SAE The Engineering Society For Advancing Mobility Land Sea Air and Space

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AEROSPACE RECOMMENDED PRACTICE

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ARP 268G

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Superseding ARP 268F

LOCATION AND ACTUATION OF FLIGHT DECK CONTROLS FOR TRANSPORT AIRCRAFT

Section

Appendix

1. PURPOSE AND SCOPE:

1.1 Purpose: The purpose of this document is to set forth the recommendations of SAE Committee S-7 relative to the location and actuation of flight deck controls. These recommendations are intended to minimize confusion and distraction and thereby reduce transition training time, crew errors, fatigue, and other factors detrimental to flight safety and efficiency. In arriving at these recommendations, the committee carefully reviewed the work of the flight deck layout panel of the Aircraft Committee of the Munitions Board, the recommendations and requirements of the Civil Aeronautics Board, the Federal Aviation Agency, the requirements of the airline operators, the aircraft manufacturers, etc. In cases where conflicting opinions existed, suitable compromises were made.

1.2 Scope: The recommendations of this document apply to commercial type, multi-engine transport aircraft which utilize reciprocating or turbine type powerplants and which are operated in subsonic, transonic, or supersonic speed regimes. These recommendations are not intended to apply to V/STOL configurations.

2. DEFINITIONS:

2.1 Types of Flight Decks: Two types of flight decks are covered herein: two-man flight deck (two pilots) and three-man flight deck (two pilots and flight engineer).

2.2 Definition of Functions: In paragraph 5 et seq., each of the controls is assigned a function. The definitions of these functions are as follows:

2.2.1 Primary: "Primary" indicates that the operation of the specified control is a primary function of the crew member to whom it is assigned and, hence, must be readily accessible to that crew member while he is seated in his normal position.

2.2.1.1 Normal Position: For pilots, "normal position" means that the pilot's seat is adjusted so as to bring the pilot's eye to the design flight eye position illustrated in Fig. 1.

2.2.1.2 Accessible: For controls, "accessible" means that the control is within normal reach of, and is capable of manual actuation by, the crew member to whom it is assigned.

For instruments and displays, "accessible" means that the instrument or display is in plain sight of the crew member to whom it is assigned, and that it can be read or interpreted without undue strain or difficulty under normal and emergency night lighting conditions.

2.2.2 Secondary: "Secondary" indicates that operation of the specified control is a secondary function of the crew member to whom it is assigned and, hence, some compromise regarding accessibility to this crew member may be tolerated. It is assumed that the crew member's lap belt and/or shoulder harness is in place (shoulder harness is assumed free on the locking reel); however, the flight engineer's seat itself may be moved to the limits of its travel in order to achieve such accessibility. (The pilot's seat may not be moved to achieve such accessibility during normal operation.)

2.2.3 Desirable: "Desirable" indicates that, although there is no specific requirement for that control to be accessible to that crew member, it would nevertheless be desirable.

2.3 Pilot's Design Flight Eye Position: The Pilot's Design Flight Eye Position is the primary flight deck dimensional reference point.

2.4 Visual Reference Plane: The Visual Reference Plane is a plane through the Pilot's Design Flight Eye Position which is horizontal in straight and level, subsonic cruising flight.

2.5 Pilot's Heel Rest Plane: The Pilot's Heel Rest Plane establishes the flight deck horizontal and vertical coordinates. It should be parallel to the Visual Reference Plane with a tolerance of 3 deg toward nose down for the heel rest plane.

2.5.1 The Pilot's Heel Rest Plane (extended as necessary) should be located 41 in. below the Pilot's Design Flight Eye Position. Ref. Fig. 2.

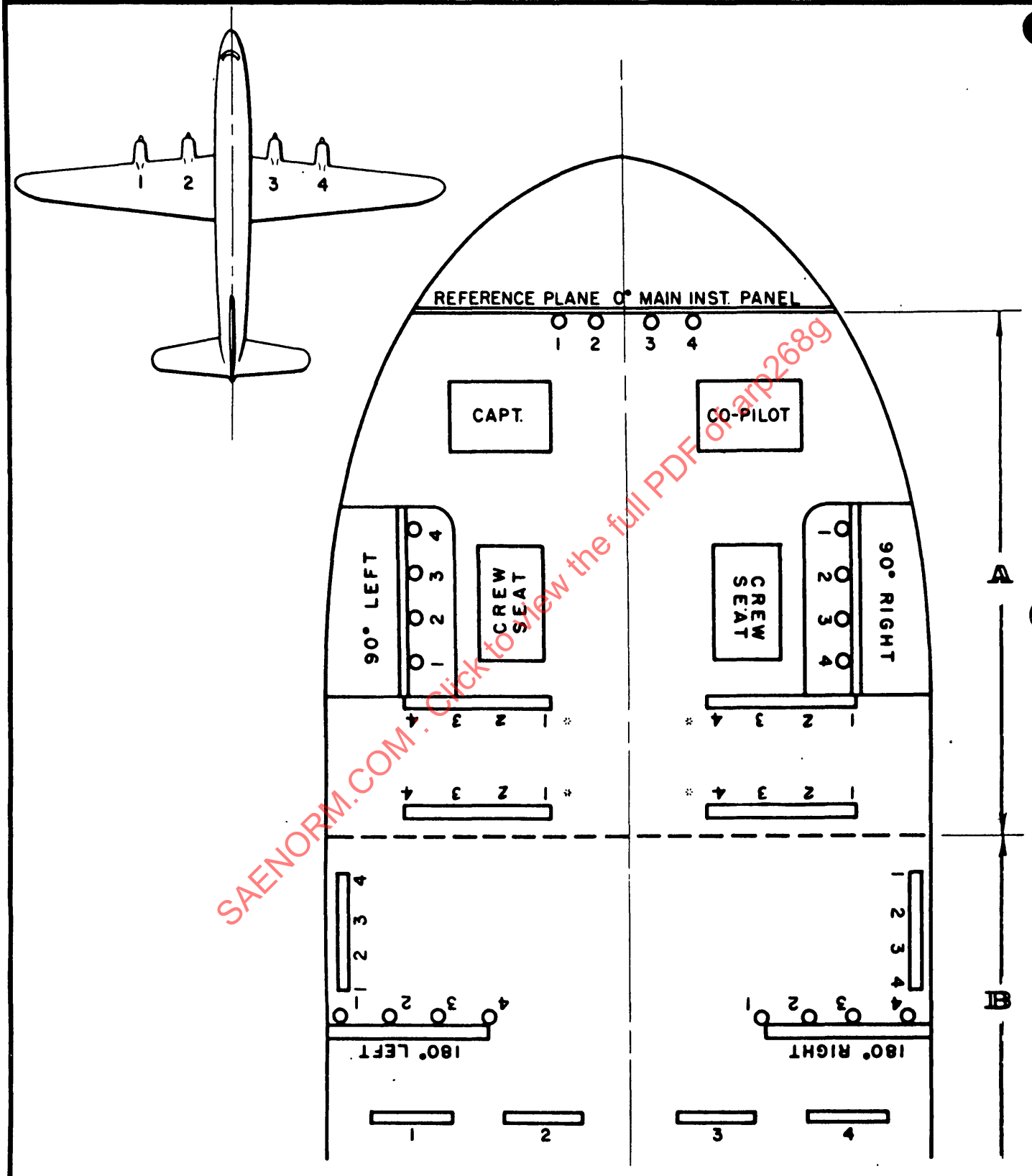
2.5.2 The rearmost position of the aft face of the control wheel or yoke should be located not less than 5 in. forward of the Pilot's Flight Eye Position. Ref. Fig. 2.

3. LAYOUT OF THREE-MAN FLIGHT DECKS: There are several possible arrangements for the flight engineer's station for three-man flight decks. It is not the purpose of this document to prescribe accurately the optimum arrangement for the flight engineer, but rather to set down some general recommendations which will apply towards any flight deck of the three-man category. These general recommendations are as follows: (See Fig. 3)

3.1 The flight engineer will not sit facing aft.

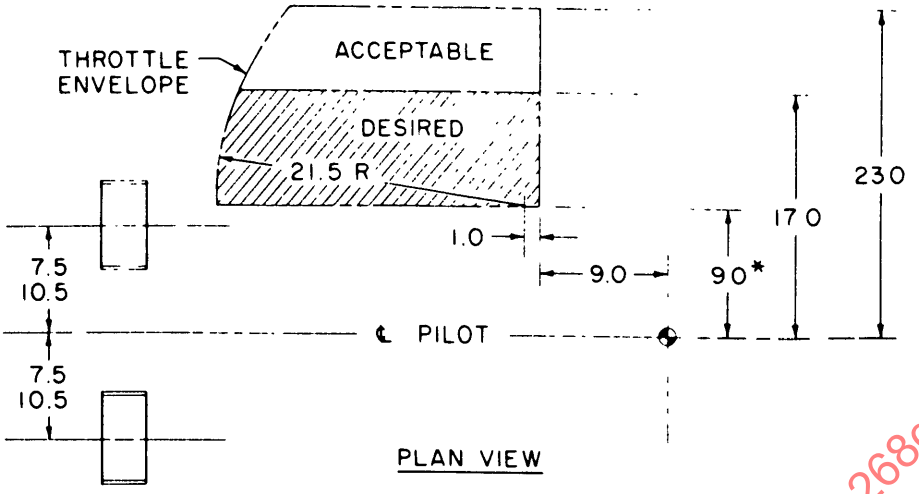
3.2 It is desirable that means be provided for the engines to be viewed from the flight engineer's station.

3.3 Regardless of whether the flight engineer's controls are located ahead of him or to his side, he should normally sit facing his instrument panel. The more important instruments and displays should be grouped at eye level or below, with the associated switches and controls below the instruments. The captain, from his station, should be able to monitor the flight engineer's station at all times.



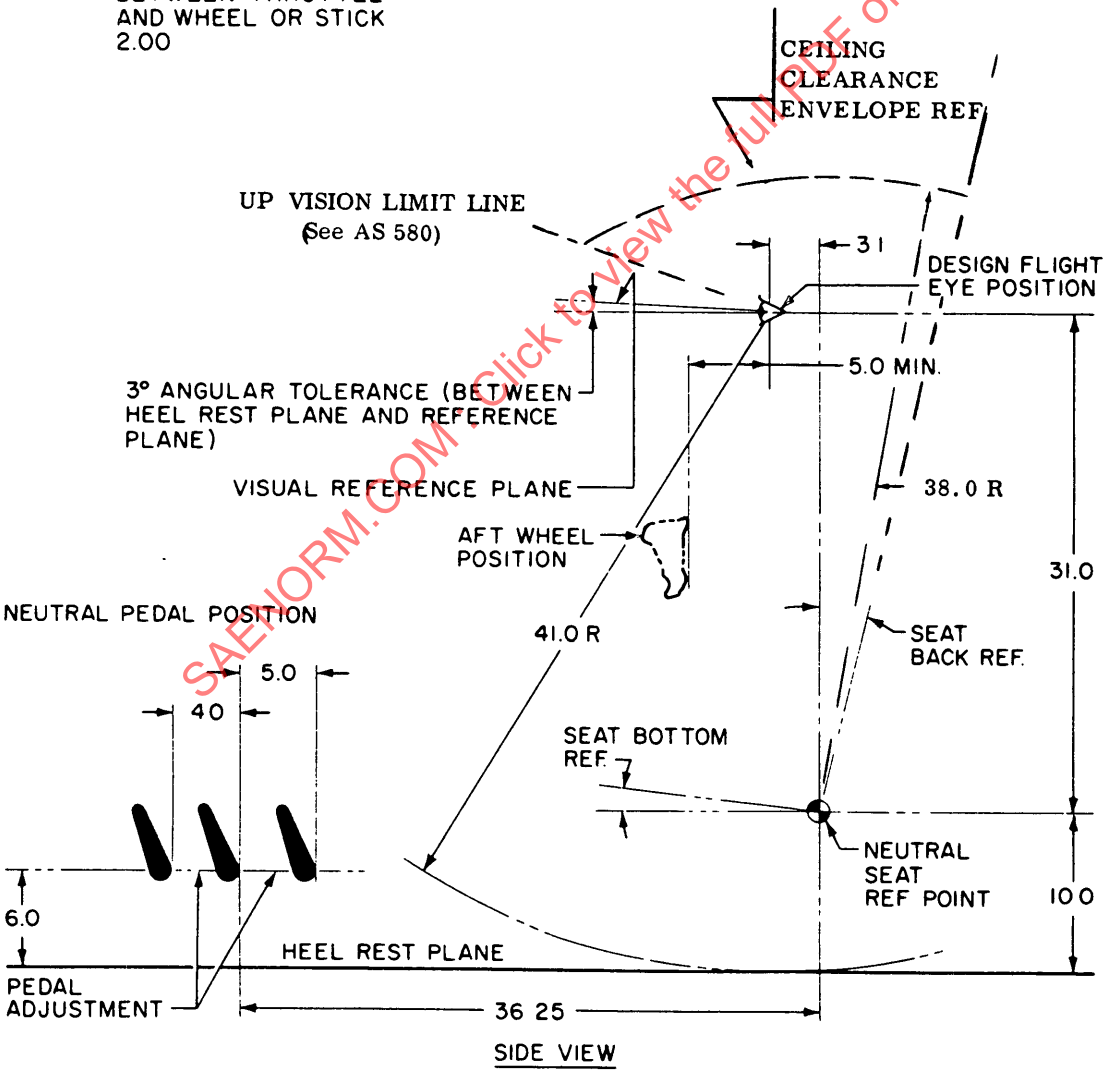
*Not allowed for location of primary controls. See para. 3.5.3

FIGURE 1



PLAN VIEW

*MINIMUM CLEARANCE BETWEEN THROTTLE AND WHEEL OR STICK 2.00



SIDE VIEW

FIGURE 2 - Pilot's Normal Position

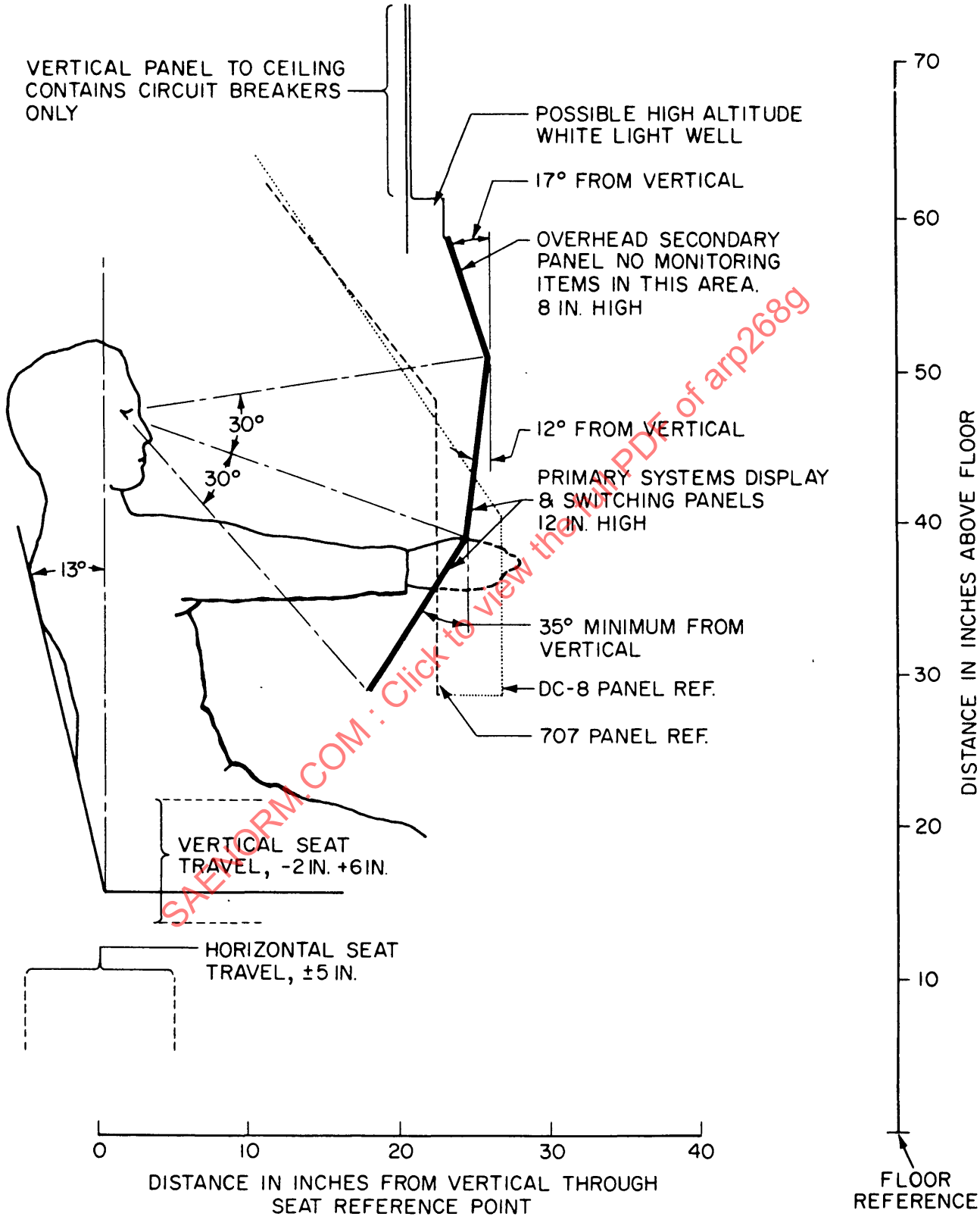


FIGURE 3 - Recommended Flight Engineer Panel Profile

3.4 The flight engineer's station should be located so as to permit conversation between crew stations without the use of intercoms.

3.5 The following principles govern the orientation of switches and controls in the flight deck area:

3.5.1 Powerplants are numbered consecutively from port to starboard.

3.5.2 Powerplant controls should be numbered corresponding to the powerplant with which they are associated regardless of their orientation at the particular flight station.

3.5.3 Primary or emergency powerplant controls and fuel system controls shall be located in Zone A of Fig. 1. These controls shall be oriented in vertical planes displaced by not more than 90 deg to the left or right from the reference plane (plane of the main flight instrument panel). This applies irrespective of whether the panels on which the controls are located are horizontal or vertical.

3.5.4 The controls in Zone A should be oriented from left to right relative to the crew member when he is facing the controls, as numbers 1, 2, 3, 4 . . .

3.5.5 The controls in Zone B should be oriented 1, 2, 3, 4 . . . from port to starboard.

3.5.6 Zone A includes all areas reached by flight crew members while they are seated at their stations with all required restraint harnesses normally secured, including shoulder harness, if provided, with locking reel free.

3.5.7 Zone B includes all other areas in or out of the flight compartment.

3.5.8 Secondary controls, if oriented vertically, should be numbered from top to bottom.

4. GENERAL RECOMMENDATIONS: There are many detailed recommendations made in this document concerning location and actuation of controls. Where no specific requirements are indicated, the following general recommendations will apply:

(Whenever the recommended assignment of system controls or displays as "secondary" or "desirable" to either pilot results in an impractical design configuration, consideration should be given to the provision of satisfactory advisory/warning displays for that pilot. Such advisory/warning displays may be included as parts of master advisory/warning displays, as appropriate.)

4.1 Location of Controls:

4.1.1 Controls should be located so as to permit their use by the crew member to whom they are assigned while he is seated at his normal station with all required restraint harnesses normally secured, including shoulder harness, if provided, with locking reel free.

4.1.2 All controls of a like function should be grouped together and segregated according to systems. Controls that are similar in configuration and actuation, but which are in different systems, should be physically separated to avoid confusion.

4.1.3 Controls should be located relative to the eye position as established in Fig. 2 and as used in AS 580 (for visibility) and AS 290 (for seats and seat reference point) or superseding documents to insure that optimum control locations coincide with the pilot's location for maximum exterior visibility.

4.2 Actuation of Controls:

4.2.1 Controls should be so designed that the actuation thereof, forward, upward or clockwise, will result in increased performance of the component or the aircraft. Also see paragraph 4.2.4.

4.2.2 Controls should be so designed that the actuation thereof, aft, downward, or counterclockwise, will decrease the performance of the component or the aircraft. Also see paragraph 4.2.4.

4.2.3 All controls of a variable nature actuated by a rotary motion should move clockwise from the "OFF" position through "LOW" or "DIM" to "HIGH" or "BRIGHT."

4.2.4 On control panels located above eye level, every effort should be made to keep these panels as nearly vertical or horizontal as possible to avoid ambiguity in control movement which attends a 45 deg panel installation.

4.2.5 Where momentary contact switches are used, exceptions to the above criteria may be desirable to facilitate operation. This is particularly true where multiple switches are used and where prolonged actuation in flight is necessary (e.g., carburetor alcohol switches). When exceptions are made, the direction of actuation should be such as to provide the greatest ease of operation.

4.3 Crew Member's Reach: Figs. 4 and 5 contain information on the reach of an average crew member in various directions. This should be helpful in initial flight layout, but is not intended to limit flight deck dimensions. Note that these charts show fingertip reach.

4.4 Where damage to the aircraft can result from exceeding a placarded limitation, initial movement of the control (flap, wingsweep, landing gear, etc.) as well as the position of the device being controlled, should be physically prevented or it should excite the appropriate aural or visual warning. (Ref. ARP 450B).

5. SPECIFIC RECOMMENDATIONS: This section sets forth specific recommendations with respect to assignment, location, and actuation of controls.

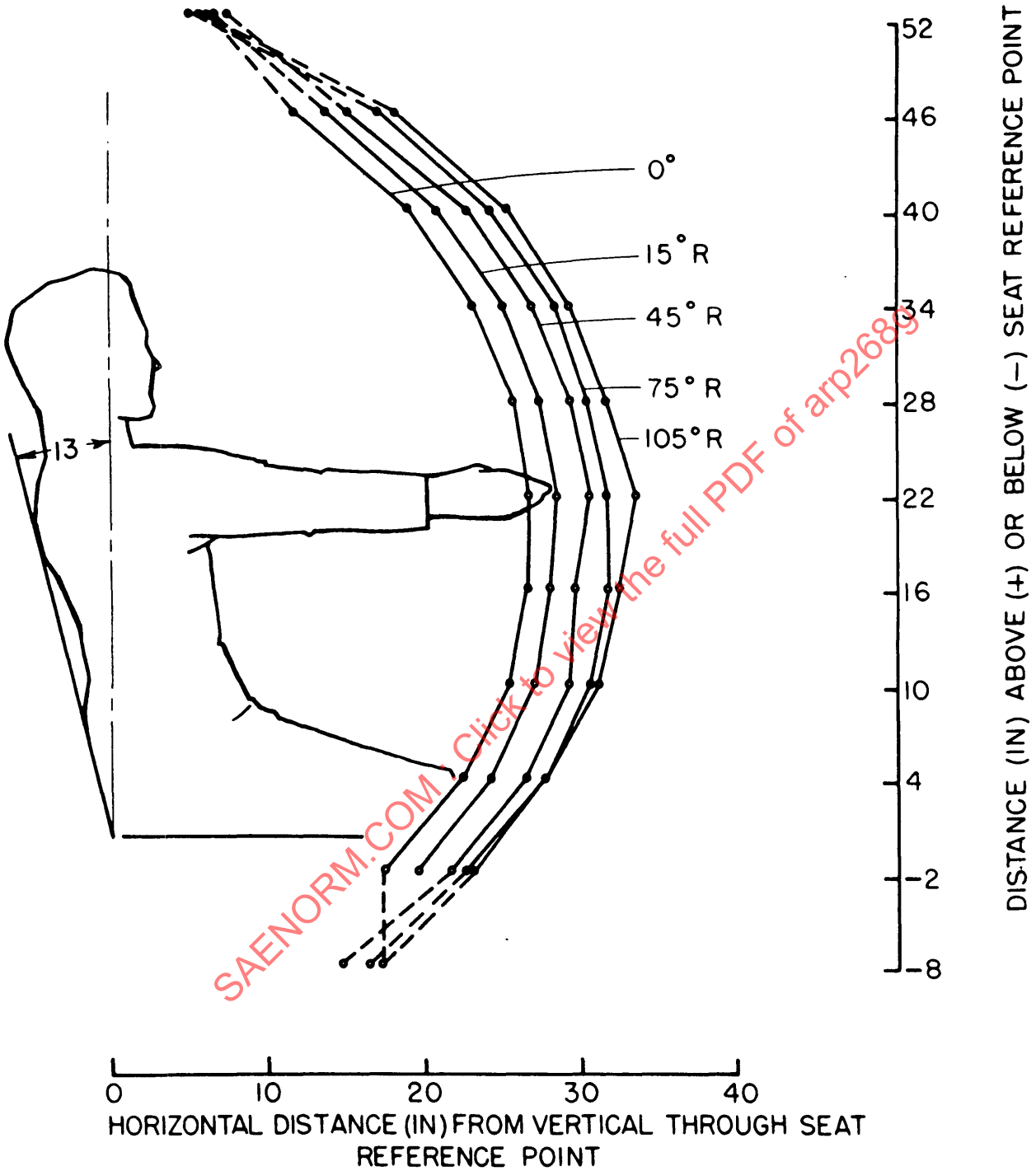


FIGURE 4 - Maximum Distances Which Can Be Reached By 97 Percent Of The Population At Each Position. The Elliptical Arcs Indicate The Maximum Boundaries Of The Working Area For Operation Of Manual Controls (At Angles From 0° To 105° To The Right) For This Group Seat Back Angle 13

NOTE: This Figure Is Reproduced From Report No. 3 Project X-651. Published By Naval Medical Research Institute.

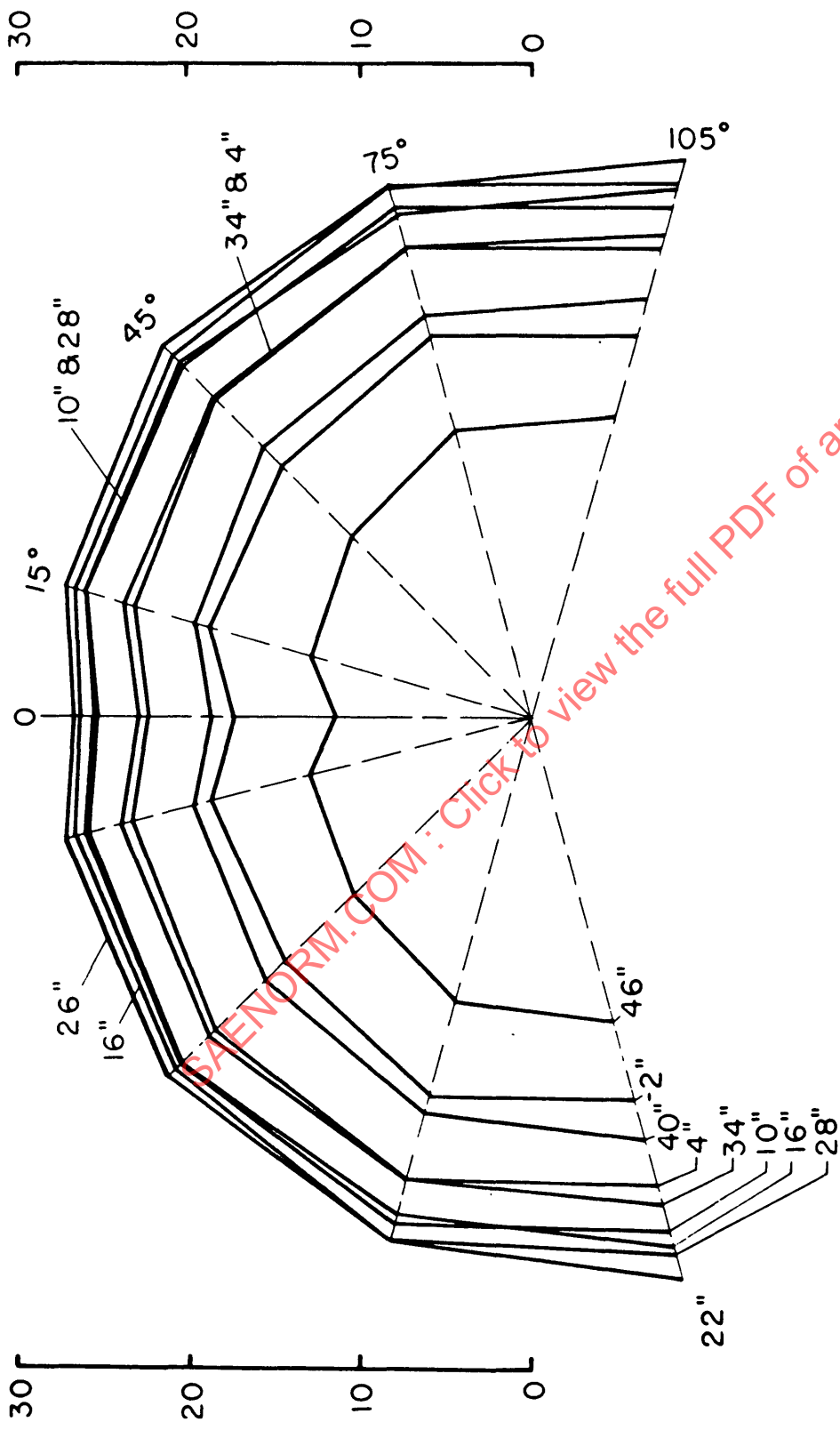


FIGURE 5 - Maximum Distances Which Can Be Reached By 97 Percent Of The Population At Each Position. The Elliptical Arcs Indicate Maximum Boundaries For This Group For Operation Of Manual Controls At Various Horizontal Levels. Seat Back 13° From Vertical.

NOTE: This Figure Is Reproduced From Report No. 3 Project X-651. Published By Naval Medical Research Institute.

5.1 Primary Flight Controls: Fig. 2 shows specific recommendations for the locations, travel, and adjustment of these controls to insure that the pilot's position, so obtained, coincides with his required position for exterior visibility as defined in AS 580. A means should be provided in the aircraft for the pilots to locate their eyes and flight position at the design eye position in order to guarantee that they will have and can use the visibility designed into the aircraft.

5.2 Secondary Flight Controls:

5.2.1 Automatic Pilot:

a. Assignment: Primary - both pilots.

b. Location: Mode and function controller and maneuvering control, when used, should be located close to the airplane centerline, below the pilot's eye level, and preferably forward of the pilot's eye position. The maneuvering control may be located separately from the mode and function controller.

c. Actuation: Conventional.

d. Comments: A suitable arm rest is desirable if a separate maneuvering control is used. A thumb-operated electrical disconnect button shall be provided on the outboard horn of each control wheel. If a mechanical disconnect is used, it should be accessible to both pilots. Suitable guards should be provided to prevent inadvertent operation of the controller and suitable priority interlocks should be provided where separate maneuvering controls are used.

5.2.2 Stability Augmentation: Stability augmentation controls, where provided, should be incorporated in the autopilot mode and function controller, or adjacent thereto.

a. Assignment: Primary - both pilots.

5.2.3 Control Surface Boost Control (where provided):

a. Assignment: Primary - both pilots.

b. Location: Pilot's overhead panel forward of pilot's normal eye position and within reach of both pilots.

c. Actuation: Conventional.

5.2.4 Wing Flap Control:

a. Assignment: Primary - both pilots.

b. Location: The wing flap control should be located on the top of the pedestal aft of the throttle(s), centrally or to the right of the centerline. It should be at least 10 in. aft of the landing gear control.

c. Actuation: Forward or upward for flaps up. Aft or down for flaps down.

d. Comments: It should be possible for either pilot to operate the control while maintaining normal forward outside visibility.

5.2.5 Wing Geometry Control:

a. Assignment: Primary - both pilots.

b. Location: Right hand side of the pedestal forward of or integrated with the wing flap control.

c. Actuation: Forward for high speed configuration. Aft for low speed configuration. EXCEPTION: For wing sweep control, actuation should be forward for wing sweep forward, and aft for wing sweep aft.

5.2.6 Windshield and/or Forward Fuselage Geometry Control:

a. Assignment: Primary - both pilots.

b. Location: On top of the pedestal to the right of the aircraft center line.

c. Actuation: Forward or upward for high speed configuration. Aft or down for low speed configuration.

5.2.7 Landing Gear Control:

a. Assignment: Primary - both pilots.

b. Location: The landing gear control shall be forward of the engine power control, on or to the right of the airplane centerline.

c. Actuation: Up for gear up. Down for gear down.

d. Comments: It shall be possible for either pilot to operate the control while maintaining normal forward visibility out of the airplane.

5.2.8 Speed Brake Control:

a. Assignment: Primary - both pilots.

b. Location: The speed brake control shall be located on the top of the pedestal to the left of the airplane centerline and positively separated from the landing gear and the wing flap controls.

c. Actuation: Forward for minimum drag configuration. Aft for maximum drag configuration.

d. Comments: It shall be possible for either pilot to operate the control while maintaining normal forward visibility out of the airplane.

CAUTION: On aircraft using speed brakes, a method of eliminating the possibility of inadvertent operation of wing flaps or landing gear instead of speed brakes must be provided unless it is demonstrated that such operation will not result in structural damage or serious effects upon control or stability under all operating conditions.

5.2.9 Wheel Brake Control:

a. Assignment: Primary - both pilots.

b. Location: Toe pedals integral with rudder control pedals.

c. Actuation: Conventional.

5.2.10 Trim Controls:

a. Assignment: Primary - both pilots.

b. Location: Within normal reach and easily accessible to each pilot.

c. Actuation: Conventional.

d. Comments:

1. Trim controls should be designed to safeguard against inadvertent or abrupt operation.

2. Each trim control should operate about the appropriate axis of the airplane and in the same sense as the desired airplane response about the axis. (A control which moves linearly, such as a sliding switch actuator, can be considered as operating about an axis at infinite radius.)

5.2.10 (Continued):

3. Marking should be provided on or adjacent to the trim control to indicate the direction of operation of that control which will produce the desired airplane response.

4. Means should be provided to indicate the position of the trim system with respect to the range of adjustment. The indicating means shall be clearly distinguishable day and night over the entire trim range.

5. Suitable aural and visual indication of pitch trim system operation should be provided on the flight deck.

5.2.11 Ground Steering:

a. Assignment: Primary - Captain; Desired - Copilot.

b. Location: If rudder pedal nose wheel steering is used, it should be provided for both pilots. A nose steering wheel should be located to the left of the pilot (and if provided for the copilot also, to his right) approximately beside the control column with its axis approximately parallel to the pilot's arm.

c. Actuation: Conventional.

d. Comments: Neutral position should be clearly identified. The position of the steering wheel should bear a definite relationship to the nose wheel position.

5.2.12 Tail Wheel Lock:

a. Assignment: Primary - Copilot; Secondary - Captain.

5.2.13 Flight Control Lock:

a. Assignment: Primary - Copilot; Secondary - Captain.

b. Comments: The flight control lock should incorporate a device that restricts throttle motion to make it impossible to apply takeoff power simultaneously to all engines, considering the effects on throttle movement of the most severe ambient air conditions likely to be encountered. However, it should be possible to apply sufficient power to all engines to permit normal taxiing and low power engine checks. It should also permit takeoff power on each engine provided that not more than 50% of the engines may be run up to takeoff power at one time.

5.2.14 Rudder Pedal Adjustment:

a. Assignment: Primary - both pilots.

b. Location: Unitary control should be provided for each pilot.

5.2.15 Parking Brake:

a. Assignment: Primary - Pilot; Secondary - Copilot.

5.3 Power Plant Controls:

5.3.1 Power Control (Throttles):

a. Assignment: Primary - both pilots; Secondary - Flight Engineer.

b. Location: The throttles, thrust levers, or composite power control units should be located on the pedestal. Refer to Fig. 2 for recommended boundaries for throttle operation. (This chart presents data obtained by studying many types of transport airplanes. In three-man flight decks, if the master throttles are not accessible to the flight engineer as defined in paragraph 2.2.2, separate throttles or power trimming or adjustment devices should be provided at the flight engineer's station.)

c. Actuation: Forward to increase forward thrust. Where reverse thrust is provided, the reverse thrust control motion should be rearward to give reverse thrust. It should be impossible to reverse inadvertently. It should be possible without difficulty to select forward or reverse thrust on any powerplant and easily regulate power output of any engine or combination of engines.

d. Comments: The recommended throttle control mechanism is the irreversible type requiring no separate control lock; however, a friction type brake will be permitted. Where separate throttles or power trimming or adjustment devices are provided at the flight engineer's station, they will be designed so as to be overridden easily by the master throttles.

5.3.2 Air Induction (Inlet Geometry) Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

5.3.2 (Continued):

b. Location: Air induction monitoring instrumentation shall be presented as a part of the powerplant condition and performance instrumentation. The primary controls shall be located adjacent to the associated monitoring instrumentation at the flight engineer's station. The secondary controls may be located on the pedestal adjacent to the associated throttles or thrust levers, or alternatively, on the forward center panel adjacent to the associated powerplant instrumentation.

5.3.3 Engine Geometry Controls (when separate from throttle, thrust lever, or composite power unit controls):

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Location: The primary engine geometry controls should be located adjacent to the associated monitoring instrumentation at the flight engineer's station.

5.3.4 Engine Injection Controls:

5.3.4.1 Anti-Detonant or Water Injection:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Copilot; Secondary - Flight Engineer.

5.3.4.2 Thrust Augmentation:

a. Assignment: Primary - both pilots; Secondary - Flight Engineer.

5.3.5 Propeller Control:

5.3.5.1 Master:

a. Assignment: Primary - both pilots; Secondary - Flight Engineer.

b. Location: To the right of the captain's throttles and at least one in. lower.

c. Actuation: Forward to increase rpm (if a lock is required, paragraph 5.3.1(d) applies).

5.3.5.2 Individual:

a. Assignment:

1. Two-Man Flight Deck: Primary - both pilots.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desired - both pilots.

5.3.5.3 Feathering Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - both pilots.

2. Three-Man Flight Deck: Primary - both pilots; Desirable - Flight Engineer.

b. Actuation: Push to feather. Pull to unfeather.

c. Comments: Feathering controls shall be protected by guards to prevent inadvertent operation. Feathering buttons shall be provided with a light to indicate power failure or feather actuation.

5.3.5.4 Auto-Feathering Controls:

a. Assignment: Primary - Copilot; Secondary - Captain.

5.3.5.5 Reverse Controls: See paragraph 5.3.1(c).

5.3.6 Mixture Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - both pilots.

b. Actuation: Forward or upward (with respect to the crew member for richer mixture).

5.3.7 Supercharger Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

5.3.7 (Continued):

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Actuation: Forward, upward, or clockwise to increase supercharger pressure.

5.3.8 Alternate Air, Filter, etc.:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Actuation: Forward or upward for ram air. Rearward or downward for alternate, filtered, or heated air.

c. Comments: Shall be irreversible. Shall not be located close to the mixture control.

5.3.9 Cooling Controls (Cowl Flaps, Intercoolers, Oil Coolers, etc.):

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Actuation: Forward, upward or clockwise for increased cooling.

5.3.10 Engine Start Controls:

a. Assignment: Primary - both pilots; Secondary - Flight Engineer.

b. Actuation:

1. Start Levers or Switches: Up or forward for start. Down or rearward for shut-off.

2. Igniter Switches: See paragraph 4.2.

c. Comments: The primer shall be to the right of the starter switch. When used, rotary engine selector switches shall switch through left to right engine positions by rotating clockwise.

5.3.11 Ignition Switches (Reciprocating Engines):

a. Assignment: Primary - both pilots; Secondary - Flight Engineer.

b. Location: Should be grouped together in a horizontal line overhead in accordance with paragraph 3.5.

c. Actuation: For dual ignition switches, the "OFF" position should be furthest counterclockwise. Clockwise rotation should produce the following sequence: "Right," "Left," "Both."

d. Comments: Ignition switches should be separated electrically and mechanically without provision for multiple cutoff.

5.3.12 Oil Dilution:

a. Assignment: Primary - Flight Engineer; Secondary - Copilot.

b. Actuation: Momentary contact type switch for "ON" position. Since these switches must be held on for relatively long periods, they should be convenient to operate. Ganged operation is permissible.

5.3.13 Manual Spark Advance:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer.

b. Actuation: Forward or up for takeoff.

5.4 Fuel System Controls: Great consideration should be given by the designer toward simplification of the fuel system so that its operation is readily understandable. In all cases, a fuel system diagram should be posted conspicuously for the use of the crew member. In cases where remote control is used for the various selectors and pumps, it is highly desirable to have these controls incorporated in a line diagram of the system.

5.4.1 Fuel Pumps:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer.

5.4.2 Fuel Tank and Crossfeed Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - both pilots.

2. Three-Man Flight Deck: Primary - Flight Engineer.

b. Actuation: For lever type controls, the takeoff position shall be forward or upward. For rotary selectors, the pointer shall be forward or upward for takeoff. For line diagram types, the system shall be illustrated as it actually exists in the airplane. This is the recommended type. All positions of selectors shall be identified by detents.

5.4.3 Fuel Tank Inerting Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Location: Fuel panel.

5.4.4 Fuel Jettison Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer.

b. Actuation: Down or aft for dump.

c. Comments: Positive means should be provided to prevent inadvertent operation.

5.5 Oil System Controls:

5.5.1 Oil Transfer Controls:

a. Assignment:

1. Two-Man Flight Deck: Secondary - Copilot.

2. Three-Man Flight Deck: Primary - Flight Engineer.

5.6 Electrical System Controls:

5.6.1 Electrical Power Source Controls (Generators, Alternators, Inverters, Batteries, Transformer-Rectifiers, etc.):

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desirable - either pilot.

b. Actuation: Conventional.

c. Comments: It is recommended that controls be incorporated in line diagram type installations.

5.6.2 Bus Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desirable - either pilot.

b. Actuation: Conventional.

c. Comments: It is recommended that controls be incorporated in line diagram type installations.

5.6.3 External Lights:

a. Actuation: Conventional (see paragraph 4.2).

5.6.3.1 Navigation, Position, Anti-Collision, Identification Lights:

a. Assignment: Primary - Copilot; Secondary - Captain.

5.6.3.2 Wing Illumination Lights:

a. Assignment: Primary - Copilot; Secondary - Captain; Desired - Flight Engineer.

5.6.3.3 Landing Lights and Taxi Lights:

a. Assignment: Primary - Captain; Secondary - Copilot.

b. Location: Bottom or forward row on panel over the windshield on the captain's side.

c. Actuation: See paragraph 4.2 - "EXTEND" and "ON" positions in the same direction.

d. Comments: Each extendable landing light should have two control switches, "ON" and "OFF" control and "EXTEND" and "RETRACT" control with the "ON" and "OFF" control furthest to the left. If two or more extendable lights are employed, the switches shall be arranged as follows: "ON" and "OFF" (L & R) then "EXTEND" and "RETRACT" (L & R). Where a combination of extendable and fixed landing lights are employed, the fixed landing light(s) "ON" and "OFF" controls shall be adjacent to and to the right of the furthest right "EXTEND" and "RETRACT" control switch. Taxi lights controls shall be adjacent to and to the right of all landing light controls.

5.6.4 Seat Belt/No Smoking Controls:

a. Assignment: Primary - Copilot; Secondary - Captain.

b. Location: Overhead.

c. Actuation: Conventional.

5.6.5 Radio Master Switches: See ARP 571.

5.6.6 Master Electrical Switches:

a. Assignment:

1. Two-Man Flight Deck: Primary - both pilots.

2. Three-Man Flight Deck: Primary - Flight engineer; Desired - Captain.

5.7 Air Conditioning and Environmental Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desirable - either pilot.

b. Comments: It is recommended that controls be incorporated in line diagram type installations.

5.8 Pneumatic System Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desirable - either pilot.

b. Comments: It is recommended that controls be incorporated in line diagram type installations.

5.9 Hydraulic Power System Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Comments: It is recommended that controls be incorporated in line diagram type installations.

5.10 De-Icing and Anti-Icing System Controls:

a. Assignment: Primary - Copilot; Secondary - Captain and Flight Engineer.

b. Actuation: Conventional.

5.11 Precipitation Removal Controls:

a. Assignment: Primary - Captain; Secondary - Copilot or Flight Engineer.

5.12 Emergency or Alternate Systems: (Where indicated, warning or annunciator systems will comply with ARP 450B or superseding documents.)

5.12.1 Fire Extinguisher Controls:

a. Assignment: Primary - both pilots; Desired - Flight Engineer.

b. Actuation: Conventional.

c. Comments: Controls required for combating fire in a particular area should be grouped on an individual panel which is lighted when the fire warning system for that area is actuated. Actuation of a single control shall accomplish all operations requiring immediate action except for releasing the extinguishing agent.

5.12.2 Fluid Shut-Offs (Fuel, Oil, Hydraulic Fluid, etc.):

a. Assignment: Primary - both pilots; Desired - Flight Engineer.

b. Actuation: Down, aft, or "pull out" for "Shut-Off" position.

5.12.3 Emergency or Alternate Hydraulic Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desired - either pilot.

b. Actuation: Conventional.

5.12.4 Emergency Wheel Brakes:

a. Assignment: Primary - Captain; Secondary - Copilot.

b. Location: Toe pedals.

c. Actuation: Conventional.

5.12.5 Alternate Pilot and/or Static System Controls:

a. Assignment: Primary - Copilot or both pilots; Desired - Captain.

b. Actuation: Down, aft, or clockwise to select emergency or alternate system.

5.12.6 Flight Controls (Auxiliary, Secondary, or Alternate Boost Systems, Boost System Shut-Offs, etc.):

a. Assignment: Primary - both pilots.

b. Actuation: Conventional.

5.12.7 Flare Controls:

a. Assignment: Primary - Copilot.

b. Actuation: Conventional. A positive guard to prevent inadvertent flare release shall be provided.

5.12.8 Thrust Reverse Lockout Override:

a. Assignment: Primary - both pilots.

b. Actuation: Must be capable of operation by "feel".

5.12.9 Alternate Essential Instrument Power Selector:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Secondary - either pilot.

b. Comments: Warning shall be provided within the direct field of vision of all crew members.

5.12.10 Alternate Thrust Augmentation Controls:

a. Assignment: Primary - Copilot; Secondary - Captain.

5.12.11 Emergency Landing Gear Extension Control:

a. Assignment: Primary - Copilot; Secondary - Captain.

b. Comments: This control should be located on the flight deck and should be operated by the copilot.

5.12.12 Emergency Flap Controls:

a. Assignment: Primary - Copilot; Secondary - Captain.

5.12.13 Emergency Depressurization Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Captain.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desirable - either pilot.

5.12.14 Emergency Cabin Environmental Controls:

a. Assignment:

1. Two-Man Flight Deck: Primary - Copilot; Secondary - Pilot.

2. Three-Man Flight Deck: Primary - Flight Engineer; Desirable - either pilot.

5.13 Seat Controls: See AS 290 or superseding documents for location and actuation of seat controls.

5.14 Restraint Controls:

a. Assignment: Primary - Crew member occupying that seat.

b. Location: At the forward corner of the seat bottom. Outboard for pilots; right hand for flight engineer.

c. Actuation: Up or aft for release. Down or forward to latch or arm.

6. MISCELLANEOUS:

6.1 Control Shapes:

6.1.1 Power Control Knobs (Throttles): Power control knobs should be horizontal cylinders modified as necessary to afford proper grip.

6.1.2 RPM Control Knobs: RPM control knobs should be the shape of an expanded segment of a gear wheel. This applies only to the master rpm control. If a master control is not provided, it applies to the individual control.

6.1.3 Mixture Control Knobs: The mixture control knobs should be horizontal cylinders with 1/8 in. high radial dulled protuberances.

6.1.4 Supercharger Control Knobs: The supercharger control knobs should have the shape of a two-sided fluted impeller.

6.1.5 Landing Gear Control Knob: The landing gear control knob should be a wheel-shaped knob radially mounted.

6.1.6 Flap Control Knob: The flap control knob should have the shape of a flap section.

6.1.7 Speed Brake Control Knob: The speed brake control should have a wye (Y) shaped knob.

6.1.8 Wing Geometry Control Knob (when separate from wing flap control): The wing geometry control knob should be a horizontal arrowhead pointing forward.

6.1.9 Windshield and/or Forward Fuselage Geometry Control Knob: The windshield and/or forward fuselage geometry control knob should be cone-shaped with the apex preferably forward.

6.1.10 Landing Light Control: The landing light controls should be provided with a tab having three fluorescent dots where the location of the control does not present a safety hazard. (Acceptable type is shown by illustration of Switch No. 8207 on page 6 of Cutler Hammer Catalog No. KSP-32, dated August, 1939.) Any other control used to de-lethalize the installation should be marked in a similar manner so it is readily distinguished.

6.1.11 In case of switch-actuated controls, the same knob shapes shall be used in miniature form.

6.2 Colors for Control Knobs: The knobs for the following controls shall be of a color equivalent to flat gray No. 16307 per Federal Standard No. 595:

1. Power Control
2. RPM Control
3. Mixture Control
4. Supercharger Control
5. Landing Gear Control
6. Flap Control

6.3 Conflict with Federal Air Regulation: The following conflict exists between this ARP and the current Federal Air Regulation:

Shapes of control knobs, paragraph 6.1 et seq., may conflict with FAR 25.781.

6.4 Placards for Circuit Breakers: Circuit breakers (or fuses) will be clearly placarded to designate the primary circuits which they protect. In addition, circuit breakers which affect more than one electrical circuit will be code numbered for identification, such that reference to a conveniently located chart will provide a list of the multiple functions involved. Refer to AS 486 for additional information on circuit breaker problems.

PREPARED BY
SAE COMMITTEE S-7,
FLIGHT DECK AND HANDLING
QUALITIES STANDARDS FOR
TRANSPORT AIRCRAFT