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DEPARTMENT OF DEFENSE HANDBOOK

SWITCHES,

SELECTION AND USE OF

This handbook is for guidance only. Do not cite this document as a requirement.

AMSC N/A FSC 5930

FOREWARD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides selected standard switches for use in the design of Department of Defense equipment. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

   a. The application information and performance characteristics contained in this handbook are offered for guidance and are not to be considered as mandatory. Additional application information will be added when coordinated with the Department of Defense.

   b. Additional switch types of this handbook will be developed as standard switch of a given specification family are selected and coordinated with the Department of Defense.

3. Comments, suggestions or questions on this document should be addressed to Defense Supply Center Columbus, ATTN: VAT, Post Office Box 3990, Columbus, OH 43218-3990, or emailed to switch@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil/.

CONTENTS

PARAGRAPH		PAGE
FOREWARD		ii
1. SCOPE		1
1.1	Scope	1
1.2	Purpose of handbook	1
2. APPLICABLE DOCUMENTS		1
2.1	General	1
2.2	Government documents	1
2.2.1	Specifications, standards, and handbooks	1
3. DEFINITIONS		3
3.1	Ratings and design applications terms	3
3.1.2	General definitions	3
4. GENERAL REQUIREMENTS		5
4.1.1	Reliability	5
4.1.2	Qualified sources	5
4.2	Item identification	5
4.3	Conflict of requirements	5
4.4	Criteria for inclusion in this handbook	6
5. DETAILED REQUIREMENTS		
5.1	Detailed requirements	6
6. NOTES		
6.1	Intended use	6
6.2	Subject term (key word) listing	6
6.3	Environmentally preferable material.	6

CONTENTS

APPENDIX		PAGE
GENERAL APPLICATION INFORMATION		
A.1	Scope	7
A.1.1	Scope	7
A.1.1.1	Switch types	7
A.2	Applicable documents	
A.3	General characteristics of switches	7
A.3.1.1	Selection factor	7
A.3.1.1.1	Design and construction	7
A.3.1.1.2	Contacts	7
A.3.1.1.3	Electrical considerations	9
A.3.1.1.4	Environmental considerations	10
A.3.1.1.5	Insulation requirements	12
A.3.1.1.6	Switch speed	12
A.3.1.1.7	General load and life discussion	12
A.3.2	Switch types	14
A.3. 2 .1	General definitions	15
A.3.2.2	General device characteristics	15
A.3.2.2.1	Push and sensitive switches	15
A.3.2.2.2	Toggle switches	16
A.3.2.2.3	Rotary switches	18
A.3.2.2.4	Thermostatic switches	19
A.3.2.2.5	Pressure switches	20
A.3.2.2.6	Toggle switch guard	20
A.3.2.2.7	Dual in-line package (DIP)	21
A.4	Supplement information	21
A.4.1	Reliability	21
A.4.2	Metric equivalent	21
A.4.3	International standardization agreements	21
A.4.4	Cross reference	21

TABLE

Table A-I	Typical switch ratings	9
Table A-II	Typical electrical rating comparing various manual switches	10

FIGURE

Figure A-1	Switch current rating vs. temperature for typical switch	8
Figure A-2	Life expectancy vs. current for a typical switch	13
Figure A-3	Switch configurations	14

1. SCOPE

1.1 Scope. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply. This handbook consists of the following:

a. Selected standard switches, for use in the design and manufacturer of Department of Defense equipment under the jurisdiction of the Department of Defense.

b. Guides for the choice and application of switches for use in Department of Defense equipment.

Requirements for switches listed in this handbook are covered in the applicable specification (see 2.1). When it has been determined that requirements cannot be met by using switch styles or characteristics listed in the applicable specifications, the design engineer should, with the approval of the cognizant activity, select from the applicable switch specification styles or characteristics not listed herein.

1.2 Purpose of handbook.

a. To provide the equipment designer with a selection of standard switches for use in most Department of Defense applications.

b. To control and minimize the variety of switches used in Department of Defense equipment in order to facilitate logistic support of equipment in the field.

c. To outline criteria pertaining to the use, choice, and application of switches in Department of Defense equipment.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-3786	Switches, Rotary (Circuit Selector, Low-Current Capacity), General Specification For.
MIL-DTL-3950	Switches, Toggle, Environmentally Sealed General Specification For.
MIL-DTL-5423	Boots, Dust And Moisture Seal (For Toggle And Push Button Switches, Circuit Breakers And Rotary-Actuated Parts), General Specification.
MIL-DTL-6807	Switch, Rotary, Selector Power, General Specification For.
MIL-DTL-7703	Guard, Switch, General Specification For.
MIL-DTL-8834	Switches, Toggle, Positive Break, General Specification For.
MIL-DTL-9395	Switches, Pressure, (Absolute, Gage, And Differential), General Specification For.
MIL-DTL-9419	Switch, Toggle, Momentary, Four-Position On, Center Off, General Specification For.
MIL-DTL-12211	Switch, Pressure.

MIL-DTL-12285	Switches, Thermostatic.
MIL-DTL-13484	Switch, Sensitive 30 Volts Direct Current Maximum, Waterproof.
MIL-DTL-13623	Switch, Rotary, 28 Volt DC.
MIL-DTL-13625	Switches, Pull, Switches, Push, Switches Beam Selecting Headlight Electrical (28 Volts DC Maximum, For Military Vehicles).
MIL-DTL-13735	Switches, Toggle 28 Volt DC.
MIL-DTL-15291	Switches, Rotary, Snap Action And Detent/Spring Return Action, General Specification For.
MIL-DTL-15743	Switches, Rotary, Enclosed.
MIL-DTL-21604	Switches, Rotary, Multipole And Selector, General Specification For.
MIL-DTL-24317	Switches, Multistation, Pushbutton, Illuminated And Non-Illuminated, General Specification For.
MIL-DTL-28786	Switches, Electrical And Fiber Optic Packaging Of.
MIL-DTL-28788	Switches Air And Liquid Flow, Switches, Air And Liquid Flow, Sensing, General Specification For.
MIL-DTL-28827	Switches Thermostatic, (Volatile Liquid), Hermetically Sealed, General Specification For.
MIL-DTL-83731	Switches, Toggle, Unsealed And Sealed, General Specification For.
MIL-PRF-8805	Switches And Switch Assemblies, Sensitive, Snap Action (Basic, Limit, Push Button And Toggle Switches), General Specification For.
MIL-PRF-22710	Switches, Code Indicating Wheel (Printed Circuit), Thumbwheel And Push Button, General Specification For.
MIL-PRF-22885	Switches, Push Button, Illuminated, General Specification For.
MIL-PRF-24236	Switches, Thermostatic (Metallic and Bimetallic) General Specification For.
MIL-PRF-24711	Switch Proximity, Solid-State.
MIL-PRF-83504	Switches, Dual In Line Package (DIP) General Specification For.
MIL-S-5594	Switch, Toggle, Electrically Held Sealed General Specification For
MIL-S-16032	Switches And Detectors, Shipboard Alarm Systems.
MIL-S-62742	Switch, Pressure (Metric).
W-S-896	Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil/.or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094).

2.3 Order of precedence. In event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Rating and design application terms. A list of common terms used in rating and design application of switches is as follows:

3.1.2 General definitions

a. Absolute Pressure: Pressure reference to a perfect vacuum (zero pressure) is called absolute pressure. It may be obtained by adding the pressure of reading of a gage to the barometric pressure. For all practical purposes 14.7 lbf/in2 is barometric pressure or the pressure of the atmosphere at sea level. Therefore, if the gage reads 10 psi (lbf/in2) at sea level, adding 14.7 psi (lbf/in2) gives the absolute pressure as 24.7 psi (lbf/in2).

b. Actuating force: The force applied to the actuator to operate the contacts.

c. Ambient temperature: The temperature of the air or liquid surrounding any object, neglecting small localized variations.

d. Angle of throw: The number of degrees of rotation through which the shaft travels in moving from one position of the switch to the next consecutive position.

e. ARC: One of several kinds of visible electrical discharge between separated contacts of a switch. It is primarily a stream of electrons and is accompanied by incandescent metal vapor.

f. Break: An interruption in a circuit is known as a break. Break denotes the number of pairs of separated contacts the switch introduces into each circuit it opens. It actuating the switch opens the circuit in one place, then the switch is a single-break switch. If actuating the switch opens the circuit in two places, then the switch is a double-break switch.

g. Break-before-make contacts (nonshorting): Contact which interrupts one circuit before establishing the previous one.

h. Bifurcated contacts: A set of contacts in which the movable or stationary contact configuration is divided to provide two mating contact surfaces in parallel.

i. Contact voltage drop: The voltage drop across a pair of closed contacts as measured from terminal to terminal.

j. Contact separation: The contact separation distance of a switch is the minimum open gap distance between the stationary and movable contacts or live parts connected there to, with moving contact member in the open position.

k. Cycle of operation: A cycle of operation is the movement of the actuating means through the entire range of its travel, causing the switch contacts to change from one position to another position and then return to their original position. Each stroke of the actuating means includes a full range of travel from free position to full overtravel position and return to the fully released position.

l. Dielectric: The term dielectric is almost synonymous with electrical insulation, which can be considered the applied form of the dielectric.

m. Dielectric breakdown: Rupture of insulating material when the electric stress exceeds the dielectric strength.

n. Dielectric strength: The maximum potential gradient that a material can withstand without rupture. As a material property it usually is calculated by dividing the breakdown voltage by the thickness of the material between a pair of test electrodes. The term often is applied to switches to mean the maximum voltage a switch can withstand between specified terminals or between terminals and ground without leakage current exceeding a specified value.

o. Electrical Life: Life of a switch under a specified combination of electrical load, actuation, environment and criterion of failure, synonymous with switch life.

p. Enclosed Switch: One or more basic switches enclosed in a protective housing.

q. Hermetic seal: Hermetic seal results from fusing metal-to-metal, ceramic-to-metal, or glass-to-metal only.

r. Hermetic switch: Hermetic switches are switches with an enclosure constructed to be gas tight by complete sealing of glass or ceramic to metal or bonding metal to metal by fusion.

s. Logic level circuits: Electrical loads in which the applied voltage is less than the arcing voltage and greater than the melting voltage of the contact material. As a general rule, non-arcing application loads in excess of 0.5 volt are considered logic level circuits.

t. Low level circuits: Electrical loads in which the applied voltage is less than the softening voltage of the contact material.

u. Make-before-break contact (shorting): Contact which established the new circuit first, before interrupting the previous one.

v. Overtravel: Overtravel is the distance or angle between the operating position and the extreme position to which the actuator may be moved.

w. Overtravel force or torque: Overtravel force or torque is the force or torque applied to actuating mechanism to move the actuator to the overtravel limit position.

x. Pole: The number of completely separate circuits that can pass through a switch at one time. A single pole switch can control; only one circuit at a time. A double pole switch can control two independent circuits (such as a 120 volt AC heater and a 6 volt DC lamp) at the same time. The number of poles is completely independent of the number of throws and number of breaks.

y. Power circuits: Electrical loads where the voltage and current exceed the minimum arcing conditions of the contact material. As a general rule, application loads in excess of 8 volts 0.5 ampere are considered power circuits.

z. Pretravel: The distance or angle through which the actuator moves from free position to operating position.

aa. Releasing force or torque: The releasing force or torque is the value to which the force or torque on the actuator must be reduced to permit the contacts to return to the unoperated position.

ab Sensitive switch: A switch having a snap action such that the speed of the moving contacts is independent of the speed of the actuator.

ac. Switch life: The number of cycles of operation during which the electrical and mechanical performance of the switch will meet predetermined and stated life- limiting criteria.

ad. Switch rating: The load-carrying and breaking ability of a switch.

ae. Tin whisker growth: The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM-B545 (Standard Specification for Electrodeposited Coatings of Tin).

af. Solid waste: "Solid waste means (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility: and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. It does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Clean Water Act, (33 U.S.C, 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C, 2011 et seq.) (Source: Federal Acquisition Regulations, section 23.402).

ag. Voltage drop: When the switch is built with permanently attached flexible tails and the switch terminals have been sealed (as with a molded sealant or potting compound), it may be necessary to measure total conductor terminal or conductors terminal drop and make necessary allowance for conductor voltage drop.

ah. Watertight: An enclosure which prevents leakage when water strikes or covers enclosure. No ventilation or other openings are permitted in the enclosure.

4. GENERAL REQUIREMENTS

4.1 Choice of switch types. The variety of switch types used in any particular equipment should be the minimum necessary to obtain satisfactory performance. Consideration should be given to cost and availability (use of strategic materials, multiple sources). The switches identified in this handbook meet all the criteria for standard types (see 1.1 and 4.4).

4.1.1 Reliability. Where quantitative reliability requirements specified as part of the equipment requirements are such that the use of parts with established reliability is dictated, such parts should be selected from the established reliability specification.

4.1.2 Qualified sources. After a preliminary selection of the desired switch has been made, reference should be made to the applicable qualified products list for listing of qualified sources.

4.2 Item identification. A type designation for any switch referenced herein may be constructed as indicated in the example given in the applicable section. The Part or Identifying Number (PIN) designations are depicted in the applicable specification.

4.3 Conflict of requirements. This handbook provides selected standard switches for use in the design of Department of Defense equipment. This handbook is for guidance only. This handbook can not be cited as a requirement.

4.4 Criteria for inclusion in this handbook. The criteria for the inclusion of switch types in this handbook are as follows:

a. The switch should be the best type available for general use in military equipment.

b. Coordinated Department of Defense specifications should be available (see 2.1).

c. Switches should be in production, or should have been in production.

5. DETAILED REQUIREMENTS

5.1 Detailed requirements. The detailed requirements for standard switch types are contained in the applicable specification of this handbook.

6. NOTES

6.1 Intended use. General application notes are as indicated in the appendix.

6.2 Subject term (key word) listing.

Contact resistance
Contact voltage drop
Pretravel
Releasing force or torque
Sensitive switch
Switch life
Switch rating

6.3. Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmentally Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals is available on their website at http://www.epa.gov/epaoswer/hazwaste/minimize/chemlist.htm. Further information is available at the following EPA site: http://www.epa.gov/epaoswer/hazwaste/minimize/. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements.

APPENDIX A

GENERAL APPLICATION INFORMATION

A.1 SCOPE

A.1.1 Scope. The application information in this handbook is designed to help in the selection of Switches (application information pertaining to specific switch types is contained in the applicable sections). As with other types of components, the most important thing a user must decide is which type of switches will be best for use in the military equipment being designed. Proper selection in its broadest sense is the first step in building reliable equipment. The user must know as much as possible about the types of switches to choose. The advantages and disadvantages should be known, as well as their behavior under various environmental conditions and their construction, and a knowledge of what makes switches fail. This appendix is not a mandatory part of the handbook. The information contained herein is intended for guidance only.

A.1.1.1 Switch types. There are many different types of switches that are widely used in electronic equipment. The most common types of switches are toggle, rotary, thermostatic, pressure, DIP (Dual In-Line Package), thumbwheel, push and sensitive. These switches differ from each other in size, cost, current rating, power rating, contacts, number of poles, and general characteristics. Some are better than others for a particular purpose. The choice among them, therefore, depends on the requirements, both initial and long-term; the environment in which they must exist; and numerous other factors which the designer must understand. The designer must realize that the summaries of the requirements of a particular application must be taken into consideration and compared with the advantages and drawbacks of each of the several types, before a final choice is made.

A.2 APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

A.3 GENERAL CHARACTERISTICS OF SWITCHES

A.3.1. Switch selection. The designer, in selecting a switch type for a particular function to be performed, must weight numerous factors before coming to a final decision. Selection normally starts with the most important characteristic for the application then selecting and compromising other characteristics.

A.3.1.1. Selection factors. Some of the most important of these factors are noted below:

A.3.1.1.1. Design and construction.

a. Type of action: The type of action required is determined by the switch application. It is clear that toggle switches cannot provide the multi-switching capability of rotary switches.

b. Open or enclosed construction: Many types of enclosures are available to protect the switch from external conditions, particularly high humidity and dirt. Switches may be classified according to the degree of protection offered by the enclosure. Such classifications include the following: open, sealed, enclosed, environmentally (resilient), and hermetically sealed. With the open constructions switch, no effort is made to protect the switch or its parts from atmospheric conditions. The enclosed switch is one in which the contacts are enclosed in a closed case made of plastic or metal and plastic. The environmentally (resillent) sealed switch is one in a completely sealed case where any portion of the seal is a resilient material such as a gasket or a seal in the bushing of a panel-mounted switch. The hermetically sealed switch is made airtight by a sealing process which involves fusing or soldering and does not use a gasket. The hermetically sealed enclosure offers the greatest protection because it insulates against such elements as moisture, harmful gases, and dirt. It also eliminates the increased arcing by low atmospheric pressures at high altitudes.

A.3.1.1.2 Contacts. The contacts which carry the electrical load can be classified by function, current-carrying capacity, and application. The contact arrangements vary in complexity from a simple make or break, through make-before-brake, break-before-make, make-make, break-break and from single throw to multiple throw, and single pole to multiple and various combinations of these features.

a. Contact rating: Contacts are usually given in multiple ratings dependent on the type of load being switched. These ratings are resistive, low-level (dry circuit), lamp, motor and inductive loads. Most switches are rated with the resistive load capability and at least one additional rating. Table A-I provides with typical switch rating. Current ratings are established at 25°C. The values shown for multiple switches are amperes per pole, except for motor load. Lamp, motor and capacitive loads, the inrush current at the instant that the switch makes contact is considerably higher than the current that flows during normal operation. Table A-I shows the lamp load rating as about one-fourth the rating for a normal resistive load. Inrush currents for motor loads may be as much as 12 times the normal running load because of the lack of back electromagnetic force. Inductive load ratings for both ac and dc are lower than the resistive load rating because of the longer duration of the arc on current break. Inrush current in a capacitive load circuit is high because the capacitor acts as a virtual short circuit until it has acquired some charge. Table A-I gives ratings for not only maximum inrush current but also emergency current-breaking capacity. In many instances, the maximum current-making capacity may be the limiting factor rather than the running current marking capacity of the switch. The current, voltage and the characteristics of the current during make, break, and continuous duty must be carefully considered. Ratings of contacts are usually given for room ambient temperature and include some safety factor to take care of the temperature rise of the switch. Temperature has a marked effect on switch current ratings, as is shown in Figure A-1.

b. Contact operate and bounce times: In many applications, critical operate and bounce times of the contacts are important. Operate time in a double-throw switch is defined as the time it takes the moving contact to separate from the normally closed contact, travel to the normally open contact and make the circuit (this does not include bounce time). Bounce time is the interval between first make of the contact until the uncontrolled making and breaking of the contact ceases. In many electronic circuits, a millisecond is a long time and operates and bounce times become critical parameters

TABLE A-I. Typical switch ratings.

Rating 1/	Voltage (volts)	Current (amperes)
Lamp load	15 dc 30 dc 125 ac	10 7 4
Resistance load	15 dc 30 dc 125a	50 25 15
Inductive load	15 dc 30 dc 125 ac	25 15 11
Motor load	15 dc 30 dc 125 ac	40 20 6
Continuous current-carrying capacity (any voltage) 15 min of each hour 5 min of each ½ hour 1 min of each ¼ hour 5 sec of each ½ hour		 60 90 110 250
Current-marking capacity (Maximum in-rush on any type of load):	15 dc 30 dc 125 ac	100 70 40
Emergency current-breaking capacity (Opening circuit under emergency conditions for 50 operations only):	15 dc 30 dc 125 ac	225 100 20

1/ These figures are maximum current ratings for 10,000 operations longer life (more operations) can be expected when operated at less than maximum rating of switch

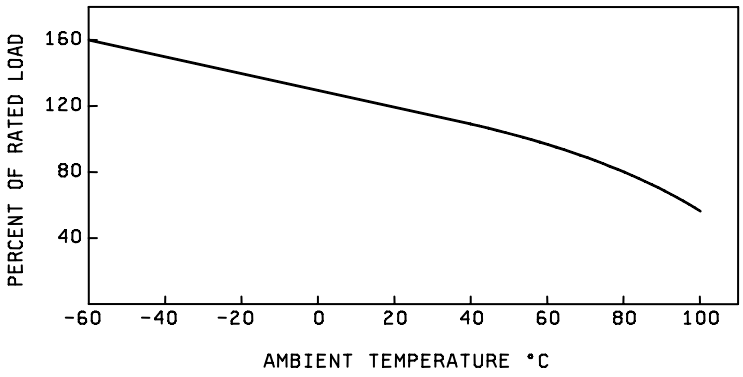


FIGURE A-1. Switch current rating verses temperature for typical switch.

c. Contact resistance: Contact resistance can be simply defined as the amount of opposition to current offered by the switch contacts. It is the resistance between two electrical contacts in contact with each other, when measured at their external terminals and is a measure of the power that will be dissipated through the contacts. Contact resistance includes the resistance of the contact material, of any oxide or other film on the surface of the contacts, and the resistance of the elements on which the contacts are mounted (such as springs, mounting and the terminals and their connections).

d. Make-before-break: The contacts which carry the electrical load can be classified by function, current-carrying capacity, and application. The contact arrangements vary in complexity from a simple make or break, through make-before-break, break-before-make, make-make, break-break, and from single throw to multiple throw, and single pole to multiple throw, and signal pole to multiple and various combinations of these features.

A.3.1.1.3 Electrical considerations. These are six basic factors that are important in the selection of a switch.

a. Current Rating: This is based on the temperature developed within the switch under service conditions. Because of arcing and welding at the contacts, most heating (and consequent wear) occurs on making and breaking the circuit. Hence, the rate of operation also affects switch life. For ac loads, 60 operations per minute is generally considered the maximum rate at which full current capacity of the switch is available. The switch can, however, be operated at higher rates if the current is reduced, or if a decrease in switch life is acceptable. Ratings are normally based on continuous, steady-state current. On table A-II shows the typical electrical rating comparison of various manual switches.

b. Voltage: Maximum voltage rating depends on the air gap, or contact separation. A gap of .005 inch to .008 inch will permit a 250 vac rating. A gap of .010 inch to .015 inch permits a 480 vac rating, and a gap of 0.020 inch to 0.070 inch. permits a 600 vac rating.

TABLE A-II: Typical electrical rating comparing various manual switches.

Switch type	Rated current (amperes)		Rated voltage (volts)
	Resistive	Inductive	
Pushbutton	5	3	30 dc 125/250 ac
	5	3	30 dc 125/250 ac
	15	15	125/250 ac
	1.5		110 dc
	1.5		250 dc
Toggle	20	12	30 dc
	1.5		110 dc
	15	15	230 dc
Rotary	15	15	125 / 250 ac
	0.5		125 dc
	0.25		250 dc

c. Insulation resistance: This is the resistance between two normally insulated metal parts, such as a pair of terminals, measured at a specific high dc potential (usually 100 or 500 vdc). Typical values for new switches are in the range of thousands of megaohms. These values usually decrease during life as a result of surface contaminant build-up.

d. Dielectric strength: This is a measure of the ability of the insulation to withstand high voltage without breaking down. During life, the deposition of contaminants and wear products on the surface of the insulation tends to reduce the dielectric withstanding voltage. In testing for this condition, a voltage considerably above rated voltage is applied, and the leakage current is measured. Test voltages are typically 1,000 vac plus twice the rated voltage.

e. Effect of loads: On any switch, electrical erosion of the contacts occurs when an arc is drawn while breaking a circuit. This erosion normally tends to increase contact resistance, generate wear products by contamination of insulating surfaces, and reduce dielectric strength and insulation resistance. The amount of this erosion is a function of current, voltage, power, frequency, and speed of operation. The higher the current, the hotter the arc and the greater the erosion will be. The higher the voltage, the longer the arc will be maintained, resulting in greater erosion. In an inductive circuit the inductance acts as an energy storage device, which returns its energy to the circuit when the circuit is broken. The amount of erosion on an inductive circuit is in proportion to the amount of inductance.

f. Contact resistance: This is the resistance of a pair of closed contacts which effectively appears in series with the load. Typical end-of-life criteria for this parameter is 20 megohms.

A.3.1.1.4 Environmental considerations.

a. Temperature: Variations of temperature must be considered, as moisture condensation within the switch could develop. In choosing a switch for a wide range of temperature, the entire temperature range must be carefully considered rather than only one extreme. Exposure to low temperature may cause certain materials of a switch to contract, thus causing cracking, permitting moisture or other foreign matter to enter the switch causing short circuit, voltage breakdown, or corona. Chemical action to which switches are subjected is accelerated by high temperatures insulation resistance between the switch contacts and ground decreases as the temperature increases. In high resistance circuits with three megohm in parallel with a circuit impedance of one megohm, the circuits impedance will change to a point where operational failure of the equipment may occur. High temperature may also affect the insulation from the standpoint of voltage breakdown due to a change in dielectric strength. Also, the increased speed of corrosion of contacts and switching mechanism is affected by high temperatures.

b. Moisture: Moisture in the dielectric will decrease the dielectric strength, life, and insulation resistance and cause corrosion by increasing the galvanic action between dissimilar metals. In general, switches which operate in high humidities should be hermetically sealed, or if this is not practical, the use of accessories, such as boots, “O” rings, or diaphragms placed over switch openings, is recommended to decrease moisture entry diaphragms.

c. Altitude: With a decrease of atmospheric pressure, the spacing required to prevent flash over increases substantially. Small switches, because of their very close contact spacing, are partially susceptible to malfunction at high altitudes. Since arc-over occurs more readily at higher altitudes, contact life decreases substantially with operation at these altitudes. To compensate for increased arcing at high altitudes, users must derate the current ratings given by the manufacturer. To compensate for increased flashover, the user must derate voltage ratings.

d. Shock and vibration: Switches should be selected which meet shock and vibration requirements. Those with contact chatter requirements will cover low-frequency vibration and shock applications. High-frequency vibration will determine the effects of fatigue and resonance on the mechanical construction of the switch contact elements. When contact bounce at the time of closing of switch contacts is important, this requirement should be a consideration to be specified. Contact bounce causes arcing which will materially shorten contact life and may generate electrical noise. Mechanical shock applied to switches may cause damage such as cracking of the switch insulating stack, or wafer; loosening of contacts from the wafers; or breaking of welds. An electrical effect which is directly attributable to mechanical shock is contact bounce, which is a separation of contacts of the contacts of the closed circuit. This is similar to contact chatter, but is usually greater in magnitude. Contact bounce is dependent on the contact mass and the spring constant of the contact arm, and may be severe enough to open a closed circuit or to close an open circuit. Most switches have good vibration resistance in either the free or the full overtravel position. Some switches do not withstand vibration if the operating plunger has been depressed almost to the operating point. Contact forces here have been reduced to a low value that depends on the remaining distance to be traveled until snap action occurs. If the switch is subjected to mechanical vibration, it is possible that the contact spring will reach a frequency which nearly corresponds to its fundamental frequency, or a harmonic. The vibration that results will cause the moving contact to chatter on the stationary contact. Chatter caused by vibration can be of particular importance in digital circuits where making and breaking contacts can result in transmittal of erroneous information. The effect of vibration chatter can be selected to take the full current rating, since the will not make and break at the exact same time.

e. Accelerations: Switches which are subject to acceleration forces due to applications arising from high-speed vehicles or aircraft should be selected from those having acceleration requirements. Failures are usually due to internal construction design which allows normally closed contacts to open and normally open contacts to close under acceleration conditions.

f. Sand and dust: A combination of dust and small amount of moisture will materially increase the possibility of voltage breakdown of the insulation between closely spaced terminals. Where low insulation resistance or high leakage currents may cause circuit malfunction, the switch must be capable of passing sand and dust test requirements.

g. Explosion: Explosion resistance requires that switches operate in a volatile atmosphere without causing explosion. Wherever possible, switches to be used in an explosive atmosphere an be sealed.

A.3.1.1.5 Insulation requirements.

a. Insulation resistance: Insulation resistance is the amount of opposition to current that would be measured between terminals, or between a terminals and ground under normal conditions. The insulation resistance of a switch depends upon the type of insulating material used in the switch and the distance between contacts. Typical insulation resistance values are from 20,000 to 500,000 megohms. Insulation resistance determines how well a switch will open a circuit. A high insulation resistance is necessary between the terminals and ground to prevent any unwanted circuits back to the source. A high insulation resistance prevents all these undesirable effects. The value of insulation resistance of a switch is affected by humidity. If the insulating material will readily absorb moisture form the surrounding air, its insulating resistance is quickly reduced. What was once an insulator becomes a conductor of current. This deterioration of the insulating material usually occurs above 90 percent relative humidity. Insulation resistance is important in high impedance circuits. Low insulation resistance in a high voltage circuit may result in excessive dissipation within the dielectric leading to ultimate failure. For applications where arc-over is a problem, switches should be selected which have a high insulation resistance. Such rated insulating materials will not form a conducting surface film, which may build up after repeated arcs on making and breaking of contacts, and lead to eventual flashover. Typical values for new switches are in the range of thousands of megohms. These values usually decrease during life as a result of surface contaminant build-up. 1/

b. Breakdown voltage: Breakdown voltage occurs in a switch when an arc takes place between two conducting or metal parts of a switch. The breakdown voltage characteristic of a switch is not related to the arcing that occurs at the contacts when a switch makes and breaks the circuit. An arc can occur between non-touching metal parts if the voltage is large enough. The voltage needed depends upon the distance and the type of insulation between the conducting members. The conducting members of a switch are all the metal parts, including the contacts, the mounting busing, the shaft, or rivets. For breakdown voltage, the voltage between conductors is increased until an arc does occur. If an arc or the specified current does not occur for a started dielectric strength voltage, the switch is considered to have passed the test. 1/

A.3.1.1.6 Switching speed. Switching speed may be an important parameter to consider when choosing a switch. The term “switching speed” means the duration of contact travel during a make or break function. This parameter is important from the standpoint of reducing any interruptive arc which may be formed, or decreasing the flashover time during the making of a switch. During the actual making of contact, a spring action is sometimes used to increase the speed of closing. This decreases the length of time that an arc, causing the voltage breakdown between the contacts, can cause pitting or burning. If the arcing during the make function is very severe, the contacts may weld together.1/. During the break function, an attempt is made to decrease the speed to give the stored energy time to dissipate slowly, because an instantaneous opening will produce heavy transient currents across the contacts. This is especially true of dc circuits and inductive ac circuits. Pitting of contacts is usually more severe during the opening of the contacts. With switches used to interrupt heavy currents, it is sometimes necessary to employ arc suppressors or arc extinguishers. These may take the form of either a capacitor across the contacts to acts as an energy sink, or a permanent magnet near the contacts to deflect the arc.

A.3.1.1.7 General load and life discussion. The problem of switch rating arises from the wide variety of requirements placed on the switch in various applications, and the sensitivity of the switch to changes in requirements. If an attempt were made to establish life ratings for all possible applications, the result would be an almost infinite variety of ratings. In an effort to simplify the problem, switch manufacturers, in cooperation with switch users and the military, have established certain reference loads, life requirements, environments, duty cycles, and failure criteria. These are arbitrarily established, and give a relative basis for comparison between different switch designs. They do not, however, match the actual requirements for most applications.

1/ Switch Engineering Handbook by John R. Mason.

a. Life requirements: In attempting to forecast life expectancy for a switch, both mechanical and electrical factors must be considered. Mechanical life usually is limited by the life of the switch's flexing parts and bearing surfaces. Electrical life is the life of a switch controlling a specified electrical load. In applications that do not require the switch to make or break large electrical loads, mechanical life is generally limited only by the fatigue characteristics of the spring. These characteristics, in turn, are influenced by the total travel required of the switch and the method of applying the actuating force. When overtravel is held within the prescribed normal limits, mechanical life can be expected to reach several million operations, regardless of the cycling rate. In most applications, however, electrical considerations are of major importance in determining switch life. Life is an inverse function of current made or broken. When determining life requirements, care should be taken to include the operations that take place during testing or screening of both the switch and the equipment that the part is used in. Figure A -2 shows the life expectancy for a typical switch. A careful analysis of the required life of the switch or total number of operations should be made. In some equipment, the operational life of the switch can be comparatively short. The terms "mechanical life: and "electrical life" sometimes are used in switch evaluation.

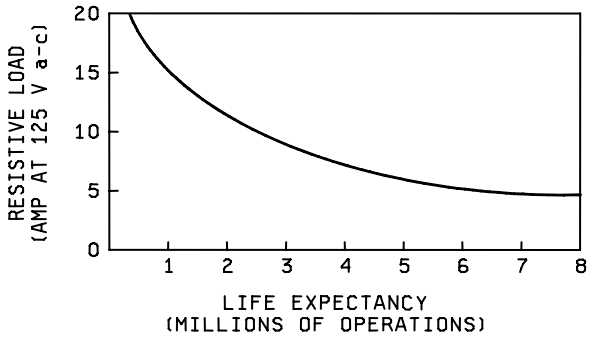


FIGURE A-2 Life expectancy verses current for a typical switch.

b. Reliability considerations: Switches are electromechanical devices subject to both electrical and mechanical failure. Contact failure can result from high in-rush or sustained high currents or from the inductive kick when an inductive circuit is opened. These currents may cause intense heat and the possible welding of contacts. Careful consideration to de-rating should be given in these cases, In selecting a switch for high reliability or space programs, hermetically welded sealed units should be used where available. Terminals should have a glass seal and be of a hook design to provide proper stress relief for the seal. Parts should be of corrosion-resistant material with no cadmium or zinc plating. Use of nonmetallic materials should be minimized. The use of pure tin, as an under-plate or final finish, is prohibited both internally and externally. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufactures. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers.

A.3.2 Switch types. The most widely used switches in military equipment can be grouped into six basic types. On figure A-3 examples of some switch configurations are given.

a. Push and sensitive.

b. Toggle.

c. Rotary.

d. Thermostatic.

e. Pressure.

f. Guard.

g. DIP (Dual in line package).

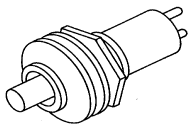
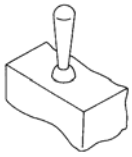
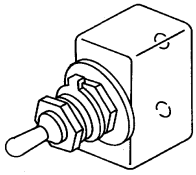
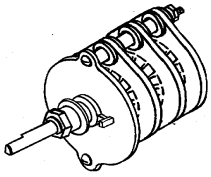
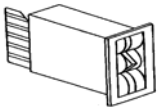
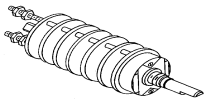
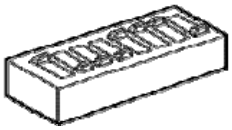
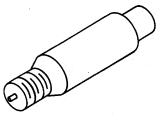
 Switch Push Pull (MIL-DTL-13625)	 Sensitive (MIL-DTL-13735)	 Toggle (MIL-PRF-8805)	 Rotary Switch (MIL-DTL-3786)
 Code indicating (MIL-PRF-22710)	 Rotary (MIL-DTL-13623)	 Dual In Line Package (MIL-PRF-83504)	 MIL-DTL-24711 Proximity Switches

FIGURE A-3 Configurations.

A.3.2.1 General definitions. The following is a list of terms which are commonly used,

Contact resistance: The resistance of a pair of closed contacts as measured from terminal to terminal, This includes the circuit resistance of the individual contact members.

Contact voltage drop: The voltage drop across a pair of closed contacts as measured from terminal to terminal.

Pretravel: The distance or angle through which the actuator moves from free position to operating position to operating position.

Releasing force or torque: The releasing force or torque is the value to which the force or torque on the actuator must be reduced to permit the contacts to return to the unoperated position.

Sensitive switch: A switch having a snap action such that the speed of the moving contacts is independent of the speed of the actuator,

Switch life: The number of cycles of operation during which the electrical and mechanical performance of the switch will meet predetermined and stated life limiting criteria.

Switch rating: The load-carrying and breaking ability of a switch.

A.3.2.2 General device characteristics. This section discusses the general characteristics of each type of switch. All types are available for ac or dc applications.

A.3.2.2.1 Push and sensitive switches.

A.3.2.2.1.1 Push and sensitive switches. These switches are actuated by a reciprocating plunger and are available as very sensitive devices, or as devices carrying large current loads.

A.3.2.2.1.2 Introduction. Pushbutton and sensitive switches are actuated by a direct thrust in line with the button travel. They are available with numerous contact configurations and modes of operation, Common modes of operation are momentary contact, maintained contact, and sequential contact.

A.3.2.2.1.3 Applicable military specifications.

MIL-DTL-5423	Boots dust and moisture seal.
MIL-DTL-13484	Switch, sensitive.
MIL-DTL-13625	Pull switches, push switches.
MIL-DTL-24317	Pushbutton, illuminated.
MIL-DTL-28788	Switches, air and liquid flow, sensing.
MIL-PRF-22710	Code Indicating wheel, thumbwheel and push-button.
MIL-PRF-22885	Switch, illuminated pushbutton.

A.3.2.2.1.4 MIL-DTL-5423 Boots dust and moisture seal switches. This detail specification covers the general requirements for molded silicone rubber boots which can be used on component parts such as toggle and pushbutton switches, circuit breakers, and rotary-actuated parts such as rotary switches, variable resistors, capacitors, inductors, and transformers. The boots protect the component parts-actuating mechanism from sand, dust, water and other contaminants, and seal the panel on which the component parts are mounted.

A.3.2.2.1.5 MIL-DTL-13484 Sensitive switch. This specification covers a waterproof, single-pole, sensitive switch used for controlling electrical circuits up to 30 vdc in tactical military vehicles.

A.3.2.2.1.6 MIL-DTL-13625 Push and pull switches. This specification covers 28-volt (V) direct-current (dc) maximum, push, pull, and headlight beam-selecting switches.

A.3.2.2.1.7 MIL-DTL-24317 Illuminated pushbutton switches. This specification covers the general requirements for manually operated illuminated and non-illuminated multistation, pushbutton switches for use in electronics and communications equipment.

A.3.2.2.1.8 MIL-DTL-28788 Sensing air and liquid flow switches. This specification covers the general requirements for flow switches intended primarily for use in equipment to sense velocity and flow of air or liquid.

A.3.2.2.1.9 MIL-PRF-22710 Code indicating wheel, thumbwheel and push-button. This performance specification covers the general requirements for illuminated and non-illuminated, thumbwheel, and push-button, printed circuit rotary switches having unsealed and sealed modules and the associated hardware. These switches are designed for low power alternating current and direct current switching applications for use in electronic and communication equipment. Procurement of switches and mounting hardware will require additional data, giving detailed electrical and mechanical requirements, tolerances, and applicable additions and exceptions to the general requirements and tests.

A.3.2.2.1.10 MIL-PRF-22885 Switches push button illuminated. This specification covers the push button switch for manually operated illuminated push button switches, assemblies and associated modular subassemblies. The term ”switches” should include the associated modular subassemblies, including switches, indicator lights, actuators, lenses, color filters, panel seals, and barriers. The two types of switches in this specification are category I and category II.

A.3.2.2.1.11 Usual applications. Pushbutton and sensitive switches are a form of precision switch with integral pushbutton actuators. They are available with numerous contact configurations and modes of operation. Banks of pushbutton or sensitive switches can be individually operated or interlocked. The exact type or configuration is determined by the application.

A.3.2.2.2 Toggle switches.

A.3.2.2.2.1 Toggle switches. Toggle switches utilize an actuator, the operator interface to trigger the internal mechanism. These switches are actuated by a bat handle and are available as very sensitive devices, or as switches carrying large current loads. Many types of toggle switches are available:

a. Single-, double-, triple-, and four-pole.

b. Single or double throw.

c. Snap-action or momentary contact.

d. Locking or non-lacking.

A.3.2.2.2.2 Introduction. Toggle-action switches are available with two types of action, momentary contact and maintained contact. Additionally, they are available as two- or three-position switches with single, double, triple, or four poles. A two-position toggle typically has these two positions at equal angles on each side of the vertical centerline of the mounting bushing. A three-position toggle has two extreme positions plus a center position. The center position is generally for the "OFF" condition with the two extreme positions representing "ON “conditions of the circuitry.

A.3.2.2.2.3 Applicable military specifications.

MIL-DTL-3950	Switch, toggle.
MIL-DTL -8834	Switch, toggle, positive break.
MIL-DTL-9419	Switch, toggle, momentary.
MIL-DTL-13735	Switch, toggle.
MIL-DTL-83731	Switches, toggle, unsealed.
MIL-PRF-8805	Basic, limit, push button and toggle switches.
W-S-896	Switch, toggle (toggle and lock), flush mounted.

A.3.2.2.2.4 MIL-DTL-3950 Toggle switch. This detail specification covers the requirements for environmentally sealed toggle switches.

A.3.2.2.2.5 MIL-DTL-8834 Toggle switch positive break. This specification covers the military service requirements for snap-action, non-teasable, positive-break and make, one-hole mounting toggle switches. These switches are intended for use in alternating current and direct current applications for dry circuit, low level, and power switching. The sealing characteristics covered by this specification include toggle sealed devices and environmentally sealed devices.

A.3.2.2.2.6 MIL-DTL-9419 Momentary toggle switch. This specification covers a four-positions, momentary on, center off, positive action switch with free return to the off position.

A.3.2.2.2.7 MIL-DTL-13735 Toggle switch 28 volts DC. This specification covers toggle switches for use in direct current (dc) electrical circuits. The toggle switch will be referred to as “switch” herein.

A.3.2.2.2.8 MIL-DTL-83731 Unsealed and sealed toggle switches. This specification covers the military requirements for unsealed and toggle sealed toggle switches.

A.3.2.2.2.9 MIL-PRF-8805 Basic, limit, push button and toggle switches: This performance specification covers the general requirements for snap action sensitive switches and switch assemblies. The sensitive switch assemblies include limit, push-button, and toggle operated types.

A.3.2.2.2.10 W-S-896 Switch, toggle (toggle and lock), flush mounted. This federal specification covers the general requirements for flush mounted toggle and lock switches, designed for mounting in switch boxes by means of an integral strap.

A.3.2.2.2.11 Usual applications. Toggle switches are widely used where simple make-and-break action is required, and are suitable for use on ac or dc circuits. Toggle switches are available with various actuating handles and subsequent switching actions in some 50 styles.

A.3.2.2.3 Rotary switches.

A.3.2.2.3.1 Rotary switches. A rotary switch is an electromechanical device which is capable of selecting, making, or breaking an electric circuit and activated by a rotational force applied to the shaft. The principal parts of a rotary switch are (a) a shaft and bushing, (b) a deck section, (c) a stop mechanism and (d) a detent mechanism. The shaft is the element to which rotational force is applied to cause a change in the switching elements. The busing is an integral part of a rotary switch which the switch can be mounted to a panel or a bracket of a piece of equipment. A detent system allows the operator of the shaft to positively feel the location of the switch contacts. The stop mechanism limits the rotation of the shaft to the active switch positions. The deck section contains the switching circuitry. These switches are actuated by the rotary motion of a shaft for the selection of any one or more of a number of circuits. Many types of switching arrangements are available for use in varying one or more functions such as voltage, frequency resistance.

A.3.2.2.3.2 Introduction. Rotary switches are actuated with a twisting action and are generally available with either momentary contact or maintained contact. Rotation can be either unlimited (turned through more than one complete circle) or limited to 360 degrees or less, after which the direction of rotation must be reversed. A rotary switch may have many points of actuation with several decks of contacts and combinations of actuating cans.

A.3.2.2.3.3 Applicable military specification.

MIL-DTL-3786	Switch, rotary (circuit selector, low- current capacity) general specification
MIL-DTL-6807	Switch, rotary, selector, general specification for
MIL-DTL-13623	Switches, pull; switches, push
MIL-DTL-15291	Switch, rotary, snap action
MIL-DTL-15743	Switches, rotary, enclosed
MIL-DTL-21604	Switches, rotary, multipole and selector
MIL-PRF-22710	Switch, rotary (printed circuit)

A.3.2.2.3.4 MIL-DTL-3786 Switch rotary (circuit selector, low-current). This detail specification covers the general requirements for circuit selector, rotary switches, designed for low power, alternating current (ac) or direct current (dc) switching applications capable of making and breaking a resistive load of 2 amperes or less, which are primarily for use in electronic and communications equipment. Acquisition of switches of a design not covered by a specification sheet will require additional data, giving detailed electrical and mechanical requirements, tolerances, and applicable additions and exceptions to the general requirements and tests specified in the specification. Switches which differ because of electrical configuration, shape, or size of operating shaft, type of construction, number of switch sections, bushing length, temperature life characteristics, angle of throw, vibration grade, shock type, insulation, or altitude are considered to be standard switches under a particular style, provided they meet the envelope size and dimensional, environmental, and electrical requirements of the particular style.

A.3.2.2.3.5 MIL-DTL-6807 Switch, rotary, selector: Unless otherwise specified this specification covers the general requirements for closed construction rotary switches designed for use in power circuits and capable of making, carrying, and breaking electrical loads of up to and including 10 amperes.

A.3.2.2.3.6 MIL-DTL-13623 Switches, pull; switches, push. This specification covers 28 volt direct current rotary switches intended primarily for use in tactical vehicles.

A.3.2.2.3.7 MIL-DTL-15291 Switch, rotary, snap action. This specification covers snap-action and detent and spring action rotary switches for use in alternating and direct current applications, with ratings as specified.

A.3.2.2.3.8 MIL-DTL-15743 Switches, rotary, enclosed. This specification covers enclosed snap action, spring return, positive detent, multipole and selection rotary switches.

A.3.2.2.3.9 MIL-DTL-21604 Switches, rotary, multipole and selector: This specification covers the general requirements for closed construction rotary multipole and selector switches which are able to make, break, and carry electrical loads up to and including 10 amperes.

A.3.2.2.3.10 MIL-PRF-22710 Switch, rotary (printed circuit). This performance specification covers the general requirements for illuminated and non-illuminated, thumbwheel, and push-button, printed circuit rotary switches having unsealed and sealed modules and the associated hardware. These switches are designed for low power alternating current and direct current switching applications for use in electronic and communication equipment. Acquisition of switches and mounting hardware will require additional data, giving detailed electrical and mechanical requirements, tolerances, and applicable additions and exceptions to the general requirements and tests specified.

A.3.2.2.3.11 Usual applications. Rotary switches are used for the selection of any one of a number of circuits or combinations of circuits with a rotary motion of the shaft. Rotary switches can handle a great many connections. The basic contact arrangements may be expressed by the number of poles and the switch positions or decks per pole.

A.3.2.2.4 Thermostatic switches.

A.3.2.2.4.1 Thermostatic switches. These switches are actuated by temperature change. They are available in two types of construction: Bimetallic element and non-bimetallic element actuated. Thermostatic switches are used for temperature protection, accurate temperature control, and as detection devices.

A.3.2.2.4.2 Introduction. Thermal switches (thermostats) are used either for the indication or control of temperature, or in a protective function. The majority of thermal switches are simple thermostatic devices whose performance depends upon the action of a bimetallic element. The principal design factors relate to accuracy, repeatability, temperature range, and thermal lag.

A.3.2.2.4.3 Applicable military specification.

MIL-DTL-12285	Switches, thermostatic.
MIL-DTL-28827	Switches, thermostatic, (volatile liquid), hermetically sealed, general specification for.
MIL-PRF-24236	Switches, thermostatic, bimetallic actuated.

A.3.2.2.4.4 MIL-DTL-12285 Switch thermostatic. This detail specification covers a level high coolant temperature switch that is designed to generate an alarm by light or audible sound when fluid temperature exceeds predetermined conditions

A.3.2.2.4.5 MIL-DTL-28827 Switches, thermostatic (volatile liquid) hermetically sealed. This specification covers the general requirements for hermetically sealed volatile liquid thermostatic switches intended primarily for use in equipment requiring rapid temperature response. The operating temperatures and operating temperature ranges of switches are covered by this specification.

A.3.2.2.4.6 MIL-PRF-24236 Switches, thermostatic, bimetallic actuated. This performance specification covers the general requirements for metallic-element actuated, thermostatic switches intended primarily for use in electrical and electronic equipment, in alternating current and direct current applications, where temperature protection, overheat detection, or accurate temperature control is required. The operating temperatures and operating temperature ranges of switches are covered by this specification.

A.3.2.2.4.7 Usual applications. Temperature-actuated switches provide switching action in response to temperature changes. Usually the objective is to maintain a specified temperature with in the system. However, the devices are also used for over- or under-temperature protection.

A.3.2.2.5 Pressure switches.

A.3.2.2.5.1 Introduction. Pressure switches are switches whose response is a function of the gas or liquid pressure which they are designed to regulate and control. The switching action of a pressure unit usually falls into two categories: the creep type and the snap-acting variety. The latter is preferable for applications where vibration capability and inductive load carrying capability are required. The creep type, however, can offer very close tolerances with regard to its pressure differential rating as low as ±1 percent.

A.3.2.2.5.2 Pressure switches. These switches are actuated by pressure changes in liquid or gas applications. The switch consists of an electrical snap switch actuated through the displacement of a pressure-sensing device having an inherent spring rate where its displacement is proportional to the applied pressure. These pressure-sensing devices are of three general types:

a. Capsule sensor

b. Bourdon tube

c. Bellows elements

A.3.2.2.5.3 Applicable military specification.

MIL-DTL-9395	Switches, pressure, (absolute, gage, and differential).
MIL-DTL-12211	Switch, pressure.
MIL-S-62742	Switch, pressure (metric).

A.3.2.2.5.4 MIL-DTL-9395 Switches, pressure, (absolute, gage, and differential). This detail specification covers the general requirements for absolute, gage, and differential pressure switches.

A.3.2.2.5.5 MIL- DTL-12211 Switch pressure. This specification covers two types of automotive pressure switches. Type I switches operate when fluid pressures drop below predetermined values and type II switches operate when fluid pressures exceed predetermined values.

A.3.2.2.5.6 MIL-S-62742: Switch, pressure (metric). This military specification covers two types of automotive pressure switches. Type I switch operate when fluid pressures drop below predetermined values and type II switches operate when fluid pressures exceed predetermined values.

A.3.2.2.5.7 Usual applications. Applications include response to altitude, liquid pressure liquid level, and air flow, Switches may respond to absolute, gage, or differential pressures. By means of adapting elements, these switches may be applied to a great variety of applications. By using more than one switch, control of separate circuits at different pressure or temperature steps can be provided.

A.3.2.2.6 Toggle switch guard

A.3.2.2.6.1 Introduction. A toggle switch guard is used to prevent the accidental activation of toggle switches. When the guard is in down position it is automatically turned off.

A.3.2.2.6.2 Applicable military specification.

MIL-DTL-7703	Switch guard

A.3.2.2.6.3 MIL-DTL-7703 Switch guard. This detail specification covers the military requirements for hinged switch guards for use with toggle switches. It covers the switch and secures it in the off (or on) position until the operator deliberately raises the switch guard cover.

A.3.2.2.6.4 Usual applications. Switch guards are intended for use in preventing accidental operation of switches and also to serve as switch locks. The switch guards are military unique due to the fact that these items must be able to withstand exposure to extreme environmental conditions and corrosive materials.

A.3.2.2.7 Dual in-line package (DIP).

A.3.2.2.7.1 Introduction: DIP. This switch allows configuring a circuit board for a particular type of computer or application. DIP switches are always toggle switches, which mean they have two possible positions -- on or off. (Instead of on and off, you may see the numbers 1 and 0)

A.3.2.2.7.2 Intended use. Switches covered by this specification are intended for use in low power dc applications. Also these switches are intended for use on printed circuit boards and leads may be soldered or inserted in plug in sockets. When switches add plug in sockets are used together, they should have similar or compatible contact finishes.

A.3.2.2.7.3 Applicable military specification.

MIL-PRF-83504	Dual in-line package (DIP) switches.

A.3.2.2.7.4 MIL-PRF-83504 Dual in-line package (DIP) switches. This performance specification covers the general requirements for dual in-line package (DIP) switches designed for direct insertion into printed circuit boards, plug in sockets components, and panel boards primarily for use in electronic and communications equipment.

A.3.2.2.7.5 Usual applications. The dual-in –line package (DIP) switches designed for direct insertion in to printed circuit boards, plug in sockets components, and panel boards primarily for use in electronic and communications equipment.

A.4. SUPPLEMENTAL INFORMATION

A.4.1 Reliability. The established reliability specification provides for the establishment of a failure rate figure through the single parameter of load life only.

A.4.2 Metric equivalent. The metric equivalents (to the nearest 0.01 millimeter) which are provided in the individual section are for general information only and are based upon 1 inch = 25.4 millimeter.

A.4.3. International standardization agreements. Certain provisions of the specifications referenced in this handbook are subjected on international standardization agreements. When amendment, revision, or cancellation of any if these specification is proposed which will affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

A.4.4 Cross reference. A cross reference of section number, Department of Defense specification numbers, associated specification numbers, and style numbers are included for reference.

Custodians:
Army – CR
Navy – EC
Air Force – 11
DLA – CC

Review activities:
Navy – CG
Air Force – 99

Preparing activity:
DLA – CC

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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil/.