

MIL-C-81774A

23 March 1973

SUPERSEDING

MIL-C-81774 (AS)

1 July 1970

MILITARY SPECIFICATION
CONTROL PANEL, AIRCRAFT,
GENERAL REQUIREMENTS FOR

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

1. SCOPE

1.1 Purpose - This specification covers the general requirements for control panels for aircrew stations in military aircraft. The term "aircraft control panel" as used herein includes the backing plate, the lighted panel, fasteners, markings, finish, nomenclature, controls, control guards, and displays.

1.2 Application - This specification delineates documents for the design of control panels; establishes display and control selection, utilization and arrangement; and provides for verification data of these requirements.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-S-3950	Switches, Toggle
MIL-D-5480	Data, Engineering and Technical, Reproduction Requirements for
MIL-S-5594	Switch, Toggle, Electrically Trippable
MIL-C-6781	Control Panel, Aircraft Equipment, Rack or Console Mounted
MIL-E-7080	Electric Equipment, Aircraft, Selection and Installation of

FSC 1680

MIL-C-81774A

SPECIFICATIONS

Military (Continued)

MIL-G-7703	Guard, Switch
MIL-P-7788	Panels, Information, Integrally Illuminated
MIL-D-8510	Drawings, Undimensioned, Reproducibles, Photographic and Contact, Preparation of
MIL-I-8700	Installation and Test of Electronic Equipment in Aircraft, General Specification for
MIL-H-8810	Handles, Control, Aircraft
MIL-C-14806	Coating, Reflection Reducing, for Instrument Cover Glasses and Lighting Wedges
MIL-M-18012	Markings for Aircrew Station Displays, Design and Configuration of
MIL-S-22885	Switch, Pushbutton, Illuminated, General Specification For
MIL-S-24317	Switches, Multistation, Pushbutton, (Illuminated and Non-Illuminated) General Specification for
MIL-K-25049	Knobs, Control, Equipment, Aircraft
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for
MIL-S-38039	Systems, Illuminated, Warning, Caution, and Advisory, General Specification for
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities
MIL-P-83335	Panels, Integrally Illuminated, White, General Specification for

MIL-C-81774A

STANDARDS

Federal

FED-STD-595

Colors

Military

MIL-STD-143

Standards and Specifications, Order of Precedence
for the Selection of

MIL-STD-203

Aircrew Station Controls and Displays for Fixed
Wing Aircraft

MIL-STD-250

Aircrew Station Controls and Displays for Rotary
Wing Aircraft

MIL-STD-411

Aircrew Station Signals

MIL-STD-454

Standard General Requirements for Electronic
Equipment

MIL-STD-480

Configuration Control - Engineering Changes,
Deviations and Waivers

MIL-STD-783

Legends for Use in Aircrew Stations and
on Airborne Equipment

MIL-STD-783

Nomenclature and Abbreviations in Aircrew Stations

MIL-STD-1333

Aircrew Station Geometry for Military Aircraft

MIL-STD-1472

Human Engineering Design Criteria for Military
Systems, Equipment and Facilities

MS25212

Control Panel, Console Type, Aircraft Equipment,
Basic Dimensions

MS25213

Control Panel, Aircraft Equipment, Typical
Installations

MS33742

Shafts, Control Knob

MIL-C-81774A

PUBLICATIONS

Military

DH2-2	AFSC Design Handbook for Crew Stations and Passenger Accommodations
SD-24	General Specifications for Design and Construction of Aircraft Weapon Systems

3. REQUIREMENTS

3.1 Design - The design of the control panel shall be in accordance with MIL-STD-1472, SD-24, DH2-2, data generated under the requirements of MIL-H-46855, and the system requirements of the system specification which dictates the operational environment and mission considerations specified by the procuring agency. The control panel shall be designed to assure effective operation, safety, and minimum operating error under all operating conditions of the aircraft. The control panel shall be designed for a specific location as specified by the procuring agency. When more than one location is specified, a design for each specified location shall be made; however, differences in design shall be limited to changes required by reach, manipulation and visibility. All markings, legends, and displays shall be visible and legible to the operator under the range of ambient illumination conditions in the operational environment. The surface (touch) temperature of all displays, pushbuttons, knobs, etc. that the crew members operate shall conform to the requirements of MIL-STD-454.

3.1.1 Approval - The design (as represented by the data package (3.2)) shall be reviewed and approved by the human factors and engineering personnel of the procuring agency. Only the approved design shall be fabricated for aircraft use.

3.2 Data - The contractor shall prepare and submit to the procuring agency a data package for each control panel design. The package shall be submitted in time to permit review and approval prior to the fabrication of the control panel. The package shall consist of a Control Panel Layout (3.2.1), Human Factors Data (3.2.3) and Specification Endorsement Data (3.2.4). The end product of a control panel design shall include a package of data consisting of a recommended control/display equipment configuration and location(s), and rationale for the recommended design including available experimental data.

MIL-C-81774A

Upon selection of a design approach, the data shall accordingly be revised and submitted for inclusion in performance and procurement specifications. Preliminary equipment layout drawings and component lists shall be prepared and submitted for review and concurrence. Static mockup and dynamic simulation may be required to select an optimum design or to validate the design of control/display equipment. Engineering change proposals that affect the control panel shall include updated data in accordance with MIL-STD-480.

3.2.1 Control panel layout - The control panel layout data shall be submitted in the format conforming to Appendix A and Figure 1 and shall include:

- (a) A full-size layout of the panel including markings, hole centers, and mounting plate references.
- (b) A hole schedule indicating the sizes and types of holes.
- (c) A hardware schedule (If MS hardware is not used, a dimensional specification control drawing must be attached) and a remarks block (which covers special characteristics such as color of indicators, shape of toggle handles, positions of mechanical indicators).
- (d) A signature and a title block (including the drawing title, drawing number, tolerances, etc.).
- (e) Notes (to include engineering notes such as corner radii, type of panel, and panel fabrication).
- (f) A revision block to indicate any changes made to the drawing.
- (g) Section views to clarify how hardware is mounted.
- (h) A full-size panel display drawing to include all markings and hardware shown in a true view looking into the face of the panel.

3.2.2 Film positive and film negatives - Two full-size negatives and one full-size film positive of the control panel shall be provided. The negatives and positive shall meet the requirements included in Appendix B. The

MIL-C-81774A

backing plate shall be referenced in the drawing. The film positive and film negative shall include crosses (+) for all hole centers, and all markings shall be shown. The holes shall be coded. Dimension marks shall be added to ensure accuracy of the positive and negatives within ± 0.003 inch for all markings and hole centers. Crop markings defining panel edges will also be included.

3.2.3 Human factor design - The human factor design data shall include a human engineering data package as specified in the following subparagraphs.

3.2.3.1 Panel functional description - A functional description of the panel shall be submitted (in the format defined in HED-1 of Appendix A) which defines and gives the rationale for all controls and displays, for their arrangement on the control panel, and for control protective devices. Critical controls must be identified and the precautions taken to reduce any error shall be explained. The panel functional description also shall identify, by report number, title, appropriate pages, and submittal date, the function allocation and task analysis data submitted under MIL-H-46855 requirements which were used as the basis for panel design.

3.2.3.2 Panel location(s) - The location(s) of the panel in the crew station for which the panel is designed shall be reported in the format provided in HED-2 of Appendix A. The location(s) of the panel is established by the distance from the Neutral Seat Reference Point (NSRP) to the panel center measured on the horizontal, vertical, and lateral axes as shown in Figure 2 and the angle of inclination of the panel to the horizontal, vertical, and lateral planes through the panel center.

3.2.3.3 Viewing - The viewing distance, the vertical look angle, and the horizontal look angle to the center of the panel shall be reported in the format provided in HED-2 of Appendix A. The distances and angles shall be based on the description of the crew station geometry in accordance with the requirements of MIL-STD-1333: The vertical look angle is the angle in degrees from the horizontal line of vision to the center of the panel with the apex at the design eye. The horizontal look angle is the angle in degrees measured from the forward vision line.

3.2.3.4 Legend description - A list of all legends appearing on the panel or used in panel displays shall be submitted in the format provided in HED-3 of Appendix A. Abbreviations shall include acronyms, contractions, and spelling variations. For each abbreviation listed, the abbreviated word (or words) will be spelled out, and the source of the abbreviation will be identified in accordance with MIL-STD-783.

MIL-C-81774A

3.2.3.5 Coding - A description of the methods of coding used (i.e., shape, color, symbol), an explanation of the intended purpose of each instance of coding, and the rationale underlying the choice of coding methods shall be submitted. The format to be used is provided in HED-4 of Appendix A.

3.2.3.6 Crew station control panels arrangement - The contractor shall provide a composite arrangement drawing showing all of the control panels in the crew station based on each control panel location as requested in paragraph 3.2.3.2.

3.2.4 Specification endorsement data - To facilitate creative control panel design, the following paragraphs define the procedures a contractor shall use in requesting approval of designs which are beyond the scope of, or which are in conflict with, this specification.

3.2.4.1 Specification Endorsement Request (SER) - When as a result of the use of (1) newly developed hardware or components or (2) a unique application of off-the-shelf hardware or components, a control panel design is not defined in this specification, the contractor shall submit a completed Specification Endorsement Request form to the procuring agency for approval to use the design. (A sample SER form, EDD-1, is included in Appendix A.)

3.2.4.2 Design Alternate Request (DAR) - When a design alternative is defined herein as requiring the approval of the procuring agency, or when design alternatives not specified are thought to improve operability, encompass a design improvement, or reduce cost, the contractor shall submit a completed Design Alternate Request form to the procuring agency for approval to use the design. (A sample DAR form, EDD-2, is included in Appendix A.)

3.2.4.3 Specification Deviation Notification (SDN) - Deviations to this specification that a contractor may wish to have approved shall be brought to the attention of the procuring agency as soon as the contractor has made a determination of noncompliance and in no case later than 30 days prior to submittal of the control panel drawing for approval. The contractor shall submit a completed Specification Deviation Notification form within the time period specified herein to the procuring agency to satisfy this specification requirement. (A sample SDN form, EDD-3, is included in Appendix A.)

3.2.4.4 Procuring agency approval - The contractor shall be informed of the action of the procuring agency within 30 days following the agency's receipt of the request.

MIL-C-81774A

3.2.4.5 Transmission of data - SER, DAR, and SDN forms shall be sent via certified mail to establish the date of receipt by the cognizant human factors personnel of the procuring agency.

3.3 Materials - Specifications and standards for all materials and parts, and Government certification and approval of processes and equipment, which are necessary for the execution of this specification, shall be selected in accordance with MIL-STD-143. Control panel material shall be in accordance with MIL-C-6781, and the lighted panel material shall be in accordance with MIL-P-7788.

3.3.1 Anti-reflective coating - All glass transparent areas on the control panel shall be treated in accordance with MIL-C-14806.

3.4 Mounting - All controls, displays, panels, and mounting plates shall be mounted in accordance with MIL-I-8700, MIL-E-7080, MS25212 and MS25213.

3.4.1 Control and display mounting - The mounting of controls and displays shall take into account the location of the control panel in the crew station so that all displays are legible from the design eye point as defined in MIL-STD-1333.

3.4.1.1 Toggle switches - Toggle switches shall be installed so that the top of the bushing or the switch mounting bracket is flush with the surface of the panel whenever possible.

3.4.1.2 Pushbuttons - Pushbutton switches shall be installed so that the button can be fully depressed without physical interference from the panel. If the pushbutton is mounted below the surface of the panel, a suitable cutout to permit unhampered glove hand operation shall be provided. A minimum 0.90 inch diameter cutout shall be provided for round pushbuttons. Pushbuttons may be mounted above or below the panel surface to a maximum of 0.25 inch.

3.4.1.3 Knobs - Knobs shall be installed 0.03 inch \pm 0.01 inch above the surface of the panel. For lighted control knobs, the minimum clearance shall be employed to minimize light leakage between the control knob and the panel. A knob may be installed through the panel cutout, provided that the distance from the top of the knob to the panel surface is a minimum of 0.50 inch. Metal knobs or plastic knobs with metal inserts shall have self-locking devices in accordance with MIL-K-25049 and the shaft for the knob shall conform to MS33742. In no case shall a knob with a round mounting hole be used with a "D" shaft.

MIL-C-51774A

3.4.1.4 Thumbwheels - Thumbwheels shall be installed so that they protrude from the surface of the panel not less than 0.125 inch and no greater than 0.50. The above panel distance shall be in direct relation to the diameter of the thumbwheel in Table II. The thumbwheel shall be installed so that it can be operated with no physical interference from the panel.

3.4.1.5 Finger operated control levers - Levers that are finger operated shall be installed a maximum of 2.00 inches above the panel surface.

3.4.1.6 Legend lights - Legend lights shall be installed flush with the top surface of the panel whenever possible. To avoid possible obscuration by displays, the legend light may be raised to the level of the adjacent displays.

3.4.1.7 Electro-mechanical and electro-optical indicators - Electro-mechanical and electro-optical indicators shall be installed flush with the surface of the panel whenever possible.

3.4.1.8 Digital displays - The display shall be mounted as close to the panel surface as possible and shall be aligned with any viewing windows in the plastic panel such that one series of horizontal and/or vertical digits can be read at one time.

3.4.2 Guards - Switch guards, when not an integral part of the control, shall be mounted securely to the panel backplate. The control shall not be operable without removal or opening of the guard, and upon opening the guard shall not subsequently interfere with the operation of the protected device or adjacent controls.

3.4.2.1 Frangible guards - Frangible guards shall be treated to break cleanly without sharp or jagged edges to prevent possible injury to personnel.

3.5 Color - The application of colors shall be smooth and uniform. Painted and silkscreened areas shall not bleed onto surrounding areas. Undesirable reflection shall be kept to a minimum on panel surfaces, controls, displays, and guards.

3.5.1 Opaque colors (reflected) - The opaque colors designated throughout this document shall be those specified below in accordance with FED-STD-595:

Black	37038
Light Gray	36440
Dark Gray	36231
White	37875

MIL-C-81774A

Red	21105
Orange-Yellow	33538
Green	14187

3.5.2 Color of lights - The color of the panel lighting shall be in accordance with MIL-C-25050.

3.5.3 Lighted panel - The lighted panel shall be finished in accordance with MIL-P-7788. It shall be black in compartments wherein the occupants have external visual duties and may be gray or black in other compartments. Panels to be used in USAF aircraft shall conform to MIL-P-83335 and shall be black in all compartments.

3.5.4 Mounting plate - The front face and edges of the mounting plate shall be the same color as the lighted panel and shall be finished in accordance with MIL-C-6781.

3.5.5 Fasteners - The color of panel fasteners and mounting-plate fasteners shall be the same as the panel.

3.5.6 Controls - The opaque color finish of all controls shall be dark gray on black panels and black on gray panels except as specified in the following sub-paragraphs.

3.5.6.1 Transilluminated controls - The color of the transilluminated portion shall be as determined by the required color of the emitted light. All other visible portions shall be dark gray on black panels and black on gray panels.

3.5.6.2 Transilluminated pushbuttons - Pushbuttons with transilluminated markings on the faces shall have an opaque background in the flight compartment and may be dark gray, black, or translucent background in other compartments.

3.5.6.3 Non-transilluminated pushbuttons - The non-transilluminated pushbutton cap shall be dark gray on a black panel and black on a gray panel unless otherwise specified by the procuring agency.

3.5.6.4 Toggle switches - All toggle switches shall have a non-glaring natural metallic finish as specified in MIL-S-3950 except the color of the wedge-shaped bat handles of slew-switch toggle switches shall be dark gray.

3.5.6.5 Oxygen switch (or lever) - This control shall be green with a white tip.

MIL-C-81774A

3.5.7 Panel markings - Panel markings shall be white except when illuminated or when they denote emergency-action controls and they shall be in accordance with MIL-M-18012.

3.5.8 Guards - Guards shall be the same color as the panel on which they are mounted except for emergency-type guards which shall be red. Guards shall be finished in accordance with MIL-G-7703.

3.6 Lighting - Lighting provisions shall permit the use of the panel controls and provide for readability of integral displays under night and day conditions.

3.6.1 Lighted panel - The lighted panel shall be lighted in accordance with MIL-P-7788 or MIL-P-83335 for USAF panels. Provisions for adjusting the panel lighting at installation to match that of adjacent panels shall be incorporated.

3.6.2 Controls - Controls shall be lighted sufficiently to permit the operator to locate the control, determine its position, and operate it without delay. Unless otherwise specified the following control lighting requirements shall apply.

3.6.2.1 Pushbuttons - When feasible the surface of the legend-illuminated pushbutton shall have a stroke-width border located at a maximum distance of 1/8 inch from the edge of the pushbutton surface. The brightnesses and/or contrast of pushbuttons shall meet the requirements for displays as specified herein.

3.6.2.2 Knobs - Markings such as lubber lines and numerals on knobs must have a brightness of not less than 90% of the average marking brightness of source plate as defined by MIL-P-7788. Where the knob skirt covers illuminated areas in the plastic plate, the knob skirt shall extend a minimum of 0.03 inch beyond the periphery of the lighted area. Any markings to be illuminated on the knob skirt must be approved by the procuring agency.

3.6.2.3 Thumbwheels - Thumbwheels shall be illuminated sufficiently to identify the location and configuration of the control. When the thumbwheel displays information, the readouts shall meet the requirements for displays.

MIL-C-81774A

3.6.3 Displays - Display lighting shall assure information presentation under all ambient illumination conditions. Display visibility and legibility under high ambient illumination conditions (10,000 Ft. Candles) shall be provided. Contrast between the lighted and unlighted portion of each display, under high ambient illumination conditions, shall be a minimum of 3 when calculated as follows:

$$C = \frac{B_2 - B_1}{B_1}$$

where: B_1 is the brightness of the unlighted portion.

B_2 is the brightness of the illuminated portion.

C is contrast

3.6.3.1 Mechanical indicators and digital displays - These indicators and displays shall be wired to the variable-brightness control which controls the lighted panel and they shall meet the brightnesses requirements for lighted panels except under high ambient conditions and under these conditions they shall meet the contrast requirements specified in paragraph 3.6.3.

3.6.3.2 Aircrew station signals - Warning, caution and advisory signal lights shall meet the requirements of MIL-STD-411.

3.6.4 Flashing lights - Flashing or intermittent light is distracting in an aircrew station and shall not be used unless approved by the procuring activity.

3.7 Markings - All markings shall be legible under all the ambient-illumination conditions specified in the following sub-paragraphs. Markings shall be uniform in stroke width with sharply defined edges. Markings shall be uniformly clear and without distortion. Markings shall be concise and shall be held to a minimum for ease of interpretation and prevention of excessive illumination. All panel functions, subfunctions, controls, and displays shall be so labeled to insure proper display interpretation and control selection by the operator. Functional legends shall be used for controls and displays, and control legends shall indicate the results of control movement. When controls and displays are to be used together, the legend shall indicate the functional relationship. Legends shall be selected or derived in accordance with MIL-STD-783.

MIL-C-81774A

Operational or military-service-oriented legends shall be used instead of engineering terminology.

3.7.1 Style and size - The lettering and numbering style and size shall be in accordance with MIL-M-18012 except that the height of the markings shall be $0.140 \pm .005$ inch.

3.7.2 Punctuation and symbols - Abstract symbols (i. e., squares, Greek letters) shall not be used unless prior approval has been obtained from the procuring agency. Periods shall be omitted; letter spacing may be used to preclude misinterpretation.

3.7.3 Unrelated markings - Trademarks, ground maintenance markings, and other markings not related to in-flight panel operation shall not be displayed on the panel face.

3.7.4 Lighted panels - Markings shall not extend into the panel edge radius.

3.7.4.1 Lines - When lines are required to clarify a panel display (i. e., to segregate systems, related control functions, and indicators), they shall be 0.020 ± 0.003 inch wide. The use of such lines shall be held to a minimum. Where the line appears above the functional group, the title shall be in a break in the line. Indicator lines for detented knobs shall be 0.020 inch wide. Underlining is not permissible.

3.7.4.2 Location - The distance between markings and the related subject, function or component shall be as shown in Figure 3.

3.8 Controls - Controls used on the control panel must be determined primarily by the requirements of the task to be performed and the capabilities and limitations of the operator. As a minimum in the selection and application of control components, the following factors must be taken into account.

3.8.1 Operability - The speed, accuracy, and ease of operation of the controls in the operational environment shall be considered.

3.8.2 Protection from accidental activation - All controls shall provide inherent protection from accidental activation due to vibration, loads, and light contact.

MIL-C-81774A

3.8.3 Maintainability and reliability - The controls shall permit routine cleaning and servicing and shall be compatible with applicable maintainability and reliability requirements. Requirements 35, 36 and 54 of MIL-STD-454 apply.

3.8.4 Consistency - Consideration shall be given to achieving operational consistency, and consistent training, through the use of similar components for related applications.

3.8.5 Conservation of panel space - Controls shall be selected to use a minimum of panel surface space without compromising operability and reliability.

3.8.6 Control selection - Controls shall be selected to implement the functions identified by human factors engineering analysis derived in accordance with MIL-H-46855 and MIL-STD-1472 where not covered herein. The selection of control type and control characteristics shall be based on operational considerations, circuit requirements, and the best use of space available.

3.8.6.1 Basic selection criteria - The basic criteria for the selection of a control type shall be in accordance with Table I. For functions not listed, the basis of selection must be documented and submitted to the procuring agency.

3.8.6.2 Lever-lock toggle switches - Lever-lock toggle switches may be used where a toggle switch is indicated in Table I if there is a need for additional protection from inadvertant actuation.

3.8.6.3 Miniature toggles - Miniature toggles may be selected for use to conserve panel space or for coding purposes with the approval of the procuring agency.

3.8.6.4 Solenoid-held toggles - Solenoid-held toggles may be used in special applications upon approval of the procuring agency.

3.8.6.5 Combined legend light/pushbutton - Signal legend lights may be integrated with pushbuttons where appropriate. The legend light shall conform to all requirements for displays, and the pushbutton characteristics shall be as specified herein. Illuminated pushbuttons will not be used in compartments where crew members have external visual tasks unless approved by the procuring agency.

MIL-C-81774A

3.8.6.6 Concentric knobs - Non-legend concentric knobs may be used to conserve space when such use is functionally applicable upon approval by the procuring agency.

3.8.7 Toggle switch characteristics - Toggle switches are considered herein to be discrete-position controls and shall be in accordance with MIL-S-3950. The switch shall not be capable of being stopped between positions. Toggle switch characteristics shall be in accordance with Table II.

3.8.7.1 Coding - The following coding techniques shall be used for toggle switches:

- (a) Toggle switches for slewing functions shall have a wedge-shaped bat handle with flat, ribbed gripping surfaces.
- (b) Lever-lock toggle switches shall have a distinctive shape which provides gripping surfaces on the bat handle suitable to disengage the lock.
- (c) Toggle switches may be touch-coded to increase discrimination between adjacent, closely spaced switches. This code must be approved by the procuring agency.
- (d) Solenoid-held toggle switches shall be coded to provide a cue to the holding function. The handle for this type of switch shall be rectangular in cross section with the wide dimension perpendicular to throw. Dimensions are in Table II.
- (e) Other methods of coding, such as special shapes, resistance, and diameter, may be used only if specified or approved by the procuring agency.

3.8.7.2 Momentary toggle switches (spring loaded) - Toggle switches should be considered for momentary-contact control functions when a momentary pushbutton is not feasible or when a forward-reverse slewing function is required.

3.8.7.3 Solenoid-held toggles - Solenoid-held toggles shall meet the requirements of MIL-S-5594.

MIL-C-81774A

3.8.7.4 Lever-lock switches - Lever-lock switches may be used in lieu of toggle switches when additional protection against inadvertent actuation is required. Maximum force to overcome a locked position shall be 48 ounces.

3.8.8 Pushbutton characteristics - Pushbutton characteristics shall be in accordance with the requirements of MIL-S-22885 and Table II.

3.8.8.1 Actuation - Pushbuttons shall have either a momentary actuation (push-ON, release-OFF) or a reset actuation (push-ON, push-OFF). A positive indication of control activation shall be provided (e.g., snap feel, integral light, visible displacement, external light (simple indicator)).

3.8.8.2 Shape coding - Where possible, pushbuttons shall be coded to indicate the type of switching function. A round pushbutton shall be used for momentary contact (press to actuate, release to deactuate). A rectangular or square pushbutton shall be used for a maintained-position pushbutton (push to actuate, push to deactuate). A truncated pyramid with a circular depression shall be used for data entry functions in keyboard arrangements.

3.8.8.3 Keyboard pushbutton characteristics and visual verification - Unless otherwise specified, keyboard pushbutton characteristics and visual verification shall conform to the following requirements:

- (a) Size - 0.5-inch square tops
0.5-inch-diameter round tops
- (b) Separation - The center-to-center distance of adjacent keyboard pushbuttons shall be a minimum of 0.625 inch.
- (c) Force - The actuation force shall be 25 ounces \pm 5 ounces.
- (d) Material - The limit load strength shall be 20 pounds in the direction of actuation.
- (e) Lighting - Keyboard pushbuttons shall be illuminated to meet the brightness requirements of MIL-P-7788.
- (f) Shape - Keyboard pushbuttons used for keyboard entry tasks shall have a depression on the control surface described by a sphere with a 1.00 ± 0.5 -inch radius.

MIL-C-81774A

The numbers and letters being keyed into a keyboard shall be displayed for verification before entry. For example, see Figure 4.

3.8.9 Discrete rotary control knobs - Type C bar-type knobs (see Figure 5) shall be used with rotary select switches. Knobs shall comply with the requirements of MIL-K-25049 and as specified herein.

3.8.9.1 Knob shape - Knobs shall be bar shaped with vertically parallel sides. The index end shall be tapered to minimize parallax error. The switch bar shall be short tailed to prevent reading the wrong end of the pointer.

3.8.9.2 Knob size - Acceptable knob sizes are listed in Table II. The selection of knob size shall be based on efficient use of panel space, force required, and number of settings. Knobs of different sizes may be used to increase visual and tactual discrimination between adjacent controls.

3.8.9.3 Number of positions - Rotary selector switches shall have no more than 12 positions for tactual positioning and no more than 24 positions for visual positioning. If less than 360 degrees of rotation are used, positive stops shall be provided at the beginning and end of the range of control positions. Where functional requirements dictate the elimination of stops, the design shall be referred to the procuring agency for approval. Knobs associated with digital displays shall have 10 equally spaced positions and no stops.

3.8.9.4 Displacement - Angular displacement between positions shall be in accordance with Table III, except for controls associated with digital displays. Knobs associated with digital displays shall have a displacement of 36 degrees.

3.8.9.5 Starting position - The starting position of a rotary selector switch shall make it possible for most changes in position to be made with a single wrist movement and without extreme wrist rotation. The requirements for knobs designed to be used by the right hand, left hand, or either hand shall be in accordance with Table III, except where functional indication of starting position requires position modification.

3.8.9.6 Grasping surface - The grasping surface of the knob shall be so designed as to prevent the fingers from slipping off the control. The knob shall have serrations running perpendicular to the panel surface on the sides of

MIL-C-81774A

the knob to provide a grasping surface for turning. A pull-to-turn knob shall be knurled.

3.8.10 Thumbwheel selectors, discrete - Thumbwheel controls may be used when the function requires a compact digital input device. The dimensions for these controls are specified in Table II.

3.8.10.1 Number of positions - Discrete rotary thumbwheel selectors shall have no more than 10 positions (0-9).

3.8.10.2 Thumbwheel shape - The digits or legends on the drum part of the thumbwheel shall be in line with the raised control tip of the thumbwheel so that the control tip center line is perpendicular to the panel surface when any digit or legend is being read. Thumbwheels shall not be capable of being stopped between digits or legends.

3.8.11 Continuous rotary control knobs - Continuous rotary knobs shall be selected for control functions requiring manual adjustment over a range of values. Knobs shall be designed to the requirements of MIL-K-25049 and as specified herein.

3.8.11.1 Shape - For adjustments where more than one full turn is required, a round knob shall be used. For adjustment of less than one full turn, and where the radial position of the knob is not a source of information, other shapes may be used to increase discrimination. Controls having more than 360 degrees of rotation (Type A) shall be distinguishable from those having less than 360 degrees of rotation (Type B). See Figure 5.

3.8.11.2 Knob skirts - A knob skirt with a pointer or a slotted skirt may be used to indicate the radial position of the knob. The pointer or slot shall be visible from the design eye position defined in MIL-STD-1333 for any pointer position. All knobs or knob skirts with indices shall be illuminated in accordance with the requirements of MIL-P-7788.

3.8.11.3 Concentric knobs - Concentrically stacked knobs may be used for related functions. The rotation of one knob shall not affect the setting of the other.

3.8.11.4 Knobs incorporating a switch position - If the continuous control incorporates a discrete function, the radial position of the knob shall be

MIL-C-81774A

marked and indexed with the panel label in the detent position. The force to overcome the detent position shall not exceed 12 inch-ounces but shall be at least twice the continuous resistance. The starting position or OFF position shall be at the extreme counter-clockwise position.

3.8.12 Continuous rotary thumbwheels - Thumbwheels may be selected for continuously variable control functions to conserve panel space.

3.8.12.1 Shape - Thumbwheels shall be round with serrated edges.

3.8.12.2 Dimensions - Thumbwheel dimensions are given in Table II.

3.8.13 Levers -

3.8.13.1 Levers for finger operation - Levers for finger operation shall meet the following requirements.

3.8.13.1.1 Limb support - When levers for finger movement are used to make fine or continuous adjustments, arm support shall be provided.

3.8.13.1.2 Size - If a spherical handle is provided, the diameter shall be greater than 0.5 inch and shall not exceed 0.75 inch. If a cylindrical handle is used (cylinder encircled by thumb and fingers), the cylinder shall be 0.375 inch minimum and 0.50 inch maximum.

3.8.13.1.3 Resistance - Finger operation resistance shall be 32 ounces minimum and 60 ounces maximum.

3.8.13.2 Hand controllers - Levers designed for hand control shall be in accordance with MIL-H-8810 and shall meet the following requirements.

3.8.13.2.1 Limb support - When hand control levers are used to make fine adjustments involving small hand movements, arm support shall be provided.

3.8.13.2.2 Size - The hand-grip of a controller may be either round or oval in cross-section. The diameter or major axis shall be 0.75 inch minimum and 1.50 inches maximum. The length of the lever should be at least 3.75 inches.

3.8.13.2.3 Resistance - Minimum resistance for a hand-controlled lever is two pounds. Maximum allowable resistance depends upon actuation sensitivity placement and direction of control movement. Fore-aft movement: 10 inches

MIL-C-81774A

forward of Neutral Seat Reference Point (NSRP) - 30 pounds; 16-24 inches forward of NSRP - 50 pounds. Lateral movement: 10-19 inches forward of NSRP - 20 pounds.

3.9 Displays - Selection and application of displays for the control panel shall be based on the display requirements analysis and the performance requirements of MIL-H-46855 and shall be in accordance with the criteria of MIL-STD-1472. In the selection and application of display components, consideration shall be given to the visual capabilities and limitations of the operator and to the operational environment in which the displays will be used.

3.9.1 Information - The limits, specificity and accuracy, form, redundancy, and combining of information shall be as follows:

- (a) The information displayed to an operator shall be limited to that information necessary for the operator to perform the specific actions or make the required decisions.
- (b) The information shall be displayed only to the level of specificity and accuracy required for specific operator action or decision.
- (c) The information shall be presented to the operator in a directly usable form. Requirements for decoding, transposing, computing, and interpolating shall be minimal.
- (d) Redundancy in the display of information to a single operator shall be avoided unless redundancy is required to achieve specified reliability.
- (e) Information necessary for performing different activities, such as operation and troubleshooting, shall not be combined in a single display unless the activities are comparable functions and require the same information.

3.9.2 Display selection requirements - The basic requirements for the selection of display type are given in Table IV. Additional requirements modifying the basic display-type selection are given in the following subparagraphs.

MIL-C-81774A

3.9.2.1 Legend lights - Legend lights shall be selected to communicate system function/malfunction equipment condition, or operating mode in accordance with MIL-STD-411 and, where appropriate, MIL-S-38039.

3.9.2.1.1 Combined legend light/pushbutton - Signal legend lights may be integrated with pushbuttons where applicable. The legend light shall conform to all requirements concerning such displays, and the pushbutton characteristics shall be as specified herein.

3.9.2.1.2 Warning and caution legend lights - Warning and caution lights shall not be used on a control panel without the approval of the procuring agency.

3.9.2.1.3 Advisory legend lights - An advisory light is an illuminated signal assembly which indicates safe or normal configuration, condition of performance, or operation of essential equipment, or which attracts attention and imparts information for routine action purposes. The use of advisory lights shall be minimized. They shall not be used where other methods, such as switch labeling, mechanical visual signals, etc., may be employed. Advisory legend lights require approval by the procuring agency.

3.9.2.2 Segmented-character displays - These displays may be used to present alpha-numeric information. These displays can provide a full set of letters and numbers for readout by illuminating different combinations of line segments. Segmented-character displays should be designed so that failure of the display (any segment) will be immediately apparent to the operator without his having to initiate a lamp test. Segmented-character displays shall be legible under all ambient illumination conditions. Character style, size, and spacing shall not degrade readability. The segmented displays shall dim uniformly and individual segments shall not dim out before others. The intensity distribution along the segments shall not vary noticeably. Approval by the procuring agency must be obtained prior to use.

3.9.2.3 Counters - Counters may be used to present quantitative data when a quick, precise indication is required.

3.9.2.4 Printers - Printers shall be used to present large quantities of numerical and written data. Data such as checklists, aircraft performance characteristics, electronics troubleshooting information, and detailed mission information are the primary types of information to be displayed on a printer.

MIL-C-81774A

3.9.3 Discrete-signal indicator display characteristics -

3.9.3.1 Multiple-legend arrays -

3.9.3.1.1 Stacked-legend-plate indicators - Multiple-legend indicators (legend plates stacked one behind another) shall be designed to conform with the following:

- (1) When a rear legend is illuminated, it shall not be obscured by the front legends.
- (2) Rear legend plates shall be so placed as to minimize parallax.
- (3) Rear legends shall be equal in apparent brightness to front legends, and the contrast between rear legends and background shall be equal to that between the front legend and its background.

3.9.3.1.2 Multiple-legend rear-projection indicators - These indicators shall meet the brightness requirements of MIL-STD-411.

3.9.3.1.3 Visibility - Visibility of legend lights shall not be restricted by the periphery of the enclosure for the display. The viewing limits shall be defined as any point within the frustum of an imaginary cone, whose sides make an angle of 60 degrees with a perpendicular to the center of the display, and whose frustum has the same area as the aperture of the display enclosure.

3.9.3.2 Electro-mechanical signal indicators (flip-flop) - Electro-mechanical discrete-signal indicators may be used.

3.9.3.2.1 Legibility - Electro-mechanical indicator legends shall be legible under all ambient lighting conditions. The indicator shall be integrally lighted and the brightness shall match the brightness of the adjacent displays.

3.9.3.2.2 Legends - Markings and legends shall be as specified in 3.7.

3.9.4 Variable-signal displays -

3.9.4.1 Scales and gages - Other than self-contained scales and gages shall not be used on control panels without approval of the procuring agency.

MIL-C-81774A

3.9.4.2 Counters/Segmented-character displays - The characteristics of these displays shall be in accordance with MIL-M-18012 except as specified herein.

3.9.4.2.1 Letter width - The width of the letters shall be $3/5$ of the height, except for the "I", which shall be one stroke in width, and the "M" and "W", which shall be $4/5$ of the height.

3.9.4.2.2 Stroke width - The stroke width of characters shall be $1/7$ to $1/8$ of the height.

3.9.4.2.3 Multidrum counters - If counters have several drums to display parameter values that change rapidly, the minimum value shall be a fixed zero to eliminate distractions caused by oscillations or by rapid movement of the drum. Decimal values shall be clearly indicated.

3.9.4.2.4 Rate of change - At no station on the drum shall numbers follow each other faster than two per second when the observer is expected to read the numbers consecutively.

3.10 Guard characteristics - Switch guards shall meet the requirements in the following sub-paragraphs and the requirements of MIL-G-7703 where applicable. Labeling on the panel adjacent to a guarded switch shall not be obscured by the guard or the switch. Controls shall be designed, oriented, and located so that they are not susceptible to being moved inadvertently. Particular attention shall be given to critical controls to prevent inadvertent actuation. Lockwire or safety wire shall not be used.

3.10.1 Protecting toggle switches - Critical toggle switches shall be guarded by shields, covers, or recesses.

3.10.1.1 Channel guard - A channel-type guard provides a barrier on each side of the toggle but allows for rapid actuation of the switch. The channels shall be 1.25 inches apart on centers. The channel shall be only as long and high as needed to protect the specific toggle switch.

3.10.1.2 Cover guard - A cover guard shall be used when rapid actuation is not necessary. A cover guard, when raised, serves as a flag to denote an abnormal condition.

3.10.1.3 Lever locks - Lever-lock-type toggle switches can provide barriers to prevent inadvertent actuation into or out of various positions.

MIL-C-81774A

3.10.2 Protecting pushbuttons - Pushbuttons used to control critical functions shall be guarded. Minimum clearance between the guard and pushbutton shall be 0.25 inch.

3.10.2.1 Recesses - Pushbuttons shall not be recessed more than 0.25 inch.

3.10.2.2 Cover guards - A circular collar-type guard may be attached to the backing plate in order to prevent unintended pushbutton actuation by operators. The circular collar may be provided with a cover spring-loaded to the closed position or with a permanently attached frangible cover which, when broken, will indicate intent to use. The cover guard regardless of type shall not obscure the function or status of a pushbutton control or its surrounding labeling.

3.10.2.3 Frangible cover - A frangible-type cover may be used to show that the switch has been operated.

3.10.2.4 Interlocks - Mechanically or electrically interlocked pushbuttons shall be used when it is necessary to preclude the actuation of multiple selections.

3.10.3 Protecting rotary controls - Rotary switches of a critical nature shall be protected from inadvertent operation.

3.10.3.1 Locking devices - Rotary switches with critical functions shall be protected against inadvertent actuation by a locking device which requires the operator to push in or pull out the knob before rotation.

3.10.3.2 Stops - Mechanical stops shall be provided on rotary switches to prevent actuation into an unused position.

3.10.3.3 Gate - An external gate-type guard location adjacent to the control knob can prevent actuation of the knob until the gate has been removed.

3.11 Panel layout and arrangement - A panel shall contain related controls and displays for a functional subsystem or integrated controls and displays for multiple functional subsystems. Panels shall be designed with full consideration of the operator, the environment in which the panel is to be used, and the functions it is to perform.

3.11.1 Control-display relationship - The relationship of the control to its associated display shall be immediately apparent to the operator. Such relationships are made apparent through such design techniques as proximity, grouping, coding, and marking.

MIL-C-81774A

3.11.2 Operator efficiency - The arrangement of controls and displays on a panel shall be designed to permit the operator to perform efficiently the tasks for which the panel is designed. The simplest arrangement compatible with functional requirements shall be selected. The design of the panel shall be based on an analysis of the dynamics of operation and the performance requirements.

3.11.3 Critical primary and emergency controls - Critical primary and emergency controls shall be capable of being operated under all expected operating conditions, including positive and negative G forces.

3.11.4 Clothing considerations - Controls shall be laid out so that control activation and movement are possible with gloves, pressure suits, or other clothing which may be worn by the operator. Minimum control clearances are specified in the following paragraphs; however, care shall also be taken to prevent inadvertent actuation or compromise of operation through adequate control spacing.

3.11.5 Direction of movement - When the device controlled is visible, the control shall move in the direction of the controlled device. However, when the controlled device is not visible, there is an option to move the control so as to be illustrative of either function or movement according to convention (MIL-STD-203, MIL-STD-250).

3.11.6 Panel layout conventions - The width of the panel (see MIL-C-6781) is that dimension which is perpendicular to the mounting rails and the length of the panel is the dimension parallel to the mounting rails. All directional references for control movement shall be based upon the relationship of the operator to the installed control panel. For panels mounted in a vertical or near vertical plane, within 30°, up is the direction from foot to head; down is the direction from head to foot. Right is the direction from the operator's midline toward his right hand. Left is the direction from the operator's midline toward his left hand. For panels mounted in a horizontal or near horizontal plane, the forward or 12 o'clock direction is the direction the operator faces in his standard seated position (Figure 2). Aft is in the opposite (6 o'clock) position. Right and left directions are the same as in the vertical panels (see above).

3.11.7 Panel layout - Prior to product release, a full-scale panel layout drawing, as specified in 3.2.1 and the data specified herein shall be submitted for approval of the procuring activity.

MIL-C-81774A

3.11.8 Functional grouping arrangements - When more than two control or display functions are required, the controls shall be grouped by function such that the functions may be readily identified and distinguished from one another, selected as quickly as possible without error, and manipulated accurately. The functional groups shall include the related subfunctions. Separation shall be provided between functional groups so that they may be readily distinguished and identified. Line markings to separate functional groups may be used only with the approval of the procuring agency. The functional groups shall be arranged on the panel according to the criticality of the function and frequency of use. If there is a sequential relationship among functions, the arrangement of the functional groups shall be by sequence. Controls and test points not required during a flight mission shall not be visible from the face of the control panel. Test points and controls required for general maintenance shall be separated from the inflight controls and made available on the control panel but not on the front of the panel.

3.11.9 Pushbutton arrays and matrices - An array of pushbuttons serving as an integrated control shall be such that, in a lateral array, left-to-right progression is in the order of increasing priority or sequence. In a longitudinal array, the forward progression is in order of increasing priority or sequence.

3.11.9.1 Ten-digit keyboard - Ten-digit keyboards shall use the keyboard arrangement as shown in Figure 4. When required, minus, degree, single-number insertion, decimal point, clear, and enter controls shall be added to the basic keyboard as shown in Figure 4.

3.11.10 Control separation - Controls shall be separated by enough space to permit manipulation of controls without interference or delay. Controls shall be positioned so that the operation of one control shall not cause the operation of any other control. Where separation does not eliminate inadvertent actuation, guards shall be used. Minimum control separation requirements are given in Table V.

3.11.11 Display separation - Displays shall have sufficient separation from other displays to eliminate confusion. Displays shall be separated from controls sufficiently to prevent obscuring of the display when viewed from the operating position.

3.11.12 Control actuation - Control actuation for controls installed in fixed-wing aircraft shall comply with MIL-STD-203; for controls installed in

MIL-C-81774A

rotary-wing aircraft, MIL-STD-250 shall apply. For controls not treated in the above, the following shall apply.

3.11.12.1 Discrete rotary selectors (knobs) - The extreme counter-clockwise position shall be OFF or the lowest value of the function in terms of numerical sequence. The successive clockwise positions shall be arranged in terms of increasing the value of the function or the numerical sequence.

3.11.12.2 Discrete thumbwheels - Thumbwheel switches shall be rotated forward, up, or right from the OFF position to increase value of the function or the numerical sequence.

3.11.12.3 Continuous rotary controls - OFF position, if required, shall be at the extreme counterclockwise position. Clockwise rotation shall result in increasing value of the function; i.e., increasing brightness level, increase numerical value. For functions requiring a null adjustment the null index shall be aligned at the 12 o'clock position. Clockwise rotation shall result in increasing the value and counter-clockwise rotation shall result in decreasing the value. The increase value may be presented as a plus condition and decrease value as a minus condition relative to the null or zero position.

3.11.12.4 Continuous thumbwheels - Forward, up, or right movement shall result in increasing value of the function. Aft, down, or left movement shall result in decreasing value of the function. For functions requiring a null adjustment, the null setting or zero position shall be centered in the movement range whenever possible. The index for the null position shall be centered perpendicular to the thumbwheel axis. Increasing the value may be represented by a plus presentation and decreasing the value may be represented by a minus presentation. Limit stops may be used when appropriate.

3.11.12.5 Two-position toggle switches - Actuation of two-position toggle switches shall be forward or upward for ON, normal operation, up, or forward as applied to the aircraft's longitudinal axis. Actuation of two-position toggle switches shall be aft or downward for OFF, emergency, override, or retract. Inboard/outboard movements shall be used only for selection of equipments of functions having a left or right position relationship to the longitudinal axis of the aircraft. The control actuation shall be related to the operator's left-hand/right-hand orientation.

3.11.12.6 Three-position toggle switches - The forward position shall represent the normal flight position, increase of the function, or increase when related to a slew function. The center position shall be used for OFF, neutral,

MIL-C-81774A

or an intermediate function. The aft position shall be used for decrease value of the function or override function.

3.11.12.7 Pushbutton actuation - Pushbutton actuation shall be consistent with the functional requirements for momentary contact or hold contact. For momentary pushbutton functions, actuation shall be depress: ON; release: OFF. Holding or reset function actuation shall be depress: ON; release: no change; depress: OFF; release; no change. Momentary pushbuttons shall be discriminable from holding pushbuttons.

3.11.12.7.1 Positive indication - Positive indications of control actuation (momentary and continuous), shall be provided, e.g., snap feel, integral lighting, visible displacement or simple indicator.

3.11.12.7.2 Multistation pushbuttons - A multistation pushbutton incorporates two or more pushbuttons in a single frame. Either locking or interlocking features or both shall be incorporated in multistation pushbuttons to assure error-free operation. Locking or interlocking actuation shall be based on functional requirements of the system. The type of lock or interlock used shall be selected from those described in MIL-S-24317. One pushbutton station in a multistation switch shall always be in a down or active position with its associated circuitry activated. Depressing any other pushbutton station shall not cause deactuation of activated circuitry until the pushbutton station being depressed is positively committed to activating its associated circuitry.

3.11.12.7.3 Interacting pushbutton stations - If two panels contain the same functions controlled by multistation pushbuttons, the pushbuttons on each panel shall interact to present the same indication of actuation. Panels with interacting pushbuttons shall indicate which crew station has control. Provision to lock out one set of pushbuttons may be made upon approval of the procuring agency. If lock-out of one panel is provided, the lock-out mode shall be displayed on both panels.

3.11.13 Arrangement of markings -

3.11.13.1 Orientation - Nomenclature shall be oriented left to right with respect to the operator except for the title which will be arranged top to bottom.

3.11.13.2 Location - Nomenclature for controls shall be arranged as indicated in Figure 3. Nomenclature shall not be obscured by controls when viewed from the operating position.

MIL-C-81774A

3.11.13.3 Control position nomenclature arrangement - Nomenclature which indicate control position shall be placed to relate clearly the position to the control. At least 0.375 inch shall separate control position labels from adjacent control markings.

3.12 Coding - Coding shall be used to facilitate identification, enhance discrimination and minimize error with respect to the location of panels, legibility of displays, and operation of controls within the full range of operational and environmental conditions. In a new aircraft design, coding methodology shall be established for the complete crew station and applied to individual panels.

3.12.1 Special coding applications - Where advantages are to be gained in terms of human performance, the contractor shall recommend special applications of coding principles to the procuring agency. Approval for special coding methods may be obtained in accordance with the procedures established by 3.2.4.2 of this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements. When required, the supplier will provide the Government with test data.

4.2 Inspection and testing requirements - The methods by which specification compliance will be determined are listed for each requirement in the specification. The methods are: component testing, inspection, mock-up review, demonstration, and data review. The contractor shall present evidence that the required compliance has been achieved in the design. The records of the tests, inspections, and reviews shall be available for inspection by the procuring agency. The testing and inspection performed under this specification shall not duplicate but, as necessary, shall be in addition to the tests and inspections performed against other contract requirements.

MIL-C-81774A

The Inspection and Testing Requirements List is coded to indicate one of the categories defined below:

- CT Component testing - All components used in the aircraft control panel shall be tested in accordance with the applicable military or contractor specification. Contractor specifications must be approved by the procuring agency prior to testing.
- I Inspection - Inspection includes the visual inspection of the panel and measurements of dimensions. The inspection shall also be performed on the film negative or film positive, which shall be a true copy of the panel.
- M Mock-up review - This review is an inspection of a three-dimensional mock-up of the panel design and all controls, displays, switches, switch guards, and markings on the panel. The panel will be viewed with the design eye relationship as specified to determine the legibility and visibility of all markings and legends, the control-display position relationships, and the adequacy of the panel layout and arrangement.
- D Demonstration - A demonstration shall establish that the panel or component can perform the functions for which it was designed when installed on an aircraft and operated by approved procedures. When requested, a lighting mock-up review shall be conducted to demonstrate that the lighting provides suitable visibility and legibility under the levels of illumination specified.
- DR Review of data - This category includes review and approval by the procuring agency of the data submitted in response to the requirements of 3.2.

MIL-C-81774A

INSPECTION AND TESTING REQUIREMENTS LIST

Specification Paragraph	CT	I	M	D	DR
3.3.1	X				
3.4.1		X	X	X	
3.4.2		X	X	X	
3.5.1	X				
3.5.3	X	X			
3.5.4	X				
3.5.5	X	X			
3.5.6		X			
3.5.6.1					
3.5.6.2		X			
3.5.6.3		X			
3.5.6.4		X			
3.5.6.5		X			
3.5.7		X			
3.5.8		X			
3.6.1	X		X	X	
3.6.2.1			X	X	
3.6.2.2		X	X	X	
3.6.2.3			X	X	

MIL-C-81774A

INSPECTION AND TESTING REQUIREMENTS LIST (Continued)

Specification Paragraph	CT	I	M	D	DR
3.6.3.1			X	X	
3.6.3.2	X				
3.6.3.3			X	X	
3.6.4					X
3.7.1		X			
3.7.2		X			
3.7.3		X			
3.7.4		X			
3.7					X
3.7.4.1		X			
3.7.4.2		X			
3.8.6					X
3.8.6.2					X
3.8.6.3					X
3.8.6.4					X
3.8.6.5					X
3.8.6.6					X
3.8.7	X			X	
3.8.7.1		X	X		

MIL-C-81774A

INSPECTION AND TESTING REQUIREMENTS LIST (Continued)

Specification Paragraph	CT	I	M	D	DR
3.8.7.2	X				
3.8.7.3	X				
3.8.7.4	X				X
3.8.8	X			X	
3.8.8.1	X			X	
3.8.8.2				X	
3.8.8.3	X	X			
3.8.9	X	X			
3.8.9.1		X			
3.8.9.2		X			
3.8.9.4		X			
3.8.9.5		X			
3.8.10	X				
3.8.10.1		X			
3.8.10.2		X			
3.8.11	X	X			
3.8.11.2		X			
3.8.11.3		X			

MIL-C-81774A

INSPECTION AND TESTING REQUIREMENTS LIST (Continued)

Specification Paragraph	CT	I	M	D	DR
3.8.11.4		X			
3.8.12.1		X			
3.8.12.2		X			
3.8.13.1		X			
3.8.13.2		X	X		
3.9.2					X
3.9.2.1					X
3.9.2.1.1	X				X
3.9.2.1.2					X
3.9.2.1.3					X
3.9.2.2	X			X	
3.9.2.3	X				X
3.9.2.4	X				X
3.9.3.1.1	X		X	X	
3.9.3.1.2	X	X			X
3.9.3.1.3				X	
3.9.3.2	X				
3.9.3.2.1			X	X	
3.9.3.2.2		X			X

MIL-C-81774A

INSPECTION AND TESTING REQUIREMENTS LIST (Continued)

Specification Paragraph	CT	I	M	D	DR
3.9.4.1		X			X
3.9.4.2	X				
3.9.4.2.1		X			
3.9.4.2.2		X			
3.9.4.2.3		X			
3.9.4.2.4				X	
3.10.1	X				
3.10.1.1		X		X	
3.10.1.2	X				
3.10.1.3	X				
3.10.2		X		X	
3.10.2.1		X			
3.10.2.2		X	X		
3.10.2.3	X			X	
3.10.2.4				X	
3.10.3				X	
3.10.3.1				X	X
3.10.3.2				X	X
3.10.3.3				X	

MIL-C-81774A

INSPECTION AND TESTING REQUIREMENTS LIST (Continued)

Specification Paragraph	CT	I	M	D	DR
3.11.7		X			X
3.11.8				X	X
3.11.9				X	X
3.11.10	X	X		X	
3.11.11		X		X	
3.11.12				X	
3.11.12.1				X	
3.11.12.2				X	
3.11.12.1.3				X	
3.11.12.1.4				X	
3.11.12.5				X	
3.11.12.6				X	
3.11.12.7				X	
3.11.12.7.1				X	
3.11.12.7.2				X	
3.11.12.7.3				X	
3.11.13.1		X	X		
3.11.13.2		X	X		
3.11.13.3		X	X		
3.12		-		X	X
3.12.1				X	X

MIL-C-81774A

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing and marking - Preservation, packaging, packing and marking shall be in accordance with MIL-P-7788.

6. NOTES

6.1 Intended Use - The panels covered by this specification are intended for use in the crew stations of military aircraft.

6.2 Specification Endorsement Request (SER) - The SER may only be used to request a change that involves new hardware or new uses of old hardware which improves the operability of the control panel. The SER is intended to enable a contractor to apply recent advances of hardware design to military aircraft control panels without revising this specification.

6.3 Design Alternate Request (DAR) - Included in the specification are items which may be used only under certain specified conditions rather than universally or indiscriminately. Where design alternatives or conditional uses of hardware are permitted by the specification, their use must be approved by the procuring activity. The DAR form is designed to facilitate this process. This type of change may not involve either significant improvement or degradation in design, and the implementation recommended is likely to be a function of operational conditions and specific system requirements. The DAR request has no implication on costs, schedule, or overall system effectiveness.

6.4 Specification Deviation Notification (SDN) - The SDN is a design deficiency of a serious nature. It indicates non-compliance with the specification and may have implications for costs and system performance.

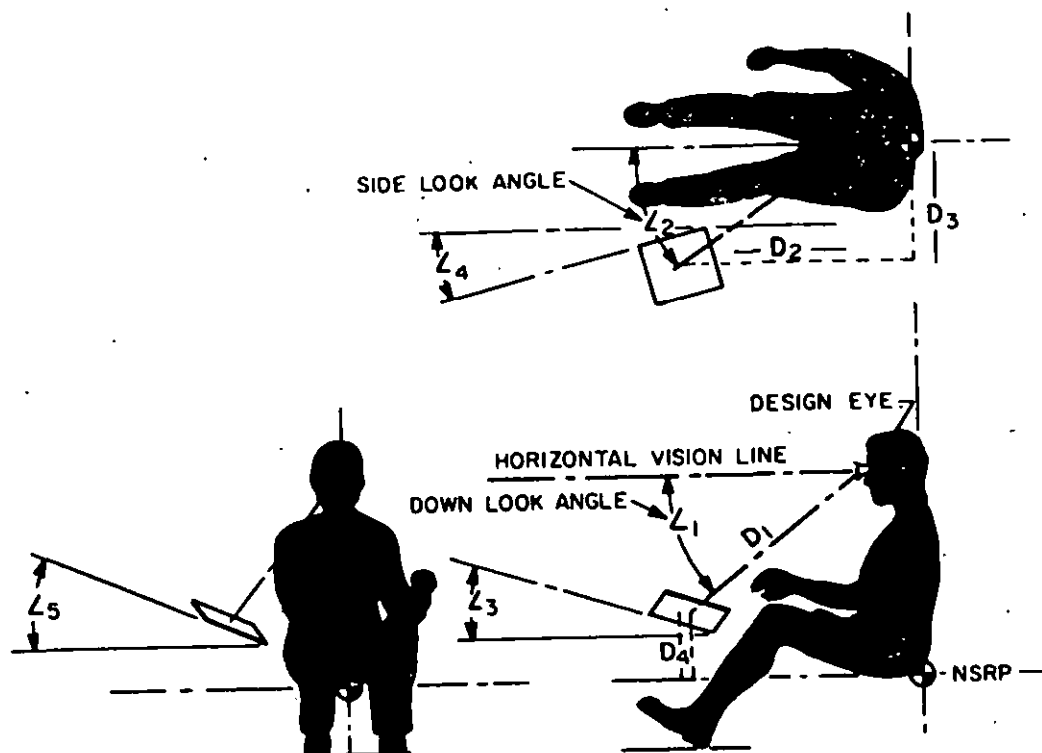
6.5 Precedence of Documents - When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence applies.

- (a) Contract - The contract shall have precedence over any specification.
- (b) This Specification - This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approved in writing by procuring activity.
- (c) Referenced Specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.



FIGURE 1. Control Panel Layout

MIL-C-81774A



VIEWING ANGLES AND DISTANCE MEASURED FROM DESIGN EYE TO THE PANEL CENTER

- L_1 - Down Look Angle
- L_2 - Side Look Angle
- D_1 - Distance (True) from Design Eye to Panel Center

MEASUREMENT FROM NSRP MEASURED TO PANEL CENTER

- D_2 - Horizontal Measurement
- D_3 - Lateral Measurement
- D_4 - Vertical Measurement

PANEL INCLINATION - (MEASURED NORMAL TO NSRP AXES)

- L_3 - From Horizontal Axis
- L_4 - From Vertical Axis
- L_5 - From Lateral Axis

NOTE: Design Eye and NSRP - See MIL-STD-1333.

FIGURE 2. Panel Location and Viewing Data

MIL-C-81774A

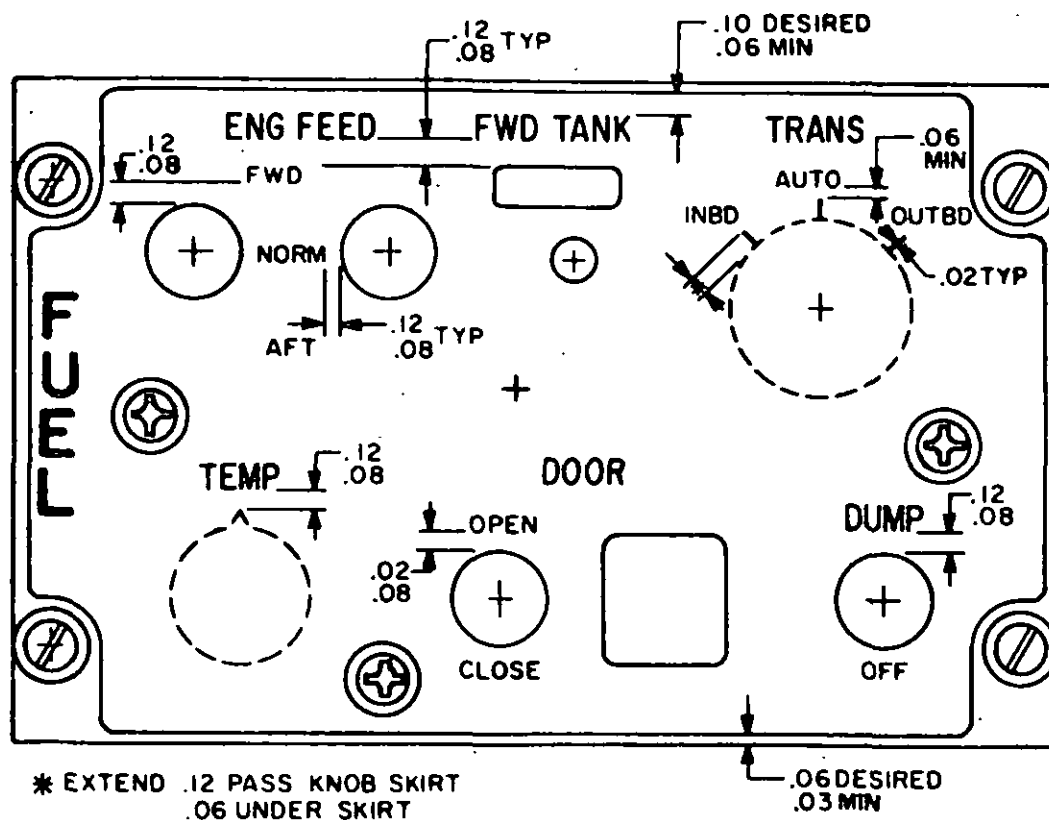


FIGURE 3. Panel Markings

MIL-C-81774A

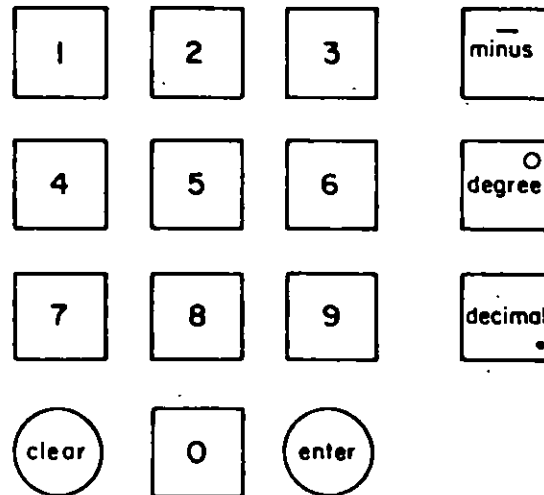
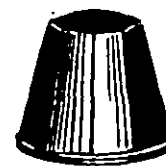
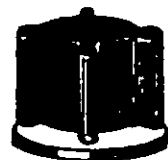


FIGURE 4. Keyboard Arrangement

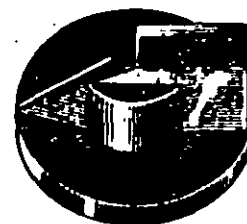
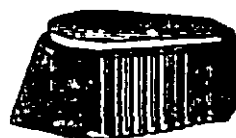
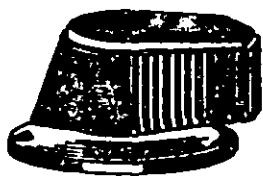
MIL-C-81774A



TYPE A KNOBS



TYPE B KNOBS



TYPE C KNOBS

FIGURE 5. Control Knob Shapes

TABLE I.
CONTROL SELECTION CHART

FUNCTION	CONTROL					
	Toggle Switch	Push Button	Bar Knob	Round Knob	Thumb-Wheel D	Thumb-Wheel C
Select system power state ON-OFF	1	2	3	X	X	X
Select between OFF/Prime Mode/Secondary Mode	1	3	2	X	X	X
Select one or more of N related functions	3	1A	2			
Select one of N mutually exclusive functions any order		1 Multiple				
Select one of 3-24 discrete alternatives — sequential order			1			
Select digit - discrete		1 Keybd	2		1	
Select function and maintain if and only if system accepts selection	1 Sol Held	1				
Select range - continuous				1		1
Select range - discrete steps			1	2	1	
Select operating condition	1	2	2			
Enter alpha-numeric data		1 Keybd			2	
Initiate test subfunction	1	1	3			
Initiate directional function	1	2 Multiple	3			

TABLE I.
CONTROL SELECTION CHART (Cont'd)

FUNCTION	CONTROL					
	Toggle Switch	Push Button	Bar Knob	Round Knob	Thumb-Wheel D	Thumb-Wheel C
Step from one condition to another		1	1		3	
Slew counters or other numeric readout	1			2		
Input momentary discrete	1	1	3	3		
Reset discrete display	1	1				
Interrupt sequence - maintain	1	1	3	3		3
Engage - Disengage subfunction	1	1				
Adjust light level cont.	3 3 levels max.			1		2
Adjust aural level				1		2
Coarse adjustment				1 small		2
Adjust input/output over continuous range				1		2
Fine adjustment				1 large		2
Null visual signal				1		2
Null aural signal				1		2

MIL-C-81774A

TABLE II.
CONTROL CHARACTERISTICS

CONTROL TYPE	SIZE	DISPLACEMENT	RESISTANCE
TOGGLE SWITCH - Regular	Height 0.69 ± 0.03 Tip Diam. 0.24 ± 0.003	2 Position 33° ± 5° 3 Position Total 33° ± 5° Adjacent 17° ± 5°	Easy 15 ± 5 oz. Hard 30 ± 5 oz.
Lever lock	Height 0.95 ± 0.05 Tip Diam. 0.42 ± 0.03	2 Position 33° ± 5° 3 Position Total 33° ± 5° Adjacent 17° ± 5°	30 ± 10 oz. 30 ± 10 oz. Lift to overcome lock
Subminiature (SM)	Height 0.44 ± 0.025 Tip Diam. 0.093 ± 0.003	2 Position 42° ± 6° 3 Position Total 42° ± 6° Adjacent 21° ± 3°	20 ± 5 oz.
Solenoid Held	Height 1.06 ± 0.05 Tip-Rectangular .1875 X .375	2 Position 30° ± 5° 3 Position Total 30° ± 5° Adjacent 15° ± 2°	Minimum 10 oz. Maximum 40 oz.
PUSHBUTTON - Momentary	Diam. Minimum 0.375 Maximum 1.000	Minimum 0.125 Maximum 0.500	15 ± 5 oz.
Holding	Smallest Dimension Minimum 0.500 Maximum 1.250	Minimum 0.25 Maximum 0.500	30 ± 10 oz.

TABLE II.
CONTROL CHARACTERISTICS (Cont'd)

CONTROL TYPE	SIZE	DISPLACEMENT	RESISTANCE
Rotary Select Knobs (Type C)	Length 1.00 - 1.50 Width 0.250 - 0.750 Height 0.875 - 1.00	SEE TABLE III	1 - 3 inch pounds for 1-inch knobs 1 - 5 inch pounds for greater than 1-inch knobs
Continuous Rotary Knobs (Type A, B)	Diameter Minimum 0.500 Maximum 1.000 Height Minimum 0.500 Maximum 1.000	Less than 360° - Type B More than 360° - Type A	1 - 4.50 inch oz. for knobs less than 1 inch 2 - 6 inch oz. for knobs 1 inch or greater
THUMBWHEEL - Discrete	Diameter 1.00 - 3.00 Height Minimum 0.125 Maximum 0.375	36° between positions	Minimum 15 ± 5 in. oz. Maximum 30 ± 10 in. oz.
Continuous	Diameter 1.00 - 3.00 Height Minimum 0.125 Maximum 0.375 Width Minimum 0.125 Maximum 0.375		Minimum 1 in. oz. Maximum 5 in. oz.

MIL-C-81774A

MIL-C-81774A

TABLE III

KNOB DETENTS PLACEMENT FOR VISUAL POSITIONING

TOTAL NO. OF SETTINGS	RECOMMENDED ANGULAR DISPLACEMENT (DEGREES)	RECOMMENDED RADIUS FOR 3/8" SEPARATION (INCHES)	RECOMMENDED STARTING POSITION (DEGREES)		
			RIGHT-HAND OPERATION	LEFT-HAND OPERATION	EITHER HAND
3	40.00	0.537	264.00	16.00	320.00
4	37.06	0.580	254.65	354.17	304.00
5	34.52	0.622	246.58	335.34	290.96
6	32.31	0.665	239.54	318.91	279.22
7	30.36	0.708	233.35	304.49	268.92
8	28.64	0.750	227.86	291.66	259.76
9	27.10	0.793	222.96	280.24	251.60
10	25.72	0.836	218.56	269.96	244.26
11	24.47	0.878	214.59	260.71	237.65
12	23.33	0.921	211.01	252.36	231.68
13	22.30	0.964	207.72	244.68	226.20
14	21.36	1.006	204.70	237.62	221.16
15	20.49	1.049	201.94	231.20	216.57
16	19.69	1.091	199.40	225.25	212.32
17	18.95	1.134	197.04	219.76	208.40
18	18.26	1.177	194.87	214.71	204.79
19	17.62	1.219	192.85	209.99	201.42
20	17.03	1.262	190.93	205.50	198.21
21	16.47	1.305	189.18	201.42	195.30
22	15.95	1.347	187.52	197.53	192.52
23	15.46	1.390	185.96	193.92	189.94
24	15.00	1.433	180, 270 or 360	0, 90, or 180	0 or 180

MIL-C-81774A

TABLE III

KNOB DETENTS PLACEMENT FOR TACTUAL POSITIONING

TOTAL NO. OF SETTINGS	RECOMMENDED ANGULAR DISPLACEMENT (DEGREES)	RECOMMENDED RADIUS FOR 1/2" SEPARATION (INCHES)	RECOMMENDED STARTING POSITION (DEGREES)		
			RIGHT-HAND OPERATION	LEFT-HAND OPERATION	EITHER HAND
3	40.00	0.716	264.00	16.00	320.00
4	38.57	0.743	253.29	351.00	302.14
5	37.24	0.769	243.31	327.73	285.52
6	36.00	0.796	234.00	306.00	270.00
7	34.84	0.822	225.29	285.67	255.48
8	33.75	0.849	217.13	266.62	241.87
9	32.73	0.875	209.45	248.71	229.08
10	31.77	0.902	202.22	231.85	217.03
11	30.86	0.928	195.42	215.98	205.70
12	30.00	0.955	180, 270, or 360	0, 90 or 180	0 or 180

**TABLE IV.
DISPLAY SELECTION CHART**

FUNCTION	NON-LEGEND SIGNAL	LEGEND LIGHTS	ELECTRO- MECHANICAL (Flip-Flop)	COUNTERS	SCALES	SEGMENTED CHARACTER READOUT
Quantitative data readout				1	3	2
Indicate function selected	2	1	1			
Indicate equipment operating condition	2	2	1			
Indicate when and which automatic or remote modes have been selected	2	2	1			
Display ground or remote command message		1	1			3
Indicate variable quantity and trend				2	1	
Indicate steps in automatic sequence	2	1	1	2		3
Indicate function of multi-purpose control or display		1	1			3
Label units of measure or type of data on multi-purpose display		2	1			3
Indicate condition of sensors	1	1	1			
Provide attention-getting signal	1	2	3			

TABLE V.
MINIMUM CONTROL SEPARATION REQUIREMENTS

	Toggle Switches	Cont. Knobs	Discrete Knobs	Discrete Thumbwheel	Cont. Thumbwheel	Levers	Pushbuttons
Toggle Switches	3/4	1	1	1/2	1/2	3/4	1/2
Continuous Knobs	1	1	1	1/2	1/2	1	1/2
Discrete Knobs	1	1	1	1/2	1/2	1	1/2
Discrete Thumbwheels	1/2	1/2	1/2	3/8	3/8	1	1/2
Continuous Thumbwheels	1/2	1/2	1/2	3/8	3/8	1	1/2
Levers	3/4	1	1	1	1	2	1/2
Pushbuttons	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Adjacent Panel	3/8	1/2	1/2	1/4	1/4	3/8	1/4
Sidewall or Obstruction	1	3-1/2	3-1/2	2-1/2	2-1/2	3-1/2	1

NOTES: 1. Separation is measured between adjacent edges.
2. All dimensions in inches.

MTL-C-81774A

APPENDIX A

FORMAT FOR CONTROL PANEL DATA

1. Scope - The data items described by the appendix shall be used to submit data, to document design and human engineering activities, and to request design changes. The data shall be submitted in the form and format shown on the following pages.

1.1 Panel Design Package - The Panel Design Package shall be used to fulfill the data requirements of 3.2.1 and shall consist of the following:

- (a) Panel Drawing (PDP-1)
- (b) Film Positive and Film Negative (PDP-2) (See Section 20 of this appendix)
- (c) Controls List (PDP-3)
- (d) Displays List (PDP-4)

1.2 Human Engineering Data Package - The Human Engineering Data Package shall be used to fulfill the data requirements of 3.2.3 and shall consist of the following:

- (a) Panel Functional Description and Rationale Data (HED-1)
- (b) Panel Location and Viewing Data (HED-2)
- (c) Abbreviation, Legend, and Symbol List (HED-3)
- (d) Coding Data (HED-4)

1.3 Endorsements and Deviations Data - The Endorsements and Deviations Data shall be used to fulfill the data requirements of 3.2.4 and shall consist of the following:

- (a) Specification Endorsement Request (EDD-1)
- (b) Design Alternate Request (EDD-2)
- (c) Specification Deviation Notification (EDD-3)

MIL-C-81774A

PDP-1

A/C type _____ Contract No. _____

Page _____ of _____

PANEL DRAWING

Panel Identification:

1. Panel Title _____ 2. Drawing No. _____
 3. Procurement Specification _____ 4. Aircraft Nos. _____
 5. Contract No. _____ 6. Submittal Date _____
 7. Prepared by _____ 8. Phone No. _____

Attach to copy of drawing described in 3.2.2.

For use of * Dept. only.

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

PDP-2

A/C type _____ Contract No. _____

Page _____ of _____

FILM POSITIVE AND FILM NEGATIVE

Panel Identification:

1. Panel Title _____ 2. Drawing No. _____
 3. Procurement Specification _____ 4. Aircraft Nos. _____
 5. Contract No. _____ 6. Submittal Date _____
 7. Prepared by _____ 8. Phone No. _____
-

Attach to film positive and negative.

For use of * Dept. only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

PDP-4

A/C type _____ Contract No. _____

Page _____ of _____

DISPLAYS LIST**Panel Identification:**

1. Panel Title _____ 2. Drawing No. _____
 3. Procurement Specification _____ 4. Aircraft Nos. _____
 5. Contract No. _____ 6. Submittal Date _____
 7. Prepared by _____ 8. Phone No. _____
-

List all displays and described their physical characteristics.

Display Type & Panel Nomen.	Night Brightness	Day Brightness	Contrast	MS Number	* use only	
					A	D

For use of * Dept. only.

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

HED-1

A/C type _____ Contract No. _____

Page _____ of _____

PANEL FUNCTIONAL DESCRIPTION AND RATIONALE DATA**A. Panel Identification**

1. Panel Title _____ 2. Drawing No. _____
 3. Procurement Specification _____ 4. Aircraft Nos. _____
 5. Contract No. _____ 6. Submittal Date _____
 7. Prepared by _____ 8. Phone No. _____

9. Package Summary: B) _____ pages; C) _____ pages; D) _____ pages; E) _____ pages

B. Panel Functional Description:

Briefly describe system function of the panel and its major subfunctions in terms of operational use.

(1) System Description:

(2) Major Functions:

(3) Operating Procedure:

(4) Enter criticality code for appropriate mission phase:
 1-Routine; 2-Affects CEP; 3-Affects flight safety; O-not used.

Preflight _____ Takeoff _____ Climbout _____ Cruise _____ Refuel _____
 Weapons Delivery _____ Approach _____ Land _____
 Other _____ (explain)

(Use other sheets as required to complete Item B)

PANEL FUNCTIONAL DESCRIPTION DATE (Item C)

CONTROL & DISPLAY RATIONALE

Check

C	D	NAME	FUNCTION	RATIONALE	* use only	
					A	D

(Use as many sheets as required)

* Army
 Navy
 Air Force
 (as applicable)

Page ____ of ____

HED-1

MIL-C-81774A

MIL-C-81774A

HED-1

Page _____ of _____

D. Error Prevention and Safety Precautions

- (1) Identify ALL controls on the panel which could introduce hazards if NOT properly operated.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

- (2) Describe measures taken to provide protection.

(Use additional forms as required.)

MIL-C-81774A

HED-1

Page _____ of _____

E. Human Factors Design Data Base:

- (1) Identify by title, report number, submission date, and page, the human factors data upon which this panel design is based:

(a) Functional Allocation:

(b) Task Analysis:

(c) Control/Display Requirements:

(d) Operation Sequence Data:

Prepared by _____
Title _____

Approved by _____
Title _____
Date _____

For use by * Dept. only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

HED-2

A/C type _____ Contract No. _____

Page _____ of _____

PANEL LOCATION AND VIEWING DATA

A. Panel Identification:

1. Panel Title _____ 2. Drawing No. _____
 3. Procurement Specification _____ 4. Aircraft Nos. _____
 5. Contract No. _____ 6. Submittal Date _____
 7. Prepared by _____ 8. Phone No. _____

B. Panel Location:

1. Panel Size: _____ x 5.75.
 (Mark out non-applicable direction reference.)
 2. Distance Forward or Aft of NSRP _____ inches.
 3. Distance Right or Left of NSRP _____ inches.
 4. Distance Above or Below NSRP _____ inches.
 5. Reach Zone _____ (See MIL-STD-1333.)
 Reach distance to the most distant control is _____ inches.
 Reach distance is the shortest distance from a line projected
 vertically from the NSRP. (See MIL-STD-1333.)
 6. Inclination angle from Horizontal (Waterline Plane).
 7. Inclination angle from Vertical (Station Line Plane).
 8. Inclination angle from Vertical (Buttline Plane).

C. Panel Viewing Data:

1. Location of eye reference point with respect to the NSRP:
 _____ inches above SRP; _____ inches forward of NSRP.
 2. Viewing distance to panel center _____ inches.
 3. Down angle from horizontal vision line _____°.
 4. Side angle from horizontal vision line _____°.

Prepared by _____ Approved by _____ Date _____

* Army

Navy

Air Force

(as applicable)

For use of * Dept. only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

HED-3

A/C type _____ **Contract No.** _____

Page of

HUMAN FACTORS ENGINEERING DATA ABBREVIATION, LEGEND & SYMBOL LIST

A. Panel Identification:

1. Panel Title _____ 2. Drawing No. _____
3. Procurement Specification _____ 4. Aircraft Nos. _____
5. Contract No. _____ 6. Submittal Date _____
7. Prepared by _____ 8. Phone No. _____

9. Package Summary: B)___pages; C)___pages; D)___pages; E)___pages

B. List in alphabetical order the abbreviations used on the panel and complete data.

Abbreviation	Word(s)	Source	New (check if ap.)	* Use Only	
				A	D

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

HED-3

Page _____ of _____

E. Symbol Identification:

Identify and define the meaning of all display symbols used.

(Provide sketch.)

For * Dept. use only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

A/C type _____ Contract No. _____

Page__ of __

CODING DATA

A. Panel Identification.

1. Panel Title _____ 2. Drawing No. _____
3. Procurement Specification _____ 4. Aircraft Nos. _____
5. Contract No. _____ 6. Submittal Date _____
7. Prepared by _____ 8. Phone No. _____

9. Package Summary: B) ___ pages; C) ___pages.

B. Coding methods used for panel, general description:

Coding Method	Rationale	* Use Only	
		A	D

(If additional space is required, use additional sheets.)

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

HED-4

Page ____ of ____

C. Coding Application. For each control or display having coded characteristics, list the control/display, describe the coded characteristics, and give the purpose in coding.

Name	Coded Characteristic Description	Purpose in Coding	* Use Only	
			A	D

* Army

Navy

Air Force

(as applicable)

66

For use of * Dept. Only
Approved _____ (Sig.)
Disapproved _____ (Sig.)
Do not use

MIL-C-81774A

EDD-1

A/C type _____ Contract No. _____

Page _____ of _____

SPECIFICATION ENDORSEMENT REQUEST

Panel Identification:

- | | |
|------------------------------------|-------------------------|
| 1. Panel Title _____ | 2. Drawing No. _____ |
| 3. Procurement Specification _____ | 4. Aircraft Nos. _____ |
| 5. Contract No. _____ | 6. Submittal Date _____ |
| 7. Prepared by _____ | 8. Phone No. _____ |

An endorsement is requested to Paragraph _____ of specification MIL-C-81774.
The following data are submitted to justify the endorsement.

A. Detailed description of change:

B. Justification

1. Reason for change:

MIL-C-81774A

EDD-1

Page ____ of ____

For Official Use Only

Date Received _____ Cognizant Agency _____
 Reviewed by _____ Title _____
 Date _____

Action Taken:

Comments and Recommendations:

SER Approved _____ Disapproved _____

Signature _____

Title _____

Contractor notified _____ (date)

For use of * Dept. only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

EDD-2

A/C type _____ Contract No. _____

Page _____ of _____

DESIGN ALTERNATE REQUEST

Panel Identification:

- | | |
|------------------------------------|-------------------------|
| 1. Panel Title _____ | 2. Drawing No. _____ |
| 3. Procurement Specification _____ | 4. Aircraft Nos. _____ |
| 5. Contract No. _____ | 6. Submittal Date _____ |
| 7. Prepared by _____ | 8. Phone No. _____ |
-

Approval of the design alternative described below is request for Paragraph _____.

A. Detailed Description of Change:

MIL-C-81774A

EDD-2

Page _____ of _____

B. Justification:

1. Reason for change:

2. Trade Off Data:

C. Request initiated by _____

Title _____

MIL-C-81774A

EDD-2

Page ____ of ____

For Official Use Only

Date Received _____

Reviewed By _____

Date _____

Cognizant Agency _____

Title _____

Action Taken:

Comments and Recommendations:

For use of * Dept. Only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

EDD-3

A/C type _____ Contract No. _____

Page _____ of _____

SPECIFICATION DEVIATION NOTIFICATION (DATA)

Panel Identification:

1. Panel Title _____ 2. Drawing No. _____
3. Procurement Specification _____ 4. Aircraft Nos. _____
5. Contract No. _____ 6. Submittal Date _____
7. Prepared by _____ 8. Phone No. _____
-

Complete, detailed statements must be provided for all of the items below. Attach additional sheets if more space is required.

- A. Describe the problem. (Why is it impossible for you to comply with the specification?)
-

- B. What alternative solutions have you considered? Which were successful, and which failed? Why did they fail?

MIL-C-81774A

EDD-3

Page _____ of _____

C. What is your recommended solution? Why?

D. How will the recommended solution affect system performance?

MIL-C-81774A

EDD-3

Page ____ of ____

E. How will the recommended solution affect system operability?

F. If the proposed solution will degrade system performance or operability, what provisions do you recommend to compensate for the degradation?

MIL-C-81774A

EDD-3

Page _____ of _____

G. How will the recommended solution affect program schedule?

H. Will the recommended solution affect cost: Yes _____ No _____

I. Request initiated by _____ Title _____

MIL-C-81774A

EDD-3

Page ____ of ____

For Official Use Only

Date Received _____ Cognizant Agency _____

Reviewed by _____ Title _____

Date _____

Action Taken:**Comments and Recommendations:**

For use of * Dept. Only

Approved _____ (Sig.)

Disapproved _____ (Sig.)

Do not use

* Army

Navy

Air Force

(as applicable)

MIL-C-81774A

APPENDIX B

PREPARATION OF MARKING PLATE FOR AIRCRAFT CONTROL PANELS

1. Scope - These are the requirements for the preparation of control panel marking artwork and the negative marking plate.

2. REQUIREMENTS

2.1 General Requirements -

2.1.1 Materials - Materials shall be of high grade commercial quality entirely suitable for the purpose intended.

- (a) Artwork - Artwork shall be on a transparent stable base material which meets the requirements for Type II material of MIL-D-8510.
- (b) Negatives - The negatives shall meet the requirements of MIL-D-8510.

2.1.2 Preparation of artwork - The artwork shall be made by applying all markings indicated in the coordination drawing or other preliminary drawing to a sheet of transparent stable material. The sheet shall be at least three inches larger in each dimension than the control panel face (see Figure B-1).

- (a) Crop marks - Crop marks to locate the corners of the control panel are positioned on the artwork.
- (b) Cutout centers - The cutout centers are to locate all cutouts for the control panel and also to locate on the mounting plate the matching cutouts. The cutout centers shall be applied to the transparent sheet as indicated.
 - (1) Cutout code - All cutouts which appear in the panel must be coded, i. e., "A", "B", "C", see Detail A, etc.
- (c) Markings - All markings which are to appear on the panel face shall be applied to the stable material. The markings shall be produced by a photographic method which shall be on clear material with adhesive backing. The nomenclature markings shall be made of a type produced by a Fotosetter machine or equivalent to the required size.
 - (1) Lines, clear area under knobs - These markings may be produced by other means than photographic methods. However, these markings must be accurate and opaque.

MIL-C-81774A

- (d) Preparation of negatives - The artwork is reproduced by a photographic transfer process to produce the marking negative. The reproduction shall meet the requirements of MIL-D-5480.

3. QUALITY ASSURANCE PROVISIONS

3.1 Inspection and acceptance - Inspection and acceptance shall meet the requirements of MIL-D-8510.

4. PREPARATION FOR DELIVERY

4.1 Packaging - Packaging shall meet the requirements of MIL-D-8510 and MIL-D-5480.

5. NOTES

5.1 Intended use - The artwork and resulting negatives covered by this specification are used in the design of control panels in accordance with MIL-C-81774.

5.2 Definitions -

5.2.1 Control Panel Coordination Layout Drawing - Layout or sketch of the proposed avionics panel face.

5.2.2 Artwork - Markings applied to the stable material.

5.2.3 Mounting plate - Metal plate to which the control and edge-lighted panel are attached.

5.2.4 Crop marks - Marks which define the perimeter of the panel.

5.2.5 Check points - Control dimensions added to the undimensioned production drawing so that size and stability of the negatives may be checked both laterally and longitudinally.

MIL-C-81774A

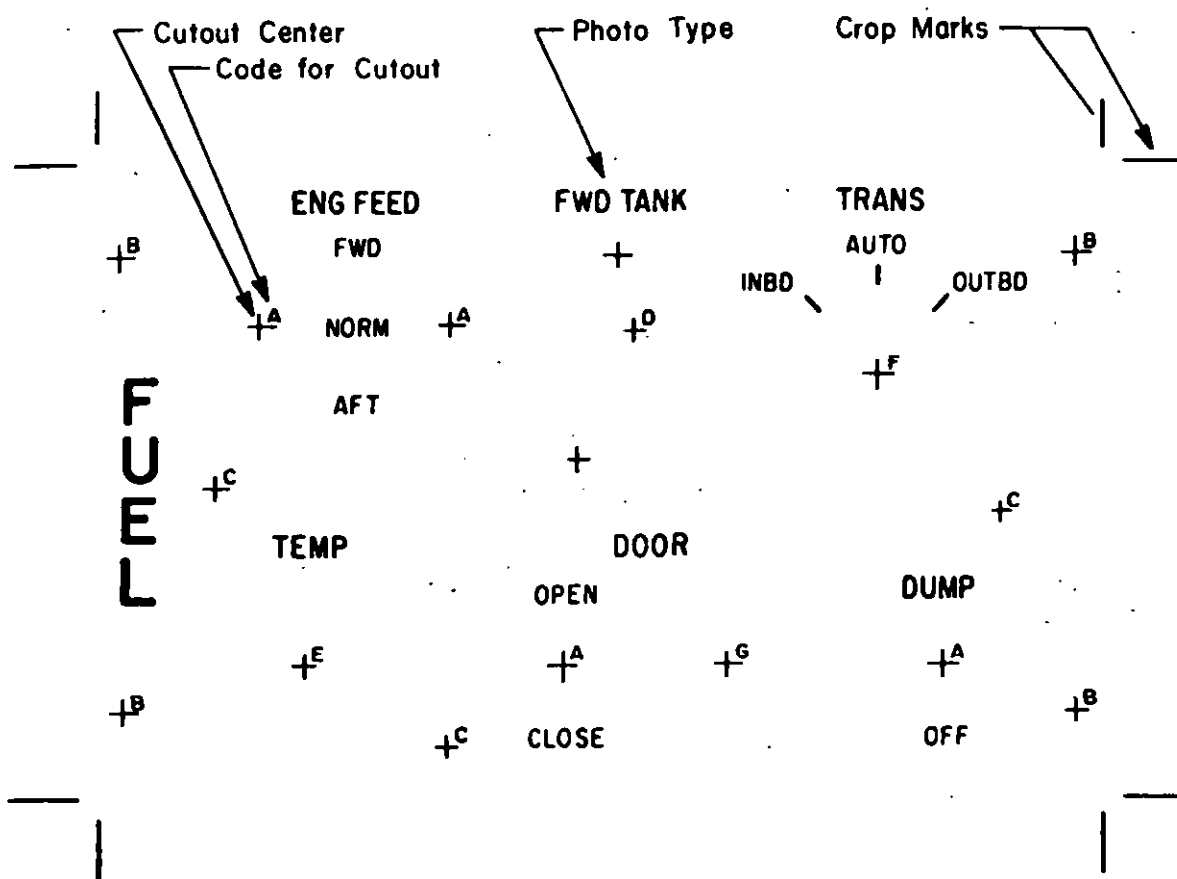


FIGURE B-1. Artwork Sheet Sample.

Custodians:

Army - AV

Navy - AS

Air Force - 11

Preparing activity:

Navy - AS

Project No. 1680-0266

MIL-C-81774A

INDEX

Paragraph	Page
1. SCOPE	
1.1 Purpose	1
1.2 Application	1
2. APPLICABLE DOCUMENTS	1
3. REQUIREMENTS	
3.1 Design	4
3.1.1 Approval	4
3.2 Data	4
3.2.1 Control panel layout	5
3.2.2 Film positive and film negatives	5
3.2.3 Human factor design	6
3.2.3.1 Panel functional description	6
3.2.3.2 Panel location(s)	6
3.2.3.3 Viewing	6
3.2.3.4 Legend description	6
3.2.3.5 Coding	7
3.2.3.6 Crew station control panels arrangement	7

MIL-C-81774A

Paragraph	Page
3.2.4 Specification endorsement data	7
3.2.4.1 Specification Endorsement Request (SER)	7
3.2.4.2 Design Alternative Request (DAR)	7
3.2.4.3 Specification Deviation Notification (SDN)	7
3.2.4.4 Procuring agency approval	7
3.2.4.5 Transmission of data	8
3.3 Materials	8
3.3.1 Anti-reflective coating	8
3.4 Mounting	8
3.4.1 Control and display mounting	8
3.4.1.1 Toggle switches	8
3.4.1.2 Pushbuttons	8
3.4.1.3 Knobs	8
3.4.1.4 Thumbwheels	9
3.4.1.5 Finger operated control levers	9
3.4.1.6 Legend lights	9
3.4.1.7 Electro-mechanical and electro-optical indicators ...	9
3.4.1.8 Digital displays	9
3.4.2 Guards	9
3.4.2.1 Frangible guards	9

MIL-C-81774A

Paragraph	Page
3.5 Color	9
3.5.1 Opaque colors (reflected)	9
3.5.2 Color of lights	10
3.5.3 Lighted panel	10
3.5.4 Mounting plate	10
3.5.5 Fasteners	10
3.5.6 Controls	10
3.5.6.1 Transilluminated controls	10
3.5.6.2 Transilluminated pushbuttons	10
3.5.6.3 Non-transilluminated pushbuttons	10
3.5.6.4 Toggle switches	10
3.5.6.5 Oxygen switch (or lever)	10
3.5.7 Panel Markings	11
3.5.8 Guards	11
3.6 Lighting	11
3.6.1 Lighted panel	11
3.6.2 Controls	11
3.6.2.1 Pushbuttons	11

Paragraph	Page
3.6.2.2 Knobs	11
3.6.2.3 Thumbwheels	11
3.6.3 Displays	12
3.6.3.1 Mechanical indicators and digital displays	12
3.6.3.2 Aircrew station signals	12
3.6.4 Flashing lights	12
3.7 Markings	12
3.7.1 Style and size	13
3.7.2 Punctuation and symbols	13
3.7.3 Unrelated markings	13
3.7.4 Lighted panels	13
3.7.4.1 Lines	13
3.7.4.2 Location	13
3.8 Controls	13
3.8.1 Operability	13
3.8.2 Protection from accidental activation	13
3.8.3 Maintainability and reliability	14
3.8.4 Consistency	14

MIL-C-81774A

Paragraph	Page
3.8.5 Conservation of panel space	14
3.8.6 Control selection	14
3.8.6.1 Basic selection criteria	14
3.8.6.2 Lever-lock toggle switches	14
3.8.6.3 Miniature toggles	14
3.8.6.4 Solenoid-held toggles	14
3.8.6.5 Combined legend light/pushbutton	14
3.8.6.6 Concentric knobs	15
3.8.7 Toggle switch characteristics	15
3.8.7.1 Coding	15
3.8.7.2 Momentary toggle switches (spring loaded)	15
3.8.7.3 Solenoid-held toggles	15
3.8.7.4 Lever-lock switches	16
3.8.8 Pushbutton characteristics	16
3.8.8.1 Actuation	16
3.8.8.2 Shape coding	16
3.8.8.3 Keyboard pushbutton characteristics and visual verification	16

MIL-C-81774A

Paragraph	Page
3.8.9 Discrete rotary control knobs	17
3.8.9.1 Knob shape	17
3.8.9.2 Knob size	17
3.8.9.3 Number of positions	17
3.8.9.4 Displacement	17
3.8.9.5 Starting position	17
3.8.9.6 Grasping surface	17
3.8.10 Thumbwheel selectors, discrete	18
3.8.10.1 Number of positions	18
3.8.10.2 Thumbwheel shape	18
3.8.11 Continuous rotary control knobs	18
3.8.11.1 Shape	18
3.8.11.2 Knob skirts	18
3.8.11.3 Concentric knobs	18
3.8.11.4 Knobs incorporating a switch position	18
3.8.12 Continuous rotary thumbwheels	19
3.8.12.1 Shape	19
3.8.12.2 Dimensions	19
3.8.13 Levers	19

MIL-C-81774A

Paragraph	Page
3.8.13.1 Levers for finger operation	19
3.8.13.1.1 Limb support	19
3.8.13.1.2 Size	19
3.8.13.1.3 Resistance	19
3.8.13.2 Hand controllers	19
3.8.13.2.1 Limb support	19
3.8.13.2.2 Size	19
3.8.13.2.3 Resistance	19
3.9 Displays	20
3.9.1 Information	20
3.9.2 Display selection requirements	20
3.9.2.1 Legend lights	21
3.9.2.1.1 Combined legend light/pushbutton	21
3.9.2.1.2 Warning and caution legend lights	21
3.9.2.1.3 Advisory legend lights	21
3.9.2.2 Segmented-character displays	21
3.9.2.3 Counters	21
3.9.2.4 Printers	21
3.9.3 Discrete-signal indicator display characteristics	22

MIL-C-81774A

Paragraph	Page
3.9.3.1 Multiple-legend arrays	22
3.9.3.1.1 Stacked-legend-plate indicators	22
3.9.3.1.2 Multiple-legend rear-projection indicators	22
3.9.3.1.3 Visibility	22
3.9.3.2 Electro-mechanical signal indicators (flip-flop)	22
3.9.3.2.1 Legibility	22
3.9.3.2.2 Legends	22
3.9.4 Variable-signal displays	22
3.9.4.1 Scales and gages	22
3.9.4.2 Counters/Segmented-character displays	23
3.9.4.2.1 Letter width	23
3.9.4.2.2 Stroke width	23
3.9.4.2.3 Multidrum counters	23
3.9.4.2.4 Rate of change	23
3.10 Guard characteristics	23
3.10.1 Protecting toggle switches	23
3.10.1.1 Channel guard	23
3.10.1.2 Cover guard	23
3.10.1.3 Lever locks	23

MIL-C-81774A

Paragraph	Page
3.11.9.1 Ten-digit keyboard	26
3.11.10 Control separation	26
3.11.11 Display separation	26
3.11.12 Control actuation	26
3.11.12.1 Discrete rotary selectors (knobs)	27
3.11.12.2 Discrete thumbwheels	27
3.11.12.3 Continuous rotary controls	27
3.11.12.4 Continuous thumbwheels	27
3.11.12.5 Two-position toggle switches	27
3.11.12.6 Three-position toggle switches	27
3.11.12.7 Pushbutton actuation	28
3.11.12.7.1 Positive indication	28
3.11.12.7.2 Multistation pushbuttons	28
3.11.12.7.3 Interacting pushbutton stations	28
3.11.13 Arrangement of markings	28
3.11.13.1 Orientation	28
3.11.13.2 Location	28
3.11.13.3 Control position nomenclature arrangement	29
3.12 Coding	29

MIL-C-81774A

Paragraph	Page
3.10.2 Protecting pushbuttons	24
3.10.2.1 Recesses	24
3.10.2.2 Cover guards	24
3.10.2.3 Frangible cover	24
3.10.2.4 Interlocks	24
3.10.3 Protecting rotary controls	24
3.10.3.1 Locking devices	24
3.10.3.2 Stops	24
3.10.3.3 Gate	24
3.11 Panel layout and arrangement	24
3.11.1 Control-display relationship	24
3.11.2 Operator efficiency	25
3.11.3 Critical primary and emergency controls	25
3.11.4 Clothing considerations	25
3.11.5 Direction of movement	25
3.11.6 Panel layout conventions	25
3.11.7 Panel layout	25
3.11.8 Functional grouping arrangements	26
3.11.9 Pushbutton arrays and matrices	26

MIL-C-81774A

Paragraph	Page
3.12.1 Special coding applications	29
4. QUALITY ASSURANCE PROVISIONS	
4.1 Responsibility for inspection	29
4.2 Inspection and testing requirements	29
5. PREPARATION FOR DELIVERY	
5.1 Preservation, packaging, packing and marking	37
6. NOTES	
6.1 Intended use	37
6.2 Specification Endorsement Request (SER)	37
6.3 Design Alternate Request (DAR)	37
6.4 Specification Deviation Notification (SDN)	37
6.5 Precedence of documents	37
<u>Figures and tables -</u>	
Figure 1. Control Panel Layout	38
Figure 2. Panel Location and Viewing Data	39
Figure 3. Panel Markings	40
Figure 4. Keyboard Arrangement	41
Figure 5. Control Knob Shapes	42
Table I. Control Selection Chart	43

MIL-C-81774A

Paragraph	Page
Table II. Control Characteristics	45
Table III. Knob Detents Placement for Visual and Tactual Positioning...	47
Table IV. Display Selection Chart	49
Table V. Minimum Control Separation Requirements	50
Appendix A. Format For Control Panel Data	51
Appendix B. Preparation of Marking Plate for Aircraft Control Panels	77

*U.S. GOVERNMENT PRINTING OFFICE: 1973-714-918/1422

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEPARTMENT OF THE NAVY



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

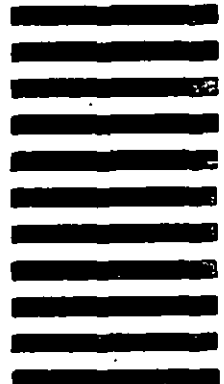
OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 12503 WASHINGTON D. C.

POSTAGE WILL BE PAID BY THE DEPARTMENT OF THE NAVY

Commanding Officer
Naval Air Engineering Center
Engineering Specifications & Standards
Department (ESSD) Code 93
Lakehurst, NJ 08733



STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐ VENDOR☐ USER☐ MANUFACTURER☐ OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

TO DETACH THIS FORM, CUT ALONG THIS LINE.)