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**MATERIALS AND PROCEDURES FOR IN-FLIGHT ASSESSMENT
OF AUDITORY FUNCTION IN AIRCREWMEN**

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FOREWORD

This research was conducted by the Audiology and Hearing Conservation Function, Otolaryngology Branch, under task No. 7755-08-01 during the period November 1971 to June 1972. This paper was submitted for publication on 15 June 1973.

Acknowledgment is given to the following individuals who assisted in compiling the single-syllable word lists: Roy Danford, Jr., Master Sergeant James F. Boyer, Jr., Staff Sergeant Kathy O. Paxton, and Sergeant David W. Patterson.

This report has been reviewed and is approved.



EVAN R. GOLTRA, Colonel, USAF, MC
Commander

ABSTRACT

The need to assess the ability of aircrewmembers to perceive and understand voiced communications transmitted under headsets during flight conditions has been recognized since the early 1940s. A standardized approach is needed to evaluate the adequacy of auditory function in flyers who fail to pass pure-tone physical profile standards (Class II and III examinations). It is this need that prompted the research described in this report.

This report describes four sets of 50 phrases extracted from voice communications used in ground and airborne operations, as well as six lists of 50 single-syllable words. These lists have not been evaluated under the conditions proposed for their use.

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MATERIALS AND PROCEDURES FOR IN-FLIGHT ASSESSMENT
OF AUDITORY FUNCTION IN AIRCREWMEN

I. INTRODUCTION

The U.S. Air Force performs a wide range of flight operations. Dependence upon electroacoustic voice communication systems has increased in parallel with the complexity of ground and airborne operations. Flying personnel routinely encounter a variety of environmental stresses that may decrease the overall effectiveness of their hearing, and if protection is not adequate, noise-induced hearing losses may occur (1, 3).

When an aircrewman fails to meet the hearing standards set forth in Air Force Manual 160-1 for Flying Class II (rated) and Class III (non-rated), a decision must be made whether or not the failure to meet the pure-tone criterion is significant enough to require removal from flying duties (4, 5). The primary factor governing this decision is the individual's ability to understand voice communications received during actual ground and airborne operations. Using standard measures of auditory function, the aeromedical evaluator cannot determine if an aircrewman has this capability. Experienced pilots may fail to meet Class II pure-tone hearing standards and may have difficulty hearing during everyday situations, yet have no significant problem communicating while in flight. The present clinical tests used to evaluate speech discrimination also fail to identify persons who have difficulty accomplishing listening tasks associated with flight.

A properly designed and executed in-flight hearing test would assess the functional hearing and allow an intelligent disposition of flyers with substandard hearing by conventional testing. In-flight hearing tests have been used for approximately 15 years; however, no standard approach to this task has been available.

This paper proposes the development, in the following five phases, of an in-flight hearing test: (1) selecting appropriate test materials, (2) arranging materials for standardized administration, (3) establishing tentative pass-fail criteria, (4) evaluating pass-fail criteria by feedback from field testing, and (5) revising and modifying test materials, procedures, and criteria so that standardization can be achieved.

II. PROCEDURE

Selection of test materials

Speech signals encountered within a variety of fixed- and rotary-wing aircraft, during various phases of ground and airborne operation, were recorded on electromagnetic tape. A vocabulary of single-syllable and two-word elements was compiled (2), from which samples were extracted and developed into test materials as follow.

TEST 1 -- EXAMINER'S TEST SHEET

List 1

1. LATE
2. PUMP
3. KEEP
4. BASE
5. RUT
6. BLIP
7. HAZE
8. CHOP
9. LUMP
10. DIP
11. DASH
12. FILL
13. FIVE
14. FLAP
15. GUN
16. GEAR
17. PURGE
18. LATCH
19. GROUP
20. JET
21. HULL
22. HOOK
23. PHASE
24. CAGE
25. CODE
26. CALL
27. LOG
28. FITCH
29. LAST
30. MIKE
31. POD
32. SEAT
33. SIGHT
34. SCOPE
35. SLIP
36. SPEED
37. TAKE
38. SENT
39. DECK
40. CLASH
41. DWELL
42. MADE
43. WILL
44. REELS
45. SCAN
46. COARSE
47. RIDE
48. RED
49. LOCKED
50. MIST

List 2

1. RATE
2. BUMP
3. BEEP
4. RACE
5. CUT
6. SHIP
7. BLAZE
8. STOP
9. SUMP
10. RIP
11. FLASH
12. SPILL
13. LIVE
14. SLAP
15. SUN
16. NEAR
17. SURGE
18. HATCH
19. SWOOP
20. GET
21. NULL
22. LOOK
23. DAZE
24. STAGE
25. LOAD
26. STALL
27. FOG
28. WHICH
29. BLAST
30. STRIKE
31. SOD
32. FLEET
33. RIGHT
34. SLOPE
35. GRIP
36. NEED
37. BRAKE
38. VENT
39. SPECK
40. BASH
41. SWELL
42. BLADE
43. KILL
44. FEELS
45. SPAN
46. FORCE
47. SLIDE
48. HEAD
49. CLOCKED
50. LIST

List 3

1. DATE
2. DUMP
3. DEEP
4. CASE
5. NUT
6. FLIP
7. RAISE
8. FLOP
9. CLUMP
10. SKIP
11. CRASH
12. STILL
13. DIVE
14. SNAP
15. RUN
16. REAR
17. MERGE
18. BATCH
19. LOOP
20. WET
21. GULL
22. CROOK
23. PAYS
24. PAGE
25. NODE
26. FALL
27. SMOG
28. DITCH
29. FAST
30. LIKE
31. ROD
32. NEAT
33. LIGHT
34. GROPE
35. STRIP
36. BLEED
37. LAKE
38. WENT
39. WRECK
40. TRASH
41. SMELL
42. FADE
43. HILL
44. MEALS
45. FAN
46. SOURCE
47. GUIDE
48. LED
49. BLOCKED
50. TWIST

TEST 1 -- ANSWER SHEET

SSAN: _____

NAME: _____

DATE: _____

INSTRUCTIONS: Mark through word heard. If not certain, guess.

List No. _____

- | | | | | | |
|-----------|-------|-------|-------------|---------|--------|
| 1. LATE | DATE | RATE | 26. STALL | FALL | CALL |
| 2. DUMP | PUMP | BUMP | 27. LOG | SMOG | FOG |
| 3. BEEP | KEEP | DEEP | 28. DITCH | WHICH | PITCH |
| 4. RACE | BASE | CASE | 29. BLAST | LAST | FAST |
| 5. RUT | CUT | NUT | 30. MIKE | STRIKE | LIKE |
| 6. FLIP | BLIP | SHIP | 31. POD | SOD | ROD |
| 7. BLAZE | HAZE | RAISE | 32. NEAT | SEAT | FLEET |
| 8. STOP | FLOP | CHOP | 33. SIGHT | RIGHT | LIGHT |
| 9. LUMP | CLUMP | SUMP | 34. GROPE | SLOPE | SCOPE |
| 10. SKIP | DIP | RIP | 35. GRIP | SLIP | STRIP |
| 11. DASH | CRASH | FLASH | 36. NEED | SPEED | BLEED |
| 12. STILL | FILL | SPILL | 37. TAKE | LAKE | BRAKE |
| 13. FIVE | DIVE | LIVE | 38. SENT | VENT | WENT |
| 14. SLAP | SNAP | FLAP | 39. WRECK | SPECK | DECK |
| 15. SUN | RUN | GUN | 40. TRASH | CLASH | BASH |
| 16. GEAR | REAR | NEAR | 41. SWELL | SPELL | DWELL |
| 17. SURGE | PURGE | MERGE | 42. FADE | BLADE | MADE |
| 18. BATCH | HATCH | LATCH | 43. WILL | HILL | KILL |
| 19. GROUP | SWOOP | LOOP | 44. FEELS | REELS | MEALS |
| 20. GET | JET | WET | 45. SCAN | FAN | SPAN |
| 21. NULL | GULL | HULL | 46. COARSE | FORCE | SOURCE |
| 22. HOOK | CROOK | LOOK | 47. SLIDE | GUIDE | RIDE |
| 23. PAYS | DAZE | PHASE | 48. LED | HEAD | RED |
| 24. STAGE | CAGE | PAGE | 49. CLOCKED | BLOCKED | LOCKED |
| 25. CODE | LOAD | NODE | 50. MIST | TWIST | LIST |

SCORE 2% for each word (All correct - 100%) SCORE _____% Examiner's initials _____

TEST 2 -- EXAMINER'S TEST SHEET

List 1

1. LATE
2. LEAN
3. HAD
4. SPEED
5. GROSS
6. BUST
7. REEL
8. SLAP
9. HALF
10. CHASE
11. GRADE
12. TRIP
13. CREEP
14. FADE
15. GUN
16. PLACE
17. CAME
18. CHICKS
19. SLANT
20. LEG
21. MAZE
22. RAISE
23. HUT
24. JUDGE
25. LATCH
26. NET
27. FLANK
28. SEAT
29. KEEN
30. WISH
31. CLASP
32. SUMP
33. PATH
34. BLADE
35. FAN
36. LOOSE
37. CHAFF
38. FEET
39. CRASHED
40. HOLD
41. NODE
42. GATE
43. FIN
44. SKIP
45. PACE
46. MADE
47. GULFS
48. MIST
49. LID
50. SURF

List 2

1. LAID
2. LEAD
3. HATCH
4. SPEECH
5. GROPE
6. BUDGE
7. READ
8. SLAM
9. HAVE
10. CHANGE
11. GRAZE
12. TRICK
13. CREAM
14. PHASE
15. SUNK
16. PLANE
17. CASE
18. CHIPS
19. SLASH
20. LED
21. MAIN
22. RAID
23. HUNG
24. JUNK
25. LAND
26. NEST
27. FLAP
28. SEEN
29. KEEP
30. WIND
31. CLAMP
32. SUCH
33. PAD
34. BLAZE
35. FAT
36. LOOP
37. CHAP
38. FIELD
39. CRACKED
40. HOSE
41. NOTE
42. GAZE
43. FILL
44. SKIM
45. PAVE
46. MATE
47. GUNS
48. MIX
49. LINK
50. SURGE

List 3

1. LANE
2. LEAK
3. HASH
4. SPEAK
5. GROVE
6. BUMP
7. REACH
8. SLAB
9. HANG
10. CHAIN
11. GREAT
12. TRIM
13. CREEK
14. FACE
15. SUB
16. PLATE
17. CAGE
18. CHILLS
19. SLACK
20. LESS
21. MAKE
22. RATE
23. HUNT
24. JUMP
25. LAP
26. NEXT
27. FLAT
28. CEASE
29. KEYS
30. WING
31. CLAP
32. SOME
33. PAST
34. BLAME
35. FAST
36. LUBE
37. CHAT
38. FEED
39. CRAMPED
40. HOME
41. NOSE
42. GAIN
43. FIFTH
44. SKID
45. PAYS
46. MALE
47. GULLS
48. MID
49. LIPT
50. SEARCH

TEST 2 -- ANSWER SHEET

SSAN: _____

NAME: _____

DATE: _____

INSTRUCTIONS: Mark through word heard. If not certain, guess.

List No. _____

- | | | | | | | | |
|-----|--------|--------|--------|-----|---------|---------|---------|
| 1. | LAYD | LATE | LANE | 26. | NET | NEST | NEXT |
| 2. | LEAN | LEAD | LEAK | 27. | FLAP | FLAT | FLANK |
| 3. | HASH | HATCH | HAD | 28. | SEEM | CEASE | SEAT |
| 4. | SPEECH | SPEAK | SPEED | 29. | KEEP | KEEN | KEYS |
| 5. | GROSS | GROVE | GROPE | 30. | WISH | WIND | WING |
| 6. | BUST | BUDGE | BUMP | 31. | CLASP | CLAP | CLAMP |
| 7. | READ | REEL | REACH | 32. | SOME | SUMP | SUCH |
| 8. | SLAB | SLAP | SLAM | 33. | PATH | PAD | PAST |
| 9. | HANG | HALF | HAVE | 34. | BLADE | BLAZE | BLAME |
| 10. | CHASE | CHANGE | CHAIN | 35. | FAT | FAN | FAST |
| 11. | GRAZE | GREAT | GRADE | 36. | LOOSE | LUBE | LOOP |
| 12. | TRIP | TRIM | TRICK | 37. | CHAP | CHAFF | CHAT |
| 13. | CREEP | CREAM | CREEK | 38. | FEET | FIELD | FEED |
| 14. | PHASE | FACE | FADE | 39. | CRAMPED | CRACKED | CRASHED |
| 15. | SUN | SUNK | SUB | 40. | HOSE | HOLD | HOME |
| 16. | PLATE | PLACE | PLANE | 41. | NODE | NOSE | NOTE |
| 17. | CASE | CAME | CAGE | 42. | GATE | GAZE | GAIN |
| 18. | CHICKS | CHIPS | CHILLS | 43. | FIFTH | FILL | FIN |
| 19. | SLACK | SLASH | SLANT | 44. | SKIM | SKID | SKIP |
| 20. | LESS | LED | LEG | 45. | PACE | PAVE | PAYS |
| 21. | MAZE | MAKE | MAIN | 46. | MALE | MADE | MATE |
| 22. | RAID | RATE | RAISE | 47. | GUNS | GULPS | GULLS |
| 23. | HUNG | HUT | HUNT | 48. | MIST | MIX | MID |
| 24. | JUDGE | JUNK | JUMP | 49. | LIFT | LINK | LID |
| 25. | LAP | LAND | LATCH | 50. | SURF | SURGE | SEARCH |

SCORE 2% for each word (All correct - 100%) SCORE: _____ % Examiner's initials

TEST 3 -- EXAMINER'S TEST SHEET

PHRASE SET 1 (page 1 of 2)

1. Begin your BOMB RUN at twenty-five hundred feet.
2. Careful of turbulence due to PROP WASH.
3. Increase power to reduce SINK RATE.
4. Move lever to WHEELS UP position.
5. TURN LEFT to course two one zero.
6. Would you repeat time of HIGH TIDE.
7. Attempt to hold FAST CRUISE flight.
8. Pull the MAIN SWITCH on the left.
9. Use caution when passing the TRIM PAD.
10. This is TEST FLIGHT two four zero.
11. Careful to check PINS OUT.
12. Attempt to SLOW DOWN airspeed.
13. Insure that BOMB BAY is clear.
14. You are OFF COURSE, correct to the right.
15. Look on the LEFT SIDE of the console.
16. It should be a DOWN HILL run from here.
17. Use UHF master control on the RIGHT SIDE.
18. The FREEZE LINE is fifty miles south of base.
19. Ask vehicle to DIM LIGHTS.
20. Main BUS BOX is below right console.
21. We have a BRISK WIND from the north.
22. BREAK OFF and climb to fifteen thousand.
23. You are SOUTH WEST of the field.
24. I see an AIR PLANE at four o'clock, three miles.
25. Reduce AIR SPEED to three fifty knots.

PHRASE SET 1 (page 2 of 2)

26. We have LIGHT SNOW with mild wind.
27. Extend lever into LOW BOOST range.
28. You should encounter CLOUD LAYER at eight thousand.
29. I have the CHASE PLANE in sight.
30. Adjust prop to LOW PITCH.
31. The GAS GAUGE appears to be faulty.
32. Come to NEW COURSE of two six zero.
33. I see GUN FIRE on the left at one mile.
34. It appears to be a PROP JET aircraft.
35. See if you can get an AIR START.
36. Do you have your PINS OUT?
37. Below GLIDE PATH, adjust rate of descent.
38. Retract TAIL HOOK into locked position.
39. Execute a SLOW ROLL to the left.
40. You can expect a fifty knot HEAD WIND.
41. Use the HAND CRANK, if necessary.
42. That's a NO JOY.
43. I am picking up GROUND FIRE.
44. After climb out, BREAK LEFT.
45. You should encounter CALM WIND above.
46. I passed through CLEAR AIR during climb out.
47. Move prop control to HIGH PITCH.
48. Do you have SAFE GUNS?
49. BREAK RIGHT after climb out.
50. You are ON COURSE, slightly above glide path.

TEST 3

PHRASE SET 2 (page 1 of 2)

1. Execute MID COURSE correction.
2. Caution, TAKE CARE when taxiing by tanker.
3. Attempt to HOLD COURSE throughout descent.
4. She attempts to slide off when I BANK RIGHT.
5. Move the switch into the HOT MIKE position.
6. I do not have the DRAG CHUTE in sight.
7. We have heavy fog with LIGHT MIST.
8. Make a TIGHT TURN to the right.
9. SET COURSE to two seven zero.
10. Reduce power and maintain SLOW CRUISE.
11. ON TOP at twenty-one thousand.
12. I do not have a GEAR UP condition.
13. We have a hold on your FLIGHT PLAN.
14. We have fog and LIGHT HAZE.
15. Am encountering MILD CHOP.
16. The clouds tend to BREAK UP over to the left.
17. Check CODE BOOK for proper identification.
18. We have ten minutes before DAY BREAK.
19. Engines DRINK FUEL at an excessive rate.
20. JOIN UP to the left of the flight leader.
21. Turn FLOOD LIGHT off.
22. We have DENSE FOG over the base.
23. O.K. pull FLAPS UP.
24. Rendezvous for LINK UP with tanker.
25. Validate LIVE FUSE condition.

PHRASE SET 2 (page 2 of 2)

26. Should be about five minutes to TOUCH DOWN.
27. I have a negative BLADE PITCH indication.
28. STEER COURSE three one zero.
29. It appears to have hit the TAIL WHEEL.
30. You are intersecting the BASE LEG now.
31. The CLOUD DECK extends to eighteen thousand.
32. Be advised you have a FLAT TIRE on the left main gear.
33. We have dense smoke in the FLIGHT DECK.
34. On my command, DUMP STORES.
35. Do not place BOARDS OUT above three hundred and fifty knots.
36. There's a BIG BLOW off to the west.
37. The FUEL FLOW indicator is defective.
38. Attempt to DUMP FUEL over the water.
39. I am encountering LIGHT RAIN.
40. Do you have a target SOUTH BOUND at four miles?
41. The AIR BRAKE will not extend.
42. On my command, execute a LEFT TURN.
43. We can expect HIGH WIND after sunset..
44. Do not attempt a SIDE SLIP.
45. Your target is to the left of the large ICE BERG.
46. You can expect THICK CLOUDS with intermittent showers.
47. Give me HALF FLAPS.
48. Check to see that LAP BELT is secure.
49. Form up with aircraft headed NORTH WEST.
50. You are cleared to depart active at NEXT TURN.

TEST 3

PHRASE SET 3 (page 1 of 2)

1. We have a CODE THREE on board.
2. You are on final at FOUR MILES.
3. Execute a WIDE TURN to the right.
4. Tower, give me a TIME HACK.
5. Fuel is expended from DROP TANKS.
6. Go ahead and WARM UP radar.
7. Four-six-zero, FORM RIGHT.
8. I am unable to maintain HIGH BOOST.
9. The target area is completely BURNED OUT.
10. The SQUALL LINE is just north of the base.
11. I have three gears LOCKED DOWN.
12. I am approaching COAST LINE.
13. Pass to the FRONT SIDE of the vehicle.
14. Look below left main WHEEL WELL.
15. Did you meet your BLOCK TIME?
16. Next to the left FUSE BOX.
17. You are slightly below FLIGHT PATH.
18. Put your FACE PLATE down.
19. Traffic is WEST BOUND at two miles.
20. Retract SPEED BRAKE and recycle gear.
21. Perform a SPLIT-S maneuver.
22. Just passing the FAR SIDE of the field.
23. I am close to having DRY TANKS.
24. Perform a SNAP ROLL to the right.
25. We have a FLAME OUT on number two.

PHRASE SET 3 (page 2 of 2)

26. Do not exceed FIVE G's.
27. Careful during descent, we have a CALM SEA.
28. The STORM LINE is fifty miles south.
29. I was AIR BORNE at fifteen-thirty.
30. Affirmative, it belongs to an AIR LINE.
31. It is powered by FAN JET engines.
32. You are slightly on the HIGH SIDE.
33. About to intersect the DOG LEG.
34. Move up and FORM LEFT of leader.
35. BANK LEFT and you can see it.
36. It appears to be a defective FUEL PUMP.
37. Give me FULL FLAPS.
38. Start your RUN UP on my command.
39. Passed below me at FULL SPEED.
40. Try to KEEP PACE with lead ship.
41. Execute a RIGHT TURN at next taxi-way.
42. Fuel in WING TANKS is expended.
43. Just west of the SHORE LINE.
44. Follow in a STEEP TURN to the left.
45. THANK YOU for your assistance.
46. Check breaker on BLEED AIR mechanism.
47. I have THREE LIGHTS in the green.
48. Careful to KEEP CLEAR of exhaust.
49. Remove safety and CHARGE GUNS.
50. Five hundred feet above TREE TOPS.

TEST 3

PHRASE SET 4 (page 1 of 2)

1. Do not CHANGE SPEED during initial.
2. Wait for engine to SPOOL DOWN.
3. The FUEL FEED mechanism is faulty.
4. We will approach during LOW TIDE.
5. Thrust is on the LOW SIDE.
6. Set scope for HIGH GAIN.
7. The aircraft is twelve miles, EAST BOUND.
8. I have a red light for the NOSE GEAR.
9. Let go of the JOY STICK.
10. Your target is in the MARSH LAND.
11. Arm and blow TIP TANKS.
12. ALL's CALM to the southwest.
13. The HATCH CLOSED, but I have a red light.
14. Attempt to contact WING MAN again.
15. Lightning off to the NORTH EAST.
16. Give me a SLOW COUNT.
17. Unable to FILL TANKS.
18. Off to the LEFT FLANK.
19. Break off if you DRAW FIRE.
20. Make a LOW RUN over the area.
21. Remove safety and ARM GUNS.
22. Remove FACE MASK and check hose.
23. I see a BRIGHT LIGHT below and to the left.
24. Lower airspeed and put GEAR DOWN.
25. Park on EAST SIDE of ramp.

TEST 3

PHRASE SET 4 (page 2 of 2)

26. Do not park DOWN WIND from sprayers.
27. Thanks for assistance, GOOD BYE.
28. Put BRAKE OUT to control airspeed.
29. The DOME LIGHT is not operating.
30. O.K. number six, YOU'RE HOT.
31. Begin evasive maneuver when IN RANGE.
32. I have the HOOK DOWN and locked.
33. My instruments indicate DRY TANKS.
34. He is on final with WHEELS DOWN.
35. Do you have visual on NORTH BOUND traffic.
36. I have ice build-up on PORT SIDE.
37. You're number two following LEAD SHIP.
38. I see the FUEL POD on the right.
39. I have an unsafe indication for the right MAIN GEAR.
40. Go ahead and put FLAPS DOWN.
41. Try to pull up with minimum G-FORCE.
42. Attempt once more to PURGE TANKS.
43. Your pigeons are in HOME PLATE.
44. Give me a CALL BACK on channel five.
45. DROP DOWN to ten thousand feet.
46. Contact squadron before you SHUT DOWN.
47. Just a little further, you are in HOME STRETCH.
48. The left windshield is ICED UP.
49. I will enter area from SOUTH EAST.
50. The FUEL GAUGE indicates six hundred pounds.

Single-syllable words. Tests 1 and 2 contain single-syllable words, each test consisting of three 50-word lists. The three lists of words on Test 1 are arranged by terminal rhyme; for example, No. 1 items for lists 1, 2, and 3 are "late, rate, and date." The lists on Test 2 are arranged by frontal rhyme; for example, No. 1 items are "late, laid, and lane."

The answer sheets are marked by the subject and scored by the aeromedical evaluator. The Test 1 answer sheet can be used for any list on Test 1, and the Test 2 answer sheet for any list on Test 2.

Two-word phrases. Test 3 contains four sets of phrases (50 phrases in each set) to be used by the aeromedical evaluator. These phrases were prepared by selecting two-word elements (two single-syllable words) from actual recorded communications. For example, the two-word element of "south west" was used to derive the phrase "You are SOUTH WEST of the field." Each phrase usually can be repeated in less than 3 seconds, using a speaking rate of approximately 120-180 words per minute (normal for males).

General guidance

Many variables beyond those associated with the hearing function of the person being tested can influence test results. The aeromedical evaluator must be aware of at least certain of these variables, such as how the individual enunciates, the characteristics of the microphone and intercom, the output level, the degree of masking present within the aircraft as well as background noise under the headset, the condition of the headsets, and if the listener has any auditory fatigue (temporary threshold shift) as a result of previous noise exposure. Although the evaluator cannot be expected to control all these variables, he must be aware that they may affect the final test result. Our experience has shown that ambient noise will not significantly affect the test results as long as the subject has well-fitted headsets and has control of the volume of the signals he receives. For example, when a person who flies an F-4E aircraft is tested in a C-131E, the difference in the ambient noise will not significantly influence his discrimination.

The recommendations below should be followed as closely as possible:

1. The aeromedical evaluator should have a minimum of 50 flying hours during which he has monitored voice communications so that he has "learned" to understand their use in flight.
2. One complete testing sequence requires approximately 13 minutes. If possible, the tests should be administered aboard a multiplace aircraft where the intercom can be used for at least 15 minutes without interfering with the operation of the aircraft. The individual being tested should not be in primary control of the aircraft during the testing period.

3. The evaluator and the subject should use standard Air Force communication headsets and microphones. If an oxygen mask is not required, the H-157 headset (gray) should be used; if an oxygen mask and crash helmet are required, the standard mask fitted with an AIC-M-101 noise-cancelling microphone and the HGU-2A/P helmet fitted with H-154 headsets should be used. The evaluator should ensure that both his and the subject's devices are properly fitted and in good repair, with the microphone positioned so that the speaker can "kiss the microphone." Earplugs should not be worn by either the evaluator or the subject during the testing. Prior to flight, the intercom, including the side tone supplied via the intercom units, should be checked to ensure that it is working properly and that sufficient gain (volume) is available.

4. The tests should be administered in a location as close to the flight deck as possible (ideally on the flight deck) so that the evaluator as well as the flightcrew can be more readily aware of what is going on and prevent compromise of flight safety.

5. Preferably, testing should be done during daylight flights and in areas where the lighting is adequate for the examiner to easily read the tests and the subject to mark his answers. If testing must be accomplished at night, the examiner should have two flashlights with red lenses to provide proper illumination without interfering with the flightcrew.

6. Tests should be administered (approximately 15 minutes) only during conditions of level flight and normal cruise. All systems (air-conditioning, pressurization, etc.) should be operated normally, and if possible, the commander should request radio silence and attempt to fly within a secure air space during the testing period. Prior to flight, the aircraft commander and the evaluator should establish precise guidelines about the use of the intercom during the test period. The evaluator must know when incoming UHF or VHF messages require that he maintain silence so that he never compromises flight safety. Usually, the problem of interrupting UHF and/or VHF transmissions can be avoided by letting ground control know of the need for radio silence and maintaining a radar-controlled orbiting flight profile.

7. The evaluator should use a "hot mike" during all tests, and during Test 3 (phrases), the hot mike is required for the subject as well. If the microphone circuit must be keyed, care must be taken so that all acoustic elements of the test materials are clearly audible and not abbreviated nor cut out by improper use of the microphone button.

8. The evaluator should "dry run" the procedures so that the actual testing can be accomplished in a professional manner. Preferably, the dry run should be performed in the aircraft that will be used for the test. The subject selected for the dry run should be accustomed to listening to in-flight communications. The value of practice cannot be over-emphasized, since the aeromedical evaluator must be familiar with using the test materials and feel confidence while administering the tests. The dry run should be considered separate from tests performed to establish the range of pass-fail scores (See "Determining adequacy of hearing.")

Specific guidance

Tests to be accomplished. Generally, three tests are required:

1. One word list from Test 1,
2. One word list from Test 2, and
3. One phrase set from Test 3.

This selection provides three separate lists of materials to be used during the actual evaluation.

Responses. Responses to Tests 1 and 2 are recorded on the proper answer sheets by simply marking through the word heard. Responses to Test 3 can be evaluated by noting whether or not the subject correctly repeats the essential content of each phrase. The subject need not repeat the entire message, but he should respond with enough information to clearly indicate that he understood the basic content of the phrase. For example, if the phrase read was "You are off course, correct to the right," then the response "off course, correct right" would be considered adequate. Answer sheets are not required for the phrases; the evaluator need only record the number of incorrect responses and then compute the score (2% for each phrase).

Presentation of tests. Before beginning the actual testing, the volume control of the intercom unit should be checked to ensure clearly audible speech reception. Also, the master gain of the intercom unit used by the subject should be adjusted so that an adequate signal is available. The evaluator should read the following passage while the subject adjusts the gain of his intercom receiver:

"The United States Air Force uses a variety of aircraft to accomplish different missions. For example, the Tactical Air Command uses aircraft, such as the F-100 and the F-4, to provide close ground support as well as control of the air in the vicinity of friendly ground forces."

If necessary, additional general material can be read so that the subject has an adequate sample of speech to determine his best listening level. The signal should be loud enough to be easily heard, but not so loud that aural distortions occur.

The single-syllable words must be pronounced clearly. Each word is preceded by the appropriate identification number (e.g., No. 1--"date"), with a slight pause between the identification number and the test word. Approximately 3 seconds should be allowed for the subject to cross through the word he chooses from the three words provided on the answer sheet. Words should not be repeated. If the test word should be made nonintelligible by intrusion of extraneous interruptions, simply go to the next word

(in sequence) and do not score the interrupted word as a miss. Do not give the subject a direct feedback concerning the correctness of his response. Generally, each of the 50 single-syllable word lists can be accomplished in 4-5 minutes.

After Tests 1 and 2 are completed, one of the four phrase sets will be administered to the subject. In scoring the responses to the phrases (Test 3), the evaluator must listen closely and determine the adequacy of each response. As with the single-syllable words, no direct feedback of the accuracy of the subject's responses will be given.

Scoring responses. Each single-syllable word list is scored separately, and each correct response counts 2%. For example, if there were four incorrect responses, the score for the entire list of 50 words would be 92%. The phrase sets are scored in the same way.

Reporting results

A format is given below for reporting results of testing, along with other pertinent information. Results from aircrewmembers with both normal and subnormal hearing (by standard testing evaluations) should be reported so that evaluations and revisions of this in-flight assessment can be made.

It is requested that the following information be submitted to USAFSAM/NGEA, Brooks AFB, TX 78235.

Examiner: _____ Autovon No.: _____

Type aircraft used: _____

Name of subject: _____ Age: _____ AFSN: _____

Total flying time: _____ AFSC: _____

Audiometric results: Freq. (Hz) 500 1000 2000 3000 4000 6000

Right ear: _____

Left ear: _____

In-flight test scores (list as appropriate):

TEST 1: List 1 _____ List 2 _____ List 3 _____

TEST 2: List 1 _____ List 2 _____ List 3 _____

TEST 3: Phrase 1 _____ Phrase 2 _____ Phrase 3 _____ Phrase 4 _____

Range of scores examiner obtained among normal-hearing flying personnel: _____

Remarks: _____

Determining adequacy of hearing

The purpose of the in-flight hearing test is to determine the ability of aircrewmembers to receive and understand speech signals during aircraft operation. The final decision is a clinical determination. The materials and procedures described in this report are intended to assist aeromedical evaluators in accomplishing this task. Until this test is validated, each evaluator should establish the range of scores elicited on at least five experienced flyers with Class II (or better) hearing. These scores can then serve as a guide and establish an acceptable control/normal range.

A rapid, uncomplicated statistical procedure described by Dixon and Massey (6) may be used to determine if a particular flyer's score on the test is significantly poorer than scores yielded by the normal hearing group. This procedure would be used only when the flyer with questionable hearing has a score on this test that is poorer than all the scores from the normal-hearing (control) persons. If the subject scores better than any of the normals, he is unquestionably performing in a normal manner. However, if he scores poorer than all the normals, a determination must be made as to how significant the difference is. The exact procedure is to (1) subtract the subject's score from the lowest score made by a normal listener, (2) subtract the subject's score from the highest score made by a normal listener, (3) compute the ratio of the two values yielded in steps 1 and 2, and (4) compare the ratio to a criterion value. If five normal-hearing flyers are in the control group, then a criterion ratio of .560 can be used to achieve a significance level of 5% (table A-8e, Dixon and Massey)(6). That is, a resultant ratio of .560 or larger indicates that the subject's score was significantly poorer than scores from the known normal group; conversely, a ratio less than .560 indicates that the subject's score is not significantly different from the normals. For example, if five normal-hearing flyers scored 94%, 88%, 100%, 98%, and 90% and a flyer with questionable hearing scored 72%, our calculations would be:

$$\frac{88 \text{ (lowest normal score)} - 72 \text{ (subject's score)}}{100 \text{ (highest normal score)} - 72 \text{ (subject's score)}} = \frac{16}{28} = .5714$$

The ratio (.5714) is larger than our criterion ratio (.560), so the subject's score is significantly poorer than the normal scores.

To provide an actual example, Test 1 - list 1 and Test 2 - list 1 were administered to five normal hearing subjects who each had considerable flight experience (in excess of 2000 hrs.). The tests were conducted in a reverberation chamber with an ambient noise of 107.5 dB C-weighted and 102.5 dB A-weighted. The scores obtained from the five subjects were as follows:

	<u>Test 1 - list 1</u>	<u>Test 2 - list 1</u>
Subject 1	78%	90%
Subject 2	84%	94%
Subject 3	94%	84%
Subject 4	92%	98%
Subject 5	94%	100%

Application of the statistical procedure revealed that for a subject with questionable hearing, 58% on test 1 would be passing while 56% would be failing.

$$\frac{78 - 58}{94 - 58} = \frac{20}{36} = .556 \text{ (Passing)}$$

and

$$\frac{78 - 56}{94 - 56} = \frac{22}{38} = .579 \text{ (Failing)}$$

On Test 2, a score of 64% would be passing while 62% would be failing.

$$\frac{84 - 64}{100 - 64} = \frac{20}{36} = .556 \text{ (Passing)}$$

and

$$\frac{84 - 62}{100 - 62} = \frac{22}{38} = .579 \text{ (Failing)}$$

This statistical procedure should not be used without reservation. For example, if all normal subjects scored 100%, then a score of 98% from another subject would be failing if the formula was used literally. A reasonable approach would be to consider any score of 90% or more as passing, even though the criterion ratio is exceeded when the scores are processed. In addition, test results should simply be further information to use in arriving at a clinical judgment as to whether or not a waiver for hearing loss should be recommended. This test should not be used as the ultimate basis for making that decision.

If conditions change so that the previous normal scores are no longer considered valid, a new group of five normal-hearing flyers should be tested. This validity could be lost if a gross change occurred in conditions under which the test is given. For instance, if normal scores are obtained in the cargo area of a reciprocating engine aircraft and it becomes necessary to test in the cockpit of a jet fighter aircraft, it may be necessary to establish normal scores under the new conditions. Any test condition change that might make scores generally poorer or generally better calls for establishing a new set of normal results.

III. CONCLUSIONS AND RECOMMENDATIONS

The materials and procedures described in this report have been carefully selected and are proposed for in-flight assessment of the auditory function of aircrewmembers. Their value can be determined only by application and appraisal of results.

We propose an in-flight hearing test that consists of five phases of development. The first three phases are dealt with in this report: selecting test materials, arranging these materials for standardized administration, and establishing tentative pass-fail criteria. The fourth phase of development must be accomplished by aeromedical evaluators who perform the tests and report their findings to the authors so that the final phase of the task can be accomplished, namely, revision and modification of materials, procedures, and criterion so that standardization of the method can be achieved. Since this final phase can be completed only after information is obtained from persons who have actually used the test materials, medical evaluators who use the test materials are urged to report their results so that realistic pass-fail criteria can be established and materials and procedures can be standardized. Test results obtained on aircrewmembers with normal hearing should be reported as well as data on subjects with hearing loss.

REFERENCES

1. Aerospace systems noise, ch. 7. In Flight surgeon's guide. Air Force Pamphlet 161-18. Washington: Department of the Air Force, Dec. 1968.
2. Gasaway, D. C. Single-syllable words and two-word message units used in Air Force voice communications. In preparation.
3. Communications in fixed- and rotary-wing aircraft, ch. 10. In Physiology of flight. Air Force Pamphlet 161-16. Washington: Department of the Air Force, Apr. 1968.
4. Examination technique, Air Force Manual 160-17. Washington: Department of the Air Force, July 1972.
5. Medical examination and medical standards. Air Force Manual 160-1. Washington: Department of the Air Force, Apr. 1971.
6. Dixon, W. J., and F. J. Massey, Jr. Introduction to statistical analysis, 2d ed., ch. 16. New York: McGraw-Hill, 1957.

APPENDIX

SAMPLE TESTS AND REPORT SHEET
FOR USE BY EVALUATORS

TEST 1 -- EXAMINER'S TEST SHEET

List 1

1. LATE
2. PUMP
3. KEEP
4. BASE
5. RUT
6. BLIP
7. HAZE
8. CHOP
9. LUMP
10. DIP
11. DASH
12. FILL
13. FIVE
14. FLAP
15. GUN
16. GEAR
17. PURGE
18. LATCH
19. GROUP
20. JET
21. HULL
22. HOOK
23. PHASE
24. CAGE
25. CODE
26. CALL
27. LOG
28. PITCH
29. LAST
30. MIKE
31. POD
32. SEAT
33. SIGHT
34. SCOPE
35. SLIP
36. SPEED
37. TAKE
38. SENT
39. DECK
40. CLASH
41. DWELL
42. MADE
43. WILL
44. REELS
45. SCAN
46. COARSE
47. RIDE
48. RED
49. LOCKED
50. MIST

List 2

1. RATE
2. BUMP
3. BEEP
4. RACE
5. CUT
6. SHIP
7. BLAZE
8. STOP
9. SUMP
10. RIP
11. FLASH
12. SPILL
13. LIVE
14. SLAP
15. SUN
16. NEAR
17. SURGE
18. HATCH
19. SWOOP
20. GET
21. NULL
22. LOOK
23. DAZE
24. STAGE
25. LOAD
26. STALL
27. FOG
28. WHICH
29. BLAST
30. STRIKE
31. SOD
32. FLEET
33. RIGHT
34. SLOPE
35. GRIP
36. NEED
37. BRAKE
38. VENT
39. SPECK
40. BASH
41. SWELL
42. BLADE
43. KILL
44. FEELS
45. SPAN
46. FORCE
47. SLIDE
48. HEAD
49. CLOCKED
50. LIST

List 3

1. DATE
2. DUMP
3. DEEP
4. CASE
5. NUT
6. FLIP
7. RAISE
8. FLOP
9. CLUMP
10. SKIP
11. CRASH
12. STILL
13. DIVE
14. SNAP
15. RUN
16. REAR
17. MERGE
18. BATCH
19. LOOP
20. WET
21. GULL
22. CROOK
23. PAYS
24. PAGE
25. NODE
26. FALL
27. SMOG
28. DITCH
29. FAST
30. LIKE
31. ROD
32. NEAT
33. LIGHT
34. GROPE
35. STRIP
36. BLEED
37. LAKE
38. WENT
39. WRECK
40. TRASH
41. SMELL
42. FADE
43. HILL
44. MEALS
45. FAN
46. SOURCE
47. GUIDE
48. LED
49. BLOCKED
50. TWIST

TEST 2 -- EXAMINER'S TEST SHEET

List 1

1. LATE
2. LEAN
3. HAD
4. SPEED
5. GROSS
6. BUST
7. REEL
8. SLAP
9. HALF
10. CHASE
11. GRADE
12. TRIP
13. CREEP
14. FADE
15. SUN
16. PLACE
17. CAME
18. CHICKS
19. SLANT
20. LEG
21. MAZE
22. RAISE
23. HUT
24. JUDGE
25. LATCH
26. NET
27. FLANK
28. SEAT
29. KEEN
30. WISH
31. CLASP
32. SUMP
33. PATH
34. BLADE
35. FAN
36. LOOSE
37. CHAFF
38. FEET
39. CRASHED
40. HOLD
41. NODE
42. GATE
43. FIN
44. SKIP
45. PACE
46. MADE
47. GULPS
48. MIST
49. LID
50. SURF

List 2

1. LAID
2. LEAD
3. HATCH
4. SPEECH
5. GROPE
6. BUDGE
7. READ
8. SLAM
9. HAVE
10. CHANGE
11. GRAZE
12. TRICK
13. CREAM
14. PHASE
15. SUNK
16. PLANE
17. CASE
18. CHIPS
19. SLASH
20. LED
21. MAIN
22. RAID
23. HUNG
24. JUNK
25. LAND
26. NEST
27. FLAP
28. SEEM
29. KEEP
30. WIND
31. CLAMP
32. SUCH
33. PAD
34. BLAZE
35. FAT
36. LOOP
37. CHAP
38. FIELD
39. CRACKED
40. HOSE
41. NOTE
42. GAZE
43. FILL
44. SKIM
45. PAVE
46. MATE
47. GUNS
48. MIX
49. LINK
50. SURGE

List 3

1. LANE
2. LEAK
3. HASH
4. SPEAK
5. GROVE
6. BUMP
7. REACH
8. SLAB
9. HANG
10. CHAIN
11. GREAT
12. TRIM
13. CREEK
14. FACE
15. SUB
16. PLATE
17. CAGE
18. CHILLS
19. SLACK
20. LESS
21. MAKE
22. RATE
23. HUNT
24. JUMP
25. LAP
26. NEXT
27. FLAT
28. CEASE
29. KEYS
30. WING
31. CLAP
32. SOME
33. PAST
34. BLAME
35. FAST
36. LUBE
37. CHAT
38. FEED
39. CRAMPED
40. HOME
41. NOSE
42. GAIN
43. FIFTH
44. SKID
45. PAYS
46. MALE
47. GULLS
48. MID
49. LIFT
50. SEARCH

TEST 1 -- ANSWER SHEET

SSAN: _____

NAME: _____

DATE: _____

INSTRUCTIONS: Mark through word heard. If not certain, guess.

List No. _____

- | | | | | | | | |
|-----|-------|-------|-------|-----|---------|---------|--------|
| 1. | LATE | DATE | RATE | 26. | STALL | FALL | CALL |
| 2. | DUMP | PUMP | BUMP | 27. | LOG | SMOG | FOG |
| 3. | BEEP | KEEP | DEEP | 28. | DITCH | WHICH | PITCH |
| 4. | RACE | BASE | CASE | 29. | BLAST | LAST | FAST |
| 5. | RUT | CUT | NUT | 30. | MIKE | STRIKE | LIKE |
| 6. | FLIP | BLIP | SHIP | 31. | POD | SOD | ROD |
| 7. | BLAZE | HAZE | RAISE | 32. | NEAT | SEAT | FLEET |
| 8. | STOP | FLOP | CHOP | 33. | SIGHT | RIGHT | LIGHT |
| 9. | LUMP | CLUMP | SUMP | 34. | GROPE | SLOPE | SCOPE |
| 10. | SKIP | DIP | RIP | 35. | GRIP | SLIP | STRIP |
| 11. | DASH | CRASH | FLASH | 36. | NEED | SPEED | BLEED |
| 12. | STILL | FILL | SPILL | 37. | TAKE | LAKE | BRAKE |
| 13. | FIVE | DIVE | LIVE | 38. | SENT | VENT | WENT |
| 14. | SLAP | SNAP | FLAP | 39. | WRECK | SPECK | DECK |
| 15. | SUN | RUN | GUN | 40. | TRASH | CLASH | BASH |
| 16. | GEAR | REAR | NEAR | 41. | SWELL | SMELL | DWELL |
| 17. | SURGE | PURGE | MERGE | 42. | FADE | BLADE | MADE |
| 18. | BATCH | HATCH | LATCH | 43. | WILL | HILL | KILL |
| 19. | GROUP | SWOOP | LOOP | 44. | FEELS | REELS | MEALS |
| 20. | GET | JET | WET | 45. | SCAN | FAN | SPAN |
| 21. | NULL | GULL | HULL | 46. | COARSE | FORCE | SOURCE |
| 22. | HOOK | CROOK | LOOK | 47. | SLIDE | GUIDE | RIDE |
| 23. | PAYS | DAZE | PHASE | 48. | LED | HEAD | RED |
| 24. | STAGE | CAGE | PAGE | 49. | CLOCKED | BLOCKED | LOCKED |
| 25. | CODE | LOAD | NODE | 50. | MIST | TWIST | LIST |

SCORE 2% for each word (All correct - 100%) SCORE _____ % Examiner's initials _____

TEST 2 -- ANSWER SHEET

SSAN: _____

NAME: _____

DATE: _____

INSTRUCTIONS: Mark through word heard. If not certain, guess.

List No. _____

- | | | | | | | | |
|-----|-------------|-------------|-------------|-----|---------------|---------------|---------------|
| 1. | L A I D | L A T E | L A N E | 26. | N E T | N E S T | N E X T |
| 2. | L E A N | L E A D | L E A K | 27. | F L A P | F L A T | F L A N K |
| 3. | H A S H | H A T C H | H A D | 28. | S E E M | C E A S E | S E A T |
| 4. | S P E E C H | S P E A K | S P E E D | 29. | K E E P | K E E N | K E Y S |
| 5. | G R O S S | G R O V E | G R O P E | 30. | W I S H | W I N D | W I N G |
| 6. | B U S T | B U D G E | B U M P | 31. | C L A S P | C L A P | C L A M P |
| 7. | R E A D | R E E L | R E A C H | 32. | S O M E | S U M P | S U C H |
| 8. | S L A B | S L A P | S L A M | 33. | P A T H | P A D | P A S T |
| 9. | H A N G | H A L F | H A V E | 34. | B L A D E | B L A Z E | B L A M E |
| 10. | C H A S E | C H A N G E | C H A I N | 35. | F A T | F A N | F A S T |
| 11. | G R A Z E | G R E A T | G R A D E | 36. | L O O S E | L U B E | L O O P |
| 12. | T R I P | T R I M | T R I C K | 37. | C H A P | C H A F F | C H I A T |
| 13. | C R E E P | C R E A M | C R E E K | 38. | F E E T | F I E L D | F E E D |
| 14. | P H A S E | F A C E | F A D E | 39. | C R A M P E D | C R A C K E D | C R A S H E D |
| 15. | S U N | S U N K | S U B | 40. | H O S E | H O L D | H O M E |
| 16. | P L A T E | P L A C E | P L A N E | 41. | N O D E | N O S E | N O T E |
| 17. | C A S E | C A M E | C A G E | 42. | G A T E | G A Z E | G A I N |
| 18. | C H I C K S | C H I P S | C H I L L S | 43. | F I F T H | F I L L | F I N |
| 19. | S L A C K | S L A S H | S L A N T | 44. | S K I M | S K I D | S K I P |
| 20. | L E S S | L E D | L E G | 45. | P A C E | P A V E | P A Y S |
| 21. | M A Z E | M A K E | M A I N | 46. | M A L E | M A D E | M A T E |
| 22. | R A I D | R A T E | R A I S E | 47. | G U N S | G U L P S | G U L L S |
| 23. | H U N G | H U T | H U N T | 48. | M I S T | M I X | M I D |
| 24. | J U D G E | J U N K | J U M P | 49. | L I F T | L I N K | L I D |
| 25. | L A P | L A N D | L A T C H | 50. | S U R F | S U R G E | S E A R C H |

SCORE 2% for each word (All correct = 100%) SCORE: _____% Examiner's initials

TEST 3 -- EXAMINER'S TEST SHEET

PHRASE SET 1 (page 1 of 2)

1. Begin your BOMB RUN at twenty-five hundred feet.
2. Careful of turbulence due to PROP WASH.
3. Increase power to reduce SINK RATE.
4. Move lever to WHEELS UP position.
5. TURN LEFT to course two one zero.
6. Would you repeat time of HIGH TIDE.
7. Attempt to hold FAST CRUISE flight.
8. Pull the MAIN SWITCH on the left.
9. Use caution when passing the TRIM PAD.
10. This is TEST FLIGHT two four zero.
11. Careful to check PINS OUT.
12. Attempt to SLOW DOWN airspeed.
13. Insure that BOMB BAY is clear.
14. You are OFF COURSE, correct to the right.
15. Look on the LEFT SIDE of the console.
16. It should be a DOWN HILL run from here.
17. Use UHF master control on the RIGHT SIDE.
18. The FREEZE LINE is fifty miles south of base.
19. Ask vehicle to DIM LIGHTS.
20. Main BUS BOX is below right console.
21. We have a BRISK WIND from the north.
22. BREAK OFF and climb to fifteen thousand.
23. You are SOUTH WEST of the field.
24. I see an AIR PLANE at four o'clock, three miles.
25. Reduce AIR SPEED to three fifty knots.

PHRASE SET 1 (page 2 of 2)

26. We have LIGHT SNOW with mild wind.
27. Extend lever into LOW BOOST range.
28. You should encounter CLOUD LAYER at eight thousand.
29. I have the CHASE PLANE in sight.
30. Adjust prop to LOW PITCH.
31. The GAS GAUGE appears to be faulty.
32. Come to NEW COURSE of two six zero.
33. I see GUN FIRE on the left at one mile.
34. It appears to be a PROP JET aircraft.
35. See if you can get an AIR START.
36. Do you have your PINS OUT?
37. Below GLIDE PATH, adjust rate of descent.
38. Retract TAIL HOOK into locked position.
39. Execute a SLOW ROLL to the left.
40. You can expect a fifty knot HEAD WIND.
41. Use the HAND CRANK, if necessary.
42. That's a NO JOY.
43. I am picking up GROUND FIRE.
44. After climb out, BREAK LEFT.
45. You should encounter CALM WIND above.
46. I passed through CLEAR AIR during climb out.
47. Move prop control to HIGH PITCH.
48. Do you have SAFE GUNS?
49. BREAK RIGHT after climb out.
50. You are ON COURSE, slightly above glide path.

TEST 3

PHRASE SET 2 (page 1 of 2)

1. Execute MID COURSE correction.
2. Caution, TAKE CARE when taxiing by tanker.
3. Attempt to HOLD COURSE throughout descent.
4. She attempts to slide off when I BANK RIGHT.
5. Move the switch into the HOT MIKE position.
6. I do not have the DRAG CHUTE in sight.
7. We have heavy fog with LIGHT MIST.
8. Make a TIGHT TURN to the right.
9. SET COURSE to two seven zero.
10. Reduce power and maintain SLOW CRUISE.
11. ON TOP at twenty-one thousand.
12. I do not have a GEAR UP condition.
13. We have a hold on your FLIGHT PLAN.
14. We have fog and LIGHT HAZE.
15. Am encountering MILD CHOP.
16. The clouds tend to BREAK UP over to the left.
17. Check CODE BOOK for proper identification.
18. We have ten minutes before DAY BREAK.
19. Engines DRINK FUEL at an excessive rate.
20. JOIN UP to the left of the flight leader.
21. Turn FLOOD LIGHT off.
22. We have DENSE FOG over the base.
23. O.K. pull FLAPS UP.
24. Rendezvous for LINK UP with tanker.
25. Validate LIVE FUSE condition.

PHRASE SET 2 (page 2 of 2)

26. Should be about five minutes to TOUCH DOWN.
27. I have a negative BLADE PITCH indication.
28. STEER COURSE three one zero.
29. It appears to have hit the TAIL WHEEL.
30. You are intersecting the BASE LEG now.
31. The CLOUD DECK extends to eighteen thousand.
32. Be advised you have a FLAT TIRE on the left main gear.
33. We have dense smoke in the FLIGHT DECK.
34. On my command, DUMP STORES.
35. Do not place BOARDS OUT above three hundred and fifty knots.
36. There's a BIG BLOW off to the west.
37. The FUEL FLOW indicator is defective.
38. Attempt to DUMP FUEL over the water.
39. I am encountering LIGHT RAIN.
40. Do you have a target SOUTH BOUND at four miles?
41. The AIR BRAKE will not extend.
42. On my command, execute a LEFT TURN.
43. We can expect HIGH WIND after sunset.
44. Do not attempt a SIDE SLIP.
45. Your target is to the left of the large ICE BERG.
46. You can expect THICK CLOUDS with intermittent showers.
47. Give me HALF FLAPS.
48. Check to see that LAP BELT is secure.
49. Form up with aircraft headed NORTH WEST.
50. You are cleared to depart active at NEXT TURN.

TEST 3

PHRASE SET 3 (page 1 of 2)

1. We have a CODE THREE on board.
2. You are on final at FOUR MILES.
3. Execute a WIDE TURN to the right.
4. Tower, give me a TIME HACK.
5. Fuel is expended from DROP TANKS.
6. Go ahead and WARM UP radar.
7. Four-six-zero, FORM RIGHT.
8. I am unable to maintain HIGH BOOST.
9. The target area is completely BURNED OUT.
10. The SQUALL LINE is just north of the base.
11. I have three gears LOCKED DOWN.
12. I am approaching COAST LINE.
13. Pass to the FRONT SIDE of the vehicle.
14. Look below left main WHEEL WELL.
15. Did you meet your BLOCK TIME?
16. Next to the left FUSE BOX.
17. You are slightly below FLIGHT PATH.
18. Put your FACE PLATE down.
19. Traffic is WEST BOUND at two miles.
20. Retract SPEED BRAKE and recycle gear.
21. Perform a SPLIT-S maneuver.
22. Just passing the FAR SIDE of the field.
23. I am close to having DRY TANKS.
24. Perform a SNAP ROLL to the right.
25. We have a FLAME OUT on number two.

PHRASE SET 3 (page 2 of 2)

26. Do not exceed FIVE G's.
27. Careful during descent, we have a CALM SEA.
28. The STORM LINE is fifty miles south.
29. I was AIR BORNE at fifteen-thirty.
30. Affirmative, it belongs to an AIR LINE.
31. It is powered by FAN JET engines.
32. You are slightly on the HIGH SIDE.
33. About to intersect the DOG LEG.
34. Move up and FORM LEFT of leader.
35. BANK LEFT and you can see it.
36. It appears to be a defective FUEL PUMP.
37. Give me FULL FLAPS.
38. Start your RUN UP on my command.
39. Passed below me at FULL SPEED.
40. Try to KEEP PACE with lead ship.
41. Execute a RIGHT TURN at next taxi-way.
42. Fuel in WING TANKS is expended.
43. Just west of the SHORE LINE.
44. Follow in a STEEP TURN to the left.
45. THANK YOU for your assistance.
46. Check breaker on BLEED AIR mechanism.
47. I have THREE LIGHTS in the green.
48. Careful to KEEP CLEAR of exhaust.
49. Remove safety and CHARGE GUNS.
50. Five hundred feet above TREE TOPS.

TEST 3

PHRASE SET 4 (page 1 of 2)

1. Do not CHANGE SPEED during initial.
2. Wait for engine to SPOOL DOWN.
3. The FUEL FEED mechanism is faulty.
4. We will approach during LOW TIDE.
5. Thrust is on the LOW SIDE.
6. Set scope for HIGH GAIN.
7. The aircraft is twelve miles, EAST BOUND.
8. I have a red light for the NOSE GEAR.
9. Let go of the JOY STICK.
10. Your target is in the MARSH LAND.
11. Arm and blow TIP TANKS.
12. ALL's CALM to the southwest.
13. The HATCH CLOSED, but I have a red light.
14. Attempt to contact WING MAN again.
15. Lightning off to the NORTH EAST.
16. Give me a SLOW COUNT.
17. Unable to FILL TANKS.
18. Off to the LEFT FLANK.
19. Break off if you DRAW FIRE.
20. Make a LOW RUN over the area.
21. Remove safety and ARM GUNS.
22. Remove FACE MASK and check hose.
23. I see a BRIGHT LIGHT below and to the left.
24. Lower airspeed and put GEAR DOWN.
25. Park on EAST SIDE of ramp.

TEST 3

PHRASE SET 4 (page 2 of 2)

26. Do not park DOWN WIND from sprayers.
27. Thanks for assistance, GOOD BYE.
28. Put BRAKE OUT to control airspeed.
29. The DOME LIGHT is not operating.
30. O.K. number six, YOU'RE HOT.
31. Begin evasive maneuver when IN RANGE.
32. I have the HOOK DOWN and locked.
33. My instruments indicate DRY TANKS.
34. He is on final with WHEELS DOWN.
35. Do you have visual on NORTH BOUND traffic.
36. I have ice build-up on PORT SIDE.
37. You're number two following LEAD SHIP.
38. I see the FUEL POD on the right.
39. I have an unsafe indication for the right MAIN GEAR.
40. Go ahead and put FLAPS DOWN.
41. Try to pull up with minimum G-FORCE.
42. Attempt once more to PURGE TANKS.
43. Your pigeons are in HOME PLATE.
44. Give me a CALL BACK on channel five.
45. DROP DOWN to ten thousand feet.
46. Contact squadron before you SHUT DOWN.
47. Just a little further, you are in HOME STRETCH.
48. The left windshield is ICED UP.
49. I will enter area from SOUTH EAST.
50. The FUEL GAUGE indicates six hundred pounds.

It is requested that the following information be submitted to USAFSAM/NGEA,
Brooks AFB, TX 78235.

Examiner:

Autovon No.:

Type aircraft used:

Name of subject:

Age:

AFSN:

Total flying time:

AFSC:

Audiometric results: Freq. (Hz) 500 1000 2000 3000 4000 6000

Right ear:

Left ear:

In-flight test scores (list as appropriate):

TEST 1: List 1 _____ List 2 _____ List 3 _____

TEST 2: List 1 _____ List 2 _____ List 3 _____

TEST 3: Phrase 1 _____ Phrase 2 _____ Phrase 3 _____ Phrase 4 _____

Range of scores examiner obtained among normal-hearing flying personnel:

Remarks:

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13. ABSTRACT <p>The need to assess the ability of aircrewmembers to perceive and understand voiced communications transmitted under headsets during flight conditions has been recognized since the early 1940s. A standardized approach is needed to evaluate the adequacy of auditory function in flyers who fail to pass pure-tone physical profile standards (Class II and III examinations). It is this need that prompted the research described in this report.</p> <p>This report describes four sets of 50 phrases extracted from voice communications used in ground and airborne operations, as well as six lists of 50 single-syllable words. These lists have not been evaluated under the conditions proposed for their use.</p>		

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Otolaryngology Audiology Hearing Test Speech Audiometry In-Flight Hearing Test						

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