SAE Aerospace
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AEROSPACE RECOMMENDED PRACTICE

ARP 4102/6

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COMMUNICATIONS AND NAVIGATION EQUIPMENT

RATIONALE

This document has been reaffirmed to comply with the SAE 5-Year Review policy.

1. **SCOPE:**

1.1 This document recommends criteria for the control and display of communications and navigation equipment on the flight deck. The equipment includes:

   a. **Communications:** Ultra High Frequency (UHF), Very High Frequency (VHF), and High Frequency (HF) Radios, Cabin/Service Interphones, Public Address (PA), Select Call (SELCAL), Call Select (CALSEL), Satellite Communications (SATCOM).

   b. **Navigation:** Very High Frequency Omnidirectional Range (VOR), Tactical Air Navigation (TACAN), Automatic Direction Finder (ADF), Distance Measuring Equipment (DME), Instrument Landing System (ILS), Markers (MKR), Omega, Very Low Frequency (VLF), Inertial Navigation Systems (INS), Inertial Reference Systems (IRS), Satellite Navigation (SATNAV), Low Range Radio Altimeter (LRRA).

   c. **Weather Radar**

   d. **Data Link:** Company, Air Traffic Control (ATC) Transponders (Mode-S) and others.

2. **REFERENCES:**

2.1 **Documentation:** This annex should be used in conjunction with the ARP4102 Core Document. The following documents may also be applicable:

   - ARP4101 - Flight Deck Layout and Facilities
   - ARP4102/4 - Flight Deck Alerting System
   - ARP4102/7 - Electronic Displays
   - ARP4102/9 - Flight Management System
   - ARP4102/12 - Microwave Landing System
   - ARP4105 - Nomenclature and Abbreviations for Use on the Flight Deck

2.2 Definitions:

2.2.1 Remote Tuning: A means of tuning communication and navigation radio equipment other than that normally associated with the radio frequency display panel. Remote tuning includes auto-tuning and keyboard tuning from a flight management system or other systems having radio management capability.

2.2.2 Auto Tuning: A means of tuning communication and navigation radio equipment automatically to frequencies that satisfy the associated navigation or other task.

2.2.3 Preselected Frequency: A frequency that can be readily tuned, either manually or automatically, as the active frequency from a previously programmed or selected list.

3. OPERATIONAL REQUIREMENTS:

3.1 Audio:

3.1.1 MIC: Hand-held and/or Boom and Oxygen Mask MIC capabilities shall be provided to all crew members and be considered for all stations.

3.1.2 Audio Selection: The crew shall each have an audio selection capability covering all voice communications and aural radio navigation equipment.

3.1.3 Volume: It shall be possible to decrease each audio level to the point where no signal is audible except that a minimum preset level shall be provided for the receiver associated with the selected transmitter.

3.1.4 Ident Signal: Means should be provided to automatically decode and display audio ident signals. If this capability is not provided, a switch to select between audio ident/voice communication and voice communication only shall be provided.

3.1.5 Public Address (PA) and Interphone: PA, Flight, Cabin, and Service Interphone facilities shall be provided from the boom, oxygen mask, and hand-held microphones.

The selected flight deck microphone shall have direct access to the interphone or the PA system. This requirement does not preclude the provision of dedicated microphones for any or each service.

The capability may be provided for any flight deck station to call directly any or all cabin and service locations.

3.1.6 Oxygen Mask Microphone: Consideration should be given to the automatic selection of the oxygen mask microphone on mask deployment.

3.1.7 Push to Talk Switch (PTT): An open microphone should deactivate automatically after an appropriate length of time and this condition indicated to the crew. If automatic deactivation is not provided, the open microphone condition shall be clearly annunciated.

3.1.8 <u>Loud Speakers</u>: If individual loud speakers are installed for crew members for the reception of aural communication and navigation signals, an ON-OFF and/or volume control means shall be provided for each.

Side tone and speaker muting shall be provided, i.e., MIC-1 PTT muting SPKR-1 and MIC-2 PTT muting SPKR-2 except for Audio Warnings which should not be muted or be adjustable.

There shall be no undesirable interference between speakers when more than one is installed. However, all transmissions must be intelligible to both pilots throughout the full range of movement of the respective seats under all normal flight conditions.

3.2 <u>Communication Equipment</u>:

3.2.1 <u>UHF/VHF</u>: Frequency selection and pre-selection shall be provided. Auto-tuning shall not be provided. If remote tuning is provided, the source controlling for frequency shall be annunciated.

The last active frequency should be retained to facilitate reselection.

3.2.2 <u>HF</u>: Frequency, mode selection and squelch control shall be provided. Frequency pre-selection should be considered.

The last active frequency should be retained to facilitate reselection.

3.2.3 <u>SELCAL/CALSEL</u>: A SELCAL system may be installed for providing visual and aural annunciation of a radio call intended for the aircraft.

A CALSEL system may be installed for selective alerting of a ground station and if installed, aural feedback of CALSEL activation shall be provided.

3.3 <u>Navigation Equipment</u>:

3.3.1 <u>ILS/VOR/DME</u>: Frequency selection shall be provided. Preselection of frequency should be considered. Auto tuning should also be considered.

When the frequency of an ILS localizer or VOR is selected, the frequency of the paired glideslope and/or DME (where provided) shall also be set. This does not preclude the use of separate VOR/DME equipment which provides manual pairing capability.

A DME "HOLD" function is discouraged.

Where two navigation receivers are used, the No. 1 receiver shall be connected to the left navigation instruments and the No. 2 shall be connected to the right navigation instruments. A transfer switching arrangement for each crew member's indicator may be used. If switching is incorporated, annunciation clearly indicating which receiver is being displayed shall be provided.

For MLS, see ARP4102/12.

3.3.2 <u>ADF</u>: Preselection of frequency should be considered.

Auto tuning should be considered.

The last active frequency shall be retained to facilitate reselection.

3.3.3 <u>Marker Beacon</u>: Where two sensitivities are provided they shall be referred to as High and Low. Low sensitivity shall be used where only one is provided. The receiver shall always be active, i.e., no "OFF" position shall be provided. The audio control shall incorporate an ON/OFF switch.

3.3.4 <u>Weather Radar</u>: Selection of display ranges (in nautical miles) should be provided. Ranges shall be a multiple of two consecutively increasing from the lowest selectable range.

3.3.5 <u>Data Link</u>: Data link for ATC communications is considered of higher priority than data link for company communications.

Visual or audio presentation should be dedicated to ATC and would therefore not require a signature on uplink messages. ATC messages may also be provided by hard copy.

Where hard copy printout is used, the printer shall be accessible to a crew member.

Priority messages shall displace less urgent messages. Automatic recall of displaced messages shall be provided.

A combined Control and Display Unit (CDU) is preferred for the control and display functions.

Frequently used, routine data link communications may be provided via prerecorded messages readily selectable at the CDU on dedicated keys or on a dedicated data link control panel.

Immediate access standby voice communication must be provided in case the crew is unwilling or unable to comply with ATC directives by Data Link.

All ATC Data Link messages must be acknowledged by the crew.

For company and ATC data link, automatic tuning is preferred.

4. <u>PANELS</u>:

4.1 <u>Audio Panels</u>:

4.1.1 <u>Audio Selector</u>: An audio selector panel shall be accessible to each crew member. Each pilot's panel shall be visible to both pilots.

5. <u>CONTROLS</u>:

5.1 <u>Audio Controls</u>:

5.1.1 <u>Audio Selection</u>: The selectors shall have separate audio level controls for all systems; level adjustments made by any crew member shall not affect the levels set by other crew members.

The selectors shall provide means to enable the crew member to select aural information for his headset (and speaker, if installed) from any combination of receivers or any desired transmitter.

5.1.2 <u>Push-to-Talk Switch (PTT)</u>: A PTT switch shall be located on the outboard horn of each yoke or on each controller. In addition, there shall be a PTT switch located in an accessible area for each crew member.

5.2 <u>Communication Equipment Control</u>:

5.2.1 <u>VHF</u>: If a receiver requires squelch control, the control shall be located adjacent to the frequency selector. In the case where automatic squelch control is provided, consideration should be given to providing a squelch disable function.

5.2.2 <u>HF</u>: Frequency shall be selectable in 1 kHz steps.

5.3 <u>Navigation Equipment Control</u>:

5.3.1 <u>ILS/VOR/DME</u>: Each ILS/VOR receiver shall be provided with individual means for selecting a desired course.

5.3.2 <u>ADF</u>: Frequency selection shall be provided on a receiver control panel which shall also incorporate the mode selector and other functions, including an "OFF" position if desired.

Remote tuning is also acceptable.

5.3.3 <u>INS</u>: INS controls and displays shall provide the following functions:

     a. Alignment and attitude/heading reference data (Mode Selector).

     b. Navigation and System Status.

     c. Means to Input Data.

     d. Navigation Data Display.

5.3.4 <u>Omega/VLF, VLF/Omega, and SATNAV</u>: Omega/VLF, VLF/Omega, and SATNAV control and display panels shall provide the functions of paragraph 5.3.3 with the exception that they may control system initialization only instead of alignment and attitude/heading reference data.

5.3.5 <u>Weather Radar</u>: Tilt control shall be referenced to the inertial horizon or the flight path angle.

5.3.6 Data Link: Control shall be provided for pilot authorization of air/ground/air data link communication systems with both manual and automatic modes. Systems include ATC transponders, Mode S, and Company, and ATC data link communication equipment.

ATC Transponder: Control shall be provided for:

a. Selection and annunciation of any one of 4,096 discrete codes for ATC use.

b. ON/OFF selection of Altitude Reporting.

c. Pilot actuation of the ident feature in response to ATC request.

d. Automatic switching of the transponder to ON during flight and to OFF/Standby on the ground. Manual override shall be provided. Means shall be provided to indicate transponder failure.

For ATC data link systems, the controls shall be accessible to the Captain and First Officer from their normal operating position.

For Company data link systems, the controls shall be accessible to any flight crew member.

6. DISPLAYS:

6.1 Audio Displays:

6.1.1 Audio Level: Audio levels shall be displayed.

Where indication of level is other than by knob or lever position, the display shall be close to the control device. The type of indication shall be consistent for all audio level display functions.

6.1.2 Microphone Selection: The selected transmitter/microphone shall be displayed. The display shall be close to the selector.

6.1.3 Push to Talk Switch (PTT): Lack of transmitter output signal due to simultaneous transmission shall be annunciated.

6.2 Communications Equipment Displays:

6.2.1 UHF/VHF/HF: It is desirable that each pilot be provided with indication of all communication frequency/modes information; however, it is permissible to provide a single display common to both pilots.

If remote tuning of frequency is provided, any failure shall be annunciated. Where frequency preselection is provided, a clear visual distinction shall be made in the display between the active and the preselected frequency.

6.2.2 SELCAL/CALSEL: Clear indication of the transceiver addressed by SELCAL shall be provided. CALSEL selection indication is desirable.