METRIC

NOTICE OF CHANGE

MIL-HDBK-765 (MI)
NOTICE 1
27 January 1989

MILITARY HANDBOOK
GUIDELINES FOR SAFE DESIGN OF POLYPHASE ELECTRICAL SYSTEMS

TO ALL HOLDERS OF MIL-HDBK-765(MI):

1. THE FOLLOWING PAGES OF MIL-HDBK-765(MI) HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE REPRINTED WITHOUT CHANGE
4-9	14 July 1988	4-9	
4-10	27 January 1989	4-10	14 July 1988

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-HDBK-765(MI) will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military handbook is completely revised or canceled.

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generators, and terminals. Where precipitation or condensation is unavoidable, insulators that have ribbed surfaces to increase the leakage path length should be used. Also all conductors located nearby should be grounded so that any leakage currents will be safely drained away.

4-4.2 FIRE CONTROL SYSTEMS

Fire control systems are systems that, upon detection of fire, take measures to contain or extinguish the fire by spraying or flooding the area or by containing the fire by automatically shutting off fuel supplies.

4-4.2.1 Extinguishing Systems

Extinguishing systems include both manual and automatic apparatus designed to extinguish fire by smothering or cooling the flames. The familiar fire extinguisher is an example of a manual system. To operate manual systems, personnel must position the extinguisher near the fire, activate it, and direct the flow of the extinguishing agent toward the flames. Automatic systems are permanently installed and configured so that, upon detection of fire, the areas most susceptible to, or most likely damaged by, fire are covered by the extinguishing agent. Manual and automatic systems may use the same extinguishing agents. Agents suitable for the combined liquid fuel and electrical fires likely to occur in engine-driven-generator sets are discussed in the paragraphs that follow.

4-4.2.1.1 Carbon Dioxide

CO_2, a nonflammable gas at normal temperatures and pressures, is nonpoisonous at concentrations below 9%. It acts to smother fire by displacing the oxygen necessary to support combustion or, if stored under pressure and cooled with rapid expansion upon expulsion, by producing a powdered dry ice, which rapidly cools the burning objects. Because of the low temperature of dry ice, CO_2 dry ice extinguishers should be used only on apparatus that can withstand sudden cold temperatures.

Available CO_2 extinguisher configurations include portable tanks, fixed tanks with long, flexible hoses, or central tanks connected to permanently installed nozzles. These extinguishers are appropriate for electrical or liquid fuel fires, and they should contain sufficient gas to fill completely the enclosed area in which they are to be used, plus an allowance for leakage. Extinguishers to be used in open areas should have a capacity sufficient to flood the surface with gas and/or solid mixture for 1 min. Sizing considerations are discussed in Ref. 6.

The effectiveness of CO_2 extinguishers is minimal for materials that contain their own oxidizing agents and superheated materials with sufficient heat retention to reignite after the CO_2 has dissipated. The hazards introduced by the use of CO_2 as an extinguishing agent include freezing of tissue upon exposure to the gaseous CO_2 and/or dry ice stream, suffocation in oxygen-deficient atmospheres (confined spaces), and reduced visibility during emergency exiting due to the dry ice "snow".

4-4.2.1.2 Halogenated Agents

Halogenated agents are hydrocarbons in which the hydrogen atoms are replaced by an element from the halogen series. Example halogens are listed in Table 4-3. Those containing fluorine are the most stable and least toxic. Chlorine and bromine atoms increase the ability of the halogenated agents to extinguish fires, but increased toxicity is a result.

Concern about the toxicity of halogenated agents that were developed before World War II led to the study of effects of halogenated agents and the identification of Halon 1301 and 1211 as safe fire-suppression agents. Both are gases at 23°C (74°F) but can be stored as liquids in pressure vessels. While some halogenated agents are corrosive, these are not and thereby permit their use around electrical apparatus without damage to the equipment.

Halogenated agents suppress fires by chemically reacting with the burning reactants. Total flooding of the area is not necessary to extinguish fires, and concentrations as low as 5 to 8% are sufficient. Human exposure to the following compounds should be kept below specified concentrations even for 15-min intervals—7% for Halon 1301 and 4% for the Halon 1211. A greater hazard is the toxic materials that may be produced upon heating of these halogenated compounds to 482°C (900°F) or from contact with flame. Toxic compounds that may be produced at this temperature include hydrochloric acid (HCl) and chlorine gas (Cl_2).

Halogenated agents are used usually as part of a permanently installed system that totally floods the enclosed area. This system is used in conjunction with other systems to shut down ventilation systems and to warn personnel of the presence of halogens. These systems are installed on aircraft, vehicles, and engine-driven-generator sets. Such systems are suitable in conditions where

1. A clean agent is required.
2. Live electrical conductors are present.
3. Flammable gases are present.
4. Surface burning materials are present.
5. Valuable objects are to be protected.
6. Personnel are present.
7. Water is limited.

4-4.2.1.3 Dry Chemicals

Sodium bicarbonate, potassium bicarbonate, potassium chloride, urea-potassium bicarbonate, or monoammonium phosphate in powder form are sometimes used to extinguish fires. These materials extinguish fires by smothering, cooling, radiation shielding, and chemical reaction. They are most effective for liquids and surface burning materials. Since the materials are nonconductive, dry chemicals are especially suitable for engine-driven-generator set fires where electricity and fuel are both present. Water or other wetting extinguishing agents may be necessary to extinguish fires smoldering beneath the material surface. Powders are especially suitable for liquid fires and electrical fires.

TABLE 4-3
PROPERTIES OF COMMON HALOGENATED FIRE-EXTINGUISHING AGENTS (Ref. 6)

Agent	Chemical Formula	Halon No.	Type of Agent	Approx. Boiling Point, °C	Approx. Boiling Point, °F	Approx. Freezing Point, °C	Approx. Freezing Point, °F	Specific Gravity of Liquid at 20°C (68°F) (Water = 1)	Approx. Critical Temperature, °C	Approx. Critical Temperature, °F	Latent Heat of Vaporization, kJ/kg	Latent Heat of Vaporization, Btu/lb
Carbon tetrachloride	CCl_4	104	Liquid	77	170	−22	−8	1.595			492	212
Methyl bromide	CH_3Br	1001	Liquid	4	40	−93	−135	1.73			259	112
Bromochloromethane	$BrCH_2Cl$	1011	Liquid	66	151	−88	−126	1.93				
Dibromodifluoromethane	Br_2CF_2	1202	Liquid	24	76	−142	−223	2.28	198	389	121	52
Bromochlorodifluoromethane	$BrCClF_2$	1211	Liquified Gas*	−4	25	−161	−257	1.83	154	309	134	58
Bromotrifluoromethane	$BrCF_3$	1301	Liquified Gas	−58	−72	−168	−270	1.57	67	153	117	50
Dibromotetrafluoroethane	BrF_2CCBrF_2	2402	Liquid	47	117	−111	−167	2.17			105	45

*May be kept as a liquid at reduced temperatures.

Supersedes page 4-10 of MIL-HDBK-765(MI)