or processes currently required by some manufacturers' maintenance instructions, including instructions for continuing airworthiness.

2. BACKGROUND. The National Emission Standards for Hazardous Air Pollutants (NESHAP) for Aircraft Manufacturing and Rework Facilities applies to major sources and limits the amount of certain chemical agents used by aerospace facilities in depainting and cleaning aviation products. Methylene chloride and methyl ethyl ketone are the most prevalent of these used. The standards became effective September 1, 1998. Federal Aviation Administration (FAA) regulations require that aerospace facilities follow the manufacturers' maintenance manuals, or other acceptable methods, which may specify use of the same chemicals which the NESHAP would limit. Substitution of alternative chemicals without tests and an acceptable application process could result in damage to the aircraft and loss of airworthiness.

3. DISCUSSION. This AC is intended to apply industry wide and as a guide when selecting alternative maintenance chemical agents and/or processes to ensure that these chemical agents or processes, when used in accordance with the manufacturer's instructions, will not degrade the airworthiness of the aircraft or aviation product to which they are applied.

a. Each certificated person engaged in aviation maintenance is responsible for ensuring that, when an alternative chemical agent or process is applied to an aircraft or aircraft product, the results are equivalent to the original manufacturer's maintenance requirements. A record of the tests used to determine equivalency must be made available to the Administrator upon request.

b. Per Title 14 of the Code of Federal Regulations (14 CFR) part 43, section 43.13 for tasks where use of FAA-approved maintenance data is required, changes in agents/processes must be approved by the FAA. Repairs covered by Airworthiness Directives (AD) are examples of such tasks. The usual procedure for obtaining approval of these changes is to submit a request for an

alternative means of compliance (AMOC) to the appropriate Flight Standards District Office (FSDO) or Manufacturing Inspection District Office (MIDO). The FSDO or MIDO will review the application for completeness and forward it with recommendations to the Aircraft Certification Office (ACO) for approval or disapproval. Flight standards inspectors will review AMOC requests to confirm that they comply with established directives.

c. The tests and substantiation criteria herein can assist aerospace facilities in requesting an AMOC where the manufacturer has not specified an alternative. When a manufacturer's maintenance instructions are revised to include alternative chemical agents and/or processes, any facility performing maintenance or rework on that aviation product can use those alternatives.

d. In the future, the FAA intends to only issue new AD's, requiring the use of chemical agents and/or processes that are regulated by the NESHAP, when there is no other acceptable method of accomplishing the action required by the AD. However, there remain a number of AD's already published which require the use of such agents. For such cases, the AMOC procedure described above is applicable.

e. For tasks which do not require the use of FAA-approved maintenance data, changes in materials/processes can be specified by the manufacturer through service bulletins, service letters, maintenance instructions, etc., and are accepted by the FAA. If the manufacturer has not produced such documents, changes may be selected from a chemical or process testing facility. A record of the tests used to make the determination that the airworthiness is not degraded (per the criteria herein) must be made available to the Administrator upon request.

4. COMMON TESTS AND ACCEPTANCE CRITERIA. This section (Tables 1 and 2) documents the common testing criteria from a select number of sources for qualifying depainting and general cleaning agents for aviation products. The sources used for identifying the common test criteria were taken from applicable military, Society of Automotive Engineers (SAE), and aircraft industry standards. The depainting testing procedures identified in this document are for agents used for removing paint from metal surfaces. The cleaning agents testing procedures identified are for agents used for general cleaning of painted and unpainted surfaces.

a. Vendors interested in marketing their agents to the aerospace industry need to have their agents tested and certified by an independent laboratory before making the agent available to the industry.

b. Table 1 may be used by the mechanic as guidance in establishing the testing criteria for the agent. The mechanic should then have the agents tested by an independent laboratory, if not previously accomplished by the vendor.

5. COMMON TESTING PROCEDURES FOR GENERAL AIRCRAFT CLEANING MATERIAL AND FOR PAINT REMOVAL MATERIAL. Common testing procedures and acceptance criteria for general cleaning agents and for paint removal agents have been identified based on a comparison of the testing and acceptance criteria outlined as follow: The common testing procedures are presented in Table 1. The common acceptance criteria are presented in Table 2.

Table 1: Accepted Testing Methods for Aircraft Depainting and General Cleaning Materials

	Corrosion			Hydrogen Embrittlement ASTM F 519	Effect on Painted Surfaces ASTM F 502	Acrylic Craze Test ASTM F 484	Residue ASTM F 485
	Dissimilar Metals Corrosion Test MIL-R-81294	Sandwich Corrosion Test ASTM 1110	Immersion Corrosion Test ASTM F 483				
Paint Removal Material	X	X	X	X			
General Aircraft Cleaning Material		X	X	X	X	X	X

Table 2: Acceptance Criteria for Aircraft Depainting and General Cleaning Materials

	Corrosion			Hydrogen Embrittlement ASTM F 519	Effect on Painted Surfaces ASTM F 502	Acrylic Craze Test ASTM F 484	Residue ASTM F 485
	Dissimilar Metals Corrosion Test MIL-R-81294	Sandwich Corrosion Test ASTM 1110	Immersion Corrosion Test ASTM F 483				
Paint Removal Material	No pitting, etching, and corrosion	Rating not worse than 1 (See ASTM 1110)	Avg. weight loss of metals not to exceed 10 mg.	Per ASTM-519			
General Aircraft Cleaning Material		Rating not worse than 1	Avg. weight loss of metals not to exceed 10 mg.	Per ASTM-519	Material shall not decrease in film hardness greater than 1 pencil and no staining	Material shall not crack, craze or stain acrylic	Material shall leave no residue or stain

6. NOTES, CAUTIONS, AND WARNINGS. This section provides general precautions that should be observed when using chemical cleaning agents or chemical depainting agents for

general aircraft maintenance. The notes, cautions, and warnings listed are not meant to be an exhaustive list. The compounds included in chemical cleaning and depainting agents will change as alternatives are developed, and along with new agents will come new warnings and precautions.

NOTE: Aviation manufacturer's instructions, notes, warnings, and cautions addressing the agents must be followed to ensure no harm is caused to the products, parts, equipment, or appliances.

a. Chemical Agents Used For General Aircraft Cleaning.

(1) Warnings: Personal Protection.

(a) Protective clothing should be worn when working with chemical cleaning and/or chemical depainting agents. Avoid skin contact. Wear rubber gloves, chemical or splash proof goggles and water resistant boots. If cleaner is splashed in the eyes, rinse thoroughly in fresh water for 20 minutes and report to a medical facility. Remove clothing saturated with chemical agent immediately and flush exposed skin areas with fresh water.

(b) Use cleaning agents in a well ventilated area. Contact a safety office regarding respiratory protection.

(c) Cleaning agents are slippery. Maintenance stands should be used, where practical. Safety harness and safety lines should be used when standing on upper surfaces of aircraft during cleaning operations.

(d) Before cleaning electrical and avionic equipment, make sure electrical power is disconnected. Injury or death may otherwise result.

(2) Warnings: Use Of Chemical Cleaning Agents.

(a) Open all circuit breakers associated with battery power (refer to applicable aircraft manuals) prior to application of flammable solvents.

(b) Do not use synthetic wiping cloths with flammable agents. Wiping cloths made of natural materials such as cotton should be used.

(c) Agents should not be applied with atomizing spray equipment. This is not only hazardous, but violates environmental regulations in most areas.

(d) Keep all agents away from open flames, any live electrical circuit, or potential sources of electrical arcing. Ensure that residual agents are removed from the aircraft, engine bays, and equipment.

(e) Do not mix any cleaning agent with any solvent. The added agents may create a fire hazard, a serious disposal problem, or both, and may cause damage to nonmetallic products, parts equipment or appliances.

(f) Do not use cleaning compounds at higher concentrations than what is recommended. Do not allow cleaning agents to dry on aircraft surfaces. Such practices can cause streaking and damage aircraft finishes and components.

(g) To prevent entrapment of water and cleaning agents inside aircraft parts and structural areas, all drain holes, flap valves, etc., should be opened before washing to ensure that proper drainage occurs.

(3) Warnings: Ammonium Hydroxide. When using Ammonium Hydroxide do not breathe vapors and avoid skin contact. Wash immediately if such contact occurs.

(4) Cautions: Use of Chemical Cleaning Agents.

(a) Do not use excessive amounts of cleaning agents on control cables. The agent can remove internal lubricant. To avoid excessive amounts of the agent, wipe cables with a clean cloth dampened with the agent.

(b) Cover tires during cleaning of wheel wells in order to protect tires from contact with cleaning solutions.

(5) Cautions: Hydrogen Embrittlement.

(a) When high strength steels, some high strength aluminum, and some stainless steels are exposed to acid paint removers, plating solutions, other acidic conditions (cleaners, etc.) even some alkaline agents, cathodic reaction on the metal surface produces hydrogen, which diffuses into the bulk metal, accumulating at grain boundaries that weaken the structure. If the part is under a load or contains residual manufacturing stresses, sudden catastrophic failure can occur and the part may no longer sustain internal and/or applied stresses. Hydrogen embrittlement has been known to occur in parts stressed to only 15 percent of nominal tensile strength.

(b) When there is a possibility of high strength steels, aluminum, or stainless steel incurring any exposure to solutions or materials which can cause hydrogen embrittlement, each part of steel, aluminum, or stainless steel subject to the hydrogen embrittlement process must be totally protected from that exposure.

(c) Any alternative solutions or materials that are selected, and eventually receive approval for use that have the potential for causing hydrogen embrittlement, must be prevented from contacting all metals discussed in the previous paragraph in the same manner.

(6) Cautions: Ammonium Hydroxide. When using Ammonium Hydroxide, do not allow any agents to contact aircraft wiring. Flush immediately with fresh water if such contact occurs.

(7) Notes: Ozone Depleting Substances.

(a) Ozone depleting substances (ODS) are agents such as, but not limited to 1,1,1 trichloroethane (aka methyl chloroform) and trichlorotrifluoroethane (aka Freon 113 or CFC-113 or R-113). These agents are still used in some aircraft maintenance processes. Alternative agents continue to be identified, but some applications still requiring their use include: high pressure oxygen systems and some avionics equipment cleaning.

(b) Many products are being sold as replacements for 1,1,1 trichloroethane or trichlorotrifluoroethane, but there is no universal replacement. Although commercial cleaners may perform as well or better than 1,1,1 trichloroethane or trichlorotrifluoroethane, these materials may be corrosive to aircraft alloys. Also, fast evaporating substitutes are very flammable, with the exception of Hydrocarbon Fluorocarbons (HCFC) which are also scheduled for phaseout. Read warning and caution labels on product containers carefully.

b. Chemical Agents Used For Aircraft Depainting.

(1) Warnings: Personal Protection.

(a) Chemical strippers are toxic and contain ingredients harmful to skin and eye tissues.

(b) Protective clothing should be worn when working with chemical cleaners and/or chemical depainting agents. Avoid skin contact. Wear rubber gloves, chemical or splash proof goggles and water resistant boots. Remove clothing saturated with chemical agents immediately. Prolonged skin contact with agents containing organic agents can damage affected skin areas.

(c) Prolonged breathing of vapors from organic solvents, or materials containing organic solvents, is dangerous. Use a cartridge respirator in confined areas and ensure good ventilation.

(2) Warnings: Use of Chemical Depainting Agents.

(a) All seams must be masked and protected from chemical agents during aircraft depainting.

(b) No eating, drinking, or smoking should be allowed in areas where paint removers or solvents are being used or stored.

(c) Never exceed the manufacturer's recommended temperature for heating and/or maintaining depainting agents.

(d) Containers of chemical paint removers are under pressure, even when cold. If pressure is not bled off slowly the agent may splatter violently.

(e) Whenever possible, paint removal should be accomplished in a corrosion control facility. If such a facility is not available, ensure adequate ventilation.

(f) Extra effort must be made when rinsing the aircraft after depainting, to ensure all of the chemical agents have been removed.

(g) A thorough inspection of the aircraft should be performed after depainting, to ensure all entrapped material and chemical depainting agents have been removed.

(3) Cautions: Hydrogen Embrittlement.

(a) When exposed to acid paint removers, plating solutions, and other acidic conditions including some alkaline agents, cathodic reactions may occur on metal surfaces: high strength steels, some high strength aluminum, and some stainless steels. The result of these reactions produce hydrogen, which diffuses into the bulk metal, accumulating at grain boundaries that weaken the structure. If the part is under a load or contains residual manufacturing stresses, sudden catastrophic failure can occur and the part may no longer sustain the internal and/or applied stresses. Hydrogen embrittlement has been known to occur in parts stressed to only 15 percent of nominal tensile strength.

(b) When there is a possibility of high strength steels, aluminum, or stainless steel incurring any exposure to agents which could cause hydrogen embrittlement, each part that may be subject to the hydrogen embrittlement process must be totally protected from that exposure.

(c) Any alternative solutions or materials that are selected and eventually receive approval for use that have the potential for causing hydrogen embrittlement must be prevented from contacting all metals discussed in the previous paragraph in the same manner.

(4) Cautions: Epoxy Paint Removers. Epoxy paint removers should not be used on plastics, fiberglass, graphite composites, or other organic matrix structural composite surfaces. Keep epoxy paint removers away from fuel or water-tight seam sealants, since they tend to soften and destroy the integrity of sealants.

(5) Cautions: Use of Chemical Depainting Agents.

(a) Chemical paint removers will seriously damage most nonmetallic materials such as tires, electrical insulation, canopies, fiber-reinforced composite materials, and some sealants. Synthetic rubber parts, aircraft tires, fabrics, and acrylic plastics must be completely protected against possible contact with paint removers.

(b) Overaged chemical paint removers (past the manufacturer's date of expiration) can seriously degrade. Under no circumstances should overaged agents be used on high strength steel aircraft parts or structural fittings, such as landing gears.

/s/

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