

**INSTRUMENTATION AND COCKPIT CONTROL ARRANGEMENT FOR
ELECTRONIC NAVIGATION AND COMMUNICATION AIDS**

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1. **PURPOSE:** The purpose of this report is to present a recommended standard for the manner in which information from electronic navigation and communication aids is portrayed in the cockpit. It also recommends a standard arrangement for the cockpit controls used to operate and receive information from this equipment.

The basic factors considered, not necessarily in the order of importance are:

- a. Ability of the crew to use the equipment.
- b. Flexibility combined with safety to provide optimum use of the equipment.
- c. Degree of accuracy necessary.
- d. Simplicity.
- e. Economy of the installation.

Since all of these items are not always compatible, certain compromises have been made. It is desired to obtain the maximum possible use out of the installed equipment; however, some compromise in flexibility may be accepted when the degree of complication required for accomplishment creates a probability of error above an acceptable limit.

2. **SCOPE:** The facilities covered in this bulletin are:

- a. Navigational equipment which makes use of radio or other electronic devices.
- b. Equipment for weather surveillance, anti-collision devices, etc.
- c. Air traffic control equipment.
- d. All air-borne communications equipment both for communication within the aircraft and to points outside the aircraft.

3. **GENERAL ITEMS, ALL EQUIPMENT:**

3.1 **Nomenclature:**

- 3.1.1 Where the words "primary" and "secondary" with respect to control location are used in this proposal, "primary" means readily accessible and "secondary" means that some compromise with accessibility may be tolerated.

- 3.1.2 Where abbreviations are used, they should follow the SAE aerospace standard for Standard Cockpit Nomenclature and shall be used in designating and placarding equipment covered by this bulletin, plus the additional listings below:

Low Frequency Automatic Direction Finding System.....ADF-1
A navigation equipment operating on radio frequencies in the low frequency-medium frequency band (100-2000 KC) which provides automatic information as to the direction to the radio station tuned in.

-2-

VHF Omni-Range/Localizer.....VOR-1
A radio navigation equipment operating in the VHF frequency
(108-118 MC) band and providing VOR and localizer reception.

Glide Slope Receiver.....GS-1
Receiver for reception of the glide slope signals of an
instrument landing system. (329-335 MC)

Marker Receiver.....MKR-1
Receiver for reception of 75MC marker signals.

Range Receiver.....RNG-1
Receiver for reception of radio range signals in the low
frequency-medium frequency range. (200-400KC)

Localizer Receiver.....LOC-1
Receiver for reception of the localizer direction
signals (108-112MC) of the Instrument Landing System.

Loran.....LRN-1
A Long Range Navigation System providing fixing through
the intersection of hyperbolic lines of position.

*Lo-Range Altimeter.....R/A-LO

*High-Range Altimeter.....R/A-HI

Radar.....RDR

Air Traffic Control Transponder.....ATCTR

VHF Communications Transceiver (or transmitter plus receiver
combined).....VHF-1

VHF Communications Transmitter Only.....VHFT-1

VHF Communications Receiver Only.....VHFR-1

Double Channel Operation.....DBLC
Double channel operation is radio communication where one
frequency is used for transmitting and a different one
for receiving. The two frequencies are tied in together
automatically and when the desired channel is selected,
reception on one frequency and transmission on the
associated frequency is automatic.

Single Channel Operation.....SGLC
Single channel operation is radio communication where
transmission and reception are on the same channel.

HF Communication Transceiver or Transmitter Combined With
Receiver.....HF-1

*ABBREVIATIONS FOR BASIC SYSTEM TAKEN FROM "AS" FOR STANDARD COCKPIT NOMENCLATURE

-3-

HF Communication Transmitter.....HFT-1
HF Communication Receiver.....HFR-1
Cockpit Loud Speaker.....SPK-1
Microphone.....MIC
Headphone.....PHONE
Cabin Passenger Address System.....PA
Interphone.....INT
ATC Signalling System.....ATCSS
Tacan.....TCN
Volume.....VOL
Squelch.....SQ
Selcal.....SCL

3.1.3 Where more than one unit or indicator is installed, they shall be designated as No. 1, 2, 3, etc. No. 1 refers to Captain's side of the airplane, No. 2 to co-pilot, No. 3 to F/E. Where other crew members involved, it shall be so specified as NAV. SPK.

3.2 Auxiliary Monitoring Systems:

3.2.1 Loud Speaker: In addition to head sets, individual loud speakers may be installed for crew members for the reception of aural signals.

3.2.1.1 An ON-OFF switch shall be provided for each speaker. The audio panel level control shall control the volume of the associated speaker. Side tone shall be provided.

3.2.1.2 The design and installation shall be such that each speaker is useable for the full range of movement of the respective seat, and there shall be no undesirable interference between speakers when more than one is installed.

3.2.2 Selcal: A system may be installed for providing visual and aural indication of a radio call intended for that particular aircraft.

3.2.2.1 Visual indication shall be provided for each receiver for which the calling system is provided, by an advisory light (of a color conforming to ARP 450). Each light shall be located as close as practical to the respective receiver's frequency selector and/or volume control.

-4-

3.2.2.2 Aural indication shall be provided by a chime which will sound for each activation of the selective calling de-coder. A repetitive chime at a frequency not to exceed 1/sec. is permissible. A means shall be incorporated for re-setting the system to permit indication of subsequent calls. The re-set control(s), if manual, shall be located as close as practical to the advisory light(s).

Ø 3.2.3 Auralert: A system may be installed to provide for the automatic transmissions of a pre-recorded distress message on pre-selected communication frequencies.

Ø 3.2.3.1 Activation and de-activation of the system shall be possible by a single action by either pilot.

Ø 3.2.3.2 The transmission shall consist of at least a distinctive warbling audio tone followed by MAYDAY MAYDAY MAYDAY and the aircraft identification.

4. CONTROLS:

Ø 4.1 Main Control Panel: A main radio control panel, or group of associated sub-panels shall be provided primary to both the pilot and the co-pilot and so located that no portion is less than 18" from the normal eye position as referenced in ARP 580. This panel shall be further located such that angular measurement from each reference point shall not be more than 45° above the horizon, 75° below the horizon, and no portion of the panel shall be aft of 115° to right or left from straight ahead.

Ø 4.1.1 The panels specified in 4.1 shall contain as a minimum all VHF communication and VHF navigation frequency selector and sensitivity controls. It is desired that the following additional controls also be included on these panels.

- a. Marker receiver controls.
- b. Frequency selectors, and sensitivity controls for all other navigation receivers.
- c. All H.F. communications transmitter and receiver controls.
- d. ATC transponder controls.
- e. Doppler computer and receiver controls.
- f. Weather radar controls.
- g. Other related controls may be included except where another location is specified by other parts of this ARP.

4.1.2 Master switching shall be provided to turn on the power to the radio equipment and shall be so arranged that no single unit failure can result in a complete radio failure. The master switching shall be located at least secondary to the pilot and co-pilot or, in case of Type III - cockpit secondary to at least one pilot and the flight engineer. The radio master switch specified need not be separate from normal electrical power controls in those cases where design of the radio racks and equipment is such as to provide internal cooling and overboard ducting.

-5-

4.1.3 It shall be possible to decrease volume with all audio volume controls to the point where no signal is audible, except the level control specified in 4.2.4.

4.1.4 Functionally related controls for each individual piece of navigation equipment shall be grouped together.

4.2 Audio Selector Panel:

4.2.1 The pilot and the co-pilot shall each have an independent audio selector panel covering all voice communications and aural radio navigation equipment. A common panel or panels covering that portion of the equipment from which it is necessary for them to receive audio signals shall be provided for other crew members.

4.2.2 The audio selector panels for the pilot and the co-pilot shall be located so that each panel is readily visible to both pilots when occupying their seats in the normal position for flying. Each panel shall be readily accessible to the user. Space permitting, it is considered desirable that the location be accessible to the inboard hand.

4.2.3 The audio selector panel for the pilot, and the co-pilot, shall each be provided with a selector switch enabling the user to select any desired transmitter.

4.2.4 Each audio selector panel shall be provided with a single level control or controls for controlling the audio level - a minimum of 12 decibels - for at least the audio communication signals being received. If more than 12 decibel control is provided for the pilot and the co-pilot, care shall be exercised to assure that low frequency range course reversal or excessive course broadening shall not occur.

4.2.5 The audio selector panels for the pilot and the co-pilot shall each provide means to enable the user to select aural information from any combination of receivers, for his head set (and speaker, if installed).

4.2.6 Each audio selector panel provided to receive aural range and voice signals shall be equipped with the necessary switch or switches enabling the user to filter out range or voice signals as desired from each receiver used. The ADF audio/range filter switch(es) shall be easily distinguishable by shape from other audio selector switches. Where space is available, a rotary switch may be used for this purpose.

4.3 V.H.F. Navigation Receiver Controls:

4.3.1 Each receiver shall be provided with a separate frequency selector control located as specified in 4.1, except for any receiver provided for the exclusive use of a navigator, in which case the frequency selector for such receiver shall be at the navigation station. When the frequency of an ILS localizer or VOR is selected, the frequency of the associated glide slope and/or DME (where provided) shall also be selected automatically.

-6-

- 4.3.1.1 The frequency selector shall show the VOR/localizer frequency directly in megacycles and shall be controlled and readable to tenths.
- 4.3.2 Each receiver shall be provided with a single separate volume control stacked on top of the frequency selector control.
- 4.3.2.1 If a power "on-off" control is employed, the volume control required in 4.3.2 shall be used for this purpose. The extreme counter-clockwise position shall be "off" and it shall be through a definite and noticeable detent.

4.4 Low Frequency Navigation Receiver Controls:

- 4.4.1 Each receiver shall be provided with a frequency selector located on the main radio control panel, except for receivers provided for the exclusive use of a navigator, in which case, the selector shall be at the navigation station. The frequency selector shall show the frequency directly in kilocycles.
- 4.4.2 Each receiver shall be provided with a separate function switch to select the various functions of the receiver, including an "OFF" position if desired. This control shall be located as specified in 4.1, except where such receiver is for the exclusive use of the navigator, in which case, the control shall be at the navigation station.
- 4.4.3 Each receiver shall be provided with a single separate volume control stacked on the frequency selector control, or band selector.

4.5 Marker Receiver Controls: Marker receiver controls shall be located on the main radio panel required in 4.1.

- 4.5.1 Two sensitivities shall be provided, referred to as "Sharp" and "Broad", (or abbreviated SHP and BRD).
- 4.5.2 If a power "on-off" switch is used, it shall be combined with a three-position sensitivity control moving clockwise from "off" to "Sharp" to "Broad", with a noticeable detent between "off" and "sharp". If an audio volume control is used, it shall be stacked on top of the switch assembly.
- 4.5.3 When a power "on-off" switch is not provided, the sensitivity control shall be a toggle switch. Up or forward for "broad" - down or rearward for "sharp".

4.6 Communication Receiver Controls:

4.6.1 V.H.F. Communication.

- 4.6.1.1 Frequency selector shall read directly in megacycles to the nearest tenth. Control shall rotate clockwise to increase the reading. Simple visual interpolation to the nearest .05 of a megacycle shall be possible, where 50 KC spaced VHF is installed.

-7-

- 4.6.1.2 Each receiver shall be provided with a single volume or squelch control stacked on the frequency selector. If a receiver is provided with both squelch and volume controls, the squelch control shall be located adjacent to the frequency selector.
- 4.6.1.3 If single channel/double operation is employed, the control switch shall be adjacent to the respective frequency selector. Switch actuation shall be LEFT for SGLC and RIGHT for DBLC.

4.7 Actuation of Controls:

- 4.7.1 Where no specific actuation is listed, the General Recommendation of ARP 268 shall be presumed to apply.
- 4.7.2 Volume or squelch controls shall rotate clockwise to increase volume or sensitivity.
- 4.7.3 Frequency controls shall rotate clockwise to increase frequency.
- 4.7.4 Where a control is used to select between items of equipment to operate a single indicator, the following actuation will apply:
- a. LEFT for No. 1 equipment, or equipment normally connected to the Captain's indicator; RIGHT for No. 2 equipment or equipment normally connected to the co-pilot's indicator.
 - b. UP for VHF equipment, DOWN for LF equipment.

5. NAVIGATION EQUIPMENT INDICATION:

5.1 General:

- 5.1.1 It is desired that the captain and co-pilot each be provided with his own indication of all navigational information; however, it is permissible, where later spelled out in this document, to provide a single display common to both pilots.
- 5.1.2 When a separate navigator is used, any special information needed for his work need be provided for him only.

Where a separate navigation station is provided and where the navigational equipment used by the pilots is also used by the navigator, and controls are located at both positions, the transfer control shall be located at the Captain's control panel only.

- 5.1.3 Where an indicator may be switched to provide information to the pilot(s) from more than one source, clearly recognizable means must be provided to indicate to which source the indicator is currently connected.
- 5.1.3.1 The means provided to comply with 5.1.3 must be in the direct vision of the respective crew member when looking at the indicator involved, and shall display an indication consistent with the control actuation required by 4.7.