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485 LEXINGTON AVENUE
NEW YORK 17, N.Y.

AEROSPACE RECOMMENDED PRACTICE

ARP 268C

Issued 5-1-52
Revised 11-15-62

LOCATION AND ACTUATION OF FLIGHT DECK CONTROLS FOR COMMERCIAL TRANSPORT TYPE AIRCRAFT

1.1 PURPOSE: The purpose of this bulletin is to set forth the recommendations of the SAE Committee S-7 (Cockpit Standardization) 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 bulletin apply to commercial type, multiengine transport aircraft utilizing reciprocating or turbine type powerplants.

2. DEFINITIONS:

2.1 Types of Flight Decks:

2.1.1 Type I: This is a dual pilot flight deck with no flight engineer.

2.1.2 Type II: This is a dual pilot type of flight deck with auxiliary seating provisions for a flight engineer. The airplane may be operated with or without a flight engineer.

2.1.3 Type III: This is a dual pilot flight deck with a separate flight engineer's station. The flight engineer's station contains certain controls and instruments assigned specifically to the flight engineer. In this case a flight engineer is a required member of the crew.

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

2.2.1 Capital P: "P" stands for primary, and 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.

2.2.2 Capitol S: "S" stands for secondary, and 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 members' lap belt and/or shoulder harness to be in place (shoulder harness is assumed free on the inertia reel).

2.2.3 Capital N: "N" stands for none, and indicates that at the particular crew station specified, there is no requirement for the control.

2.2.4 Capital D: "D" stands for desirable, and indicates that although there is no specific requirement for that control to be accessible to that crew member, it would nevertheless be desirable.

3. LAYOUT OF TYPE III FLIGHT DECKS: There are several possible arrangements for the flight engineer's station for Type III flight decks. It is not the purpose of this bulletin 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 Type III category. These general recommendations are as follows:

3.1 The flight engineer will not sit facing aft.

3.2 It is desirable that means be provided to view the engines 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 should be grouped at eye level. The captain, from his own station, should be able to monitor the flight engineer's station at all times.

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

3.5 The following principles govern the orientation of switches and controls in the flight station.

3.5.1 Power plants are numbered consecutively from port to starboard.

3.5.2 Power plant controls shall be numbered corresponding to the power plant with which they are associated regardless of their orientation at the flight station.

3.5.3 Primary or emergency power plant controls and fuel system controls shall be located in Zone A of Figure V. These controls shall be oriented in vertical planes displaced by not more than ninety degrees 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 shall be oriented from left to right relative to the crew member when facing the controls as numbers 1, 2, 3, 4...

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

3.5.6 Zone A includes all areas reached by flight crew members while 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, shall be numbered from top to bottom.

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

4.1 Location of Controls:

4.1.1 Controls shall be so located as to permit their use by the crew member to which they are assigned while 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 shall be grouped together and segregated according to systems.

4.2 Actuation of Controls:

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

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

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

4.2.4 On panels located above eye level, every effort will be made to keep these panels as nearly vertical or horizontal as possible to avoid ambiguity in control movement which attends a forty-five degree 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 (i.e., carburetor alcohol switches). When exceptions are made, the direction of actuation shall be such as to provide the greatest ease of operation.

4.3 Crew Member's Reach: Figures I and II 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 finger tip reach.

5. ASSIGNMENT OF CONTROLS TO CREW STATIONS: Figure III gives the recommended location of each of the controls and the definition of the function of each control as related to the crew member.

6. CONTROLS FOR WHICH A SPECIFIC LOCATION IS RECOMMENDED: For obvious reasons, certain controls require a more specific location than is given in Section 5, 7. or Figure III. Such controls are described in this section.

6.1 Primary Flight Controls: Specific locations are required for these controls; however, standardization on flight controls has already been achieved to a satisfactory degree, so no further mention need be made of it in this bulletin.

6.2 Secondary Flight Controls:

6.2.1 Automatic Pilot:

a. Location - The controller shall be on the pedestal aft of the power controls and convenient to each pilot.

b. Actuation - Conventional.

c. Comments - A suitable arm rest is desirable. A thumb operated electrical disconnect button shall be provided on the outboard side of each wheel. Where necessary, a guard should be provided to prevent inadvertent operation of the controller. See Figure III for additional details. If a mechanical disconnect is used it shall be accessible to both pilots.

6.2.2 Wing Flap Control:

a. Location - The wing flap control shall be located on the top of the pedestal aft of the throttle, centrally or to the right of the centerline. It shall be at least 10 inches aft of the landing gear control.

b. Actuation - Forward for flaps up; rearward for flaps down.

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

6.2.3 Landing Gear Control:

a. Location - The landing gear control lever shall be forward of the power control on or to the right of the airplane centerline.

b. Actuation - Up for gear up; down for gear down.

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

6.2.4 Wheel Brakes:

a. Location - Toe pedals integral with rudder pedals.

b. Actuation - Conventional

6.2.5 Trim Tabs:

a. Location - Within normal reach and easily accessible to each pilot for all critical flight conditions.

b. Actuation - (1) Trim controls shall be designed to safeguard against inadvertent or abrupt operation.

(2) Each trim control shall operate in the plane and with the sense of motion of the airplane.

(3) Means shall be provided adjacent to the trim control to indicate the direction of the control movement relative to the airplane motion.

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

6.3 Power Plant Controls:

6.3.1 Power Control (Throttles):

a. Location - The throttles, or composite power control units, when used, shall be located on the pedestal. Refer to Figure IV for recommended boundaries for throttle operation. This chart contains data obtained by studying many types of transport airplanes. In Type III flight decks, if the master throttles are not accessible to the flight engineer as defined in Par. 2.2.2, separate throttles or power trimming or adjustment devices shall be provided at the flight engineer's station.

b. Actuation - Forward to increase forward thrust. Where reverse thrust is provided, the reverse thrust control motion shall be rearward to give reverse thrust. It shall be impossible to inadvertently reverse. It shall be possible to easily select forward or reverse on any propeller and easily regulate power of any engine or combination.

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

6.3.2 Anti-Detonant or Thrust Augmentation (Water) Injection Control:

a. Location - See Figure III (pump switch).

b. Actuation - Injection flow shall be automatically controlled by power. A separate switch shall be provided for the pumps.

6.3.3 RPM Control:

6.3.3.1 Master

a. Location - To the right of the captain's throttles and at least one inch lower.

b. Actuation - Forward to increase RPM. (If a lock is required, 6.3.1c applies.)

6.3.3.2 Individual

a. Location - See Figure III.

b. Actuation - Forward (with respect to crew member) to increase RPM.

6.3.4 Feathering Control:

a. Location - (1) For Type I and Type II flight decks - ahead of the pilots, above eye level, and in the normal field of vision looking forward.

(2) For Type III flight decks it should be accessible to the flight engineer as a primary control and to the captain as a secondary control.

b. Actuation - Push to feather.

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 feathering actuation.

6.4 Fuel System: See Section 7.

6.5 Oil System: See Section 7.

6.6 Electrical System: See Section 7, (except for landing lights).

6.6.1 Landing Lights:

a. Location - Bottom or forward row on panel over the windshield on the captain's side.

b. Actuation - In accordance with Section 4.2 "on" and "extend" position in the same direction.

6.6.1 Landing Lights: (Continued)

c. Comments - Each extendable landing light shall 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.

6.7 Air Conditioning: See Section 7.

6.8 Emergency Systems: See Section 7.

6.9 De-Icing and Anti-Icing Systems: See Section 7.

7. CONTROLS FOR WHICH NO DETAILED LOCATION IS REQUIRED: There are many controls for which a detailed location is unnecessary, an assignment to the crew member being sufficient. The items in this category are described below. For the general location with respect to crew member assignment, refer to Figure III.

7.1 Primary Flight Controls: This item is covered in 6.1.

7.2 Secondary Flight Controls:

7.2.1 Nose Wheel Steering:

a. Location - See Figure III. To the left of the captain (and if provided for the co-pilot also, to his right) approximately beside the control column with axis approximately parallel to pilot's arm.

b. Actuation - Wheel, or segment of a wheel, if a separate control is provided.

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

7.2.2 Tail Wheel Lock:

a. Location - See Figure III.

b. Actuation - Upward and/or forward to lock.

7.2.3 Parking Brake:

a. Location - See Figure III.

b. Actuation - Pull to actuate. Push pedals to release.

7.2.4 Speed Brake Control:

a. Location - On the control pedestal accessible to both pilots and positively separated from the landing gear and wing flap controls. See Figure III.

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 at high speeds must be provided unless it is demonstrated that structural damage or serious effects upon control and stability do not result from such operation.

b. Actuation - The motion shall be aft for braking.

7.2.5 Flight Control Lock:

a. Location - See Figure III.

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

7.2.6 Rudder Pedal Adjustment:

a. Location - See Figure III.

b. Actuation - Unitary control.

7.3 Power Plant Controls:

7.3.1 Throttles: See 6.3.1.

7.3.2 Propeller Controls:

a. Master Control - See 6.3.3.1

b. Individual Control - See 6.3.3.2

c. Feather - See 6.3.4a.

d. Automatic Feathering Controls (arming and test) - See Figure III.

e. Reverse - See 6.3.1b.

7.3.3 Mixture:

a. Location - See Figure III.

b. Actuation - Forward or upward (with respect to the crew member) for "RICH".

7.3.4 Supercharger:

a. Location - See Figure III.

b. Actuation - To increase supercharger pressure forward, upward, or clockwise.

7.3.5 Alternate Air, Filter:

a. Location - See Figure III.

b. Actuation - Forward and/or upward for ram air; rearward and/or downward for alternate or filtered air.

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

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

a. Location - See Figure III.

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

7.3.7 Start Switches:

a. Location - See Figure III.

b. Actuation - The momentary or non-momentary type for ground start, prime or ignition boost shall be provided. Flight start switches shall be non-momentary.

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

7.3.8 Engine Switches (Magnetos):

a. Location - See Figure III. Shall be grouped together in a horizontal line in accordance with Section 3.5.

b. Actuation - The "OFF" position shall be furthest counterclockwise. Clockwise rotation shall produce the following sequence: "RIGHT", "LEFT", "BOTH".

c. Comments - Ignition switches shall be separated electrically and mechanically without provisions for multiple cutoff.

7.3.9 Oil Dilution:

a. Location - See Figure III.

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. It may be desirable to make provisions to operate all simultaneously.

7.3.10 Manual Spark Advance:

a. Location - See Figure III.

b. Actuation - Forward or up for take-off.

7.3.11 Start Levers:

a. Location - See Figure III.

b. Actuation - Start levers should operate forward or upward (with respect to the crew member) for start, idle or run functions.

7.4 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.

7.4.1 Fuel Pumps:

a. Location - See Figure III.

b. Actuation - Upward or forward for "ON" or "HIGH".

7.4.2 Fuel Tank Controls:

a. Location - See Figure III.

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

7.4.3 Fuel Dump:

a. Location - See Figure III.

b. Actuation - Down or aft for dump.

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

7.5 Oil System:

7.5.1 Transfer: See Figure III.

7.6 Electrical System Controls: For location, see Figure III. Actuation in all cases is conventional (covered by general recommendations). As in the case of the fuel system, location of the switches as a part of a line diagram is highly desirable.

7.7 Air Conditioning Controls: Incorporation of the various controls in line diagrams is also highly desirable for air conditioning controls. For location, see Figure III.

7.8 Emergency Controls:

7.8.1 Fire Extinguisher Controls: Controls required for combating fire in a particular area shall 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.

a. Power Plant Fire Controls:

Location - See Figure III.

Actuation - Conventional. See general recommendations Section 4.2.

b. Other Fire Areas:

Location - See Figure III.

Actuation - Conventional.

7.8.2 Emergency Fluid Shut-offs: This refers to the emergency shut-off controls for fuel, engine oil, hydraulic oil, etc.

a. Location - See Figure III.

b. Actuation - Rearward, pull or down for "OFF" position.

7.8.3 Emergency Hydraulic Pump and Selector:

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.4 Emergency Brakes:

a. Location - See Figure III.

b. Actuation - Rearward, downward, or clockwise to energize emergency brake system.

7.8.5 Emergency Pitot and Static System Controls:

a. Location - See Figure III.

b. Actuation - Rearward, downward or clockwise to select emergency system.

7.8.6 Emergency Flight Controls (Tabs, Auxiliary Boosters, Booster Shut-off, Etc.):

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.7 Windshield Precipitation Removal Control:

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.8 Flares:

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.9 Reverse Throttle Lock Override:

a. Location - See Figure III.

b. Actuation - Not specified.

7.8.10 Emergency Instrument Power Selector and Warning:

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.11 Jato:

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.12 Emergency Landing Gear Extension:

a. Location - See Figure III.

b. Actuation - If the control is provided in the flight deck, it should be operated by the co-pilot. This control should be available on the flight deck.

7.8.13 Emergency Flap:

a. Location - See Figure III.

b. Actuation - Conventional.

7.8.14 Emergency Depressurization:

a. Location - See Figure III.

b. Actuation - Conventional.

7.9 De-Icing and Anti-Icing Systems:

7.9.1 Wing and Tail: See Figure III.

7.9.2 Engine and Nacelle:

a. Location - See Figure III.

b. Actuation - Conventional (if momentary contact switches are required as for carburetor alcohol, see Paragraph 4.2.4).

7.9.3 Windshield: See Figure III.

7.9.4 Pitot System: See Figure III.

7.9.5 Miscellaneous External Surfaces: See Figure III.

7.9.6 Propellers: See Figure III.

8. MISCELLANEOUS:

8.1 Control Shapes:

8.1.1 Power Control Knobs (Throttles): Power control knobs shall be a horizontal cylinder modified as necessary to afford proper grip.

8.1.2 RPM Control Knobs: RPM control knobs shall 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.

8.1.3 Mixture Control Knobs: The mixture control knobs shall be a horizontal cylinder with 1/8 inch high radial dulled protuberances.

8.1.4 Supercharger Control Knobs: The supercharger control knobs shall have the shape of a two sided fluted impeller.

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

8.1.6 Flap Control Knob: The flap control knob shall have the shape of a flap section.

8.1.7 Landing Light Control: The landing light controls shall be provided with a tab having three fluorescent dots. (Acceptable type is shown by illustration of switch No. 8207 on Page 6 of Cutler Hammer Catalog No. KSP-32 dated August 1939.)

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

8.2 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

8.3 Conflict with Civil Air Regulation: The following conflict exists between this ARP and the current Civil Air Regulation:

1. Colors for control knobs, Section 8.2; may conflict with CAR 4b.353 depending on the color of other control knobs and surrounding flight deck.

8.4 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.

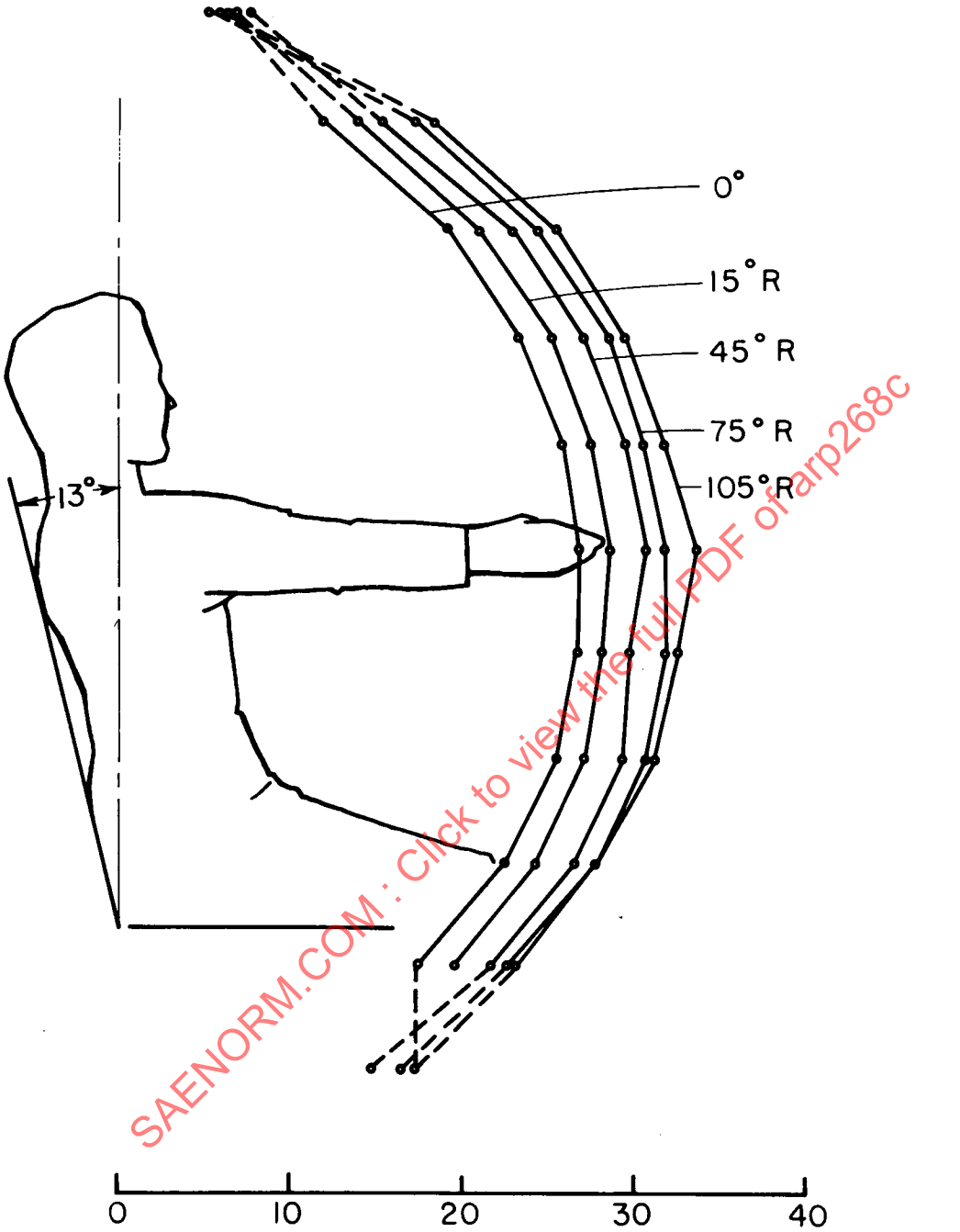

FIGURE I.- MAXIMUM DISTANCES WHICH CAN BE REACHED BY 97 PERCENT OF THE POPULATION AT EACH POSITION. THE ELLIPTICAL ARCS INDICATE THE MAXIMUM BOUNDARIES OF THE WORKING AREA FOR OPERATION OF MANUAL CONTROLS (AT ANGLES FROM 0° TO 105° TO THE RIGHT) FOR THIS GROUP SEAT BACK ANGLE 13°

NOTE: THIS FIGURE IS REPRODUCED FROM REPORT NO. 3. PROJECT X-651. PUBLISHED BY NAVAL MEDICAL RESEARCH INSTITUTE.

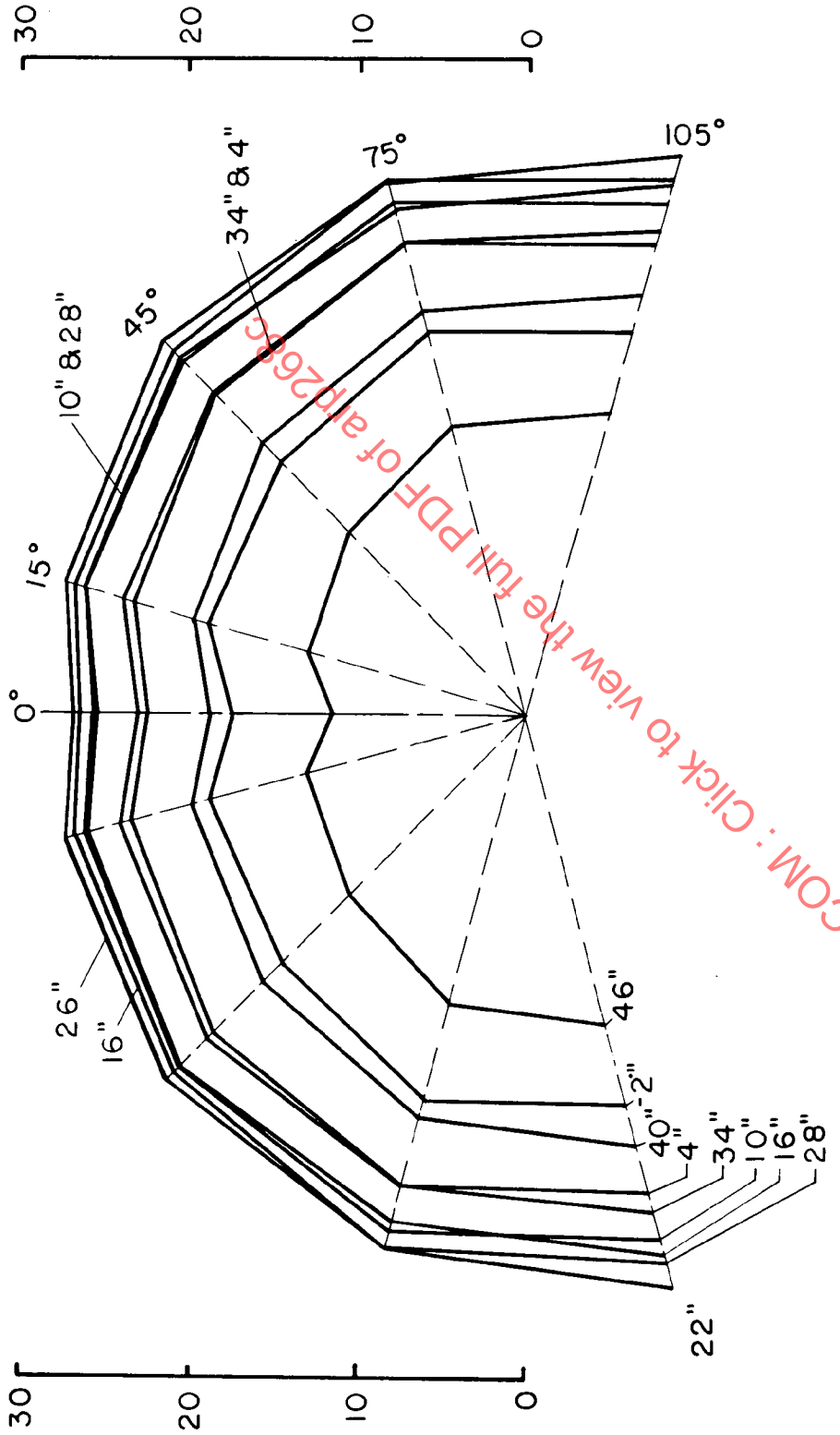

FIGURE II.— MAXIMUM DISTANCES WHICH CAN BE REACHED BY 97 PER CENT OF THE POPULATION AT EACH POSITON. THE ELLIPTICAL ARCS INDICATE MAXIMUM BOUNDARIES FOR THIS GROUP FOR OPERATION OF MANUAL CONTROLS AT VARIOUS HORIZONTAL LEVELS. SEAT BACK 13° FROM VERTICAL

NOTE: THIS FIGURE IS REPRODUCED FROM REPORT NO. 3. PROJECT X-651. PUBLISHED BY NAVAL MEDICAL RESEARCH INSTITUTE.

FIGURE III

ASSIGNMENT OF CONTROLS TO CREW MEMBERS

CONTROL	TYPE I NO ENGINEER		TYPE II THREE ABREAST TYPE			TYPE III SEPARATE ENGR. STA.		
	Captain	Copilot	Captain	Copilot	Engr.	Captain	Copilot	Engr.
A. Primary Flight Controls	P	P	P	P	N	P	P	N
B. Secondary Flight Controls								
1. Ground Steering	P	D	P	D	N	P	D	N
2. Tail wheel lock	S	P	S	P	N	S	P	N
3. Automatic Pilot								
a. Controller	P	P	P	P	N	P	P	N
b. Mechanical disconnect	P	S	P	S	N	P	S	N
c. Elect. disconnect	P	P	P	P	N	P	P	N
d. Other (cage switch, etc.)	P	S	P	S	N	P	S	N
4. Parking brake	P	S	P	S	N	P	S	N
5. Tabs	P	P	P	P	N	P	P	N
6. Flaps	S	P	S	P	N	S	P	N
7. Landing gear	S	P	S	P	N	S	P	N
8. Brakes	P	P	P	P	N	P	P	N
9. Speed brake	P	S	P	S	N	P	S	N
10. Flight control locks	S	P	S	P	N	S	P	N
11. Rudder pedal Adjustment	P	P	P	P	N	P	P	N

FIGURE III CONT'D.

ASSIGNMENT OF CONTROLS TO CREW MEMBERS

CONTROL	TYPE I NO ENGINEER		TYPE II THREE ABREAST TYPE			TYPE III SEPARATE ENGR. STA.		
	Captain	Copilot	Captain	Copilot	Engr.	Captain	Copilot	Engr.
C. Power Plant								
1. Throttles or thrust levers	P	P	P	P	S	P	P	S
2. Propeller controls								
a. Master control	P	P	P	P	S	P	P	S
b. Individual controls	P	P	P	P	S	D	D	P
c. Feather	P	P	P	P	S	S	N	P
d. Auto feather arming & tests	S	P	S	P	N	S	P	N*
e. Reverse	P	P	P	P	N	P	P	N
3. Anti-Detonant or thrust augmentation injection								
a. Pump	S	P	S	P	D	N	N	P
4. Supercharger								
a. Two speed	S	P	S	P	N	N	N	P
b. Turbo	S	P	S	P	S	N	N	P
5. Mixture	S	P	S	P	S	N	N	P
6. Alternate air, filter	S	P	S	P	S	N	N	P
7. Cooling controls (cowl flaps, oil flaps, intercooler, etc.)	S	P	S	P	S	N	N	P

* Rejection only.

FIGURE III CONT'D.

ASSIGNMENT OF CONTROLS TO CREW MEMBERS

CONTROL	TYPE I NO ENGINEER		TYPE II THREE ABREAST TYPE			TYPE III SEPARATE ENGR. STA.		
	Captain	Copilot	Captain	Copilot	Engr.	Captain	Copilot	Engr.
8. Start	P	P	P	P	S	P	P	S
9. Engine switches - mags.	P	P	P	P	S	P	P	S
10. Oil dilution	N	S	N	S	S	N	N	P
11. Manual spark advance	S	P	S	P	S	N	N	P
12. Start levers	P	P	P	S	P	P	P	S
D. Fuel System								
1. Fuel pumps	S	P	S	P	S	N	N	P
2. Fuel Tanks and crossfeeds	P	P	P	P	S	N	N	P
3. Fuel dumps	S	P	S	P	S	N	N	P
E. Oil System								
1. Transfer	N	S	N	S	P	N	N	P
F. Electrical								
1. Generators	S	P	S	P	S	N	N	P
2. Inverter switches								
a. Manual changeover type	S	P	S	P	D	N	N	P*
b. Auto changeover type	S	S	S	S	P	S	S	P

* Failure Warning Light required in front of pilots.