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COMPENDIUM OF SPEECH TESTING MATERIAL
AND TYPICAL NOISE SPECTRA FOR USE IN
EVALUATING COMMUNICATIONS EQUIPMENT

J. C. Webster

Naval Electronics Laboratory Center
San Diego, California

13 September 1972

TECHNICAL DOCUMENT 191

# COMPENDIUM OF SPEECH TESTING MATERIAL AND TYPICAL NOISE SPECTRA FOR USE IN EVALUATING COMMUNICATIONS EQUIPMENT

Explanatory material, lists, and answer sheets allow
selection of tests appropriate to needs

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**13. ABSTRACT**

This compendium of speech tests and typical naval noise spectra was assembled to meet the recurring need for good speech tests for evaluation of speech communication systems. Because of the complex nature of spoken language, many facets of language and test design must be specified before a quantitative score has meaning. These points are treated briefly here, and published material is referenced for the reader who has need for further details.

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I

| ¹⁴ KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Speech intelligibility | | | | | | |
| Communication system evaluation | | | | | | |
| Naval noise | | | | | | |
| Human engineering | | | | | | |

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II

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## EXHIBITS

## ILLUSTRATIONS

# INTRODUCTION

At least once a year over the past 25 years the Psychoacoustics Branch of the Human Factors Technology Division has been asked for a good (appropriate, meaningful, expeditious, scientific, quantitative) speech (word, sentence, navy phrase) test for evaluating (proving, condemning, whitewashing) a speech communication system (component, equipment, circuit). There are, in fact, at least 10 standardized tests that can, when properly chosen, give reliable (repeatable) scores varying from 50% to 95% on the same "test system." This apparent anomaly exists not because speech scientists do not know their business but because of the extreme redundancy of spoken language. There are many facets of language and test design that must be understood, controlled, and specified before any quantitative score (percentage of words or sentences correct) really has any meaning. Since this document is not meant to be a comprehensive treatise on the subject but more of a handbook or guide, these points are mentioned only in the briefest form. Reference is made to published papers and books for more details.

Actual lists and answer sheets are included so that anyone can choose a test ONCE HE UNDERSTANDS WHICH TEST IS APPROPRIATE FOR HIS NEEDS.

## LANGUAGE FACTORS AFFECTING INTELLIGIBILITY

### VOCABULARY SIZE AND PHONETICALLY BALANCED WORD TESTS

The potential size of the word lists from which either the talker or the listener makes his selection affects the intelligibility score. If both talker and listener know that only two words will be transmitted — say, "yes" and "no" — a score of 50% will result from chance alone and scores near 100% can well be expected. If only the digits zero through nine(r) are transmitted, chance scores of 10% will occur and scores above 90% can be expected.

The oldest and most respected of commonly used word tests was compiled by Egan (1948) during World War II. Egan compiled 1000 monosyllabic words, then arranged them in 20 lists of 50 words so that each list was "phonetically balanced." That is, within each list the phonetic balance of the English language as a whole was accurately represented. These phonetically balanced (PB) words are listed in exhibit 1. Each word is followed by a numeral from 1 to 20 specifying the list it is to be used in.

To give the test, separate the words into the 20 lists and randomize the word order (do not read them alphabetically). The listener copies on plain paper what he hears. Spelling is NOT crucial - "aisle" equals "isle."

Caution. These tests are difficult to administer, score, and interpret. Talker and listening crews must be trained for weeks. A gap of 4 seconds must be allowed between words (to give listener time to write). The talkers must use a carrier phrase such as, "Number one, you will write the word _____ now." In tightly controlled tests, the talker should monitor each transmission to get the same voice level or intensity (reading on a VU, or equivalent, meter) on the word "word." Assuming the talker/listener crews

# EXHIBIT 1: EGAN'S 1000 PHONETICALLY BALANCED MONOSYLLABIC WORDS.

| # | Word | | # | Word | | # | Word | | # | Word | | # | Word | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | ACE | 20 | 51. | BECK | 5 | 101. | CAMP | 16 | 151. | CLOG | 20 | 201. | DAB | 2 |
| 2. | ACHE | 3 | 52. | BEE | 4 | 102. | CANE | 1 | 152. | CLOSED | 16 | 202. | DAD | 6 |
| 3. | ACT | 7 | 53. | BEEF | 9 | 103. | CANT | 19 | 153. | CLOTH | 6 | 203. | DAME | 16 |
| 4. | ADD | 5 | 54. | BELL | 15 | 104. | CAPE | 3 | 154. | CLOTHE | 10 | 204. | DARN | 14 |
| 5. | AGE | 19 | 55. | BEST | 6 | 105. | CAR | 14 | 155. | CLOTHES | 6 | 205. | DART | 17 |
| 6. | AID | 16 | 56. | BET | 7 | 106. | CART | 20 | 156. | CLOUD | 2 | 206. | DASH | 14 |
| 7. | AIL | 10 | 57. | BID | 8 | 107. | CARVE | 9 | 157. | CLOVE | 1 | 207. | DAUB | 10 |
| 8. | AIM | 7 | 58. | BIG | 17 | 108. | CASE | 17 | 158. | CLOWN | 9 | 208. | DAY | 8 |
| 9. | AIMS | 18 | 59. | BIND | 8 | 109. | CAST | 3 | 159. | CLUB | 9 | 209. | DEAD | 14 |
| 10. | AIR | 3 | 60. | BIRTH | 9 | 110. | CAT | 18 | 160. | CLUE | 17 | 210. | DEAF | 13 |
| 11. | ALL | 17 | 61. | BIT | 9 | 111. | CATCH | 8 | 161. | CLUTCH | 12 | 211. | DEATH | 1 |
| 12. | AM | 7 | 62. | BLACK | 5 | 112. | CAVE | 12 | 162. | COAST | 7 | 212. | DEBT | 18 |
| 13. | AND | 12 | 63. | BLESS | 18 | 113. | CHAFE | 12 | 163. | COAX | 14 | 213. | DECK | 3 |
| 14. | APT | 17 | 64. | BLIND | 15 | 114. | CHAFF | 18 | 164. | COB | 6 | 214. | DEED | 1 |
| 15. | ARC | 11 | 65. | BLISS | 11 | 115. | CHAIN | 18 | 165. | COD | 8 | 215. | DEEP | 6 |
| 16. | ARCH | 9 | 66. | BLONDE | 4 | 116. | CHAIR | 12 | 166. | CODE | 11 | 216. | DEPTH | 12 |
| 17. | ARE | 1 | 67. | BLUFF | 12 | 117. | CHAMP | 10 | 167. | COMES | 7 | 217. | DEUCE | 8 |
| 18. | ARM | 11 | 68. | BLUSH | 2 | 118. | CHANCE | 10 | 168. | COOK | 7 | 218. | DICE | 18 |
| 19. | ART | 18 | 69. | BOB | 10 | 119. | CHANGE | 13 | 169. | CORD | 10 | 219. | DID | 20 |
| 20. | AS | 6 | 70. | BOG | 6 | 120. | CHANT | 8 | 170. | CORK | 20 | 220. | DIG | 3 |
| 21. | ASK | 8 | 71. | BOLT | 8 | 121. | CHAP | 12 | 171. | CORN | 13 | 221. | DIKE | 1 |
| 22. | ASS | 12 | 72. | BOOK | 16 | 122. | CHARGE | 2 | 172. | CORPSE | 2 | 222. | DILL | 3 |
| 23. | AT | 14 | 73. | BOOST | 9 | 123. | CHART | 6 | 173. | COST | 15 | 223. | DIME | 12 |
| 24. | AWE | 2 | 74. | BOOTH | 17 | 124. | CHAT | 19 | 174. | COURSE | 4 | 224. | DIN | 16 |
| 25. | AXE | 18 | 75. | BORED | 8 | 125. | CHEAP | 15 | 175. | COURT | 4 | 225. | DINE | 17 |
| 26. | BACK | 10 | 76. | BOSS | 15 | 126. | CHEAT | 5 | 176. | COW | 10 | 226. | DIP | 11 |
| 27. | BAD | 1 | 77. | BOUGH | 19 | 127. | CHECK | 3 | 177. | CRAB | 18 | 227. | DISH | 1 |
| 28. | BADGE | 6 | 78. | BOUGHT | 2 | 128. | CHEESE | 16 | 178. | CRACK | 8 | 228. | DITCH | 9 |
| 29. | BAIT | 2 | 79. | BOUNCE | 2 | 129. | CHESS | 9 | 179. | CRASH | 1 | 229. | DIVE | 15 |
| 30. | BALD | 3 | 80. | BOX | 1 | 130. | CHEST | 9 | 180. | CRATE | 20 | 230. | DODGE | 4 |
| 31. | BALE | 18 | 81. | BRACE | 17 | 131. | CHEW | 8 | 181. | CRAVE | 3 | 231. | DOG | 13 |
| 32. | BALL | 12 | 82. | BRAID | 17 | 132. | CHILL | 18 | 182. | CREED | 1 | 232. | DONE | 12 |
| 33. | BAR | 1 | 83. | BRASS | 20 | 133. | CHINK | 12 | 183. | CREWS | 16 | 233. | DOPE | 7 |
| 34. | BARB | 3 | 84. | BRONZE | 5 | 134. | CHIP | 18 | 184. | CRIB | 6 | 234. | DOSE | 7 |
| 35. | BARGE | 16 | 85. | BROWSE | 5 | 135. | CHOOSE | 5 | 185. | CRIME | 3 | 235. | DOT | 18 |
| 36. | BARK | 19 | 86. | BUCK | 17 | 136. | CHOP | 7 | 186. | CROWD | 9 | 236. | DOUBT | 11 |
| 37. | BARN | 14 | 87. | BUD | 2 | 137. | CHOSE(CHŌZ) | 19 | 187. | CRUDE | 19 | 237. | DOUGH | 19 |
| 38. | BASE | 20 | 88. | BUDGE | 4 | 138. | CHUNK | 11 | 188. | CRUSH | 17 | 238. | DOUSE | 14 |
| 39. | BASH | 10 | 89. | BUG | 10 | 139. | CLASH | 11 | 189. | CRUTCH | 11 | 239. | DOVE(DUV) | 15 |
| 40. | BASK | 1 | 90. | BUS | 4 | 140. | CLASS | 3 | 190. | CRY | 11 | 240. | DRAPE | 16 |
| 41. | BAT | 13 | 91. | BUSH | 4 | 141. | CLAW | 18 | 191. | CUB | 18 | 241. | DRAKE | 11 |
| 42. | BATH | 4 | 92. | BUST | 14 | 142. | CLAWS | 18 | 192. | CUD | 9 | 242. | DROOP | 16 |
| 43. | BATHE | 5 | 93. | BUT | 7 | 143. | CLEANSE | 1 | 193. | CUE | 10 | 243. | DROP | 3 |
| 44. | BAY | 19 | 94. | BUZZ | 19 | 144. | CLICK | 20 | 194. | CUFF | 15 | 244. | DRUG | 19 |
| 45. | BEAD | 3 | 95. | BY | 7 | 145. | CLIFF | 16 | 195. | CUP | 19 | 245. | DUB | 16 |
| 46. | BEAM | 11 | 96. | CAB | 19 | 146. | CLIMB | 13 | 196. | CURB | 13 | 246. | DUKE | 20 |
| 47. | BEAN | 2 | 97. | CAD | 12 | 147. | CLING | 12 | 197. | CURSE | 5 | 247. | DULL | 11 |
| 48. | BEARD | 20 | 98. | CAGE | 19 | 148. | CLIP | 14 | 198. | CURVE | 14 | 248. | DUMB | 8 |
| 49. | BEAST | 4 | 99. | CALF | 8 | 149. | CLOAK | 4 | 199. | CUT | 7 | 249. | DUNE | 19 |
| 50. | BEAU | 13 | 100. | CALVE | 19 | 150. | CLOD | 8 | 200. | CUTE | 14 | 250. | DUNG | 14 |

EXHIBIT 1 (Continued).

| # | Word | | # | Word | | # | Word | | # | Word | | # | Word | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 251. | DUPE | 4 | 301. | FIT | 17 | 351. | FUSE | 9 | 401. | HAT | 10 | 451. | ITCH | 9 |
| 252. | DWARF | 7 | 302. | FIVE | 2 | 352. | FUSS | 1 | 402. | HATCH | 4 | 452. | JAB | 11 |
| 253. | EACH | 8 | 303. | FLAG | 9 | 353. | GAB | 16 | 403. | HATE | 13 | 453. | JADE | 15 |
| 254. | EARL | 2 | 304. | FLAME | 15 | 354. | GAGE | 6 | 404. | HAVE | 11 | 454. | JAG | 6 |
| 255. | EARN | 4 | 305. | FLANK | 19 | 355. | GANG | 20 | 405. | HEAP | 1 | 455. | JAM | 3 |
| 256. | EARS | 10 | 306. | FLAP | 5 | 356. | GAP | 6 | 406. | HEAL | 12 | 456. | JAUNT | 11 |
| 257. | EARTH | 10 | 307. | FLARE | 18 | 357. | GAPE | 5 | 407. | HEAT | 14 | 457. | JAW | 12 |
| 258. | EASE | 8 | 308. | FLASH | 20 | 358. | GAS | 16 | 408. | HEDGE | 15 | 458. | JAY | 10 |
| 259. | EAT | 6 | 309. | FLAUNT | 10 | 359. | GASH | 15 | 409. | HEED | 4 | 459. | JAZZ | 12 |
| 260. | EBB | 19 | 310. | FLEET | 15 | 360. | GASP | 7 | 410. | HENCE | 17 | 460. | JELL | 8 |
| 261. | EDGE | 15 | 311. | FLICK | 6 | 361. | GATE | 5 | 411. | HID | 1 | 461. | JIG | 13 |
| 262. | EEL | 4 | 312. | FLIGHT | 10 | 362. | GEM | 13 | 412. | HIDE | 18 | 462. | JOB | 2 |
| 263. | ELF | 15 | 313. | FLING | 7 | 363. | GET | 20 | 413. | HIGH | 5 | 463. | JOKE | 20 |
| 264. | ELK | 13 | 314. | FLIP | 8 | 364. | GILL | 2 | 414. | HIKE | 19 | 464. | JOLT | 12 |
| 265. | ELM | 13 | 315. | FLOAT | 4 | 365. | GIN | 19 | 415. | HILL | 5 | 465. | JUDGE | 20 |
| 266. | ELSE | 2 | 316. | FLOG | 12 | 366. | GIVE | 9 | 416. | HIM | 7 | 466. | JUG | 7 |
| 267. | END | 1 | 317. | FLOOD | 12 | 367. | GLOSS | 2 | 417. | HIRE | 2 | 467. | KEPT | 6 |
| 268. | ETCH | 10 | 318. | FLOP | 6 | 368. | GLOVE | 15 | 418. | HIS | 18 | 468. | KEY | 9 |
| 269. | EYE | 20 | 319. | FLUFF | 9 | 369. | GNASH | 12 | 419. | HISS | 4 | 469. | KICK | 14 |
| 270. | EYES | 6 | 320. | FLUSH | 3 | 370. | GNAW | 3 | 420. | HIT | 2 | 470. | KID | 5 |
| 271. | FACT | 15 | 321. | FOAM | 14 | 371. | GOAT | 11 | 421. | HITCH | 6 | 471. | KILL | 8 |
| 272. | FAD | 8 | 322. | FOE | 9 | 372. | GOB | 20 | 422. | HIVE | 1 | 472. | KIND | 16 |
| 273. | FADE | 18 | 323. | FOLD | 13 | 373. | GOD | 19 | 423. | HOCK | 2 | 473. | KISS | 15 |
| 274. | FAIR | 20 | 324. | FOLK | 1 | 374. | GOLF | 15 | 424. | HOG | 11 | 474. | KIT | 11 |
| 275. | FAKE | 7 | 325. | FOND | 19 | 375. | GOOD | 5 | 425. | HOLE | 15 | 475. | KITE | 4 |
| 276. | FALL | 6 | 326. | FOOD | 8 | 376. | GOOSE | 10 | 426. | HOOD | 17 | 476. | KNEE | 16 |
| 277. | FALLS | 17 | 327. | FOOL | 18 | 377. | GOT | 18 | 427. | HOOF | 9 | 477. | KNIFE | 12 |
| 278. | FAME | 3 | 328. | FOOT | 12 | 378. | GRAB | 18 | 428. | HOOK | 13 | 478. | KNIT | 7 |
| 279. | FAN | 19 | 329. | FOR | 13 | 379. | GRACE | 9 | 429. | HOSE | 16 | 479. | LAD | 19 |
| 280. | FAR | 3 | 330. | FORCE | 10 | 380. | GRADE | 7 | 430. | HOT | 4 | 480. | LAG | 11 |
| 281. | FAST | 20 | 331. | FORD | 1 | 381. | GRAPE | 13 | 431. | HOW | 4 | 481. | LAP | 10 |
| 282. | FAT | 18 | 332. | FORGE | 6 | 382. | GRATE | 14 | 432. | HOWL | 14 | 482. | LASH | 12 |
| 283. | FATE | 2 | 333. | FORM | 17 | 383. | GRAVE | 13 | 433. | HUG | 12 | 483. | LAST | 17 |
| 284. | FEAST | 1 | 334. | FORT | 7 | 384. | GRAY | 18 | 434. | HULL | 6 | 484. | LATCH | 11 |
| 285. | FED | 12 | 335. | FORTH | 8 | 385. | GREEK | 5 | 435. | HUM | 8 | 485. | LATHE | 14 |
| 286. | FEE | 6 | 336. | FOUGHT | 12 | 386. | GREET | 12 | 436. | HUMP | 20 | 486. | LAUGH | 12 |
| 287. | FEED | 5 | 337. | FOWL | 6 | 387. | GREW | 18 | 437. | HUNCH | 12 | 487. | LAW | 3 |
| 288. | FEEL | 11 | 338. | FRAUD | 1 | 388. | GROPE | 6 | 438. | HUNK | 14 | 488. | LAY | 16 |
| 289. | FEET | 17 | 339. | FREAK | 8 | 389. | GROUP | 14 | 439. | HUNT | 1 | 489. | LEASH | 16 |
| 290. | FELL | 17 | 340. | FREEZE | 18 | 390. | GROVE | 1 | 440. | HURL | 3 | 490. | LEAVE | 3 |
| 291. | FERN | 1 | 341. | FRESH | 17 | 391. | GRUDGE | 5 | 441. | HURT | 10 | 491. | LED | 19 |
| 292. | FEW | 13 | 342. | FRIGHT | 16 | 392. | GUESS | 8 | 442. | HUSH | 18 | 492. | LEDGE | 12 |
| 293. | FIFE | 14 | 343. | FRILL | 12 | 393. | GULL | 10 | 443. | HUT | 19 | 493. | LEFT | 8 |
| 294. | FIFTH | 16 | 344. | FRISK | 11 | 394. | GUM | 17 | 444. | ICE | 9 | 494. | LEG | 6 |
| 295. | FIG | 3 | 345. | FROCK | 8 | 395. | GUN | 7 | 445. | IF | 17 | 495. | LEND | 5 |
| 296. | FILL | 13 | 346. | FROG | 2 | 396. | GUSH | 18 | 446. | IN | 20 | 496. | LESS | 15 |
| 297. | FIN | 4 | 347. | FRONT | 8 | 397. | GYP | 19 | 447. | INCH | 5 | 497. | LICK | 8 |
| 298. | FIND | 19 | 348. | FROWN | 4 | 398. | HACK | 13 | 448. | INK | 16 | 498. | LID | 20 |
| 299. | FINE | 11 | 349. | FUDGE | 11 | 399. | HAD | 16 | 449. | IS | 1 | 499. | LIFE | 14 |
| 300. | FIR | 10 | 350. | FUME | 9 | 400. | HASH | 16 | 450. | ISLE | 14 | 500. | LIME | 18 |

EXHIBIT 1 (Continued).

| # | Word | | # | Word | | # | Word | | # | Word | | # | Word | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 501. | LINE | 10 | 551. | NAB | 2 | 601. | PACK | 20 | 651. | PROBE | 11 | 701. | RICE | 11 |
| 502. | LIP | 18 | 552. | NAG | 13 | 602. | PACT | 9 | 652. | PROD | 11 | 702. | RICH | 7 |
| 503. | LIT | 9 | 553. | NAP | 16 | 603. | PAD | 20 | 653. | PRUDE | 14 | 703. | RID | 14 |
| 504. | LOG | 2 | 554. | NAUGHT | 15 | 604. | PAGE | 10 | 654. | PUFF | 5 | 704. | RIDE | 1 |
| 505. | LOOK | 8 | 555. | NEAT | 4 | 605. | PAID | 17 | 655. | PUG | 13 | 705. | RIDGE | 17 |
| 506. | LOOSE | 12 | 556. | NECK | 3 | 606. | PAN | 1 | 656. | PULSE | 3 | 706. | RIND(RĪND) | 5 |
| 507. | LOSE(LŌOZ) | 19 | 557. | NEED | 2 | 607. | PANTS | 1 | 657. | PUMP | 16 | 707. | RIP | 10 |
| 508. | LOSS | 11 | 558. | NERVE | 9 | 608. | PARE | 17 | 658. | PUN | 6 | 708. | RIPE | 12 |
| 509. | LOUD | 18 | 559. | NEST | 3 | 609. | PARK | 12 | 659. | PUNK | 11 | 709. | RISE | 1 |
| 510. | LOUSE | 16 | 560. | NET | 11 | 610. | PART | 16 | 660. | PUNT | 5 | 710. | RISK | 11 |
| 511. | LOVE | 5 | 561. | NEW | 4 | 611. | PASS | 5 | 661. | PUP | 15 | 711. | ROAM | 17 |
| 512. | LOW | 11 | 562. | NEWS | 14 | 612. | PAST | 17 | 662. | PURGE | 14 | 712. | ROAR | 7 |
| 513. | LUNGE | 18 | 563. | NEXT | 16 | 613. | PASTE | 19 | 663. | PURSE | 11 | 713. | ROB | 18 |
| 514. | LUSH | 3 | 564. | NICE | 13 | 614. | PATCH | 13 | 664. | PUS | 6 | 714. | ROBE | 20 |
| 515. | LUST | 19 | 565. | NICK | 14 | 615. | PATH | 3 | 665. | PUSS | 20 | 715. | ROCK | 16 |
| 516. | LYNCH | 18 | 566. | NIECE | 2 | 616. | PEARL | 17 | 666. | PUT | 10 | 716. | ROD | 8 |
| 517. | MA | 17 | 567. | NIGH | 6 | 617. | PECK | 4 | 667. | QUACK | 14 | 717. | RODE | 5 |
| 518. | MADE | 13 | 568. | NIGHT | 8 | 618. | PEN | 17 | 668. | QUART | 2 | 718. | ROE | 9 |
| 519. | MANGE | 1 | 569. | NINE | 7 | 619. | PELT | 13 | 669. | QUEEN | 8 | 719. | ROGUE | 16 |
| 520. | MAP | 16 | 570. | NINTH | 15 | 620. | PENT | 7 | 670. | QUICK | 15 | 720. | ROLL | 8 |
| 521. | MASH | 6 | 571. | NIP | 13 | 621. | PERCH | 19 | 671. | QUIP | 20 | 721. | ROMP | 12 |
| 522. | MASS | 9 | 572. | NO | 1 | 622. | PERK | 2 | 672. | QUIZ | 7 | 722. | ROOMS | 6 |
| 523. | MAST | 5 | 573. | NOD | 14 | 623. | PERT | 4 | 673. | RACE | 4 | 723. | ROOST | 20 |
| 524. | MAY | 15 | 574. | NOOK | 1 | 624. | PEST | 1 | 674. | RACK | 4 | 724. | ROOT | 9 |
| 525. | MAZE | 10 | 575. | NOOSE | 9 | 625 | PEW | 20 | 675. | RAFT | 19 | 725. | ROPE | 8 |
| 526. | ME | 14 | 576. | NOSE | 5 | 626. | PHASE | 7 | 676. | RAG | 1 | 726. | ROSE | 18 |
| 527. | MERGE | 4 | 577. | NOT | 1 | 627. | PHONE | 9 | 677. | RAGE | 17 | 727. | ROT | 8 |
| 528. | MESH | 15 | 578. | NOTCH | 19 | 628. | PICK | 2 | 678. | RAID | 7 | 728. | ROTE | 19 |
| 529. | MIST | 17 | 579. | NOTE | 18 | 629. | PIG | 7 | 679. | RAISE | 6 | 729. | ROUGE | 20 |
| 530. | MITT | 15 | 580. | NUDGE | 10 | 630. | PILE | 1 | 680. | RAMP | 20 | 730. | ROUGH | 6 |
| 531. | MODE | 15 | 581. | NUT | 2 | 631. | PINCH | 4 | 681. | RANGE | 7 | 731. | ROUSE | 3 |
| 532. | MOOD | 13 | 582. | NUTS | 9 | 632. | PINK | 10 | 682. | RAP | 2 | 732. | ROUT(ROWT) | 20 |
| 533. | MOOSE | 2 | 583. | OAK | 3 | 633. | PINT | 8 | 683. | RAPE | 10 | 733. | ROVE | 12 |
| 534. | MOP | 13 | 584. | OATH | 15 | 634. | PIPE | 5 | 684. | RASH | 7 | 734. | RUB | 1 |
| 535. | MOPE | 10 | 585. | ODD | 9 | 635. | PIT | 2 | 685. | RAT | 1 | 735. | RUDE | 9 |
| 536. | MORN | 15 | 586. | ODDS | 5 | 636. | PITCH | 16 | 686. | RATE | 3 | 736. | RUG | 16 |
| 537. | MOST | 11 | 587. | ODE | 6 | 637. | PLEAD | 13 | 687. | RAVE | 4 | 737. | RULE | 19 |
| 538. | MOTE | 7 | 588. | OFF | 7 | 638. | PLEASE | 3 | 688. | RAW | 4 | 738. | RUSH | 10 |
| 539. | MOTH | 13 | 589. | OFT | 14 | 639. | PLOD | 7 | 689. | RAY | 6 | 739. | RUT | 4 |
| 540. | MOUTH | 11 | 590. | OILS | 4 | 640. | PLOW | 17 | 690. | REACH | 17 | 740. | RYE | 16 |
| 541. | MOVE | 4 | 591. | ON | 19 | 641. | PLUS | 10 | 691. | REAL | 10 | 741. | SACK | 18 |
| 542. | MOW(MŌ) | 20 | 592. | OR | 4 | 642. | PLUSH | 1 | 692. | REAP | 6 | 742. | SAG | 7 |
| 543. | MUCK | 3 | 593. | OUCH | 18 | 643. | POD | 4 | 693. | REAR | 5 | 743. | SAGE | 4 |
| 544. | MUD | 7 | 594. | OUGHT | 13 | 644. | POND | 11 | 694. | REED | 9 | 744. | SALVE | 20 |
| 545. | MUFF | 13 | 595. | OUR | 2 | 645. | POUNCE | 7 | 695. | REEF | 11 | 745. | SANG | 16 |
| 546. | MUSH | 13 | 596. | OUT | 12 | 646. | PRESS | 17 | 696. | REEK | 12 | 746. | SAP | 11 |
| 547. | MUSS | 14 | 597. | OWE | 13 | 647. | PRICE | 13 | 697. | REST | 8 | 747. | SASH | 18 |
| 548. | MUTE | 2 | 598. | OWLS | 5 | 648. | PRIEST | 12 | 698. | RETCH | 20 | 748. | SAT | 19 |
| 549. | MY | 13 | 599. | OWN | 15 | 649. | PRIG | 6 | 699. | RHYME | 8 | 749. | SCAB | 4 |
| 550. | MYTH | 17 | 600. | OX | 17 | 650. | PRIME | 6 | 700. | RIB | 2 | 750. | SCAN | 6 |

EXHIBIT 1 (Continued).

| #    | Word          | Val | #    | Word      | Val | #    | Word     | Val | #    | Word         | Val | #    | Word   | Val |
|------|---------------|-----|------|-----------|-----|------|----------|-----|------|--------------|-----|------|--------|-----|
| 751. | SCARE         | 5   | 801. | SLAP      | 4   | 851. | STRIFE   | 1   | 901. | TILE         | 12  | 951. | WASP   | 6   |
| 752. | SCOUT         | 7   | 802. | SLASH     | 15  | 852. | STUFF    | 14  | 902. | TILL         | 8   | 952. | WASTE  | 18  |
| 753. | SCOW          | 15  | 803. | SLED      | 13  | 853. | SUCH     | 1   | 903. | TILT         | 20  | 953. | WATCH  | 5   |
| 754. | SCRATCH       | 17  | 804. | SLEDGE    | 7   | 854. | SUCK     | 2   | 904. | TIME         | 15  | 954. | WAVE   | 11  |
| 755. | SCRUB         | 10  | 805. | SLICE     | 20  | 855. | SUIT     | 16  | 905. | TINGE        | 15  | 955. | WAYS   | 2   |
| 756. | SCUFF         | 13  | 806. | SLID      | 19  | 856. | SUP      | 6   | 906. | TIP          | 13  | 956. | WEAK   | 9   |
| 757. | SCYTHE        | 2   | 807. | SLIDE     | 8   | 857. | TAB      | 11  | 907. | TIRE         | 16  | 957. | WEAN   | 13  |
| 758. | SEED          | 20  | 808. | SLIP      | 1   | 858. | TACK     | 15  | 908. | TOAD         | 9   | 958. | WEAVE  | 15  |
| 759. | SELL          | 17  | 809. | SLOUCH    | 6   | 859. | TAG      | 10  | 909. | TOE          | 1   | 959. | WEB    | 20  |
| 760. | SENSE         | 15  | 810. | SLUDGE    | 2   | 860. | TAINT    | 13  | 910. | TOIL         | 3   | 960. | WED    | 15  |
| 761. | SET           | 12  | 811. | SLUG      | 10  | 861. | TAKE     | 3   | 911. | TON          | 16  | 961. | WEDGE  | 3   |
| 762. | SHACK         | 8   | 812. | SLUSH     | 20  | 862. | TAN      | 2   | 912. | TONGUE       | 6   | 962. | WEED   | 18  |
| 763. | SHADE         | 15  | 813. | SLY       | 5   | 863. | TANG     | 2   | 913. | TOUCH        | 4   | 963. | WEEP   | 17  |
| 764. | SHAFT         | 7   | 814. | SMART     | 9   | 864. | TAP      | 13  | 914. | TRADE        | 5   | 964. | WEIRD  | 17  |
| 765. | SHANK         | 6   | 815. | SMASH     | 13  | 865. | TEACH    | 15  | 915. | TRASH        | 2   | 965. | WHARF  | 3   |
| 766. | SHARE         | 18  | 816. | SMILE     | 1   | 866. | TELL     | 14  | 916. | TRAY         | 14  | 966. | WHEAT  | 1   |
| 767. | SHED          | 4   | 817. | SMITE     | 14  | 867. | TEN      | 9   | 917. | TREE         | 10  | 967. | WHEEL  | 19  |
| 768. | SHEEP         | 16  | 818. | SMOOTH    | 13  | 868. | TENT     | 14  | 918. | TRIP         | 3   | 968. | WHEEZE | 8   |
| 769. | SHEIK         | 16  | 819. | SNIFF     | 7   | 869. | TEST     | 4   | 919. | TROD         | 18  | 969. | WHIFF  | 7   |
| 770. | SHIN          | 4   | 820. | SNIPE     | 10  | 870. | THAN     | 9   | 920. | TROOP        | 9   | 970. | WHITE  | 19  |
| 771. | SHINE         | 5   | 821. | SNOW      | 11  | 871. | THANK    | 9   | 921. | TRUE         | 5   | 971. | WHO    | 3   |
| 772. | SHIP          | 17  | 822. | SNUFF     | 2   | 872. | THAT     | 15  | 922. | TUBE         | 17  | 972. | WHY    | 3   |
| 773. | SHOCK         | 17  | 823. | SO        | 15  | 873. | THAW     | 18  | 923. | TUCK         | 16  | 973. | WIDE   | 15  |
| 774. | SHOE          | 2   | 824. | SOAK      | 20  | 874. | THEM     | 2   | 924. | TUG          | 5   | 974. | WIELD  | 16  |
| 775. | SHOOK         | 14  | 825. | SOAP      | 13  | 875. | THEME    | 20  | 925. | TURF         | 3   | 975. | WIFE   | 6   |
| 776. | SHOP          | 11  | 826. | SOAR      | 16  | 876. | THEN     | 1   | 926. | TURN         | 16  | 976. | WIG    | 8   |
| 777. | SHOT          | 11  | 827. | SOB       | 3   | 877. | THERE    | 1   | 927. | TWEED        | 15  | 977. | WILD   | 9   |
| 778. | SHOUT         | 3   | 828. | SOD       | 12  | 878. | THICK    | 5   | 928. | UP           | 19  | 978. | WINK   | 5   |
| 779. | SHOVE         | 5   | 829. | SOIL      | 14  | 879. | THIEF    | 19  | 929. | URGE         | 11  | 979. | WINE   | 17  |
| 780. | SHRUB         | 15  | 830. | SOLVE     | 5   | 880. | THIGH    | 6   | 930. | US           | 8   | 980. | WIPE   | 9   |
| 781. | SHRUG         | 14  | 831. | SOUR      | 4   | 881. | THIN     | 13  | 931. | USE(YEWS)    | 1   | 981. | WIRE   | 7   |
| 782. | SHUT          | 12  | 832. | SOUSE     | 20  | 882. | THINE    | 18  | 932. | VAGUE        | 14  | 982. | WISE   | 20  |
| 783. | SHY           | 19  | 833. | SOUTH     | 7   | 883. | THIS     | 8   | 933. | VALVE        | 10  | 983. | WISH   | 2   |
| 784. | SICK          | 5   | 834. | SPED      | 3   | 884. | THORN    | 18  | 934. | VAMP         | 2   | 984. | WITH   | 9   |
| 785. | SIDE          | 13  | 835. | SPICE     | 8   | 885. | THOSE    | 10  | 935. | VASE(VACE)   | 5   | 985. | WOE    | 7   |
| 786. | SIEGE         | 7   | 836. | SPLASH    | 19  | 886. | THOU     | 16  | 936. | VAST         | 2   | 986. | WOO    | 7   |
| 787. | SIEVE         | 18  | 837. | SPRIG     | 11  | 887. | THOUGH   | 7   | 937. | VICE         | 17  | 987. | WOOD   | 11  |
| 788. | SIGH          | 20  | 838. | SPUD      | 9   | 888. | THRASH   | 3   | 938. | VILE         | 15  | 988. | WOVE   | 12  |
| 789. | SIGN          | 11  | 839. | SPY       | 11  | 889. | THREAD   | 8   | 939. | VINE         | 12  | 989. | WRATH  | 5   |
| 790. | SILL          | 19  | 840. | STAB      | 16  | 890. | THREE    | 16  | 940. | VOID         | 10  | 990. | WRECK  | 15  |
| 791. | SIN           | 7   | 841. | STAFF     | 10  | 891. | THRESH   | 16  | 941. | VOTE         | 14  | 991. | WRIST  | 14  |
| 792. | SING          | 14  | 842. | STAG      | 3   | 892. | THROAT   | 19  | 942. | VOW          | 3   | 992. | WRIT   | 6   |
| 793. | SIP           | 9   | 843. | START     | 2   | 893. | THROB    | 12  | 943. | WADE         | 10  | 993. | YAWN   | 5   |
| 794. | SIR           | 15  | 844. | STARVE    | 4   | 894. | THRONE   | 9   | 944. | WAG          | 14  | 994. | YEAR   | 9   |
| 795. | SIT           | 3   | 845. | STEAD     | 13  | 895. | THROUGH  | 20  | 945. | WAGE         | 12  | 995. | YEAST  | 8   |
| 796. | SIZE          | 3   | 846. | STEED     | 19  | 896. | THUD     | 5   | 946. | WAIF         | 14  | 996. | YES    | 19  |
| 797. | SKETCH        | 4   | 847. | STIFF     | 11  | 897. | THUG     | 10  | 947. | WAIT         | 6   | 997. | YIELD  | 19  |
| 798. | SKID          | 20  | 848. | STRAP     | 4   | 898. | THUS     | 6   | 948. | WAKE         | 10  | 998. | YOU    | 17  |
| 799. | SKY           | 12  | 849. | STRESS    | 16  | 899. | TINY     | 14  | 949. | WALK         | 20  | 999. | YOUTH  | 10  |
| 800. | SLAB          | 14  | 850. | STRIDE    | 17  | 900. | TICK     | 4   | 950. | WASH         | 20  | 1000.| ZONE   | 5   |

are adequately trained, the scores are dependent upon the size of vocabulary chosen. Repeated scores on a single 50-word list will typically be as much as 50 percentage points higher than if five lists are used. Similarly, scores on 250 words can be up to 40 percentage points higher than scores when all 1000 words are used; see figure 4-5 in Kryter, Licklider, Webster, and Hawley (1963), reproduced as figure 1.
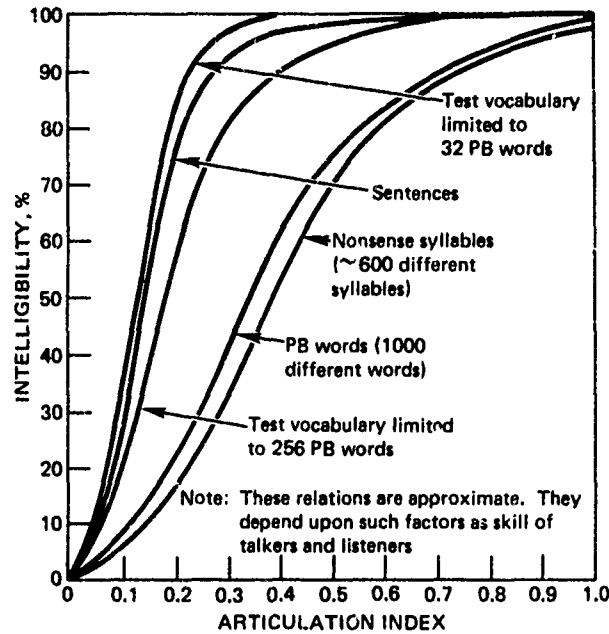


Figure 1. Sentence, PB word, and nonsense syllable intelligibility as a function of articulation index (AI).

These lists should be used with great caution, but they are excellent for evaluating GOOD SYSTEMS, or comparing one system to another, because they are sensitive to small changes AND they have been widely used in the past. Many specifications and/or comparisons to older systems will be in PB scores.

Egan (1948) recognized occasions would arise in which only 100 PB's were needed, so he constructed two R-lists. In his words, "The words were selected so that they resemble one another as much as possible....the 15 vowels and diphthongs are represented by six words each. An effort was made to distribute all the different consonant sounds among these 90 words. The remaining 10 words....are used to sample some of the compound consonants."

If 100 PB words are required for use with relatively untrained crews, randomize the R-lists shown in exhibit 2.

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**EXHIBIT 2: EGAN'S R-LISTS (100 SELECTED PB WORDS).**

### R LIST 1

| | | | | |
|---|---|---|---|---|
| 1. aisle | 21. dame | 41. jack | 61. rack | 81. still |
| 2. barb | 22. done | 42. jam | 62. ram | 82. tale |
| 3. barge | 23. dub | 43. law | 63. ring | 83. tame |
| 4. bark | 24. feed | 44. lawn | 64. rip | 84. toil |
| 5. baste | 25. feet | 45. lisle | 65. rub | 85. ton |
| 6. bead | 26. file | 46. live | 66. run | 86. trill |
| 7. beet | 27. five | 47. loon | 67. sale | 87. tub |
| 8. beige | 28. foil | 48. loop | 68. same | 88. vouch |
| 9. boil | 29. fume | 49. mess | 69. shod | 89. vow |
| 10. choke | 30. fuse | 50. met | 70. shop | 90. whack |
| 11. chore | 31. get | 51. neat | 71. should | 91. wham |
| 12. cod | 32. good | 52. need | 72. shrill | 92. woe |
| 13. coil | 33. guess | 53. oil | 73. sing | 93. woke |
| 14. coon | 34. hews | 54. ouch | 74. sip | 94. would |
| 15. coop | 35. hive | 55. paw | 75. skill | 95. yaw |
| 16. cop | 36. hod | 56. pawn | 76. soil | 96. yawn |
| 17. couch | 37. hood | 57. pews | 77. soon | 97. yes |
| 18. could | 38. hop | 58. poke | 78. soot | 98. yet |
| 19. cow | 39. how | 59. pour | 79. soup | 99. zing |
| 20. dale | 40. huge | 60. pure | 80. spill | 100. zip |

### R LIST 2

| | | | | |
|---|---|---|---|---|
| 1. ball | 21. dial | 41. hen | 61. peep | 81. tap |
| 2. bar | 22. dig | 42. huff | 62. peeve | 82. them |
| 3. bob | 23. dine | 43. hush | 63. phase | 83. then |
| 4. bong | 24. ditch | 44. jar | 64. pull | 84. title |
| 5. book | 25. doubt | 45. job | 65. put | 85. tine |
| 6. boot | 26. dowel | 46. joy | 66. raid | 86. tong |
| 7. booth | 27. drain | 47. joys | 67. raze | 87. toot |
| 8. bout | 28. em | 48. kirk | 68. rich | 88. tooth |
| 9. bowel | 29. en | 49. leap | 69. rig | 89. tout |
| 10. boy | 30. fade | 50. leave | 70. ream | 90. towel |
| 11. boys | 31. far | 51. made | 71. roe | 91. toy |
| 12. brain | 32. foam | 52. maize | 72. root | 92. toys |
| 13. bull | 33. fob | 53. mew | 73. rough | 93. weave |
| 14. crane | 34. foe | 54. muff | 74. rush | 94. weep |
| 15. cue | 35. foot | 55. mush | 75. ruth | 95. while |
| 16. curb | 36. full | 56. mute | 76. sack | 96. whine |
| 17. curd | 37. gall | 57. new | 77. sap | 97. wig |
| 18. curse | 38. gong | 58. newt | 78. slain | 98. witch |
| 19. curt | 39. grain | 59. oh | 79. tack | 99. yak |
| 20. cute | 40. hem | 60. ohm | 80. tall | 100. yap |

## WORD FREQUENCY (FAMILIARITY) EFFECTS

Not only is the size of the vocabulary a determinant of speech intelligibility but also the relative familiarity of the word; that is, how often the word occurs in the language. See Howes (1957), Egan (1957), Rosenzweig (1957), and Rosenzweig and Postman (1957). Therefore, Hirsh et al (1952), Lehiste and Peterson (1959), Peterson and Lehiste (1962), Carhart, Tillman, and Wilbur (1963), Tillman, Carhart, and Wilbur (1965), and Tillman and Carhart (1966) compiled lists of more familiar PB or CNC* words. Exhibit 3 gives the Hirsh et al (1952) lists of 200 words known as CID Test W-22. Exhibit 4 gives the Peterson and Lehiste (1962) lists of 500 words, and exhibit 5 gives the Tillman and Carhart (1966) lists of the 200 words known as Northwestern University Auditory Test 6 developed for the Air Force. NU Auditory Test 6 was designed for greater homogeneity among lists than the W-22. If 200 PB words are desired, randomize exhibit 5, and if 500 are required, randomize exhibit 4. Exhibit 4 is particularly important because the familiarity of the words in terms of the Thorndike and Lorge (1952) count is given. The words in exhibit 5 are used extensively in the USAF both clinically and for in-flight tests of air crewmen with suspected hearing losses.

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*Consonant Vowel Nucleus Consonant

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**EXHIBIT 3: HIRSH ET AL W-22 LISTS (200 FAMILIAR PB WORDS).**

| List 1 | List 2 | List 3 | List 4 |
|--------|--------|--------|--------|
| 1. ace | 1. ail | 1. add | 1. aid |
| 2. ache | 2. air | 2. aim | 2. all |
| 3. an | 3. and | 3. are | 3. am |
| 4. as | 4. been | 4. ate | 4. arm |
| 5. bathe | 5. by | 5. bill | 5. art |
| 6. bells | 6. cap | 6. book | 6. at |
| 7. carve | 7. care | 7. camp | 7. bee |
| 8. chew | 8. chest | 8. chair | 8. bread |
| 9. could | 9. die | 9. cute | 9. can |
| 10. dad | 10. does | 10. do | 10. chin |
| 11. day | 11. dumb | 11. done | 11. clothes |
| 12. deaf | 12. ease | 12. dull | 12. cock |
| 13. earn | 13. eat | 13. ears | 13. darn |
| 14. east | 14. else | 14. end | 14. dolls |
| 15. felt | 15. flat | 15. farm | 15. dust |
| 16. give | 16. gave | 16. glove | 16. ear |
| 17. high | 17. ham | 17. hand | 17. eyes |
| 18. him | 18. hit | 18. have | 18. few |
| 19. hunt | 19. hurt | 19. he | 19. go |
| 20. isle | 20. ice | 20. if | 20. hang |
| 21. it | 21. ill | 21. is | 21. his |
| 22. jam | 22. jaw | 22. jar | 22. in |
| 23. knees | 23. key | 23. king | 23. jump |
| 24. law | 24. knee | 24. knit | 24. leave |
| 25. low | 25. live | 25. lie | 25. men |
| 26. me | 26. move | 26. may | 26. my |
| 27. mew | 27. new | 27. nest | 27. near |
| 28. none | 28. now | 28. no | 28. net |
| 29. not | 29. oak | 29. oil | 29. nuts |
| 30. or | 30. odd | 30. on | 30. of |
| 31. owl | 31. off | 31. out | 31. ought |
| 32. poor | 32. one | 32. owes | 32. our |
| 33. ran | 33. own | 33. pie | 33. pale |
| 34. see | 34. pew | 34. raw | 34. save |
| 35. she | 35. rooms | 35. say | 35. shoe |
| 36. skin | 36. send | 36. shove | 36. so |
| 37. stove | 37. show | 37. smooth | 37. stiff |
| 38. them | 38. smart | 38. start | 38. tea |
| 39. there | 39. star | 39. tan | 39. tin |
| 40. thing | 40. tear | 40. ten | 40. than |
| 41. toe | 41. that | 41. this | 41. they |
| 42. true | 42. then | 42. three | 42. through |
| 43. twins | 43. thin | 43. though | 43. toy |
| 44. up | 44. too | 44. tie | 44. where |
| 45. us | 45. tree | 45. use | 45. who |
| 46. wet | 46. way | 46. we | 46. why |
| 47. what | 47. well | 47. west | 47. will |
| 48. wire | 48. with | 48. when | 48. wood |
| 49. yard | 49. young | 49. wool | 49. yes |
| 50. you | 50. your | 50. year | 50. yet |

*Alphabetical Lists of the Words in Auditory Test W-22*

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## EXHIBIT 4: PETERSON AND LEHISTE CNC LISTS
## (500 FAMILIAR PB WORDS).

| CNC List 1 | | CNC List 2 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 1. bean* | 43 | 1. beam* | 41 |
| 2. boat | AA 1000 | 2. beg | A |
| 3. boil | A | 3. bought* | A |
| 4. cape* | 34 | 4. car* | AA 500 |
| 5. check* | AA | 5. choice | A |
| (cheque) | (2) | 6. choose* | A |
| 6. chore | 3 | 7. coat | AA 1000 |
| 7. dead* | AA 1000 | 8. cob* | 2 |
| 8. dime* | 11 | 9. dam | 19 |
| 9. ditch* | 28 | (damn) | (18) |
| 10. fall* | AA 500 | 10. dire | 8 |
| 11. fit* | AA 1000 | 11. dodge* | 16 |
| 12. gale | 15 | 12. fake* | 3 |
| 13. goose* | 45 | 13. fern* | 13 |
| 14. hate* | A | 14. gain | AA 1000 |
| 15. hone | AA 500 | 15. germ | 10 |
| 16. hull* | 3 | 16. goal | 21 |
| 17. jar | 43 | 17. hash* | 2 |
| 18. jug* | 8 | 18. hide* | A |
| 19. king | AA 500 | (hied) | (2) |
| 20. kite* | 10 | 19. hill* | AA 1000 |
| 21. knife* | A | 20. jet | 9 |
| 22. lag* | 9 | 21. late | AA 500 |
| 23. lease | 14 | 22. lead [lid] | AA 1000 |
| 24. loop | 15 | 23. leak | 8 |
| 25. make | AA 500 | (leek) | (1) |
| 26. merge* | 6 | 24. love* | AA 500 |
| 27. mess | 17 | 25. met | AA 1000 |
| 28. name | AA 500 | 26. moon | AA |
| 29. pad* | 17 | 27. much | AA 500 |
| 30. patch* | 34 | 28. nose* | AA 1000 |
| 31. pick* | AA 1000 | (knows) | (AA 500) |
| 32. ripe* | 34 | 29. nurse | A |
| 33. rose* | AA 1000 | 30. pan* | A |
| (rows) | (A) | 31. pave | 14 |
| 34. rout* | 8 | 32. puff* | 28 |
| 35. salve* | 3 | 33. rail | A |
| 36. seize | A | 34. red | AA 500 |
| (sees) | (AA 500) | 35. ring | AA 1000 |
| (seas) | (AA 500) | (wring) | (9) |
| 37. shirt | 47 | 36. root* [rut] | A |
| 38. shore | AA 1000 | (route) | (A) |
| 39. sob* | 36 | 37. sap* | 18 |
| 40. sun | AA 500 | 38. ship* | AA 500 |
| (son) | (AA 500) | 39. should | AA 500 |
| 41. thin* | AA 1000 | 40. soul | AA 1000 |
| 42. toad* | 15 | (sole) | (25) |
| (towed) | (9) | 41. south* | AA 1000 |

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EXHIBIT 4 (Continued).

## CNC List 1

| Word | Frequency |
|---|---|
| 43. tooth | 47 |
| 44. tough | 18 |
| 45. van | 29 |
| 46. wheel* [ʍil] | A |
| 47. wish* | AA 500 |
| 48. wood* | AA 1000 |
| (would) | (AA 500) |
| 49. wreck* | 41 |
| 50. yearn | 10 |

## CNC List 2

| Word | Frequency |
|---|---|
| 42. suck* | 15 |
| 43. tall | AA 1000 |
| 44. talk | AA 500 |
| 45. this* | AA 500 |
| 46. tire* | AA 1000 |
| 47. vine* | 38 |
| 48. wag* | 12 |
| 49. weep | 38 |
| 50. which [ʍitʃ] | AA 500 |

## CNC List 3

| Word | Frequency |
|---|---|
| 1. bar* | A |
| 2. bell* | A |
| (belle) | (13) |
| 3. bush* | A |
| 4. chin | 27 |
| 5. dab* | 2 |
| 6. dike* | 4 |
| (dyke) | (1) |
| 7. dip* | 34 |
| 8. fade* | 41 |
| 9. faith | A |
| 10. four* | AA 500 |
| (fore) | (11) |
| (for) | (AA 500) |
| 11. gap* | 17 |
| 12. gull* | 5 |
| 13. head | AA 500 |
| 14. house [ haus ] | AA 500 |
| 15. hut* | 32 |
| 16. jail | 22 |
| (gaol) | (1) |
| 17. joke* | 32 |
| 18. keen | 35 |
| 19. keg | 3 |
| 20. kid* | A |
| 21. lake | AA 1000 |
| 22. leave* | AA 500 |
| 23. life* | AA 500 |
| 24. man | AA 500 |
| 25. mate | 48 |
| 26. more | AA 500 |
| 27. noise | A |
| 28. numb | 5 |
| 29. perch* | 23 |
| 30. piece | AA 1000 |
| (peace) | (AA 1000) |
| 31. pod* | 3 |

## CNC List 4

| Word | Frequency |
|---|---|
| 1. birch | 16 |
| 2. bone | A |
| 3. bug* | 10 |
| 4. can | AA 500 |
| 5. cash | 46 |
| 6. chief | AA 1000 |
| 7. chum | 4 |
| 8. date | AA 1000 |
| 9. deal | AA 1000 |
| 10. dose* [doʊs] | 8 |
| 11. foot* | AA 1000 |
| 12. gas* | A |
| 13. give* | AA 500 |
| 14. him* | AA 500 |
| 15. hire* | A |
| 16. hoof* [huf] | 26 |
| 17. job* | AA 1000 |
| 18. keep | AA 500 |
| 19. lap* | 36 |
| 20. loan | 30 |
| (lone) | (22) |
| 21. long | AA 500 |
| 22. loud* | A |
| 23. mill | A |
| (mil) | (1) |
| 24. mirth | 16 |
| 25. mop* | 5 |
| 26. net* | A |
| 27. nice* | AA 1000 |
| 28. pack* | A |
| 29. pause | A |
| (paws) | (29) |
| 30. phone* | 20 |
| 31. pool | 34 |
| 32. rage* | 49 |
| 33. read* [rid] | AA 500 |
| (reed) | (22) |

EXHIBIT 4 (Continued).

| CNC List 3 | | CNC List 4 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 32. purge* | 6 | 34. rice* | 38 |
| 33. rat* | 37 | 35. said | AA 500 |
| 34. rig | 6 | 36. serve | AA 500 |
| 35. room [rum] | AA 500 | 37. shake | A |
| 36. rouge* [ruʒ] | 9 | 38. shut* | A |
| 37. sheep* | A | 39. sock | 12 |
| 38. shine* | A | 40. take* | AA 500 |
| 39. size* | AA 1000 | 41. thumb | 27 |
| (sighs) | (A) | 42. till* | AA 1000 |
| 40. soon | AA 500 | 43. tower | A |
| 41. sung | 16 | 44. void* | 12 |
| 42. toll | 10 | 45. wail | 20 |
| 43. tone | A | 46. war | AA 500 |
| 44. toss | 46 | (wore) | (A) |
| 45. vote* | AA | 47. when [ʌɛn] | AA 500 |
| 46. well | AA 500 | 48. wig* | 10 |
| 47. what [ʌat] | AA 500 | 49. write | AA 500 |
| 48. with* [wɪð] | AA 500 | (right) | (AA 500) |
| 49. work | AA 500 | 50. youth* | AA |
| 50. yam | 1 | | |

| CNC List 5 | | CNC List 6 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 1. back* | AA 500 | 1. bad* | AA 1000 |
| 2. bathe* | 39 | 2. bed | AA 1000 |
| 3. beach | A | 3. birth* | A |
| (beech) | (10) | 4. bud* | 30 |
| 4. boot | 37 | 5. cage* | 30 |
| 5. cab* | 15 | 6. calf* | 14 |
| 6. care | AA 500 | 7. cat* | A |
| 7. chalk | 13 | 8. chain* | AA 1000 |
| 8. coal | AA 1000 | 9. cheese* | 45 |
| (cole) | (2) | 10. cool | AA 1000 |
| 9. cup* | AA 1000 | 11. dig* | 43 |
| 10. dawn | A | 12. door | AA 500 |
| 11. dim | 37 | 13. dull* | 48 |
| 12. dock | 16 | 14. fan* | 38 |
| 13. five* | AA 500 | 15. fire | AA 500 |
| 14. food* | AA 500 | 16. get* | AA 500 |
| 15. gaze | A | 17. gone | AA 500 |
| 16. good* | AA 500 | 18. hike* | 10 |
| 17. half | AA 500 | 19. hiss* | 16 |
| 18. hot* | AA 1000 | 20. howl* | 34 |
| 19. hush* | 26 | 21. jam* | 16 |
| 20. juice | 37 | 22. jot [dʒat] | 3 |
| 21. knit* | 30 | 23. knock | A |
| 22. lean | A | 24. lawn | 37 |
| 23. light | AA 500 | 25. live [lɪv] | AA 500 |

EXHIBIT 4 (Continued).

| CNC List 5 | | CNC List 6 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 24. limb | 38 | 26. look* | AA 500 |
| 25. luck | 46 | 27. map* | A |
| 26. match | A | 28. mode* | 23 |
| 27. mean | AA 500 | (mowed) | (6) |
| 28. myth* | 8 | 29. move* | AA 500 |
| 29. nag* | 5 | 30. niece* | 10 |
| 30. nudge* | 2 | 31. night* | AA 500 |
| 31. peg* | 9 | (knight) | (AA 1000) |
| 32. pull | AA 1000 | 32. pace | A |
| 33. purse* | 38 | 33. pole | A |
| 34. raid* | 11 | (poll) | (17) |
| 35. robe* | 31 | 34. pope | 26 |
| 36. rough* | A | 35. raise* | AA 1000 |
| (ruff) | (1) | (raze) | (2) |
| 37. sail | AA 1000 | (rays) | (A) |
| (sale) | (A) | 36. rug* | 40 |
| 38. shop* | AA 1000 | 37. rush* | AA 1000 |
| 39. sing | AA 1000 | 38. search | A |
| 40. sore* | 38 | 39. shock* | A |
| 41. tease | 14 | 40. shone | 34 |
| (teas) | (A) | 41. sit* | AA 1000 |
| 42. tell* | AA 500 | 42. sour* | 15 |
| 43. then* | AA 500 | 43. team | A |
| 44. thought | AA 500 | (teem) | (6) |
| 45. town | AA 500 | 44. tube* | 32 |
| 46. veil | 30 | 45. turn* | AA 500 |
| (vale) | (13) | 46. veal | 5 |
| (vail) | (1) | 47. web* | 14 |
| 47. wire* | A | 48. whip [ʍɪp] | 41 |
| 48. worm | 37 | 49. wife* | AA 500 |
| 49. yoke | 13 | 50. wing | AA 1000 |
| (yolk) | (3) | | |
| 50. zeal | 15 | | |

| CNC List 7 | | CNC List 8 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 1. bet* | 23 | 1. bag | AA 1000 |
| 2. big* | AA 500 | 2. bath* | 46 |
| 3. bun | 4 | 3. bite | 33 |
| 4. call | AA 500 | 4. calm | A |
| 5. caught | AA 1000 | 5. cheap* | A |
| 6. cheek | A | 6. cough | 18 |
| 7. coke | 5 | 7. cub* | 11 |
| 8. did* | AA | 8. daze | 12 |
| 9. doom | 20 | (days) | (AA 500) |
| 10. dumb* | 34 | 9. den | 23 |
| 11. face | AA 500 | 10. dive* | 21 |
| 12. jar* | AA 500 | 11. foam* | 21 |

EXHIBIT 4 (Continued).

| CNC List 7 | | CNC List 8 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 13. fish | AA 1000 | 12. fuss* | 11 |
| 14. geese | 26 | 13. gag | 3 |
| 15. gem* | 24 | 14. gear | 9 |
| 16. gun* | A | 15. gin* | 9 |
| 17. have* | AA 500 | 16. guide | AA 1000 |
| (halve) | (2) | 17. hail | 40 |
| 18. heat* | AA 1000 | (hale) | (7) |
| 19. hole* | AA 1000 | 18. hoop | 8 |
| (whole) | (AA 500) | (whoop) | (7) |
| 20. join | AA 1000 | 19. hurl* | 20 |
| 21. laugh* | AA 500 | 20. jerk | 18 |
| 22. led* | AA 1000 | 21. lash* | 22 |
| 23. loot | 3 | 22. learn | AA 500 |
| 24. lose* | AA 1000 | 23. loathe | 7 |
| 25. mine | AA 1000 | 24. lock | A |
| 26. mole | 14 | 25. moss | 22 |
| 27. mouth* | AA 1000 | 26. muff* | 5 |
| 28. nap* | 15 | 27. near | AA 500 |
| 29. neck* | AA 1000 | 28. noose* | 2 |
| 30. note* | AA 500 | 29. page* | AA 1000 |
| 31. pass* | AA 500 | 30. poor | AA 500 |
| 32. pearl* | 47 | 31. pose | 10 |
| 33. pine | A | 32. rain | AA 1000 |
| 34. reach* | AA 500 | (reign) | (44) |
| 35. rib* | 31 | 33. real* | AA 500 |
| 36. ridge* | 31 | (reel) | (19) |
| 37. sack* | 30 | 34. road* | AA 500 |
| (sac) | (1) | (rode) | (A) |
| 38. save | AA 1000 | (rowed) | (A) |
| 39. shall | AA 500 | 35. rot* | 8 |
| 40. side* | AA 500 | 36. sad | A |
| (sighed) | (A) | 37. seek | AA 1000 |
| 41. such* | AA 500 | 38. shawl | 9 |
| 42. sure | AA 500 | 39. shoot | A |
| 43. tape | 8 | 40. some | AA 500 |
| 44. tar | 10 | 41. there* | AA 500 |
| 45. third | AA 1000 | (their) | (AA 500) |
| 46. top | AA 1000 | 42. thing | AA 500 |
| 47. vague* | 20 | 43. tin | 36 |
| 48. was | AA 500 | 44. tip* | A |
| 49. wit | A | 45. touch* | AA 1000 |
| 50. young | AA 500 | 46. vowel | 5 |
| | | 47. wake* | A |
| | | 48. week* | AA 500 |
| | | (weak) | (A) |
| | | 49. wet | A |
| | | 50. wheat* [ʌit] | A |

EXHIBIT 4 (Continued).

| CNC List 9 | | CNC List 10 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 1. ball* | AA 1000 | 1. bake | A |
| (bawl) | (6) | 2. bit* | AA 1000 |
| 2. beat | AA 1000 | 3. burn | AA 1000 |
| (beet) | (11) | 4. cause | AA 500 |
| 3. book* | AA 500 | (caws) | (4) |
| 4. both | AA 500 | 5. cave* | · 33 |
| 5. catch* | AA 1000 | 6. chat* | 12 |
| 6. chair* | AA 1000 | 7. chill* | 43 |
| 7. cheer | A | 8. coin | A |
| 8. curve* | 36 | 9. cone | 7 |
| 9. cut* | AA 500 | 10. death* | AA 1000 |
| 10. deck* | A | 11. deep* | AA 1000 |
| 11. dish* | A | 12. din* | 11 |
| 12. dog* | AA 1000 | 13. fine* | AA 500 |
| 13. feet* | AA 500 | 14. fool* | AA 1000 |
| (feat) | (13) | 15. gore | 7 |
| 14. fudge* | 1 | 16. guess* | AA 1000 |
| 15. girl | AA 500 | 17. hair | AA 1000 |
| 16. got* | AA 500 | (hare) | (18) |
| 17. ham | 17 | 18. hit* | A |
| 18. haze | 5 | 19. hurt* | AA 1000 |
| (hays) | (46) | 20. jade* | 4 |
| 19. hen | 49 | 21. judge* | AA 1000 |
| 20. jazz* | 5 | 22. load | A |
| 21. lack | A | (lode) | (1) |
| 22. lathe* | 2 | 23. loose* | A |
| 23. lip* | AA 1000 | 24. lot | AA 1000 |
| 24. loaf | 17 | 25. lung | 15 |
| 25. mire | 7 | 26. meek | 7 |
| 26. mob | 20 | 27. mood* | 27 |
| 27. mud* | 47 | 28. mouse | 34 |
| 28. nail | A | 29. neat* | 29 |
| 29. need* | AA 500 | 30. nick* | 5 |
| (knead) | (5) | 31. palm | 37 |
| 30. pill | 7 | 32. path* | AA |
| 31. power | AA 500 | 33. peak | 28 |
| 32. pun* | 1 | (peek) | (3) |
| 33. rag* | 28 | 34. pile* | A |
| 34. reap* | 14 | 35. ride* | AA 1000 |
| 35. roof [ruf] | AA | 36. rob* | 41 |
| 36. sane | 11 | 37. rope* | A |
| 37. shade* | AA 1000 | 38. run | AA 500 |
| 38. shout* | AA 1000 | 39. safe | AA 1000 |
| 39. sin* | A | 40. sag* | 5 |
| 40. soap* | 37 | 41. sell* | AA 1000 |
| 41. thine* | 19 | 42. shack* | 7 |
| 42. time* | AA 500 | 43. sub | 1 |
| 43. tick* | 12 | 44. term | A |

EXHIBIT 4 (Continued).

| CNC List 9 | | CNC List 10 | |
|---|---|---|---|
| *Word* | *Frequency* | *Word* | *Frequency* |
| 44. tool | 40 | 45. thatch | 6 |
| 45. voice | AA 500 | 46. towel | 18 |
| 46. watch* | AA 500 | 47. wash* [wɔʃ] | AA |
| 47. white* [ʍaɪt] | AA 500 | 48. while [ʍaɪl] | AA 500 |
| 48. word | AA 500 | 49. witch | 24 |
| 49. wrong | AA 500 | 50. your [jur] | AA 500 |
| 50. yes* | AA 500 | | |

*Also included in PB lists.

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## EXHIBIT 5: TILLMAN AND CARHART NORTHWESTERN UNIVERSITY AUDITORY TEST 6.

| List I | | List II | |
|---|---|---|---|
| 1. BEAN | 26. MET | 1. BITE | 26. MERGE |
| 2. BOAT | 27. MODE | 2. BOOK | 27. MILL |
| 3. BURN | 28. MOON | 3. BOUGHT | 28. NICE |
| 4. CHALK | 29. NAG | 4. CALM | 29. NUMB |
| 5. CHOICE | 30. PAGE | 5. CHAIR | 30. PAD |
| 6. DEATH | 31. POOL | 6. CHIEF | 31. PICK |
| 7. DIME | 32. PUFF | 7. DAB | 32. PIKE |
| 8. DOOR | 33. RAG | 8. DEAD | 33. RAIN |
| 9. FALL | 34. RAID | 9. DEEP | 34. READ |
| 10. FAT | 35. RAISE | 10. FAIL | 35. ROOM |
| 11. GAP | 36. REACH | 11. FAR | 36. ROT |
| 12. GOOSE | 37. SELL | 12. GAZE | 37. SAID |
| 13. HASH | 38. SHOUT | 13. GIN | 38. SHACK |
| 14. HOME | 39. SIZE | 14. GOAL | 39. SHAWL |
| 15. HURL | 40. SUB | 15. HATE | 40. SOAP |
| 16. JAIL | 41. SURE | 16. HAZE | 41. SOUTH |
| 17. JAR | 42. TAKE | 17. HUSH | 42. THOUGHT |
| 18. KEEN | 43. THIRD | 18. JUICE | 43. TON |
| 19. KING | 44. TIP | 19. KEEP | 44. TOOK |
| 20. KITE | 45. TOUGH | 20. KEG | 45. TURN |
| 21. KNOCK | 46. VINE | 21. LEARN | 46. VOICE |
| 22. LAUD | 47. WEEK | 22. LIVE | 47. WAG |
| 23. LIMB | 48. WHICH | 23. LOAF | 48. WHITE |
| 24. LOT | 49. WHIP | 24. LORE | 49. WITCH |
| 25. LOVE | 50. YES | 25. MATCH | 50. YOUNG |

EXHIBIT 5 (Continued).

| List III | | List IV | |
|---|---|---|---|
| 1. BAR | 26. HOUSE | 1. BACK | 26. HOB |
| 2. BASE | 27. NAME | 2. BATH | 27. HOOD |
| 3. BEG | 28. NOTE | 3. BONE | 28. NEAR |
| 4. CAB | 29. PAIN | 4. CAME | 29. NEAT |
| 5. CAUSE | 30. PEARL | 5. CHAIN | 30. PASS |
| 6. CHAT | 31. PHONE | 6. CHECK | 31. PEG |
| 7. CHEEK | 32. POLE | 7. DIP | 32. PERCH |
| 8. COOL | 33. RAT | 8. DOG | 33. RED |
| 9. DATE | 34. RING | 9. DOLL | 34. RIPE |
| 10. DITCH | 35. ROAD | 10. FIT | 35. ROSE |
| 11. DODGE | 36. RUSH | 11. FOOD | 36. ROUGH |
| 12. FIVE | 37. SEARCH | 12. GAS | 37. SAIL |
| 13. GERM | 38. SEIZE | 13. GET | 38. SHIRT |
| 14. GOOD | 39. SHALL | 14. HALL | 39. SHOULD |
| 15. GUN | 40. SHEEP | 15. HAVE | 40. SOUR |
| 16. HALF | 41. SOUP | 16. HOLE | 41. SUCH |
| 17. HIRE | 42. TALK | 17. JOIN | 42. TAPE |
| 18. HIT | 43. TEAM | 18. JUDGE | 43. THUMB |
| 19. JUG | 44. TELL | 19. KICK | 44. TIME |
| 20. LATE | 45. THIN | 20. KILL | 45. TIRE |
| 21. LID | 46. VOID | 21. LEAN | 46. VOTE |
| 22. LIFE | 47. WALK | 22. LEASE | 47. WASH |
| 23. LUCK | 48. WHEN | 23. LONG | 48. WHEAT |
| 24. MESS | 49. WIRE | 24. LOSE | 49. WIFE |
| 25. HOP | 50. YOUTH | 25. MAKE | 50. YEARN |

## NUMBER OF RESPONSE ALTERNATIVES

Another factor affecting the quantitative intelligibility score is the number of response alternatives. As far as word tests are concerned, the first practical multiple-choice answer sheet test was developed by Haagen (1946) and used extensively at the Navy Electronics Laboratory in applied studies on competing messages (in air control towers), see Webster and Thompson (1954). These tests were updated and used extensively by Black, Tolhurst, and Morrell (1953) and Black (1957) at the USN School of Aviation Medicine. Black's list and the answer sheet foils are shown in exhibit 6.

In these tests the talker is given a list of words to read and the listeners mark prepared blanks on which each word read appears as one of four similar words. The listeners require no special training: the talker reads three words, then pauses 2 seconds, allowing time for the listener to respond. This is a relatively short-duration test of about 1 minute for 27 words. It is not phonetically balanced.

Extensively used phonetically-balanced, limited-choice, answer-sheet tests have been developed by Fairbanks (1958), House et al (1965), and Kreul et al (1968). Exhibits 7 and 8 show the 250 Fairbanks (1958) words, an answer sheet, and the methods used to construct talker lists and randomization. In general, there is a one-out-of-five chance of guessing the

# EXHIBIT 6: BLACK'S MULTIPLE-CHOICE WORD TESTS

**Speaker 1 is _____**

| | | | |
|---|---|---|---|
| 1 | groove / drew* / crew / grew | modern / moderate / modesty* / modest | vice / light* / mice / bite |
| 2 | say / stay / stayed* / spade | forbade / pervade / surveyed / survey* | chink / kink* / check / chin |
| 3 | stung / stun / sun / stunned* | drunk / grunt / brunt / runt* | intent / intend / content / intense* |
| 4 | quench / went / whence / when* | busy / physics* / physic / visit | wade* / waves / wave / way |
| 5 | pass / past* / cast / task | clearly / weary* / quarry / query | fine / find* / sign / kind |
| 6 | popular / poplar / hopper* / opera | nurse / first* / birth / burst | get / gap / guess / guest* |
| 7 | immense / commence / emit / cement* | named / name / main* / knave | only / woman* / pullman / omen |
| 8 | latter / ladder* / lattice / rabbit | last / lash / laugh* / glass | swain* / slain / flame / plain |
| 9 | crash / crab / craft / crack* | gold / bowl / cold* / bold | pail* / poor / polo / palace |

**Speaker 2 is _____**

| | | | |
|---|---|---|---|
| 1 | ninety / nineteen / nightly* / nine | drum / rung / rum* / run | harrow / peril / herald* / arrow |
| 2 | ran / rank* / rang* / rag | putter / tucker* / pocket / pucker | need / lead / lean / leave* |
| 3 | kick / tick* / pick / hick | sec* / seed / siege / seize | depot / people / equal* / decoy |
| 4 | shower / scholar / sour* / scour | earthen / earthly / urban* / bourbon | bath / bat* / bad / back |
| 5 | berry / carry / bearing* / very | spring / pray* / spray / spread | listless / mistress* / restless / blissful |
| 6 | mouse / mouth / now / mount* | Saturn / sat / second / satin* | fog* / bar / bog / bug |
| 7 | quarter / fortress / portrait / porter* | felt* / belt / dealt / bell | horrible / orchid / orphan / organ* |
| 8 | heavy / happen* / package / happy | did / live / led* / lid | dollar / jealous* / zealous / develop |
| 9 | hamper / pamper / panther* / pamphlet | tendon / tender / pendant* / pendulum | pond / on / hound* / pawn |

**Speaker 3 is _____**

| | | | |
|---|---|---|---|
| 1 | apply / supply / amply* / fly | gift* / if / hit / it | lamp / lance / glance* / land |
| 2 | bust / fuss* / but / bus | handle* / anvil / amble / ample | free / freeze / freed / tree* |
| 3 | airy / hairy* / arid / carry | fed / stead* / spend / sped | laugh / glad* / lash / flash |
| 4 | throw / froze / prose / probe* | low / rose / loathsome / lonesome* | rod* / brown / brow / proud |
| 5 | desk / depth / dead / death* | stance / stand* / stamp / spent | science / silent / sound / silence* |
| 6 | broke / growth* / throat / wrote | code / told / cold / coal* | begun* / begot / forgot / deduct |
| 7 | sister / system* / cistern / pistol | hulk* / halt / pulp / fault | mild / mile* / miles / mine |
| 8 | strike / spite / fight* / spike | limp / limb / lend* / lent | town / townsman / bondsmen / count* |
| 9 | paid / page* / age / haze | cute / cunning* / honey / puny | fell / spell / felled* / bell |

**Speaker 4 is _____**

| | | | |
|---|---|---|---|
| 1 | much / mud / month / monk* | uplift / uproot* / approve / group | cypress / cipher / siphon / sightless* |
| 2 | twelve / well* / dwell / weld | mind* / mild / mine / line | blister / blissful / listful* / wistful |
| 3 | wren / went / rent / lent* | barter / barker / sparkle / parker* | found / crown* / cloud / clown |
| 4 | guide / die / died* / dive | lively / widen* / wisely / widely | love* / lull / low / lag |
| 5 | stove / sold / stole / soul* | amiss / omit / amid / emit* | equipped / acquit / equip* / quit |
| 6 | reverse / traverse* / perverse / pervert | sired* / siren / fire / sire | simple / dimple / pimple* / temple |
| 7 | drove / stroke* / strode / strove | warrant / one / warm / warn* | dog / gone / don / darn* |
| 8 | fire / hire* / tired / tire | stale / jail / dale / gale* | evil / easel* / measles / needle |
| 9 | gaily / fail / daily* / five | barn / bark / bought* / spark | lip / hit / lisp / list* |

**Speaker 5 is _____**

| | | | |
|---|---|---|---|
| 1 | crash / drag / trash / thrash* | least / lease / niece* / leaf | wouldn't / wood / wooden / wooded* |
| 2 | pillow / pillar / killer* / filler | peg / keg / egg / pay* | loosely / gruesome / loosen / nuisance* |
| 3 | lava / loud / lock / robber* | wait / which / wake* / wig | hour / how / howl* / owl |
| 4 | glad / lad / laugh / lag* | fable / tablet / habit / cattle* | part / art / heart / arch* |
| 5 | puncture / teacher / tincture / picture* | sigh* / size / side / scythe | bake / bait* / fate / faith |
| 6 | tempt / tense / lent / hemp* | green / cream / free / creed* | seller / solemn* / solid / sullen |
| 7 | youth / you / use / mute* | allege / away / allayed* / allay | muster / lusty / bluster* / luster |
| 8 | tight* / pike / height / hike | birds / bird / birth* / burden | chat* / cap / check / chap |
| 9 | devise / defy / divide / beside* | chaff* / shaft / chap / shack | Ed* / head / add / ebb |

**Speaker 6 is _____**

| | | | |
|---|---|---|---|
| 1 | feel / deal / steal / veal* | fruit* / true / troop / truth | pelvis* / elder / elbow / eldest |
| 2 | tasty / hasty / hasten / pastry* | sheep / shield / she / sheath* | add / ask / as / has* |
| 3 | wrist* / risk / rip / list | depth* / death / deal / guest | fortune / fort* / important / forty |
| 4 | shoe / choose / too* / chew | defense / methinks / repent / bethinks* | hamper / tamper / hampered* / hamburg |
| 5 | led / red / ledge / leg | palace / palate / talent* / pilot | stow / stole / stowed* / stove |
| 6 | butter / flutter / flood / fluttered* | heat / hate* / paint / ink | tick / chicken* / ticket / picket |
| 7 | thumb / from* / come / sum | coy / toy / tore / torque* | auto / bottom / often* / autumn |
| 8 | bower / borrow / flower* / power | fast / fact / fat / that* | sit / six / sick / sift* |
| 9 | deceive / precede / concede* / receive | cars* / carve / card / car | heard / verge* / urge / herb |

Correct responses (items) are underlined and the items of alternate lists are designated by asterisks.

EXHIBIT 6 (Continued).

## Speaker 7 is_____

| | | |
|---|---|---|
| **1** providence | worse | pledge* |
| problem | work | sled |
| promise | worst | sledge |
| province* | worth* | sleigh |
| **2** row | wearing* | stomach |
| throw | wearer | staunch |
| grove* | wary | stark |
| grow | wear | starch* |
| **3** suffer | scram | grandsire |
| zipper | swing | grandstand |
| supper* | slam* | transpire* |
| zephyr | swam | grandchild |
| **4** bathe | reverse | anew |
| save* | invert* | unused* |
| space | divert | amuse |
| spade | revert | unuse |
| **5** depth | dangling | bristle |
| deck | sandy | brittle |
| death* | sandwich* | ripple |
| debt | sanguine | riddle* |
| **6** attend* | bold | steward |
| akin | fold | sewer |
| attempt | bowl* | stool |
| again | hole | Stewart* |
| **7** break | spurt | increase |
| rate* | stirrup | entreat |
| rape | sterile | retreat |
| rake | syrup* | intrigue* |
| **8** tack | souse* | mystery |
| tax | south | mystic |
| facts* | sound | mischief |
| tact | sack | misty* |
| **9** anew | bake | rhythm |
| balloon | date* | written* |
| aloof* | bait | ridden |
| allude | fake | ribbon |

## Speaker 8 is_____

| | | |
|---|---|---|
| **1** eighty | trump* | irk* |
| acre | front | hurt |
| aching* | truck | earth |
| eight | trunk | heard |
| **2** delude | head* | gauge |
| remove | edge | gaze |
| elude | hedge | gave |
| renew* | egg | gay* |
| **3** can't | arm | flatter* |
| scant | armed* | climate |
| scamp | on | planet |
| scan* | odd | plant |
| **4** find | purse* | fitness |
| bind | burst | thickness |
| vine* | hurt | sickness* |
| fine | first | picnic |
| **5** dumb | bedroom | royal |
| gum* | reverend* | broil |
| dump | brother | broiled* |
| done | brethren | boil |
| **6** snout | wide | afford* |
| smelt* | why | abhor |
| snub | wise | accord |
| snap | ride* | afore |
| **7** stead | price | bury |
| dead | Christ* | barely |
| sped* | fight | fairly |
| bed | strike | fairy* |
| **8** white | gown | error |
| poison | down | errand |
| hoist | gam | barren |
| voice* | gauze* | Arab* |
| **9** next* | racket* | drab |
| nets | blacken | draft |
| mix | blackened | graft |
| neck | black | grab* |

## Speaker 9 is_____

| | | |
|---|---|---|
| **1** bite | abhor | pulse |
| bike | applause | fault |
| vice | applaud | pulp |
| fight* | apply* | false* |
| **2** apace | runny | goose |
| attain | rubbish | noose |
| face | ready | use |
| aface* | ruddy* | deuce* |
| **3** bruise | by | rather |
| brood | spy* | letter |
| brew* | fire | lever* |
| cruise | five | leather |
| **4** bramble | love | hence |
| scramble | mark* | tense |
| gravel* | large | tent |
| ramble | lark | hint* |
| **5** stain | patron | train* |
| stink | patient* | crane |
| sting | hasten | brain |
| sing* | paper | frame |
| **6** groom | cub | listen |
| prune | tug | christen |
| broom | tough* | Christmas |
| room* | tub | prison* |
| **7** handsome | parcel | fear* |
| cancer* | hardly | peer |
| camphor | partly* | hear |
| cancel | parsley | tear |
| **8** suit | cotton | neither* |
| soon* | coffin | meter |
| soothe | coffee | meager |
| sue | copy* | leader |
| **9** steam | hump | exalt* |
| seen | hunt | result |
| speed | pump | gulf |
| esteem* | punk* | exhaust |

## Speaker 10 is_____

| | | |
|---|---|---|
| **1** artist | vesper* | knoll |
| harness* | fester | known |
| harvest | pester | no |
| orchid | festive | mold* |
| **2** simple | bomb | Boston |
| sinful | bound | frosty |
| summon | bond | frosting* |
| stomach* | barn* | cross |
| **3** litter | wrestle | pope |
| little | rascal | hope |
| glitter* | rapture | oak |
| liquor | raffle* | post* |
| **4** main* | twelve | march |
| mink | welt | margin |
| make | wealth* | marching |
| mate | twelfth | Martin* |
| **5** lengthen | geese | rain* |
| ointment | cast | wing |
| Lincoln* | meat* | green |
| link | yeast | ring |
| **6** bud | rough | hearing |
| bus* | drunk | hairy* |
| bust | rump | carry |
| but | rum* | herring |
| **7** pleasant | widen | saint |
| pheasant | wide | safe |
| peasant* | wife | faint |
| present | wagon* | sink* |
| **8** winter* | model | log |
| winner | marvel | lawn |
| where | marvelous | blond |
| woman | marble* | long* |
| **9** lose* | itself | mash* |
| loose | excel | gnash |
| loot | sell | smash |
| blue | himself* | nag |

## Speaker 11 is_____

| | | |
|---|---|---|
| **1** toward | feeling | dome |
| forge | dealer* | don't* |
| ford | fever | zone |
| board* | feeler | stone |
| **2** destroy* | girl | flicker |
| deprive | pearl | clipper |
| defraud | curled* | liquor |
| defrost | curl | quicker* |
| **3** chart* | frightful* | sultry |
| short | rifle | culprit |
| shark | greatful | sculpture* |
| sharp | rightful | sculptor |
| **4** native | pearl | calf |
| navy* | crow | cad* |
| naked | throw* | calves |
| nature | grow | cab |
| **5** lathe | candy | ink |
| lay | pantry | pinch |
| laid* | pansy | inch |
| leg | handy* | hint* |
| **6** thus | legend | hit |
| bust | ledger | fist |
| duck | leaden* | this* |
| dust* | lesson | kiss |
| **7** bulb | cut | net |
| bulge | carpet | met* |
| bald* | cotton | neck |
| ball | copper* | nest |
| **8** breast | Capital | glass* |
| friend* | hapless | lad |
| breath | hatless | blast |
| bread | happen | black |
| **9** harbor | soft | hood* |
| harder | sought | could |
| ardor | salt | put |
| artist* | sulk* | good |

## Speaker 12 is_____

| | | |
|---|---|---|
| **1** needle | large | haven* |
| evil | lodge | heaven |
| meal* | lie | even |
| neither | live* | able |
| **2** dimple | interest | cast |
| gentle | penguin | past |
| devil* | hindrance | pass* |
| dental | kindred* | path |
| **3** armload | pen* | wooden* |
| armholed | ten | woody |
| armhole | tend | wood |
| armful | tent | witty |
| **4** gem | glaze | creeping |
| gent | play | greeting* |
| gin | blade | greedy |
| gym* | blaze* | reading |
| **5** flush | size | waitful* |
| pledge | sigh | wake |
| fresh | scythe* | wasteful |
| flesh | side | wakeful |
| **6** auburn | astride | dial* |
| often | ascribe | guile |
| author* | prescribe | vial |
| autumn | describe* | guide |
| **7** nest | rug | harrow* |
| ness | love | herald |
| meant* | rough* | arrow |
| met | rub | peril |
| **8** gram | bench* | nuptial* |
| raise | theft | nocturnal |
| raid | fetch | nutshell |
| rage* | thatch | neptune |
| **9** flapper | stole* | wallet |
| leopard | stone | swallow* |
| leper* | school | wall |
| letter | scold | wallow |

21

## EXHIBIT 6 (Continued).

### Speaker 13 is

| | | | |
|---|---|---|---|
| 1 | virtue / merchant*land / virgin / burden | blend / _ / when* / lend | fort* / dwarf / thwart / quart |
| 2 | birth / first / verse / burst* | casual / passion / peasant* / pageant | bud / bug / budge / fudge* |
| 3 | wench / quench / clinch* / went | caught / pot* / hot / fox | bottle / vomit / bomber / bonnet* |
| 4 | pious / highest / bias* / higher | beat* / beef / eat / deep | loop / root / loose / roof* |
| 5 | deface* / debate / base / debase | bridle* / vital / rifle / Bible | beach / seed / see* / siege |
| 6 | flare / fire / fighter* / player | pose / hose / cold / hold | left / laugh / let* / lamp |
| 7 | stun / stung / sun / sung* | peppy* / heavy / petty / penny | bring* / break / brink / drink |
| 8 | frankness / Franklin / practice* / frankly | foil / boil / toil / coil | callo is / palace / pilot / palate |
| 9 | craze / phrase* / praise / pray | limit / women / linen / lemon | third* / thoroughly / heard / bird |

### Speaker 14 is

| | | | |
|---|---|---|---|
| 1 | mouse / mountain / mount / mouth* | drink / bring / brink / spring* | towel* / Holland / tallow / hallow |
| 2 | quarter / porter / order* / border | dove / dope / dough / dull* | cook / approach / croak* / broke |
| 3 | dull / gulf / gull* / dog | detect / effect / deflect / defect* | hinge* / tinge / pin / king |
| 4 | effect / infect / inspect / confess* | goat / scope / spoke* / stake | hash* / add / ask / ash |
| 5 | root / group / droop* / roof | wash / watch / why / walk* | doubtless* / thoughtless / dauntless / darkness |
| 6 | shell / chow / shall* / child | try / cry / fry / pry* | staple* / table / stable / spacious |
| 7 | sudden / sun / seven / southern* | front* / punch / punt / hunt | cause / cause* / guard / dog |
| 8 | cuss / put / puss* / push | given / dream / greed / grieve | razor / raisin / reason / brazen |
| 9 | talk / toss / laugh* / hat | happy / utter / happily / athletic* | repress / depress* / regret / request |

### Speaker 15 is

| | | | |
|---|---|---|---|
| 1 | urge / heard / purge / courage* | envy* / engine / ending / pending | cobweb / cobbler / problem / copper* |
| 2 | scallop / scholar / scout / gallop* | gild* / fill / hill / ill | fog / five / bog* / by* |
| 3 | bless* / less / left / last | often / author / auto / offer* | perish / parent / carrot* / parrot |
| 4 | bridge / rich* / ridge / rig | downing* / doubt / downy / down | grace / brake / brace / great* |
| 5 | even / beacon* / deacon / deepen | fear / beer / beard / dear* | deluge / elude / delude* / village |
| 6 | settle / subtle / settled* / seven | list / lisp / left* / lip | gallon* / gallop / galley / gallant |
| 7 | hung / hum / tongue* / come | listful* / wistful / whisper / wishful | day* / bay / days / bathe |
| 8 | meager / maker / meter / eager | kill / till / fill / pil | brook / rook / cook / roof |
| 9 | caught / talk / taught / trough* | bring / grin* / brim / grim | repute / refuse / refute / compute |

### Speaker 16 is

| | | | |
|---|---|---|---|
| 1 | decides / besides / beside / decide* | hate / taste / hast / paste* | pamper / tamper* / hamper / pamphlet |
| 2 | spinach / clinic / senate* / cynic | all / fog / fall / hall | dozed / dove / goes* / doze |
| 3 | litter / lizard / whether / blizzard | fat / back / spat / stack* | mouth / moss / moth / malt |
| 4 | in / hinge / pin / king* | rubbish / radish / reddish / ready* | hate / take / cake* / intake |
| 5 | scared* / secret / safety / sacred | aid / aim / paid / age* | lava / Florida / larva / larger |
| 6 | plant / slam / slant / plan* | Farley* / barley / parley / Harley | cloth* / fall / flog / flaw |
| 7 | passing / after* / apple / acid | foundry / founder* / bounder / flounder | crawled / craw / frog / crawl |
| 8 | content / contest / contact / convent* | Dick / dig / gig / big* | rapid / rattle / wrapper / grapple |
| 9 | cause / poise / pause* / car | atom / abbot / habit / avid* | toward / torn / tore / board |

### Speaker 17 is

| | | | |
|---|---|---|---|
| 1 | lurch* / work / lurk / alert | faces* / baker / basic / basis | shuffle / shudder* / shutter / shuttle |
| 2 | sought* / sock / sun / stop | muster / rustic / rusty* / rustle | hard / card / tarred* / car |
| 3 | only / olden / older* / golden | horn / corn / form* / thorn | fruit / root / brute / group |
| 4 | island / highland / pilot / pylon* | flange / plan / clam / planned | shelf / shout / shelve / shell |
| 5 | bondage / abandon / bandit / bandits* | ten* / pen / pin / pinned | blimp / blink / bleak / link |
| 6 | cat / hat / cap* / catch | line* / lying / flying / lion | theft / heck / peck / pet* |
| 7 | rim / brim / grim / grin* | gobble / goblet / goggle / gobbled | cleft / theft* / crept / slept |
| 8 | bed / did* / dead / bid | spill / still / spilled* / fill | counting* / bounty / country / county |
| 9 | mail / maiden / neighbor / maybe* | earl / pearl / burrow* / girl | horn / torn / thorn* / corn |

### Speaker 18 is

| | | | |
|---|---|---|---|
| 1 | summer / summon / summit / summon* | man / mass / mask / mad* | bun / fun / front / fund |
| 2 | lighter* / spider / fighter / piker | roller / rolling / roll / roar* | none / mountain / now / numb |
| 3 | verbal / burble / gurgle / purple | breeze* / greed / breathe / grieve | eat / heat / feet / peak |
| 4 | fried / try / tribe* / tried | plus / flood / bust / pluck | child / childish / childless / childhood |
| 5 | we / read / weed / weave | retold / refold / threefold / repose* | guess / guest / gas / get |
| 6 | sofa / soap / silver / sober | hate / cape* / cake / case | best / bet / desk / theft |
| 7 | lung* / love / drunk / lump | hurt / turn / turf / Turk* | pardon* / hardly / harden / hard |
| 8 | shilling / chilling* / chilly / killing | falcon* / pulpit / culprit / poker | mark / mock / lock / mop |
| 9 | gag / gad / gas / gab | nap / nest / mess / net* | allow / aloft / lock / allot* |

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EXHIBIT 6 (Continued)

**Speaker 19 is** ............. ..

| 1 | pleasing* | wolf | chap* |
|---|---|---|---|
| | easy | wolves* | chaff |
| | fleecy | wore | chat |
| | sleepy | wool | check |
| 2 | yule | noise | hem |
| | fuel* | snow | hemp |
| | new | snowy | pen* |
| | mule | snowing* | hemmed |
| 3 | field | woodland | curse |
| | deal | wooden | hearse* |
| | heel* | wouldn't | purse |
| | feel | woodman | perch |
| 4 | farm | heel | tighten |
| | harm | feel | type |
| | pawn | yield* | tight* |
| | arm* | eel | title |
| 5 | mouthful | palm | lip |
| | mirthful | calm | lick |
| | Myrtle | pound | lift* |
| | merciful* | come* | lit |
| 6 | shaky | face | glow |
| | shady | fate | blow |
| | shade | faith* | slow |
| | shaving* | base | flow* |
| 7 | raw | buy | enjoying* |
| | drawl | bought | enjoin |
| | brawl | box | enjoyment |
| | draw* | fought* | enjoy |
| 8 | hairy | kind | paid |
| | fairy | mind | hey* |
| | carriage | pine | pay |
| | carry* | time* | key |
| 9 | soothe | whence | sweep* |
| | sue | glimpse | sweeten |
| | suit | bliss | sweet |
| | soon* | blimp* | sweetened |

**Speaker 20 is** ...... ..... .... ...

| 1 | scout | weed* | rider* |
|---|---|---|---|
| | spouse | weave | lighter |
| | bout* | reed | writer |
| | spout | leave | writing |
| 2 | needy | put* | clean |
| | meeting | foot | please |
| | easy | book | plead* |
| | need* | cook | flea |
| 3 | pick | snuck | naive* |
| | detect | snub* | name |
| | depict | snow | maid |
| | eclipse* | snuff | nave |
| 4 | fold* | logic* | string* |
| | cold | logging | strain |
| | hold | lodging | strange |
| | hole | Roger | drain |
| 5 | brazen | brought | scald* |
| | break | broad | gull |
| | great | drop | stall |
| | raisin* | drought* | skull |
| 6 | hot | course | tenant* |
| | not* | force | penance |
| | pet | horse | pennant |
| | plot | forest* | tennis |
| 7 | mission* | troll | doomed* |
| | vision | toll* | dune |
| | fisher | told | do |
| | bishop | crawl | doom |
| 8 | soft | barren* | court |
| | sought | bear | courts* |
| | sauce | bearer | corpse |
| | saw* | barrel | torch |
| 9 | fill | defile | wreck |
| | built | file | wrench |
| | guild* | defy* | wretch* |
| | bill | devise | rest |

**Speaker 21 is** ... ... . . . . .... .

| 1 | far* | want | late* |
|---|---|---|---|
| | barn | one | like |
| | farm | wanton | light |
| | arm | wanted* | right |
| 2 | unstained | wasp | dog |
| | insane | watch | dull |
| | unseen | lost | gull |
| | unstain* | what* | doll* |
| 3 | vowel | hammer | elf* |
| | bow | hemlock* | held |
| | vow* | cannon | elm |
| | valve | hammock | elves |
| 4 | spouse | cost | platter |
| | astound | cross | planter |
| | espouse | frost* | planted |
| | espoused* | fraud | lantern* |
| 5 | tongue | tall | viper |
| | hung | called | piper* |
| | hum | call* | lighter |
| | ten* | solve | vital |
| 6 | wet* | time | icing |
| | west | ton | icy |
| | wept | come* | ice |
| | weapon | tongue | item |
| 7 | author | vest | thought |
| | offer | best* | box |
| | often* | theft | fox |
| | office | desk | fought* |
| 8 | prune | mouth* | reduce |
| | crude | month | review |
| | true | mumps | refute* |
| | prove* | monk | rebuke |
| 9 | fuse | pity | saved |
| | feud | city | save |
| | hue | tippy | say |
| | few* | fitting* | sage* |

**Speaker 22 is** .... ......... ..........

| 1 | jig | right | lay* |
|---|---|---|---|
| | gate | brighten | blade |
| | dig* | frighten* | blaze |
| | gig | bright | glaze |
| 2 | safer | worn | lift |
| | savor | one* | lick |
| | favor* | wand | lit* |
| | saber | blend | lip |
| 3 | decay | gross | smile |
| | debate | growth | smart |
| | efface* | group | smock |
| | deface | broke* | mock* |
| 4 | wool | blast* | village |
| | woe | glad | visit* |
| | wove* | glass | busy |
| | low | black | vivid |
| 5 | plain | room | gold |
| | playmate | loom* | go |
| | plainly* | move | dull |
| | plainness | moon | dough* |
| 6 | rigid | lion | bit |
| | bridges* | why | fit* |
| | frigid | wind* | disc |
| | tribute | wine | dip |
| 7 | mortar | flood | press |
| | marble* | luck | crept |
| | mortal | blunt* | crest* |
| | morbid | bluff | pressed |
| 8 | does | bend* | resort* |
| | bud* | gem | export |
| | buzz | dim | absorb |
| | bug | den | exhort |
| 9 | lesson | bud* | sold |
| | glisten* | bug | so |
| | blessing | buzz | scold |
| | blessed | budge | sole* |

**Speaker 23 is** .... ......... ..........

| 1 | long | ask | vulture |
|---|---|---|---|
| | round | act | bolster* |
| | loud | hat | also |
| | lounge* | ax* | vulgar |
| 2 | puzzle | might | able |
| | huddle | nice | table |
| | cuddle* | knife* | fable* |
| | puddle | night | cable |
| 3 | ounce | bless | earthly |
| | out | less* | virtue |
| | house* | bled | virgin* |
| | bounce | blessed | urgent |
| 4 | omit | flow | jade* |
| | commit* | slow | jail |
| | commenceblow* | glow | jay |
| | permit | | jig |
| 5 | tiny | bran | blunder* |
| | kindly | brand* | plunger |
| | hang | grand | plunder |
| | timing* | brass | thunder |
| 6 | purpose | string* | keeper |
| | propose | strength | caper |
| | oppose | strain | taper* |
| | suppose* | strange | paper |
| 7 | frighten | guise | tremble* |
| | brightness | guide | several |
| | greatness | dies | trouble |
| | breakfast* | dive* | treble |
| 8 | bland | hem* | smithy* |
| | land* | hand | Smitty |
| | plan | end | smitten |
| | gland | hen | Smith |
| 9 | flack* | gave* | merit |
| | flat | gain | match |
| | black | gave | marriage* |
| | blast | gay | marry |

**Speaker 24 is** ... ......

| 1 | wax | herb | glance |
|---|---|---|---|
| | waxing* | hurt | glass |
| | waxy | urge | gland |
| | waxen | heard* | glands* |
| 2 | home | and | speaker |
| | roam | end | teacher |
| | own | an | feature |
| | old* | hand* | Beecher* |
| 3 | screen | lying* | love* |
| | free* | line | log |
| | spree | lion | lost |
| | spring | lining | loud |
| 4 | length* | bank | whiskey |
| | link | thank | trip |
| | leak | sank* | drifting* |
| | blink | think | thrifty |
| 5 | yea | basin | move |
| | gave | hasten | mood |
| | gale | basement | lewd |
| | gay* | basic | smooth* |
| 6 | follow | stuffed | brought* |
| | folly | stuff | wrought |
| | bother* | stop | rock |
| | father | stuck* | rocked |
| 7 | intrude | brass | paint |
| | confess | drag | ink |
| | improve* | grass* | pink |
| | intrigue | grasp | peak* |
| 8 | loss* | bathe | stomach* |
| | block | spade | summon |
| | lost | fade* | summit |
| | gloss | phase | summer |
| 9 | grip* | address | frock* |
| | drift | regress | crock |
| | rip | regret | crop |
| | drip | redress* | prop |

## EXHIBIT 7: FAIRBANKS' RHYME TEST (FIVE SETS OF 50 RHYMING WORDS).

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | BACK | 51. | FED | 101. | LAW | 151. | PAST | 201. | SOD |
| 2. | BALE | 52. | FEEL | 102. | LED | 152. | PAW | 202. | SOIL |
| 3. | BANG | 53. | FELL | 103. | LEND | 153. | PAY | 203. | SOLD |
| 4. | BARK | 54. | FIG | 104. | LET | 154. | PEEL | 204. | SOON |
| 5. | BEAT | 55. | FIGHT | 105. | LICK | 155. | PEN | 205. | SORE |
| 6. | BED | 56. | FILE | 106. | LIGHT | 156. | PICK | 206. | SUCK |
| 7. | BELL | 57. | FILL | 107. | LINK | 157. | PIG | 207. | SUN |
| 8. | BEND | 58. | FINE | 108. | LINE | 158. | PILE | 208. | TAIL |
| 9. | BENT | 59. | FIRE | 109. | LIP | 159. | PIN | 209. | TAKE |
| 10. | BEST | 60. | FIT | 110. | LOCK | 160. | PINK | 210. | TALE |
| 11. | BID | 61. | FOIL | 111. | LOOK | 161. | POP | 211. | TELL |
| 12. | BIG | 62. | FUN | 112. | LOT | 162. | POT | 212. | TEN |
| 13. | BILL | 63. | GAIN | 113. | LUCK | 163. | PUMP | 213. | TEND |
| 14. | BIT | 64. | GAME | 114. | LUMP | 164. | RAGE | 214. | TENT |
| 15. | BOIL | 65. | GANG | 115. | MAIL | 165. | RAIN | 215. | TEST |
| 16. | BOOK | 66. | GATE | 116. | MAIN | 166. | RANG | 216. | TICK |
| 17. | BOON | 67. | GET | 117. | MAKE | 167. | RATE | 217. | TIDE |
| 18. | BORE | 68. | GOD | 118. | MALE | 168. | RAW | 218. | TILE |
| 19. | BORN | 69. | GOLD | 119. | MARK | 169. | RED | 219. | TILL |
| 20. | BUCK | 70. | GOT | 120. | MAST | 170. | REEL | 220. | TIN |
| 21. | BUMP | 71. | GUN | 121. | MAY | 171. | RENT | 221. | TIP |
| 22. | BUST | 72. | HANG | 122. | MEAL | 172. | REST | 222. | TIRE |
| 23. | CAGE | 73. | HATE | 123. | MEAT | 173. | RID | 223. | TOIL |
| 24. | CAKE | 74. | HEAL | 124. | MEN | 174. | RIDE | 224. | TOLD |
| 25. | CAME | 75. | HEAT | 125. | MEND | 175. | RIGHT | 225. | TOOK |
| 26. | CAST | 76. | HEEL | 126. | MET | 176. | RIP | 226. | TOP |
| 27. | COCK | 77. | HEN | 127. | MIGHT | 177. | ROCK | 227. | TORE |
| 28. | COD | 78. | HID | 128. | MILE | 178. | ROD | 228. | TORN |
| 29. | COIL | 79. | HIDE | 129. | MINK | 179. | RUN | 229. | TUCK |
| 30. | COLD | 80. | HIP | 130. | MINE | 180. | RUST | 230. | VAIN |
| 31. | COOK | 81. | HIRE | 131. | MOCK | 181. | SACK | 231. | VILE |
| 32. | COON | 82. | HIT | 132. | MOON | 182. | SAGE | 232. | WAGE |
| 33. | COP | 83. | HOLD | 133. | MOP | 183. | SAIL | 233. | WAKE |
| 34. | CORN | 84. | HOOK | 134. | MORE | 184. | SALE | 234. | WAY |
| 35. | DARK | 85. | HOP | 135. | MUST | 185. | SAME | 235. | WED |
| 36. | DATE | 86. | HORN | 136. | NAIL | 186. | SANG | 236. | WELL |
| 37. | DAY | 87. | HOT | 137. | NAME | 187. | SAW | 237. | WENT |
| 38. | DEAL | 88. | JACK | 138. | NEAT | 188. | SAY | 238. | WEST |
| 39. | DEN | 89. | JAW | 139. | NEST | 189. | SEAL | 239. | WIDE |
| 40. | DID | 90. | JUMP | 140. | NIGHT | 190. | SEAT | 240. | WIG |
| 41. | DIG | 91. | JUST | 141. | NINE | 191. | SELL | 241. | WILL |
| 42. | DIN | 92. | KEEL | 142. | NOD | 192. | SEND | 242. | WIN |
| 43. | DIP | 93. | KICK | 143. | NOON | 193. | SENT | 243. | WINK |
| 44. | DOCK | 94. | KID | 144. | NOT | 194. | SET | 244. | WINE |
| 45. | DUCK | 95. | KILL | 145. | NUN | 195. | SICK | 245. | WIRE |
| 46. | DUMP | 96. | LACK | 146. | PACK | 196. | SIDE | 246. | WIT |
| 47. | DUST | 97. | LAKE | 147. | PAGE | 197. | SIN | 247. | WORE |
| 48. | FAIL | 98. | LARK | 148. | PAIN | 198. | SINK | 248. | WORN |
| 49. | FAME | 99. | LAST | 149. | PALE | 199. | SIRE | 249. | YET |
| 50. | FAST | 100. | LATE | 150. | PARK | 200. | SIT | 250. | ZEAL |

## EXHIBIT 8: FAIRBANKS' RHYME TEST ANSWER SHEET AND RANDOMIZATION OF INITIAL CONSONANTS FOR EACH OF THE FIVE LISTS

**NAME:**

**DATE:**

**TEST No. _____**

| | | | | |
|---|---|---|---|---|
| 1. _____ ot | h,g,n,p,l | 26. _____ ast | c,p,f,l,m |
| 2. _____ ay | p,m,d,w,s | 27. _____ ain | g,p,m,r,v |
| 3. _____ op | t,h,p,m,c | 28. _____ est | n,w,t,b,r |
| 4. _____ eel | p,r,f,h,k | 29. _____ un | g,n,r,s,f |
| 5. _____ ake | w,t,m,c,l | 30. _____ eal | h,d,s,z,m |
| 6. _____ aw | l,s,j,p,r | 31. _____ in | s,w,t,d,p |
| 7. _____ ile | v,m,f,t,p | 32. _____ ust | b,j,m,r,d |
| 8. _____ eat | n,s,b,h,m | 33. _____ ine | f,m,w,n,l |
| 9. _____ ook | l,c,h,t,b | 34. _____ ink | m,l,p,w,s |
| 10. _____ ill | f,k,w,t,b | 35. _____ old | s,t,h,c,g |
| 11. _____ ire | t,h,s,f,w | 36. _____ it | h,s,w,f,b |
| 12. _____ ale | m,t,s,p,b | 37. _____ ed | l,b,r,w,f |
| 13. _____ ent | s,r,w,b,t | 38. _____ end | t,s,b,l,m |
| 14. _____ oon | m,n,c,b,s | 39. _____ id | r,b,k,d,h |
| 15. _____ ick | k,s,l,t,p | 40. _____ ack | b,l,p,j,s |
| 16. _____ ame | s,f,n,c,g | 41. _____ ail | t,s,m,n,f |
| 17. _____ ide | w,t,s,r,h | 42. _____ ight | f,l,r,m,n |
| 18. _____ ip | r,d,l,h,t | 43. _____ orn | t,w,b,h,c |
| 19. _____ ore | s,b,t,m,w | 44. _____ od | r,g,c,s,n |
| 20. _____ ang | b,h,s,g,r | 45. _____ ock | d,m,c,l,r |
| 21. _____ on | m,d,h,p,t | 46. _____ ump | b,p,l,d,j |
| 22. _____ ark | p,b,l,m,d | 47. _____ ate | d,r,g,l,h |
| 23. _____ oil | c,f,b,s,t | 48. _____ ell | w,f,t,b,s |
| 24. _____ ig | b,w,d,f,p | 49. _____ et | s,l,g,y,m |
| 25. _____ age | r,c,p,s,w | 50. _____ uck | l,t,d,s,b |

correct word, but the number of possible words can range as high as nine. For example, although only got, hot, lot, not, and pot are actually used, a listener might think of jot, rot, sot, or tot. This test was used extensively at the Naval Electronics Laboratory Center in studies of the speech interfering effects of navy noises; see Webster and Klumpp (1965).

A criticism of the Fairbanks Rhyme Test is that it tests initial consonants only (and the response set varies from five to nine). House et al (1965) and Kreul et al (1968) took care of both of these flaws by making a six-alternative-answer sheet foil and testing for initial and final consonants, see exhibits 9 and 10.

The Kreul et al (1968) tests are easy to administer, require no training, and are relatively fast to complete — about 90 seconds for 50 words, since only a 1½-second interval is required between words. The Kreul is the preferred test at NELC now. The word score equivalency between it, the Fairbanks test, and PB words can be found in figure 12, Webster and Allen (1972), simplified and reproduced as figure 2.

# EXHIBIT 9: KREUL ET AL AND HOUSE ET AL MODIFIED RHYME TESTS (MRT)
## (SIX SETS OF 50 RHYMING WORDS).

| | | | | |
|---|---|---|---|---|
| 1. BACK | 61. DULL(-) | 118. LANE | 176. POT | 233. SUB |
| 2. BAD | 62. DUN | 119. LARK | 177. PUB | 234. SUD |
| 3. BALE | --(DUNG) | 120. LATE | --(PUCK) | 235. SUM |
| 4. BAN | 63. DUST | 121. LAW | 178. PUFF | 236.(2)SUN |
| 5. BANG | 64. EEL | 122. LAY | 179. PUG(-) | 237. SUNG |
| 6. BARK | 65. FAME | 123. LED | 180. PUN | 238. SUP |
| 7. BASS | 66. FANG | 124. LICK | 181. PUP | 239. TAB |
| 8. BAT | 67. FEAT | 125. LIP | --(PUS) | 240. TACK |
| 9. BATH | 68. FED | 126. LOOK | 182. PUTT(-) | 241. TALE |
| 10. BEACH | 69. FEEL | 127. LOT | 183. RACE | 242. TAM |
| 11. BEAD | 70. FIB | 128. MAD | 184. RAKE | 243. TAME |
| 12. BEAK | 71.(2)FIG | 129. MALE | 185. RANG | 244. TAN |
| 13. BEAM | 72.(2)FILL | 130. MAN | 186. RATE | 245. TANG |
| 14. BEAN | 73.(2)FIN | 131. MAP | 187. RAVE | 246. TAP |
| 15.(2)BEAT | 74.(2)FIT | 132. MARK | 188. RAW | 247. TEACH |
| 16. BED | 75. FIZZ | 133. MASS | 189. RAY | 248. TEAK |
| 17. BENT | 76. FOIL | 134. MAT | 190. RAZE | 249. TEAL |
| 18. BEST | 77. FOLD | 135. MATH | 191. RED | 250. TEAM |
| 19. BIG | 78. FUN | 136. MAY | 192. REEL | 251. TEAR |
| 20. BILL | 79. GALE | 137. MEAT | 193. RENT | 252. TEASE |
| 21. BIT | 80. GAME | 138. MEN | 194. REST | 253. TEN |
| 22. BOIL | 81. GANG | 139. MOP | 195. RIG | 254. TENT |
| 23. BOOK | 82. GAY | 140. MUST | 196. RIP | 255. TEST |
| 24. BUCK | 83. GOLD | 141. NAME | 197. RUN | 256. THAW |
| 25. BUFF | 84. GOT | 142. NEAT | 198. RUST | 257. THEN |
| 26. BUG | 85. GUN | 143. NEST | 199. SACK | 258. TICK |
| 27.(2)BUN | 86. GUST | 144. NOT | 200. SAD | 259. TILL |
| 28. BUS | 87. HANG | 145. NUN | 201. SAFE | 260. TIN |
| 29. BUST | 88. HARK | 146. OIL | 202. SAG | 261. TIP |
| 30. BUT | 89. HEAL | 147. PACE | 203. SAKE | 262. TOIL |
| 31. CAKE | 90. HEAP | --(PACK) | 204.(2)SALE | 263. TOLD |
| 32.(2)CAME | 91. HEAR | 148. PAD | 205.(2)SAME | 264. TOOK |
| 33. CANE | 92.(2)HEAT | 149. PAGE | 206. SANE | 265. TOP |
| 34. CAPE | 93. HEATH | 150.(2)PALE | 207. SANG | 266. TOT |
| 35. CASE | 94. HEAVE | 151. PAN | 208. SAP | 267. VEST |
| 36. CAVE | 95. HEEL | 152. PANG(-) | 209. SASS | 268. WAY |
| 37. COIL | 96. HEN | 153. PANE | 210. SAT | 269. WED |
| 38. COLD | 97. HILL | 154. PARK | 211. SAVE | 270. WENT |
| 39. COOK | 98. HIP | 155. PASS | 212. SAW | 271. WEST |
| 40. COP | 99. HIT | 156. PAT | 213. SAY | 272. WICK |
| 41. CUB | 100. HOLD | 157. PATH | 214. SEAT | 273. WIG |
| 42. CUD | 101. HOOK | 158. PAVE | 215. SEED | 274. WILL |
| 43. CUFF | 102. HOP | 159. PAW | 216. SEEK | 275. WIN |
| 44. CUP | 103. HOT | 160.(2)PAY | 217. SEEM | 276. WIT |
| 45. CUSS | 104. JAW | 161. PEACE | 218. SEEN | |
| 46. CUT | 105. JIG(-) | 162. PEACH | 219. SEEP | |
| 47. DARK | 106. JUST | 163. PEAK | 220. SEETHE | |
| 48. DAY | 107. KEEL | 164. PEAL | 221. SENT | |
| 49. DEN | 108. KICK(KICK)(2) | 165. PEAS | 222. SHED | |
| 50. DENT | 109. KID | 166. PEAT | 223. SHOOK | |
| 51. DID | 110.(2)KILL | 167. PEEL | 224. SHOP | |
| 52. DIG(DIG)(2) | --(KIN) | 168. PEN | 225.(2)SICK | |
| 53. DILL | 111. KING | 169.(2)PICK | 226. SILL | |
| 54. DIM | 112. KISS(-) | 170.(2)PIG | 227.(2)SIN | |
| 55.(2)DIN | 113.(2)KIT | 171. PILL | 228. SING | |
| 56.(2)DIP | 114. KITH(-) | 172.(2)PIN | 229.(2)SIP | |
| 57. DUB | 115. LACE | 173. PIP | 230.(2)SIT | |
| 58. DUCK | 116. LAKE | 174. PIT | 231. SOIL | |
| 59. DUD | 117. LAME | 175. POP | 232. SOLD | |
| 60. DUG | | | | |

Notes. The numeral 2 in parentheses signifies that the word is used twice in the test.
The words in parentheses are those used by House et al and not by Kreul et al.

# EXHIBIT 10: KREUL ET AL MODIFIED RHYME TEST ANSWER SHEETS.

NAME _____ EAR_____ DATE _____

MODIFIED RHYME HEARING TEST 1                                    LIST _____

| 1. | 2. | 3. | 4. | 5. |
|---|---|---|---|---|
| 1. sing  2. sit<br>3. sin   6. sill<br>4. sip   5. sick | 6. look  3. shook<br>4. cook  2. took<br>5. hook  1. book | 2. vest  6. rest<br>1. nest  4. test<br>5. best  3. west | 6. kill  3. kid<br>4. kit   2. king<br>1. kith  5. kiss | 5. putt  2. puff<br>6. pub   1. pun<br>3. pup   4. pug |

| 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|
| 3. fin   2. fig<br>6. fit   5. fib<br>1. fill  4. fizz | 5. toil  3. boil<br>1. foil  6. soil<br>2. coil  4. oil | 3. rust  4. must<br>2. just  5. gust<br>6. dust  1. bust | 4. rig   5. pig<br>2. wig   3. big<br>1. jig   6. fig | 4. sane  3. save<br>5. safe  6. same<br>2. sale  1. sake |

| 11. | 12. | 13. | 14. | 15. |
|---|---|---|---|---|
| 2. bit   6. hit<br>4. sit   6. wit<br>3. fit   1. kit | 1. came  2. cape<br>3. cane  4. cake<br>5. cave  6. case | 3. hold  6. cold<br>4. fold  5. gold<br>2. told  1. sold | 5. mass  1. map<br>3. math  4. man<br>6. mad   2. mat | 5. sale  6. pale<br>1. gale  4. bale<br>2. male  3. tale |

| 16. | 17. | 18. | 19. | 20. |
|---|---|---|---|---|
| 1. raw   6. saw<br>2. paw   5. thaw<br>4. jaw   3. law | 5. rent  3. went<br>1. dent  6. sent<br>4. tent  2. bent | 3. pace  5. pale<br>1. page  4. pay<br>6. pave  2. pane | 3. came  6. game<br>4. name  1. fame<br>2. same  5. tame | 4. dub   3. du.1<br>6. dun   1. duck<br>2. dud   5. dug |

| 21. | 22. | 23. | 24. | 25. |
|---|---|---|---|---|
| 2. rake  1. rave<br>6. ray   5. raze<br>4. rate  3. race | 6. bill  2. hill<br>5. fill  1. will<br>3. kill  4. till | 6. pan   3. pang<br>4. pad   1. pass<br>2. pat   5. path | 5. keel  1. peel<br>2. reel  6. eel<br>3. feel  4. heel | 2. bus   1. bun<br>4. buff  5. buck<br>6. bug   3. but |

| 26. | 27. | 28. | 29. | 30. |
|---|---|---|---|---|
| 2. heath  5. heat<br>4. heave  1. hear<br>3. heal   6. heap | 3. sag   4. sack<br>6. sat   2. sass<br>5. sap   1. sad | 3. gun   2. nun<br>6. run   1. sun<br>5. bun   4. fun | 6. tick  4. pick<br>3. sick  5. wick<br>2. lick  1. kick | 3. cuff  4. cup<br>5. cud   2. cub<br>6. cuss  1. cut |

| 31. | 32. | 33. | 34. | 35. |
|---|---|---|---|---|
| 1. peace  3. peak<br>6. peach  5. peat<br>4. peal   2. peas | 6. pay   1. way<br>4. gay   2. may<br>3. say   5. day | 3. den   2. pen<br>4. hen   6. men<br>1. ten   5. then | 4. seat  5. beat<br>1. meat  3. heat<br>2. feat  6. neat | 4. dip   5. hip<br>2. rip   1. sip<br>6. lip   3. tip |

| 36. | 37. | 38. | 39. | 40. |
|---|---|---|---|---|
| 2. dip   6. din<br>4. dim   3. did<br>1. dig   5. dill | 5. ceam  6. teak<br>3. tease 2. tear<br>1. teach 4. teal | 3. sub   4. sun<br>6. sung  5. sup<br>1. sud   2. sum | 4. pig   1. pill<br>5. pin   2. pick<br>3. pip   6. pit | 5. fed   3. red<br>2. shed  6. wed<br>4. bed   1. led |

| 41. | 42. | 43. | 44. | 45. |
|---|---|---|---|---|
| 5. mop   6. shop<br>1. top   2. hop<br>4. cop   3. pop | 5. lane  6. lame<br>4. lace  3. lay<br>2. lake  1. late | 2. peach 3. beat<br>1. bean  6. beak<br>5. bead  4. beam | 5. sang  6. hang<br>3. gang  4. bang<br>1. rang  2. fang | 1. seep  4. seed<br>5. seem  3. seethe<br>2. seen  6. seek |

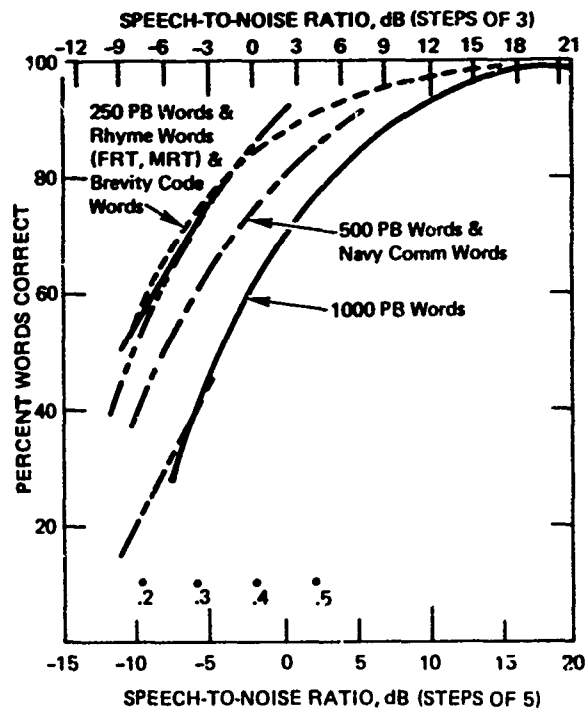| 46. | 47. | 48. | 49. | 50. |
|---|---|---|---|---|
| 5. park  2. dark<br>3. mark  6. bark<br>4. lark  1. hark | 1. pin   5. din<br>2. sin   3. tin<br>6. fin   4. win | 1. tab   4. tang<br>2. tan   3. tam<br>5. tack  6. tap | 6. bath  3. back<br>1. bat   5. ban<br>4. bass  2. bad | 1. hot   3. not<br>6. tot   2. got<br>5. lot   4. pot |

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Figure 2. PB, rhyme, brevity code, and Navy communication word intelligibility as a function of speech-to-noise ratio and AI.

## NUMBER OF SYLLABLES

Another factor affecting speech intelligibility scores is the number of syllables in a word. Bisyllabic words with equal stress on each syllable (railroad, birthday, etc.), called spondees, or spondaic words, have long been used clinically for determining degree of deafness and evaluating hearing aids. However, since this document is intended to be a handbook of speech tests for evaluating equipment, only passing mention is made of tests used primarily in a speech and hearing clinic.

An early and much-used spondee test was developed as Psycho-Acoustic Laboratory (PAL) Auditory Test 9; see Hudgins, Hawkins, Karlin, and Stevens (1947) and for later modification, Hirsh et al (1952). The Hirsh list is shown in exhibit 11. Spondaic words are the easiest of word tests and, if used in equipment evaluation, should be used primarily for setting voice levels, since the equally stressed syllables make it easy to monitor VU or other sound level meters.

| SPONDAIC WORDS OF CID AUDITORY TESTS W-1 AND W-2 | | | |
|---|---|---|---|
| 1. airplane | 10. eardrum | 19. iceberg | 28. railroad |
| 2. armchair | 11. farewell | 20. inkwell | 29. schoolboy |
| 3. baseball | 12. grandson | 21. mousetrap | 30. sidewalk |
| 4. birthday | 13. greyhound | 22. mushroom | 31. stairway |
| 5. cowboy | 14. hardware | 23. northwest | 32. sunset |
| 6. daybreak | 15. headlight | 24. oatmeal | 33. toothbrush |
| 7. doormat | 16. horseshoe | 25. padlock | 34. whitewash |
| 8. drawbridge | 17. hotdog | 26. pancake | 35. woodwork |
| 9. duckpond | 18. hothouse | 27. playground | 36. workshop |

## PHONETIC ELEMENTS

It has been well established in the experimental literature that vowels have greater sound pressure levels than consonants and that certain vowels – and consonants – are higher in basic vocalic level than others. Since vowels tend to be heard better under adverse conditions than consonants, it is confusion among consonants that causes confusion among words. Therefore, the statement is often made that consonants determine word intelligibility. From the beginning, attempts have been made to balance word lists with phonetic elements in the same proportion that occurs in "everyday" English. However, in many instances, especially in systems involving extensive speech processing, it is important to determine exactly which phonetic elements are intelligible and which are not.

All the rhyme tests so far discussed (Fairbanks, Kreul et al, House et al) have been consonant tests. Vowel rhyme tests are not so numerous but at least one has been developed for potential armed service use. The words of Clarke's (1965) phonetically balanced rhyme test for vowels (medial position between two consonants) are listed in exhibit 12. A typical answer sheet is shown in exhibit 13, and the phonetic structure of the test in exhibit 14.

Phonetic (consonant) analyses of the Fairbanks (1958) test and of the Modified Rhyme Tests are shown in exhibits 15 and 16. Tables 14-16 are shown as aids to anyone who really needs this depth of analysis in using the word tests.

A special test has been developed, with computerized scoring, to test diagnostically for phonetic confusion. Exhibit 17 lists the word (or syllable) pairs of Voiers's (1967, 1971) Diagnostic Rhyme Test (DRT) and exhibit 18 shows the phonetic composition of the DRT. Use of the DRT is suggested for detailed testing in the development phases of vocoders or complex speech processing systems. The listener is forced to respond to one of two fixed and known foils.

## EXHIBIT 12: CLARKE'S PBRT(V) WORD LIST.

| | | | | |
|---|---|---|---|---|
| 1. AT | 51. FATE | 101. LET | 151. PEA | 201. SLIGHT |
| 2. BAD | 52. FEAR | 102. LICK | 152. PEER | 202. SLIT |
| 3. BAIL | 53. FELL | 103. LID | 153. PEN | 203. SLOT |
| 4. BAIT | 54. FIGHT | 104. LIE | 154. PEP | 204. SOAK |
| 5. BALL | 55. FILE | 105. LIGHT | 155. PET | 205. SOCK |
| 6. BAND | 56. FILL | 106. LIKE | 156. PIE | 206. SOD |
| 7. BEAD | 57. FIT | 107. LIMB | 157. PILE | 207. SON |
| 8. BED | 58. FOOT | 108. LIME | 158. PILL | 208. SOON |
| 9. BELL | 59. FOR | 109. LIST | 159. PIN | 209. SPAN |
| 10. BEND | 60. FOUGHT | 110. LIT | 160. PIPE | 210. SPIN |
| 11. BET | 61. FOUL | 111. LOAD | 161. PIT | 211. SPINE |
| 12. BID | 62. FUR | 112. LOCK | 162. POLE | 212. SPOON |
| 13. BIND | 63. GATE | 113. LOOK | 163. POOL | 213. SPUN |
| 14. BIRD | 64. GET | 114. LOOM | 164. POOR | 214. STACK |
| 15. BIT | 65. GOAT | 115. LOST | 165. POP | 215. STAKE |
| 16. BOAT | 66. GOT | 116. LOT | 166. POPE | 216. STALK |
| 17. BOND | 67. GUT | 117. LOUD | 167. POT | 217. STALL |
| 18. BOUND | 68. HAD | 118. LOW | 168. POUR | 218. STAR |
| 19. BOUT | 69. HAIL | 119. MAR | 169. POUT | 219. STARE |
| 20. BOWL | 70. HALL | 120. MARE | 170. PUP | 220. STEER |
| 21. BRAID | 71. HAM | 121. MAT | 171. RAID | 221. STICK |
| 22. BREAD | 72. HAT | 122. MATE | 172. RAT | 222. STILL |
| 23. BREED | 73. HEAD | 123. MEET | 173. RATE | 223. STIR |
| 24. BROAD | 74. HEAT | 124. MERE | 174. RED | 224. STOCK |
| 25. BROOD | 75. HEED | 125. MESS | 175. RID | 225. STOLE |
| 26. BULL | 76. HEM | 126. MET | 176. RIGHT | 226. STOOL |
| 27. CALL | 77. HID | 127. MIGHT | 177. ROAD | 227. STORE |
| 28. COAL | 78. HILL | 128. MISS | 178. ROD | 228. STYLE |
| 29. COIL | 79. HIM | 129. MOOR | 179. ROT | 229. SUCK |
| 30. COOL | 80. HIT | 130. MORE | 180. RUT | 230. SUIT |
| 31. COWL | 81. HOLE | 131. MOSS | 181. SAD | 231. TALE |
| 32. DALE | 82. HOME | 132. MOUSE | 182. SAID | 232. TALL |
| 33. DAME | 83. HOOD | 133. MUSS | 183. SAKE | 233. TAP |
| 34. DAWN | 84. HOT | 134. NET | 184. SANE | 234. TAPE |
| 35. DEAN | 85. HOWL | 135. NIGHT | 185. SAT | 235. TEA |
| 36. DELL | 86. HUM | 136. NOT | 186. SEAT | 236. TELL |
| 37. DEN | 87. HURT | 137. NOTE | 187. SEED | 237. TEN |
| 38. DIME | 88. IT | 138. NUT | 188. SET | 238. TIE |
| 39. DIN | 89. LAID | 139. OAT | 189. SHEET | 239. TILL |
| 40. DOLE | 90. LAKE | 140. OUT | 190. SHIRT | 240. TIN |
| 41. DOLL | 91. LAMB | 141. PA | 191. SHOOT | 241. TIP |
| 42. DOME | 92. LAME | 142. PAIN | 192. SHOT | 242. TO |
| 43. DOOM | 93. LAST | 143. PAIR | 193. SHOUT | 243. TOE |
| 44. DOWN | 94. LATE | 144. PALE | 194. SICK | 244. TONE |
| 45. DULL | 95. LAW | 145. PAN | 195. SIDE | 245. TOOL |
| 46. DUMB | 96. LAY | 146. PAR | 196. SIGN | 246. TOP |
| 47. EAT | 97. LEAST | 147. PAT | 197. SIN | 247. TOWN |
| 48. FAIL | 98. LED | 148. PAW | 198. SIT | 248. TOY |
| 49. FAIR | 99. LEE | 149. PAWN | 199. SLAT | 249. TURN |
| 50. FAR | 100. LEST | 150. PAY | 200. SLATE | 250. TYPE |

Name _____ List _____ Equip. _____ Date _____

Talker _____ Talker's Mic _____ Replication # _____

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. IT | AT | OAT | EAT | OUT | 26. SIN | SON | SIGN | SANE | SOON |
| 2. MISS | MUSS | MESS | MOSS | MOUSE | 27. LIT | LET | LIGHT | LOT | LATE |
| 3. BID | BIRD | BED | BAD | BEAD | 28. TIP | TYPE | TOP | TAP | TAPE |
| 4. DULL | DELL | DOLL | DALE | DOLE | 29. STEER | STIR | STARE | STAR | STORE |
| 5. PUP | PEP | PIPE | POP | POPE | 30. TIE | TOE | TEA | TO | TOY |
| 6. SICK | SUCK | SOCK | SAKE | SOAK | 31. SIT | SET | SAT | SEAT | SUIT |
| 7. STICK | STALK | STOCK | STACK | STAKE | 32. LIE | LAW | LAY | LOW | LEE |
| 8. DIN | DEN | DAWN | DEAN | DOWN | 33. BELL | BALL | BAIL | BOWL | BULL |
| 9. BREAD | BROAD | BRAID | BREED | BROOD | 34. BIT | BET | BAIT | BOAT | BOUT |
| 10. RID | RED | ROD | RAID | ROAD | 35. DUMB | DIME | DAME | DOME | DOOM |
| 11. HIT | HURT | HOT | HAT | HEAT | 36. SPIN | SPUN | SPINE | SPAN | SPOON |
| 12. HILL | HALL | HAIL | HOLE | HOWL | 37. MET | MIGHT | MAT | MATE | MEET |
| 13. PIT | PET | PAT | POT | POUT | 38. RUT | RIGHT | ROT | RAT | RATE |
| 14. FILL | FELL | FILE | FAIL | FOUL | 39. TIN | TURN | TEN | TONE | TOWN |
| 15. HIM | HUM | HEM | HAM | HOME | 40. GUT | GET | GOT | GATE | GOAT |
| 16. SHIRT | SHOT | SHEET | SHOOT | SHOUT | 41. LIST | LEST | LOST | LAST | LEAST |
| 17. FIT | FIGHT | FOUGHT | FATE | FOOT | 42. LICK | LIKE | LOCK | LAKE | LOOK |
| 18. LIMB | LIME | LAMB | LAME | LOOM | 43. MERE | MARE | MAR | MORE | MOOR |
| 19. PEER | PAIR | PAR | POUR | POOR | 44. FEAR | FUR | FAIR | FOR | FAR |
| 20. LID | LED | LAID | LOAD | LOUD | 45. TILL | TELL | TALL | TALE | TOOL |
| 21. HID | HEAD | HAD | HEED | HOOD | 46. PIN | PEN | PAWN | PAN | PAIN |
| 22. PILL | PILE | PALE | POLE | POOL | 47. BEND | BIND | BOND | BAND | BOUND |
| 23. SLIT | SLIGHT | SLOT | SLAT | SLATE | 48. STILL | STYLE | STALL | STOLE | STOOL |
| 24. NUT | NET | NIGHT | NOT | NOTE | 49. SAID | SIDE | SOD | SAD | SEED |
| 25. CALL | COAL | COOL | COWL | COIL | 50. PIE | PAW | PA | PAY | PEA |

Phonetic Symbol

Key Word

Items     Word Foils

| ALPHA-BETICAL LISTING | RANDOM-IZED LISTING | Word Foil | bet | mat ray | lay late | bet | bat | bit dibe | bird | soap | cool | cook boll | hoy cut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 1) | - t | a | | | | | ea | i | oa | | | ou |
| 2. | 3) | b - d | a | | | | e | ea | i | ir | | | |
| 3. | 33) | b - l(l) | | a | ai | e | | | | ow | u | | |
| 4. | 47) | b - nd | a | o | | | e | i | | | | | ou |
| 5. | 34) | b - t | | | ai | | e | i | | oa | | | ou |
| 6. | 9) | br - d | | oa | ei | ea | ee | | | | oo | | |
| 7. | 25) | k c - l(l) | | a | | | | | | oa oo | oi | | ou |
| 8. | 4) | d - le | | | e | | | | | o | | | u |
| | | d - ll | | o | | | e | | | | | | u |
| 9. | 35) | d - mb | | | | | | | | | | | u |
| | | d - m(e) | | | a | | | | i | o oo | | | |
| 10. | 8) | d - n | | | aw | e | ea | i | | | | | ow |
| 11. | 14) | f - le | | | | | | i | | | | | |
| | | f - l(l) | | | ai | e | | i | | | | | ou |
| 12. | 44) | f - r | | a | o | ai | ea | | u | | | | |
| | | f - ght | | ou | | | i | | | | | | |
| 13. | 17) | f - t | | | | | i | | | oo | | | |
| | | f - te | | | a | | | | | | | | |
| 14. | 40) | g - t(e) | | o | a | e | | | | oa | | | u |
| 15. | 21) | h - d | a | | | ea | ee | i | | | oo | | |
| 16. | 12) | h - le | | | | | i | | | o | | | |
| | | h - l(l) | | a | ai | | i | | | | | | ow |
| 17. | 15) | h - m(e) | a | | | e | | i | | o | | | u |
| 18. | 11) | h - t | a | o | | | ea | i | ur | | | | |
| 19. | 32) | l - | | aw | ay | | ee | ie | | ow | | | |
| 20. | 20) | l - d | | | ai | e | | i | | oa | | | ou |
| 21. | 42) | l - ck | | o | | | i | | | | | | |
| | | l - k(e) | | | a | | | i | | oo | | | |
| 22. | 18) | l - mb | a | | | | i | | | | | | |
| | | l - m(e) | | | a | | | i | | oo | | | |
| 23. | 41) | l - st | a | o | | e | ea | i | | | | | |
| 24. | 27) | l - ght | | | | | i | | | | | | |
| | | l - t(e) | | o | a | e | | i | | | | | |

**EXHIBIT 14 (Continued).**

| Phonetic Symbol | æ | ɑ | ɔ | e | | ɛ | i | I aɪ | ɜ | o | ʊ u | ɔɪ | ʌ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Key Words** | bat | calm | jaw | late | | bet | beet | bit dine | bird | soup | cool cook | boil | hot cut |

| Items (Alphabetical / Randomized) | Word Foils | bat | calm | jaw | late | bet | beet | bit/dine | bird | soup | cool/cook | boil | hot/cut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25. 43) | { m - r | a | | | | | | | | | oo | | |
| | m - re } | | o | | | | | | | | | | |
| 26. 2) | m - s(e) | | o | | | | e | i | | | | | ou u |
| 27. 37) | { m - ght | | | | | | | i | | | | | |
| | m - t | a | | | | e | ee | | | | | | |
| | m - te } | | | a | | | | | | | | | |
| 28. 24) | { n - ght | | | | | | | i | | | | | |
| | n - t | | o | | | e | | | | | | | u |
| | n - te } | | | | | | | | | o | | | |
| 29. 50) | p - | a | aw | ay | | | ea | ie | | | | | |
| 30. 22) | { p - le | | | a | | | | i | | o | | | |
| | p - l(l) } | | | | | | | i | | | oo | | |
| 31. 46) | p - n | a | aw | ai | | e | | i | | | | | |
| 32. 5) | { p - p | | o | | | e | | | | | | | u |
| | p - pe | | | | | | | i | | o | | | |
| 33. 19) | p - r | a | | ai | | | ee | | | | oo | | cu |
| 34. 13) | p - t | a ɔ | | | | e | | i | | | | | ou |
| 35. 10) | r - d | | o | ai | | e | | i | | oa | | | |
| 36. 38) | { r - ght | | | | | | | i | | | | | |
| | r - t | a o | | | | | | | | | | | u |
| | r - te } | | | a | | | | | | | | | |
| 37. 6) | { s - ck | | o | | | | | i | | | | | u |
| | s - k(e) | | | a | | | | | | ba | | | |
| 38. 49) | s - d(e) | a o | | | | ai | ee | i | | | | | |
| 39. 26) | { s - gn | | | | | | | i | | | | | |
| | s - n | | | | | | | i | | | oo | | o |
| | s - ne } | | | a | | | | | | | | | |
| 40. 31) | s - t | a | | | | e | ea | i | | | ui | | |
| 41. 16) | sh - t | | o | | | | ee | | ir | | oo | | ou |
| 42. 23) | { sl - ght | | | | | | | i | | | | | |
| | sl - t | a o | | | | | | i | | | | | |
| | sl - te } | | | a | | | | | | | | | |
| 43. 36) | { sp - n | a | | | | | | i | | | oo | | u |
| | sp - ne } | | | | | | | i | | | | | |

EXHIBIT 14 (Continued).

Phonetic Symbol

Key Word

| Items | Word Foils | | bat | calm | jaw | late | | bet | he? | bit | dine | bird | soap | cool | cook | boil | how | cut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALPHA-BETICAL LISTING | RANDOM-IZED LISTING | | | | | | | | | | | | | | | | | |
| 44. | 7) | st – ck | a | | o | | | | | i | | | | | | | | |
| | | st – ke | | | | a | | | | | | | | | | | | |
| | | st – lk | | | a | | | | | | | | | | | | | |
| 45. | 48) | st – le | | | | | | | | | y | | o | | | | | |
| | | st – l(l) | | | a | | | | | i | | | | oo | | | | |
| 46. | 29) | st – r | a | | | | | ee | | | | ir | o | | | | | |
| | | st – re | | | | a | | | | | | | | | | | | |
| 47. | 30) | t – | | | | | | ea | | ie | | | oe | o | | oy | | |
| 48. | 45) | t – le | | | | a | | | | | | | | | | | | |
| | | t – l(l) | | | a | | | e | | i | | | | oo | | | | |
| 49. | 39) | t – n(e) | | | | | | e | | i | | ur | o | | | | ow | |
| | | t – p | a | o | | | | | | i | | | | | | | | |
| | | t – pe | | | a | | | | | y | | | | | | | | |
| | Number | | 18 | 20 | 18 | 28 | | 27 | 17 | 31 | 21 | 6 | 20 | 13 | 5 | 2 | 13 | 11 |

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# EXHIBIT 15: FAIRBANKS' RHYME TEST PHONETIC STRUCTURE.

Consonants

| No. | Vowels or Diphthongs | b | k (c) | d | f | g | h | dz (j) | k | l | m | n | p | r | s | t | v | w | J (y) | z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ___ ack (ae) | b | | | | | | j | | l | | | p | | s | | | | | |
| 2 | ___ age (e) | | c | | | | | | | | | | p | r | s | | | w | | |
| 3 | ___ ail (e) | | | | f | | | | | | m | n | | | s | t | | | | |
| 4 | ___ ain (e) | | | | | g | | | | | m | | p | r | | | v | | | |
| 5 | ___ ake (e) | | c | | | | | | | l | m | | | | | t | | w | | |
| 6 | ___ ale (e) | b | | | | | | | | | m | | p | | s | t | | | | |
| 7 | ___ ame (e) | | c | | f | g | | | | | | n | | | s | | | | | |
| 8 | ___ ang (ae) | b | | | | g | h | | | | | | | r | s | | | | | |
| 9 | ___ ark (a) | b | | d | | | | | | l | m | | p | | | | | | | |
| 10 | ___ ast (ae) | | c | | f | | | | | l | m | | p | | | | | | | |
| 11 | ___ ate (e) | | | d | | g | h | | | l | | | | r | | | | | | |
| 12 | ___ aw (ɔ) | | | | | | | j | | l | | | p | r | s | | | | | |
| 13 | ___ ay (e) | | | d | | | | | | | m | | p | | s | | | w | | |
| 14 | ___ eal (i) | | | d | | | h | | | | m | | | | s | | | | | z |
| 15 | ___ eat (i) | b | | | | | h | | | | m | n | | | s | | | | | |
| 16 | ___ ed (ε) | b | | | f | | | | | l | | | | r | | | | w | | |
| 17 | ___ eel (i) | | | | f | | h | | k | | | | p | r | | | | | | |
| 18 | ___ ell (ε) | b | | | f | | | | | | | | | | s | t | | w | | |
| 19 | ___ en (ε) | | | d | | | h | | | | m | | p | | | t | | | | |
| 20 | ___ end (ε) | b | | | | | | | | l | m | | | | s | t | | | | |
| 21 | ___ ent (ε) | b | | | | | | | | | | | | r | s | t | | w | | |
| 22 | ___ est (ε) | b | | | | | | | | | | n | | r | | t | | w | | |
| 23 | ___ et (ε) | | | | | g | | | | l | m | | | | s | | | | y | |
| 24 | ___ ick (I) | | | | | | | | k | l | | | p | | s | t | | | | |
| 25 | ___ id (I) | b | | d | | | h | | k | | | | | r | | | | | | |
| 26 | ___ ide (aI) | | | | | | h | | | | | | | r | s | t | | w | | |
| 27 | ___ ig (I) | b | | d | f | | | | | | | | p | | | | | w | | |
| 28 | ___ ight (aI) | | | | f | | | | | l | m | n | | r | | | | | | |
| 29 | ___ ile (aI) | | | | f | | | | | | m | | p | | | t | v | | | |
| 30 | ___ ill (I) | b | | | f | | | | k | | | | | | | t | | w | | |
| 31 | ___ in (I) | | | d | | | | | | | | | p | | s | t | | w | | |
| 32 | ___ ink (I) | | | | | | | | | l | m | | p | | s | | | w | | |
| 33 | ___ ine (aI) | | | | f | | | | | l | m | n | | | | | | w | | |
| 34 | ___ ip (I) | | | d | | | h | | | l | | | | r | | t | | | | |
| 35 | ___ ire (aI) | | | | f | | h | | | | | | | | s | t | | w | | |
| 36 | ___ it (I) | b | | | f | | h | | | | | | | | s | | | w | | |
| 37 | ___ ock (a) | | c | d | | | | | | l | m | | | r | | | | | | |
| 38 | ___ od (a) | | c | | | g | | | | | | n | | r | s | | | | | |
| 39 | ___ oil (ɔI) | b | c | | f | | | | | | | | | | s | t | | | | |
| 40 | ___ old (o) | | c | | | g | h | | | | | | | | s | t | | | | |
| 41 | ___ ook (ʊ) | b | c | | | | h | | | l | | | | | | t | | | | |
| 42 | ___ oon (u) | b | c | | | | | | | | m | n | | | s | | | | | |
| 43 | ___ op (a) | | c | | | | h | | | | m | | p | | | t | | | | |
| 44 | ___ ore (ɔ) | b | | | | | | | | | m | | | | s | t | | w | | |
| 45 | ___ orn (ɔ) | b | c | | | | h | | | | | | | | | t | | w | | |
| 46 | ___ ot (a) | | | | | g | h | | | l | | n | p | | | | | | | |
| 47 | ___ uck (ʌ) | b | | d | | | | | | l | | | | | s | t | | | | |
| 48 | ___ ump (ʌ) | b | | d | | | | j | | l | | | p | | | | | | | |
| 49 | ___ un (ʌ) | | | | f | g | | | | | | n | | r | s | | | | | |
| 50 | ___ ust (ʌ) | b | | d | | | | j | | | m | | | r | | | | | | |
| TOTAL | 250 | 22 | 12 | 13 | 15 | 9 | 16 | 4 | 4 | 19 | 21 | 10 | 18 | 17 | 27 | 22 | 2 | 17 | 1 | 1 |
| | | b | c (k) | d | f | g | h | j (dz) | k | l | m | n | p | r | s | t | v | w | y (J) | z |

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EXHIBIT 16:  KREUL ET AL MODIFIED RHYME TEST PHONETIC STRUCTURE.

| No. | Root | VOWEL | b | c | ch | d | f | g | h | j | l | m | n | ng | p | r | s | sh | t | th | th | v | w | y | z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | k | tʃ | | | | | dz | | | | ŋ | | | | ʃ | | ð | θ | | | j | |
| 1 | —ale | e | b | | | | | g | | | | m | | | p | | s | | t | | | | | | |
| 2 | —ame | e | | c | | | f | g | | | | | n | | | | s | | t | | | | | | |
| 3 | —ang | ae | b | | | | f | g | h | | | | | | | r | s | | | | | | | | |
| 4 | —ark | a | b | | | d | | | h | | l | m | | | p | | | | | | | | | | |
| 5 | —aw | ɔ | | | | | | | | j | l | | | | p | r | s | | | | th | | | | |
| 6 | —ay | e | | | | d | | g | | | | m | | | p | | s | | | | | | w | | |
| 7 | —eat | i | b | | | | f | | h | | | m | n | | | | s | | | | | | | | |
| 8 | —ed | ɛ | b | | | | f | | | | l | | | | | r | | sh | | | | | w | | |
| 9 | —eel | i | | k | | | f | | h | | | | | | p | r | | | | | | | | | - |
| 10 | —en | ɛ | | | | d | | | h | | | m | | | p | | | | t | th | | | | | |
| 11 | —ent | ɛ | b | | | d | | | | | | | | | | r | s | | t | | | | w | | |
| 12 | —est | ɛ | b | | | | | | | | | | n | | | r | | | t | | | v | w | | |
| 13 | —ick | I | | k | | | | | | | l | | | | p | | s | | t | | | | w | | |
| 14 | —ig | I | b | | | (d) | f | | | ┼ | | | | | p | r | | | | | | | w | | |
| 15 | —ill | I | b | k | | | f | | h | | | | | | | | | | t | | | | w | | |
| 16 | —in | I | | | | d | f | | | | | | | | p | | s | | t | | | | w | | |
| 17 | —ip | I | | | | d | | | h | | l | | | | | r | s | | t | | | | | | |
| 18 | —it | I | b | k | | | f | | h | | | | | | | | s | | | | | | w | | |
| 19 | —oil | ɔI | b | c | | | f | | | | | | | | | | s | | t | | | | | | - |
| 20 | —old | o | | c | | | f | g | h | | | | | | | | s | | t | | | | | | |
| 21 | —ook | ʊ | b | c | | | | | h | | l | | | | | | | sh | t | | | | | | |
| 22 | —op | a | | c | | | | | h | | | m | | | p | | | sh | t | | | | | | |
| 23 | —ot | a | | | | | | g | h | | l | | n | | p | | | | t | | | | | | |
| 24 | —un | ʌ | b | | | | f | g | | | | | n | | | r | s | | | | | | | | |
| 25 | —ust | ʌ | b | | | d | | g | | j | | m | | | | r | | | | | | | | | |
| | TOTAL | | 14 | 9 | 0 | 7 | 12 | 8 | 12 | 3 | 7 | 7 | 5 | 0 | 11 | 10 | 14 | 3 | 14 | 1 | 1 | 1 | 9 | 2 | 0 |

(HOUSE, et al        +1          -1 )

## EXHIBIT 16 (Continued).

| No. | Root | V O W E L | Final Consonant | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**KREUL, ET AL (CLINICAL) MODIFIED RHYME TEST**

| No. | Root | VOWEL | b | c (k) | ch (ts) | d | f | g | h | j (dz) | l | m | n | ng | p | r | s (s) | sh | t | th | th (o) | v | w | y | z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | ba – | ae | | ck | | d | | | | | | | n | | | | ss | | t | | th | | | | |
| 27 | bea – | i | | k | ch | d | | | | | | m | n | | | | | | t | | | | | | |
| 28 | bu – | ∧ | | ck | | | ff | g | | | | | n | | | | s | | t | | | | | | |
| 29 | ca – | e | | ke | | | | | | | | me | ne | | pe | | se | | | | | ve | | | |
| 30 | cu – | ∧ | b | | | d | ff | | | | | | | | p | | ss | | t | | | | | | |
| 31 | di – | I | | | | d | | g | | | ll | m | n | | p | | | | | | | | | | |
| 32 | du – | ∧ | b | ck | | d | | g | | | ll | | n | (ng) | | | | | | | | | | | |
| 33 | fi – | I | ↑ | | | | | g | | | ll | | n | | | | | | t | | | | | | zz |
| 34 | hea – | i | | | | | | | | | l | | | | p | r | | | t | | th | ve | | | |
| 35 | ki – | I | | (ck) | | d | | | | | ll | | (n) | ng | | | ss | | t | | th | | | | |
| 36 | la – | e | | ke | | | | | | | | me | ne | | | | ce | | | te | | | | y | |
| 37 | ma – | ae | | | | d | | | | | | | n | | p | | ss | | t | | th | | | | |
| 38 | pa – | ae | | (ck) | | d | | | | | | | n | ng | | | ss | | t | | th | | | | |
| 39 | pa – | e | | | | | | | ge | | le | | ne | | | | ce | | | | | ve | ⚡ | | |
| 40 | pea – | i | | k | ch | | | | | | l | | | | | | ce | | t | | | | | | s |
| 41 | pi – | I | | ck | | | | g | | | ll | | n | | p | | | | t | | | | | | |
| 42 | pu – | ∧ | b | (ck) | | | ff | g | | | | | n | | p | | (s) | | tt | | | | | | |
| 43 | ra – | e | | ke | | | | | | | | | | | | | ce | | | te | | ve | | y | ze |
| 44 | sa – | ae | | ck | | d | | g | | | | | | | p | | ss | | t | | | | | | |
| 45 | sa – | e | | ke | | | fe | | | | le | me | ne | | | | | | | | | ve | | | |
| 46 | see – | i | | k | | d | | | | | | m | n | | p | | | | | | the | | | | |
| 47 | si – | I | | ck | | | | | | | ll | | n | ng | p | | | | t | | | | | | |
| 48 | su – | ∧ | b | | | d | | | | | | m | n | ng | p | | | | | | | | | | |
| 49 | ta – | ae | b | ck | | | | | | | | m | n | ng | p | | | | | | | | | | |
| 50 | tea – | i | | k | ch | | | | | | l | m | | | | r | | | | | | | | | se |
| **TOTAL** | | | 6 | 15 | 3 | 11 | 4 | 7 | 0 | 1 | 11 | 9 | 18 | 5 | 12 | 2 | 12 | 0 | 16 | 1 | 5 | 5 | 0 | 3 | 4 |
| **GRAND TOTAL** | | | 20 | 24 | 3 | 18 | 16 | 15 | 12 | 4 | 18 | 16 | 23 | 5 | 23 | 12 | 26 | 3 | 30 | 2 | 6 | 6 | 9 | 5 | 4 |

(House, et al    +3    (+1)   -1   (-1) -1   +1   0     0    -1    -1 )

## EXHIBIT 17: VOIERS'S DIAGNOSTIC RHYME TEST.

| | | | | |
|---|---|---|---|---|
| 1. BAD | 48. DENSE | 94. JEST | 140. PEEN | 186. TENSE |
| 2. BANK | 49. DID | 95. JILT | 141. PEG | 187. TENT |
| 3. BAT | 50. DILL | 96. JACK | 142. PENCE | 188. TEST |
| 4. BEAN | 51. DINT | 97. JOE | 143. PENT | 189. THAD |
| 5. BEAT | 52. DIP | 98. JOT | 144. PEST | 190. THAN |
| 6. BEE | 53. DOCK | 99. JUICE | 145. POND | 191. THANK |
| 7. BEND | 54. DOLE | 100. KEEP | 146. POOH | 192. THAW |
| 8. BID | 55. DONG | 101. KEG | 147. POOL | 193. THEE |
| 9. BILL | 56. DOT | 102. KEY | 148. POOP | 194. THEN |
| 10. BIT | 57. DOTE | 103. KNOCK | 149. POT | 195. THICK |
| 11. BOAST | 58. DOUGH | 104. LAMP | 150. RAMP | 196. THIN |
| 12. BOB | 59. DOZE | 105. LAP | 151. RAP | 197. THING |
| 13. BOOT | 60. DUES | 106. LAW | 152. RAW | 198. THONG |
| 14. BOMB | 61. DUNE | 107. LEAK | 153. REAP | 199. THOLE |
| 15. BON | 62. FAD | 108. LEAP | 154. REED | 200. THOR |
| 16. BOND | 63. FAN | 109. LEND | 155. REEK | 201. THOSE |
| 17. BONE | 64. FAST | 110. LEST | 156. REND | 202. THOUGH |
| 18. BONG | 65. FAULT | 111. LEWD | 157. REST | 203. THOUGHT |
| 19. BOSS | 66. FEEL | 112. LID | 158. RID | 204. TICK |
| 20. BOWL | 67. FENCE | 113. LIP | 159. RIP | 205. TINT |
| 21. BOX | 68. FIN | 114. LOAD | 160. ROAD | 206. TONG |
| 22. CALF | 69. FIT | 115. LOCK | 161. ROCK | 207. TOOL |
| 23. CARE | 70. FOAL | 116. LONG | 162. ROD | 208. TOOT |
| 24. CAUGHT | 71. FOO | 117. LOOT | 163. ROOT | 209. TOT |
| 25. CHAD | 72. FOP | 118. LOT | 164. ROT | 210. TUNE |
| 26. CHAIR | 73. FORE | 119. LOW | 165. ROW | 211. VAST |
| 27. CHAW | 74. FOUGHT | 120. MAD | 166. RUDE | 212. VAULT |
| 28. CHEAT | 75. GAB | 121. MEAT | 167. RUE | 213. VEAL |
| 29. CHEEP | 76. GAFF | 122. MEND | 168. SAG | 214. VEE |
| 30. CHEW | 77. GAT | 123. MET | 169. SAID | 215. VILL |
| 31. CHIN | 78. GAUZE | 124. MIT | 170. SANK | 216. VOLE |
| 32. CHOCK | 79. GHOST | 125. MOAN | 171. SAW | 217. VON |
| 33. CHOOSE | 80. GILL | 126. MOM | 172. SHAD | 218. VOX |
| 34. CHOP | 81. GILT | 127. MOON | 173. SHAG | 219. WAD |
| 35. COAT | 82. GIN | 128. MOOT | 174. SHAW | 220. WALL |
| 36. COOL | 83. GNAW | 129. MOSS | 175. SHEET | 221. WEED |
| 37. COOP | 84. GO | 130. NAB | 176. SHOES | 222. WIELD |
| 38. COOT | 85. GOAT | 131. NECK | 177. SHOW | 223. WREN |
| 39. COP | 86. GOB | 132. NEED | 178. SING | 224. WRONG |
| 40. DAB | 87. GOOSE | 133. NET | 179. SO | 225. YAWL |
| 41. DAN | 88. GOT (2) | 134. NEWS | 180. SOLE | 226. YEN |
| 42. DANK | 89. GUEST | 135. NIP | 181. SUE | 227. YIELD |
| 43. DAUNT | 90. HIT | 136. NOON | 182. TAUGHT | 228. YOU |
| 44. DAW | 91. HOP | 137. NOTE | 183. TAUNT | 229. ZED |
| 45. DECK | 92. JAB | 138. PAN | 184. TEA | 230. ZEE |
| 46. DEED | 93. JAWS | 139. PEAK | 185. TEAK | 231. ZOO |
| 47. DEN | | | | |

**EXHIBIT 17 (Continued).**

| | |
|---|---|
| BOB – GOB | COOT – TOOT |
| DAUNT – TAUNT | POND – BOND |
| MOOT – BOOT | BONE – MOAN |
| SHEET – CHEAT | BILL – VILL |
| GAB – JAB | GUEST – JEST |
| TOT – POT | FOUGHT – THOUGHT |
| BOAST – GHOST | POOP – COOP |
| RIP – LIP | LEAP – REAP |
| SAID – ZED | FAST – VAST |
| GNAW – DAW | KNOCK – DOCK |
| SHOES – CHOOSE | DOZE – THOSE |
| KEEP – CHEEP | SING – THING |
| DANK – BANK | NET – MET |
| DOT – GOT | CAUGHT – TAUGHT |
| ROAD – LOAD | LEWD – RUDE |
| TINT – DINT | BEAN – PEEN |
| DECK – NECK | MAD – BAD |
| TONG – THONG | BOX – VOX |
| CHEW – COO | JOE – GO |
| REED – WEED | DID – BID |
| SAG – SHAG | WREN – YEN |
| LOT – ROT | LAW – RAW |
| FOAL – VOLE | ZOO – SUE |
| DIP – NIP | NEED – DEED |
| FENCE – PENCE | THAN – DAN |
| THAW – SAW | CHOP – COP |
| POOL – TOOL | FORE – THOR |
| YIELD – WIELD | FIT – HIT |
| LAP – RAP | LEST – REST |

NAME _____    DATE _____

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# EXHIBIT 18: PHONETIC COMPOSITION OF DRT.

This is reproduced from Table 2 of Voiers (1967) (or Table 1, Voiers, 1971)
CONSONANT TAXONOMY USED IN THE CONSTRUCTION OF THE DRT (FORM III)

| | /m/ | /n/ | /v/ | /ð/ | /z/ | /ʒ/ | /ǯ/ | /b/ | /d/ | /g/ | /w/ | /ɹ/ | /l/ | /j/ | /ɛ/ | /θ/ | /s/ | /ʃ/ | /ʧ/ | /p/ | /t/ | /k/ | /h/ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Voicing | + | + | + | + | + | + | + | + | + | + | + | + | + | + | − | − | − | − | − | − | − | − | − |
| Nasality | + | + | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − |
| Sustention | − | − | + | + | + | + | − | − | − | − | + | + | + | + | + | + | + | + | − | − | − | − | + |
| Sibilation | − | − | − | − | + | + | + | − | − | − | − | − | − | − | − | − | + | + | + | − | − | − | − |
| Graveness | + | − | + | − | − | o | o | + | − | o | + | o | − | − | + | − | − | o | o | + | − | o | o |
| Compactness | − | − | − | − | − | + | + | − | − | + | − | o | o | + | − | − | − | + | + | − | − | + | o |
| Vowel-like* | − | − | − | − | − | − | − | − | − | − | + | + | + | + | − | − | − | − | − | − | − | − | − |

* The DRT does not test for the apprehensibility of the opposition, vowel-like – nonvowel-like.
However, test words are chosen so as not to confound this attribute with the six attributes for
which discriminability is tested.

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## CONTEXT

The context within which the word is heard provides the greatest contribution to the word's intelligibility. There are many forms of context — grammatical, linguistic, situational, semantic, etc. An air controller has as much trouble understanding a tobacco auctioneer as either one would have in understanding a Japanese kabuki drama, yet each in turn can understand the gibberish that passes for language in his own work environment.

Sentence tests are often suggested as tests for evaluating communications equipments, or the hearing capabilities of the hard of hearing. Four general types of sentence tests have been developed: single-word answer tests ("What day comes after Tuesday?"), five-key-word sentences ("When the frost has come it is time for turkey"), colloquial speech, and synthetic sentences ("Down by the time is real enough").

Sample lists of sentences of the first two types, taken from Hudgins et al (1947), are shown in exhibits 19 and 20. Examples of colloquial speech, exhibit 21, were compiled by a CHABA working group chaired by Fairbanks and listed by Davis and Silverman (1970) in the appendix to the revised edition of Hearing and Deafness. Giolas (1966) has demonstrated a close relationship between the intelligibility of these colloquial sentences and that of samples of continuous discourse.

Speaks and Jerger (1965) and Jerger, Speaks, and Trammell (1968) developed sets of first-, second-, and third-order synthetic sentences to reduce the predictability of key words in regular English sentences while retaining many other good features of sentence testing. Their third-order sentences are shown in exhibit 22. Giolas, Cooker, and Duffy (1971) have shown that the synthetic sentences have indeed eliminated key word predictability as a factor in their sentence lists.

**EXHIBIT 19: HUDGINS ET AL SENTENCES (SINGLE-WORD ANSWERS).**

| | | LIST 1 |
|---|---|---|
| **Level** | **Answer** | **Question** |
| 0 db | B | 1. What letter comes between A and C? |
| | Yes | 2. Do flies have wings? |
| | Monday | 3. What day comes after Sunday? |
| -6 db | 3 or 4 | 4. How many colors are there in the American Flag? |
| | 11 | 5. What number comes after 10? |
| | Hammer | 6. What tool do you drive nails with? |
| -12 db | 7 | 7. What number comes between 6 and 8? |
| | Yes | 8. Are moths dangerous to clothing? |
| | February | 9. What month comes after January? |
| -18 db | 5 | 10. How many pennies are there in a nickel? |
| | No | 11. Is there a lot of water in the desert? |
| | Weak | 12. What is the opposite of strong? |
| -24 db | 9 | 13. What number comes before 10? |
| | Bullets | 14. Does a gun shoot flowers or bullets? |
| | Old | 15. What is the opposite of new? |
| -30 db | France | 16. In what country is Paris? |
| | No | 17. Do you climb mountains in a sailboat? |
| | X | 18. What letter comes after W? |
| -36 db | Tuesday | 19. What day comes after Monday? |
| | Light | 20. What is the opposite of dark? |
| | 12 | 21. What number comes after 11? |

**EXHIBIT 20: HUDGINS ET AL FIVE-KEY-WORD SENTENCES.**

LIST 1

1. The birch canoe slid on the smooth planks.
2. Glue the sheet to the dark blue background.
3. It's easy to tell the depth of a well.
4. These days a chicken leg is a rare dish.
5. Rice is often served in round bowls.
6. John is just a dope of long standing.
7. The juice of lemons makes fine punch.
8. The chest was thrown beside the parked truck.
9. The hogs were fed chopped corn and garbage.
10. A cry in the night chills my marrow.
11. Blow high or low but follow the notes.
12. Four hours of steady work faced us.
13. A large size in stockings is hard to sell.
14. Many are taught to breathe through the nose.
15. Ten days leave is coming up.
16. The Frenchman was shot when the sun rose.
17. A rod is used to catch pink salmon.
18. He smoked a pipe until it burned his tongue.
19. The light flashed the message to the eyes of the watchers.
20. The source of the huge river is the clear spring.

## LIST A

1. Walking's my favorite exercise.
2. Here's a nice quiet place to rest.
3. Our janitor sweeps the floors every night.
4. It would be much easier if everyone would help.
5. Good morning.
6. Open your window before you go to bed!
7. Do you think that she should stay out so late?
8. How do you feel about changing the time when we begin work?
9. Here we go.
10. Move out of the way!

## LIST B

1. The water's too cold for swimming.
2. Why should I get up so early in the morning?
3. Here are your shoes.
4. It's raining.
5. Where are you going?
6. Come here when I call you!
7. Don't try to get out of it this time!
8. Should we let little children go to the movies by themselves?
9. There isn't enough paint to finish the room.
10. Do you want an egg for breakfast?

## LIST C

1. Everybody should brush his teeth after meals.
2. Everything's all right.
3. Don't use up all the paper when you write your letter.
4. That's right.
5. People ought to see a doctor once a year.
6. Those windows are so dirty I can't see anything outside.
7. Pass the bread and butter please!
8. Don't forget to pay your bill before the first of the month.
9. Don't let the dog out of the house!
10. There's a good ballgame this afternoon.

## LIST D

1. It's time to go.
2. If you don't want these old magazines, throw them out.
3. Do you want to wash up?
4. It's a real dark night so watch your driving.
5. I'll carry the package for you.
6. Did you forget to shut off the water?
7. Fishing in a mountain stream is my idea of a good time.
8. Fathers spend more time with their children than they used to.
9. Be careful not to break your glasses!
10. I'm sorry.

EXHIBIT 21 (Continued).

**LIST E**

1. You can catch the bus across the street.
2. Call her on the phone and tell her the news.
3. I'll catch up with you later.
4. I'll think it over.
5. I don't want to go to the movies tonight.
6. If your tooth hurts that much you ought to see a dentist.
7. Put that cookie back in the box!
8. Stop fooling around!
9. Time's up.
10. How do you spell your name?

---

**EXHIBIT 22: SPEAKS AND JERGER SYNTHETIC SENTENCES (THIRD-ORDER APPROXIMATION TO ACTUAL ENGLISH).**

Primary Subset

1. SMALL BOAT WITH A PICTURE HAS BECOME
2. BUILT THE GOVERNMENT WITH THE FORCE ALMOST
3. GO CHANGE YOUR CAR COLOR IS RED
4. FORWARD MARCH SAID THE BOY HAD A
5. MARCH AROUND WITHOUT A CARE IN YOUR
6. THAT NEIGHBOR WHO SAID BUSINESS IS BETTER
7. BATTLE CRY AND BE BETTER THAN EVER
8. DOWN BY THE TIME IS REAL ENOUGH
9. AGREE WITH HIM ONLY TO FIND OUT
10. WOMEN VIEW MEN WITH GREEN PAPER SHOULD

Secondary Subset

11. OWN LOT IN YOUR AMERICAN FOOD HAS
12. IS MEETING IN THE COLLEGE OF THE
13. US WITHOUT FIRST THOUGHT WAS VERY NICE
14. AGREE WITH US IT ONLY SHALL COOK
15. WITH HUMAN NATURE CAN BE MET AT
16. IN OUR DIFFERENT NAME BECAUSE HE CAN'T
17. MARCH AROUND THE TIME WAS EVERYTHING THAT
18. MORE OF IT IS CERTAIN TO BE
19. WILL GO TO SCHOOL TODAY WAS THE
20. SO ALLOW US TO THE SOUND AND

# VALIDITY FACTORS

To evaluate operational equipment, or the performance of operating personnel, the test language and talker/listener team should be related in some known way to the language and personnel actually employed on the system (equipment, component) under test.

The use and/or pronounciation of certain digits, words, and short phrases are specified in specific operational situations. For example, exhibit 23 lists (at the bottom) the International Civil Aeronautics Organization (ICAO) phonetic spelling words (see Moser and Dreher (1955)) and digit pronounciation, and (at the top) a selected list of Brevity Code words for naval aircraft operations. This listing has been compiled for special testing of naval aircraft radios.

Webster and Allen (1972) reported on the speech intelligibility of USN aircraft radios and in the process made some recordings of radio transmissions of a squadron of USN aircraft on a combat mission over the Republic of Vietnam. Some of these recordings are transcribed as exhibit 24.

Walker and Black (1950) prepared 20 flight phrases equated in intensity and duration for test purposes; see exhibit 25.

Major Donald Gasaway, of the USAF, has compiled a list of words extracted from many hours of in-flight recordings in USAF aircraft.* Gasaway's words are shown in exhibit 26, together with some statistics on how familiar the words are (frequency of usage per million words); whether they are represented in the standard word tests shown in exhibits 1, 7, 9, 12, and 17; and whether they are included among the Brevity Code words.

The U. S. Army Test and Evaluation Command (1971) has prepared the lists of tactical field messages shown in exhibit 27. The report specifies exactly how the testing is to be accomplished, to wit:

"The test project officer will designate the net stations to be used for transmitting and receiving initial messages and the type messages to be used. He will assure that stations are properly manned with qualified "talkers and listeners." After procedural messages have been exchanged, the designated "talker" will transmit the designated test message in a clear, strong voice, spacing the characters/words only to the extent that proper enunciation is effected. If messages selected from Exhibit 27 contain more than 10 words/characters, the "talker" must bear in mind that the messages are being transcribed by hand and pause after each 3 or 4 words. If practicable, tape record the test messages at the transmitting station for subsequent comparison with received messages in order to eliminate from evaluation errors made by the "talkers." "Listeners" at the receiving net stations will manually transcribe all test messages. Listeners should be required to add any appropriate comments relative to characters/words that may be missed or about which they are uncertain. Sufficient log entries will be

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*Gasaway is now developing a test to evaluate the auditory performance of air crew members, in particular to test in situ experienced personnel who have lost some hearing acuity as determined by standard clinical tests on the ground. C. Williams and J. W. Greene are working on similar tests for naval air crewmen, see Greene (1970).

made at all stations to fully identify each test message. Selected transmissions will be recorded at the receiving station for comparison with recordings made at the transmitting station in order to evaluate the quality of the communications equipment being tested.

> NOTE:  For purposes of this test no repeats of test messages
> will be made.

"Transmitting and receiving responsibilities will be rotated among all or selected stations in the communication net in turn. "Talkers" and "listeners" will be rotated at each station for each test message to be transmitted. Sufficient test messages will be transmitted to give a high degree of confidence in the test results.

"Each manually transcribed test message will be checked against the transmitted messages to determine its accuracy.

"Individual letters and numerals will be pronounced using the phonetic alphabet."

Klumpp and Webster (1960) studied the language used on the flight deck of aircraft carriers as part of a study to evaluate man-worn radio equipment. One hundred and fifty flight deck phrases are listed in exhibit 28 and 100 words are extracted and listed in exhibit 29.

Webster and Henry in a report prepared for the SAMSF (Shipboard Aviation Maintenance Space and Support Facilities) Review Committee of NAVSHIPS, NAVAIR, and NAVSUP (see NAVSHIPS (1972)), have compiled the lists of aviation maintenance/supply support messages shown in exhibit 30. Note in this case the preponderance of alphanumeric symbols transmitted.

## EXHIBIT 23: BREVITY CODE WORDS FOR NAVAL AIRCRAFT OPERATIONS AND INTERNATIONAL CIVIL AERONAUTICS ORGANIZATION PHONETIC SPELLING WORDS.

| | | |
|---|---|---|
| 1. ABORT | 49. CLARA | 96. FLYING AT |
| 2. ABORTING | 50. CLEARED | 97. FOX |
| 3. AFFIRM | 51. CLUTTER | 98. FRAME |
| 4. AFFIRMATIVE | 52. COCKROACH | 99. FREE LANCE |
| 5. AIRBORNE | 53. CODE | 100. FRIENDLY |
| 6. ALTITUDE | 54. CONDITION | 101. FUEL |
| 7. ANCHORED | 55. CONFUSED | |
| 8. ANYCAP | 56. CONTACT | 102. GADGET |
| 9. ANGELS | 57. CONTINUE | 103. GATE |
| 10. ANGLE | 58. COVER | 104. GEIGER |
| 11. ANY FACE | 59. CREW | 105. GERONIMO |
| 12. APPROACH | 60. CROSSING | 106. GOBLIN |
| 13. ARK | | 107. GOODYEAR |
| 14. ASPRO | 61. DADCAP | 108. GRANDSLAM |
| 15. ASSUME | 62. DANGER | 109. GRAPHIC |
| 16. AUTOCAT | 63. DAVEY JONES | 110. GUESSER |
| 17. AWAY | 64. DAYRECCO | 111. GUNS FREE |
| | 65. DEAF | 112. GUNS TIGHT |
| 18. BABS | 66. DECIMAL | 113. GYRO |
| 19. BARCAP | 67. DECK CLEAR | |
| 20. BASE | 68. DECK FOUL | 114. HARD |
| 21. BATTERY | 69. DECOY | 115. HAWK |
| 22. BAY RUM | 70. DELTA | 116. HEADING |
| 23. BELLHOP | 71. DETACH | 117. HEADS UP |
| 24. BENCH MARK | 72. DITCH | 118. HECKLERS |
| 25. BENT | 73. DITCHING | 119. HELOT |
| 26. BINGO | 74. DIVERT | 120. HELP |
| 27. BINGO FIELD | 75. DOLLY | 121. HIGH |
| 28. BINGO STATE | 76. DRONE | 122. HOLD |
| 29. BIRD | 77. DUCKBUTT | 123. HOLDING |
| 30. BLIND | 78. DUD | 124. HOMER |
| 31. BOGEY | 79. DUMBO | 125. HOTEL FIRE |
| 32. BOWWAVE | | 126. HOSTILE |
| 33. BREAK | 80. EASE TURN | 127. HUGO |
| 34. BROWNIE | 81. ELEVATOR | 128. HUNTSMEN |
| 35. BULLMOOSE | 82. EMERGENCY | 129. HUSH |
| 36. BUSTER | 83. EMERGENCY SPACE | |
| | 84. ENGAGE | 130. IDENT |
| 37. CAP | 85. ESTIMATE | 131. IDENTIFY |
| 38. CAPREP | 86. EVERGREEN | 132. I GO |
| 39. CAUTION | | 133. INTERFERENCE |
| 40. CAVU | 87. FADED | 134. IN THE DARK |
| 41. CEASE REPORTING | 88. FAMISHED | 135. INTRUDERS |
| 42. CHARLIE | 89. FEAR | 136. I STAY |
| 43. CHASE | 90. FEET DRY | |
| 44. CHECK | 91. FEET WET | 137. JUDY |
| 45 CHERUBS | 92. FERRET | |
| 46 CHICKS | 93. FEW | 138 KEEPER |
| 47. CHOPPER | 94. FINAL | |
| 48. CIGAR | 95. FLY AT | 139. LAMPS |

EXHIBIT 23 (Continued).

| | | |
|---|---|---|
| 140. LAND | 186. PARTNER | 234. SKUNK |
| 141. LAUNCH | 187. PEDRO | 235. SKYROCKET |
| 142. LAZY | 188. PIGEONS | 236. SLINGSHOT |
| 143. LEFT | 189. PLAYBOY | 237. SMOKER |
| 144. LEVEL | 190. PLUS | 238. SNOOPER |
| 145. LIFEGUARD | 191. PLUTO | 239. SOUR |
| 146. LIGHTS | 192. POGO | 240. SPLASHED |
| 147. LINER | 193. POINT | 241. SPLITTING |
| 148. LINK | 194. POPEYE | 242. SPOTTER |
| 149. LOCAP | 195. PORT | 243. SPOOFER |
| 150. LOST | 196. POSITION | 244. SQUAWK |
| 151. LOW | 197. POUNCE | 245. SQUAWKING |
| | 198. PREP CHARLIE | 246. STARBOARD |
| 152. MACK NO | 199. PRONTO | 247. STATE CHICKEN |
| 153. MACK YES | 200. PUNCH | 248. STATE LAMB |
| 154. MAKER | 201. PURPLE | 249. STATE TIGER |
| 155. MANY | | 250. STATE WEAPONS |
| 156. MAPPO | 202. RAID | 251. STEADY |
| 157. MAYDAY | 203. RAMROD | 252. STEER |
| 158. MEDIUM | 204. RANGE | 253. STOP |
| 159. MERGED | 205. RAPCAP | 254. STRANGER |
| 160. MIDDLEMAN | 206. READY | 255. STRANGLE |
| 161. MIDNIGHT | 207. RECCO | 256. STRIKE |
| 162. MINUS | 208. RECKON | 257. SUBCAP |
| 163. MIXUP | 209. RELIABLE | 258. SWEEP |
| 164. MUSHROOM | 210. REPORT | 259. SWEET |
| | 211. RESCUECAP | |
| 165. NANCY | 212. RIALTO | 260. TALLY-HO |
| 166. NEGATIVE | 213. RIGHT | 261. TARCAP |
| 167. NIGHTCAP | 214. ROUTE | 262. TARGET |
| 168. NIGHTRECCO | | 263. TASP |
| 169. NOCOP | 215. SAINT BERNARD | 264. TIED ON |
| 170. NODUF | 216. SALVOS | 265. TIPS |
| 171. NO JOY | 217. SAPPHIRE | 266. TOOL |
| 172. NORMAL | 218. SAUNTER | 267. TOUCH |
| 173. NOT | 219. SAY | 268. TRACK |
| | 220. SCAN | 269. TRACTORS |
| 174. O'CLOCK | 221. SCENE COMMANDER | 270. TRADE |
| 175. OCTOPUS | 222. SECTOR | 271. TRAILOR |
| 176. OKAY | 223. SCRAMBLE | 272. TRANSPONDER |
| 177. ON STATION | 224. SCRUB | 273. TRIDENT |
| 178. ON TARGET | 225. SECURITE | 274. TROT |
| 179. ON THE CLOCK | 226. SEE YOU | |
| 180. ORANGES | 227. SHADS | 275. UNABLE |
| 181. ORBIT | 228. SHECAT | 276. UNKNOWN |
| 182. ORBITING | 229. SICK | |
| | 230. SINGLE | 277. VECTOR |
| 183. PAN | 231. SITREP | 278. VERY |
| 184. PANCAKE | 232. SHIP | 279. VISIBILITY |
| 185. PARROT | 233. SKIP IT | |

EXHIBIT 23 (Continued).

| | | |
|---|---|---|
| 280. WARNING RED | 285. WEAPONS FREE | 290. WHAT STATE |
| 281. WARNING WHITE | 286. WEAPONS TIGHT | 291. WHICH TRANS- |
| 282. WARNING YELLOW | 287. WEATHER | PONDER |
| 283. WATCH | 288. WELL | |
| 284. WAVE OFF | 289. WHAT LUCK | 292. YELLOW JACKET |
| | | 293. YELP |

PHONETIC ALPHABET AND NUMERALS

| | | |
|---|---|---|
| 1. ALFA | 13. MIKE | 24. X-RAY |
| 2. BRAVO | 14. NOVEMBER | 25. YANKEE |
| 3. CHARLIE | 15. OSCAR | 26. ZULU |
| 4. DELTA | 16. PAPA | 27. WUN |
| 5. ECHO | 17. QUEBEC (pronounced | 28. TWO |
| 6. FOXTROT | Kay-beck) | 29. THU-REE |
| 7. GOLF | 18. ROMEO | 30. FO-WER |
| 8. HOTEL | 19. SIERRA | 31. FI-YIV |
| 9 INDIA | 20. TANGO | 32. SIX |
| 10. JULIETT | 21. UNIFORM | 33. SEVEN |
| 11. KILO | 22. VICTOR | 34. EIGHT |
| 12. LIMA | 23 WHISKEY | 35. NI-NER |
| | | 36. ZERO |

... ___zero, over.

Pine 1, Big Tiger 102,* how do you hear?

Roger 012, read you loud and clear and Pin. Bark 110 and Pine Bark 105 will
be Pine 1 & 2 up for your control.

Roger, and 110 will be Pine 1?

110, affirmative.

Roger, 1 & 2, vector 140 for station.

And Pine Bark station will be on the 135, about twenty-five miles from South
Gate. How's the weather look out there?

Oh, the overcast _____.

Roger - when through, level at angels twenty-two point five, and it's pretty
clear above.

Roger.

_____ _____ _____

_____ _____ _____

Pine 1, this is Big Tiger___ ___ ___ request you strangle your parrot. Pine
2, squawk normal.

Pine 2, parrot sweet - 1, go back to normal, please.

And Pine 1, verify heading 140.

Roger, passing 170 for 140.

Pine   say your state now, please.

_____ _____ _____ _____

Did not copy it, Pine 2 what's yours, and will you pass Pine 1's?

Pine 1, Big Tiger.

                              *102 spoken as one zero two

EXHIBIT 24 (Continued).

Pine 1, Go ahead.

Roger, say your state, please.

_____5 plus.

Roger. Pine 2 what's your state?

Above that.

Roger.

———— ———— ———— ————

This is Big Tiger, we're a little far from you. We're moving up there. You're very broken. How do you hear me?

———— ———— ———— ————

Roger, Pine 1 vector 090 for separation -- Pine 2 starboard 180 for separation

Pine 1 090

Pine 2 180

Pine 1 & 2 in the event of no communications for any 1 minute period, attempt contact Big Tiger Button 8. If no joy, attempt contact South Gate, proceed overhead South Gate, over

Pine 1 copy.

Pine 2, you copy lost comm?

That's affirmative.

Pine 1, you want to be the first shoot?

Roger.

Pine 1, Big Tiger, I'll make the short one, uh, the first one at about twenty miles separation to get started. Then we'll make it a little more after that.

Roger

Pine 2, port 050 as the bogey, over.

_____ ___ 050 ___-.

Pine 1, starboard 230 for a bogey, over.

EXHIBIT 24 (Continued).

Pine 1, 230

Pine 2, your bogey 224 at seven-teen (should have said Pine 1)
1, roger
1, your bogey 230 at eighteen
1, your bogey, single, altitude medium
Roger

1, when steady (on heading 230) your bogey's at 050, indicating point 6
(speed mach 0.6), out

1, speed and angles as desired, check your switches safe.

1, switche-s safe.

1, your bogey 226 at nineteen

1, your bogey 225, seventeen

1, your bogey 224, eleven, Break, port 220

Steady 220

Roger, your bogey 223 at ten

Bogey now 225 at 8.  1, Starboard 230
1, 230
1, your bogey now 230 at 5

Tally!

Roger tallyho, your bogey now 230 at 2

Bogey now coming 230 about 1

1, your bogey should be passing your left wing.  Break away 250

————— ————— ———

1, you were very broken.

Skip it.

Roger, skip it.  Continue 230.  2, continue 250.

——— ——— ———

Roger, your break awaypigeons were 318 at thirty-six.

1, what state?

EXHIBIT 24 (Continued).

Pine 1, Big Tiger bears 257, twenty four miles from you.  Big Tiger's level at twenty-two point five.

Roger

2, what state?

Thirteen point four, approximately.

Roger, and 1, your state?

1, affirmative.

2, starboard 240 as the bogey, over

2, starboard 240.

1, port 060 for the bogey, over

060

1, your bogey 057, twenty-five, out

1, same bogey information as before, or do you wish any repeated?

—— —— —— ——

Roger, check Switches safe.

—— —— ——

1, your bogey now 058, thirty-one

1, is your dolly up?

—— —— ——

1, you were broken - understand your dolly is up?

1, affirm.

Roger, request you say your dolly information.

—— —— ——

1, show bogey 062, thirty

—— ——

EXHIBIT 24 (Continued).

Roger 060, and say command head

___ ___ ___

This is 012, understand no command head

___ ___ ___ ___
                                           ("Arm Warning"?)
Roger, bogey 066, twenty-five.  Are your receiving an RM-1 indication?

___ ___

Roger

1, your bogey 066, nineteen, command heading should be 060.  Do you concur?

___ ___ ___ ___ ___ ___ ___ ___ at fifteen miles.

___ ___ ___ your heading 240

___ ___ ___

Roger Judy

___ ___ ⌀ ___

___ ___ _ . ___ ___

___ ___ ___

___ ___ ___ ___

Roger, your brea-k away 060

Breakaway pigeons 316 at thirty-seven

2, continue 240

___ ___ ___ ___

2, is your dolly working?

Affirmative

Roger, we'll try to hook you up on this run

1, what state?

EXHIBIT 24 (Continued).

Twelve point three

Roger, - 2?

Twelve point three

1, come port 230 as the bogey, over
230

2, starboard 050 for bogey, over

.Starboard 050

2, your bogey 247, twenty-three

2, your bogey single, altitude medium, out

2, when steady your bogey heads 230, indicating point 7, out

2, speed and angels as desired, check your switches safe, over

Switches safe

2, your bogey 050, twenty-eight

2, your bogey 053, at thirty

2, this is Big Tiger, do you have any dolly information, over?

2 has no dolly information

Roger 2, if you get any dolly information, would you please pass it?

2, your bogey is 050 at twenty-four
        ("Arm Warn"?)

2, I have an RM-1 now

Roger, do you have a command head or a range and bearing?

Standby one

Your bogey's now 049, sixteen

2, your bogey 048, fourteen

Roger 2, I have a Judy

EXHIBIT 24 (Continued).

Roger Judy
And command heading of 047
This is 012, concur

_____ _____ _____

Understand simulated _____?

_____ _____ _____

Roger, skip it, break away will be 060
Roger, coming to 060
Break away pigeons 349, thirty-four
1, what state?
Eleven point five
Roger, 2?
2 is Twelve point two
Roger two, we'd like to try a machine drive arm 2 this time if you could.
Roger, _____ _____ _____
We'll get you a way point
1, Big Tiger, do you have Big Tiger on your 300, seventeen miles, southbound?

_____ _____ _____

2, do you hold your way point on your 060 at thirty?
2, affirmative
Roger
Roger, now 068?
Affirmative
Pine 2, this is Big Tiger, port 030 as the bogey, over
Pine 2, coming port to 030. And Pine 2 is the target?
Disregard, Pine 1, come port 030
Pine 1 to 030
And Pine 2, starboard 210 for a bogey, over
Pine 2, roger.
Pine 2, your bogey 215, twenty-five
Pine 2 has another target
That's affirm; we're taking you from way point to your assignment
Pine 2, your bogey now 1....your bogey now 0224, thrity-two and you should
    have an orbit light just going out.
This is Pine 2, arm 1
Roger
And a command heading of 090, thirty-two
This is 012, concur. _____ _____ _____ arm 2.
And it's still on normal.
This is 012, roger. It should take it a second to catch

_____ _____ _____

_____ _____ Judy, 220 at twenty

EXHIBIT 24 (Continued).

Roger

—— —— ——

2, radio check
Loud and clear

—— —— ——

And a simulated Fox (Fire ?) 1, and let's take a breakaway and get situated
    as a bogey
Roger, breakaway for 2 will be 150
Roger, 2's coming to 150
And 1 breakaway 030
1 is steady
Roger, your breakaway pigeons are 356, twenty-nine

—— —— —— ——

This is 012, concur
And 1, Big Tiger are you copying your way point
1, standby
1, negative; we do have ____ ____ and a command heading and airspeed. 030
Roger it should be 030 for a command heading. Should have just changed to 020
2, port 020 as the bogey, over
2, coming port 020 as the bogey
1, starboard 160 for bogey, over
1, your bogey 178, twenty-four
1, your bogey 177, twenty-seven
1, your bogey 174, twenty-eight
1, your bogey 175, twenty-seven
Bogey now 176, twenty-5
Bogey now 179, twenty
Bogey now 180, eighteen Break, hard starboard 190
1, has contact, appears to be about fifteen miles
Roger that's your bogey
Judy
Roger Judy

—— —— ——

1, understand Fox 2, your breakaway 190
2, your breakaway 350, and 1 or 2, did you copy?
Pine 1, Big Tiger
Go ahead
Roger, your breakaway 190, did you copy?
1, your breakaway pigeons were 314 at twenty-7
2, port 210 as the bogey, over
Roger
1, starboard 030 for a bogey, over
1, starboard 030
2, did you copy port 210?
Affirmative, coming to 210

EXHIBIT 24 (Continued).

Roger. 1, your bogey 025 at twenty-8
1, roger, and be advised you're breaking up again
Roger, we're coming back to you now
1, your bogey 014, thirty-1
1, steady 360 ("Stop your turn and steady up on heading 360)
Roger
1, your bogey 012, thirty-1
1, steady
Roger steady, your bogey 012, twenty-8
1, your bogey 010, twenty-u, just completing a port turn
1, your bogey 009, twenty-6
1, your bogey 009, twenty-4
1, your bogey 009, twenty-2
1, your bogey 009, nineteen
1 has contact at fifteen miles
Roger, that's your bogey, heading 210

———— ———— ————

This is 012, your bogey now 003, fourteen
Have a Judy
Roger Judy
1, steady up.  _____ _____ _____ ten miles.

——— ——— ——— ——

Lost contact
Roger, your bogey 335, 7
Bogey now 324, 7, Break, come port 270
Bogey now 307, 6.  Come hard port 210
Bogey now 286 at 7, moving away
Bogey now 272 at 8
Bogey now 257 at 8
Judy
Roger Judy
1, skip it.
Roger skip it, your breakaway 030
1, roger, 030
1, your breakaway pigeons are 323 at twenty-2 miles
1, what state?
1, state ten point four
2, what state?
2, state ten point 1
Roger
Understand 2 is the target this time
Roger, 2 will be the target this time
_____ _____ _____ we have no TACAN.

Roger, understand negative TACAN.  And who's that - 1 or 2?

58

EXHIBIT 24 (Continued).

That's for Pine Bark 1
Roger 1
And _____ _____ _____

That's affirmative
O.K. I'll try to check you out when we _____ _____ _____.
About forty degrees
OK, I didn't really know, but I think my _____ are in Stabilization.
2, Big Tiger, you receiving the way point excitement?
2, that's affirmative.  192 at twenty-1
012, concur
And 1 is steady 020
Roger steady
1 is now level at eighteen point five and completely VFR down here.
Roger; 2 say angels
Angels nineteen point five
Roger, did you copy 1?
2 is going lower
1, Big Tiger, starboard 180 as the bogey, over
1, starboard 180
2, port 060 for the bogey, over
2, port 060 to complete intercept
2, your bogey 026 at thirty-2
And 2, Big Tiger, could I track cat's eye this time?
See you
2, Big Tiger, could I track cat's eye this time?
Say again?
Roger, could I track cat's eye this time?
Certainly
Roger, your bogey now 026, thirty-6
Roger

_____ _____ _____

Pine 2, steady 060
Roger
Pine 1, steady 180
Pine 2, your bogey 028, thirty-2
2, your bogey 029, twenty-9
2, continue 060
2, your bogey 028, twenty-8
2, your bogey 027, twenty-5
Roger!  Contact!  Two Five at twenty-2
2, that's your bogey, heading 180
Roger
2, port, 070
Port, 040
2, your bogey 027, twenty

_____ _____ _____

EXHIBIT 24 (Continued).

Roger steady, your bogey now 028, at seventeen
Show him 020 at _____
Roger come hard port 340
340?
Roger
Wilco!
Your bogey now 018, sixteen
Your bogey now 018, thirteen
Your bogey 026, ten
Your bogey 030, seven
Bogey 050, 5, mark starboard 180, bogey head
Bogey 061, 3
Bogey 071, 2
Bogey 148, 1
Bogey 150, 1
Bogey 165, 1
And that ought to be about the finish
Roger, call final position, please
Roger, we were about a mile, six o'clock
Roger, your breakaway 360
Roger 360. That was a pretty good run
Thank you. Your breakaway pigeons 336 at thirty-6 and say state
State about nine p-int 7
Roger
And 2, Big Tiger, how's the weather out there where you are?

_____  _____  _____  _____  _____

Roger.
1, your pigeons are now 339 at forty-5
South Gate, Over.
This is 012, Roger - he still . . . . .
I. AND JIM, STAGE WANTS US TO COME UP TACTICAL SECURE -- I DON'T KNOW WHAT FOR.
Affirmative
And Stage Coach, 012.
I. AND I'VE CHECKED IN ON PIRAZ.
012, South Gate
I. OK, _____, CAN WE HEAD 180?-
I. OK
And
xxx Pine 2, Big Tiger understand you are receiving _____ _____ this time?
(buzz buzz buzz)
Pine 1, Big Tiger, I am unable to read Pine 2 - can you pass?
This is Pine 2 (broken) how do you read me now?
Big Tiger, do you have _____ any bogey dope for us?
Uh, Roger Pine 2, come starboard a long ways, 340.
Coming starboard 340
And 2's level eighteen 5 (18,500 feet) (Angels eighteen point five")
Roger 2 and starboard 340. 1, port 160.
1, port to 160

EXHIBIT 24 (Continued).

1, your bogey 168, twenty-five.

1, roger.

1, check your switches safe.

1, switches safe, (state) twenty-three ninety-seven

1, your bogey 171, twenty-six..

1, your bogey 175, twenty-five

1, your bogey 175, twenty-three

And 2's steady 340

Roger steady

1, your bogey 173, twenty-two

1, is steady 160

Roger steady, starboard 190

1, roger

1, your bogey 172, twenty-one

1, hard port 150

1, roger

1, your bogey 173, fifteen

1, your bogey 172, thirteen

1, your bogey 170, eleven/_____ cause you have the 180.*

1 has the duty/coming that direction as far (high?) as I can*

OK/Let's not make this a _____.*

Roger continue to 150/I'm not sure I can hold it though if the weather../Going
   to 150/OK*

They're about.. uh/1, your bogey 180/fifteen miles out on your port wing/
   correction, 180, five.*

1, your bogey 200, five

1, hard starboard 340, bogey heading

I got him

1, your bogey 211, six

1, your bogey 230, five

1, your bogey 270, three

1, your bogey 290, two

1, your bogey 320, two

1, your bogey 338, two and a half

1, show your bogey on the nose, two miles

1, your bogey 340, two

1, Roger, you want to break away and set up a new one?

Roger, break away. Be advised Big Tiger is on your 272, eleven miles. Your
   break away 160.

1, roger your ranges were a little long this time.

This is 012, roger, could you say final position, please?

Roger, we were six o'clock at about four miles and your contacts originally
   were about four miles difference in distance I was indicating on the (UCR?-2)

012, Roger

This is Pine 2, I had the ranges right on

Did you?

And Big Tiger, shifting my weapons.

Roger/About a mile behind

*----/----
Transmissions from 2 groups overriding
each other on the same frequency

EXHIBIT 24 (Continued).

2, what state?
Pine 2, Big Tiger, say state?
Pine 2, state 8 point oh.
Roger, Pine 1?
Pine 1, 8 point 6
Roger
1 from 2
go ahead
I.  WHEN'S OUR E-A, OUR NEW E-A-C OF TWENTY THIRTY-SEVEN.........RECOVERY
    OF TWENTY FORTY-FIVE.
Pine 1, Big Tiger, port to 360 has the bogey
1, port to 360
Pine 2, Big Tiger, Starboard 160 for a bogey
2, coming starboard to 160
2, your bogey 169, twenty-eight
Say Pine 1 heading again
Roger Pine 2, 3 - correction, Pine 1 is 360
Pine 1, Roger
And Pine 2 is 160.
I.  COMPARE WITH YOUR TIME IF THE LAUNCH GOES AT TWENTY FORTY-FIVE?
I.  I'M CHECKING THE POSITION, OVER.
Pine Bark, this is Big Tiger, we're getting your Charlie time right now
1, roger.
2, your bogey 175, thirty-eight.
I.  DID YOU CALL MARSHAL, .. CANCEL ...?
I.  I'LL CALL.
I.  DO YOU WANT US TO CALL MARSHAL TO GET THE MARSHAL INFO FOR YOUR PINES?
I.  YEAH, CAN YOU?
I.  OK.  THAT'S 110 AND 105, RIGHT?
I.  RIGHT.
... 179, twenty-nine/OK
2 is steady 160
Roger, you bogey is 182, twenty-seven, starboard 180
180, roger
2, your bogey 180, twenty-three
2, your bogey 180, nineteen, port 150
And 2 has a contact, 185 at eighteen
That's your bogey, heading 360
Roger, got him
Roger, goody

—— — —— ——

Very garbled, say again
Pine 1, radio check
1, read you loud and clear

—— —— —— ——

—— —— —— ——

EXHIBIT 24 (Continued).

This is Big Tiger, Pine 1, read you loud and clear.

——— ——— ——— ———

Roger Dog 1, you ready to break away?

——— ——— ——— ———

That's affirm, Big Tiger, did you come up with that approach time for us?
We're still working on getting it.
Say pigeons. 2, I'm starting a port turn -- join. ("Join up with me")
Roger
Roger, your pigeons are 318 at twenty-four.
And 110, your time is 50, over.
Roger, copied.

**EXHIBIT 25: WALKER AND BLACK FLIGHT PHRASES.**

1) The 20 five-syllable flight phrases were taken from:
Walker, Crayton; Black, John W., The <u>Intrinsic Intensity</u>
<u>of Oral Phrases</u> (The Ohio State University Research
Foundation, Columbus, Ohio, and the U. S. Naval School
of Aviation Medicine, 1950), p. 9-14.

2) These phrases are equated for mean intensity and duration.

3) Each order is a different randomization of the same 20
five-syllable phrases.

4) There is a total of six orders.

| | |
|---|---|
| 1. Speed is kept constant | 1. Rough terrain below |
| 2. You have no power | 2. You press right rudder |
| 3. Rough terrain below | 3. The glide is broken |
| 4. Slip close to the ground | 4. Slip close to the ground |
| 5. The glide is broken | 5. The brakes can be used |
| 6. Head into the course | 6. Always keep flying |
| 7. Release the pressure | 7. Practice these landings |
| 8. Practice these landings | 8. Drop off to one side |
| 9. Dive down to a field | 9. Unlock the tail wheel |
| 10. Turn into the wind | 10. Pull the stick back more |
| 11. Try some circle shots | 11. Reset the throttle |
| 12. Drop off to one side | 12. Try some circle shots |
| 13. Unlock the tail wheel | 13. The plane is climbing |
| 14. The brakes can be used | 14. Vary your pattern |
| 15. Pull the stick back more | 15. Speed is kept constant |
| 16. Reset the throttle | 16. You have no power |
| 17. Always keep flying | 17. Head into the course |
| 18. The plane is climbing | 18. Turn into the wind |
| 19. Vary your pattern | 19. Dive down to a field |
| 20. You press right rudder | 20. Release the pressure |

# EXPLANATION OF CODING IN EXHIBIT 26:

Symbols appearing in columns 2, 4 and 6 denote word-frequency counts (occurrences per million words), from Thorndike, E. L. and Lorge, I. (1952) and inclusion in one or more of the five word tests used in the study, as follows.

First symbol (occurrences per million words):

AA = at least 100 occurrences/million words

A  = between 50 and 100 occurrences

Numerals 1 through 49: designated number of occurrences under 50

—  = not counted.

The second through the sixth symbols in these columns indicate that the word is included in one or more of the following word lists:

Letter = Word List

P  = Egan's Phonetically Balanced Words

F  = Fairbanks Rhyme Test

M  = Modified Rhyme Test of House et al. as modified by Kreul et al.

V  = Clarke's Vowel Test

D  = Voiers's Diagnostic Rhyme Test

Thus the word "bit" as it appears on the list may be identified as follows:

```
                        ┌──────────Word appears oftener than 100 times per million words
          AA,P, F,M,V,D─Voiers's Diagnostic Rhyme Test
                        └── Clarke's Vowel Test
and appears in │ \ \ └────Modified Rhyme Test
               │  \ └──────Fairbanks Rhyme Test
               └──────────Egan's Phonetically Balanced Words
```
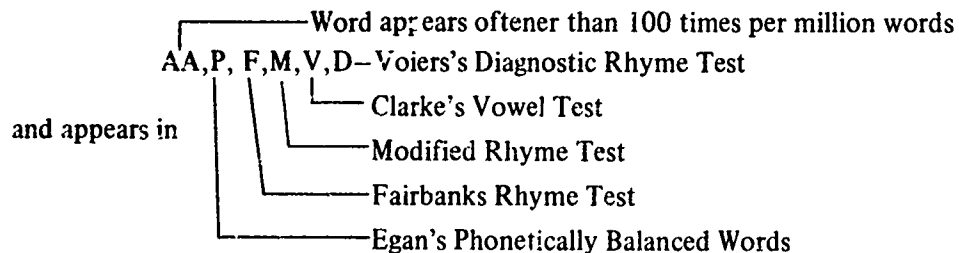
## A. SINGLE WORDS

| Word | Code | Word | Code | Word | Code | Word | Code |
|---|---|---|---|---|---|---|---|
| a | AA | bank(ed) | AA | boot | 37 | | |
| ABORT(ING) | - | bar | A,P | bore | A,F | | |
| add | AA,? | BARCAP | - | born | AA,F | | |
| AFFIRM | 10 | bare | A | botch(ed) | - | | |
| AFFIRMATIVE | 3 | barge | 12,P | both | AA | | |
| aft | 4 | barn | 45,P | bounce(d) | 10,P | | |
| aid(s) | A,P | base(d) | AA,P | bound | A,V | | |
| aim(ed) | A,P | bat | 19,P,M,D | BOWWAVE | - | | |
| air | AA,P | BATTERY | 19 | brace | 17,P | | |
| AIRBORNE | - | batch | 3 | brakes | 23 | | |
| aisle | 12 | bay | AA,P | branch | AA | | |
| ALFA | - | be | AA | BRAVO | 1 | | |
| all | AA,P | beach(ed) | A,M | break | AA | | |
| alley | 13 | beam | 42,P,M | bridge | AA | | |
| alp | - | beat(s) | AA,F,M,D | brief | A | | |
| ALTITUDE | 14 | been | AA | bright | A' | | |
| am | AA,P | BELLHOP | - | brim | 13 | | |
| an | AA | bend(-t) | 48,F,M,V,D | bring | A' | | |
| ANCHORED | 26 | best | AA,P,F,M | brink | 8 | | |
| ANYCAP | - | bet | 23,P,V | brisk | 9 | | |
| and | AA,P | big | AA,P,F,M | broad | A,V | | |
| ANGELS | 47 | bind | 39,P,V | broiled | 9 | | |
| ANGLE | 30 | | - | broke | A | | |
| any | AA | ...rd(s) | AA,V | brown | AA | | |
| APPROACH | A | bit | AA,P,F,M,V,D | BROWNIE | 6 | | |
| apt | AA,P | black | AA,P | budge(d) | 4,P | | |
| are(...) | 9,P | blade(s) | 32 | build | AA | | |
| arch(ed) | 34,P | blare | 2 | bulge | 5 | | |
| are(n't) | AA,P | blast | 31 | BULLMOOSE | - | | |
| arid | AA | blaze | 42 | bum | 6 | | |
| ARK | 7 | bleak | 9 | bury | - | | |
| arm(ed)(s) | AA,P | bleed | 16 | burn(ed)(t) | AA | | |
| as | AA,P | blind | A,P | burst(s) | A | | |
| ask(ed)(s) | AA,P | blow | AA | bus | 9,P,M | | |
| ASPRO | - | blob | - | bust | 13,P,F,M | | |
| ASSUME | A | block | A | BUSTER | - | | |
| at | AA,P,V | blow(n) | AA | but | AA,P,M | | |
| AUTOCAT | - | blue | AA | buzz(ed) | 16,P | | |
| AWAY | AA | bluff | 12,P | by | AA,P | | |
| aye | 16 | blur(red) | 8 | bye | 1 | | |
| | | board(s) | AA | | | | |
| BABS | - | boat(s) | AA,V | cab | 15,P | | |
| back | AA,P,F,M | bog(ged)(gy) | 9,P | cage | 30,P,F | | |
| bad | AA,P,M,V,D | BOGEY | | call(ed) | AA,V | | |
| bag(ged) | AA | bolts | 27,P | calm(ed) | A | | |
| ball | AA,P,V | bomb(s) | 13,D | came | AA,F,M | | |
| ban | 2,M | book | AA,P,F,M | camp | ?,? | | |
| band | A,V | boom | 19 | can('t) | AA,P | | |
| bang | 14,F,M | boost | 2,P | cap | A | | |

EXHIBIT 26 (Continued).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| cape | 34,P,M | clank | 2 | COVER | AA | | |
| CAPREP | – | clap | 22 | cowl | 5,V | | |
| car(s) | AA,P | CLARA | 12 | crack(ed) | 48,P | | |
| card | A | clash | 12,P | craft | 21 | | |
| care | AA,D | clasp | 27 | cram | 6 | | |
| carve | 26,P | class | AA,P | cramp(t) | 8 | | |
| cat | A,P | clean(ed) | AA | crane | 9 | | |
| catch | AA,P | clear(ed) | AA | crank | 8 | | |
| cause(d) | AA | clew | 2,P | crash(ed) | 34,P | | |
| CAUTION | 15 | click | 10,P | crate | 7,P | | |
| CAVU | – | cliff(s) | 38,P | crawl | 31 | | |
| cease | A | climb | A,P | creak | 9 | | |
| cell(s) | A | clinch | 3 | creep | 36 | | |
| chaff | 7,P | cling | 24,P | crest(s) | 18 | | |
| chain | A,P | clip | 16,P | crew(s) | 46,P | | |
| chance | AA,P | cloak | 28,P | crisp | 15 | | |
| change(d) | AA,P | clock(ed) | A | crook | 10 | | |
| chap | 14,P | clog(ged) | 4,P | cross(ed) | AA | | |
| charge(d) | AA,P | close(d) | AA,P | (ing) | | | |
| CHARLIE | 42 | cloud(s) | AA,P | crow | 37 | | |
| chart(s) | 15,P | clue(s) | 4,P | crowd | AA,P | | |
| chase(d) | 48 | clump(ed) | 9 | crown | A | | |
| chat | 12,P | clung | 18 | crude | 17,P | | |
| CHERUBS | – | clutch | 21,P | cruise | 10 | | |
| check(ed) | AA,P | CLUTTER | 2 | cub | 11,P,M | | |
| chew | 14,P,D | coach | 42 | cube | 9 | | |
| chick(s) | 15 | coarse | 28 | cue(d) | 3,P | | |
| chief | AA | coast | A,P | curb | 14,P | | |
| chill(ed) | 43,P | coax(ed) | 10,P | curl | 45 | | |
| chin | 27 | COCKROACH | 1 | curve(s) | 36,P | | |
| chip | 17,P | code | 21,P | | | | |
| chirp | 8 | coil | 13,F,M,V | | | | |
| chock(s) | 3,D | cold | AA,F,M | | | | |
| choice | A | colt | 21 | | | | |
| choke(d) | 27 | cone(s) | AA,P | | | | |
| choose | A,P,D | CONDITION | AA | | | | |
| chop(per) | 29,P,D | cone | 7 | | | | |
| chose | A,P | CONFUSED | 25 | | | | |
| chuck | 9 | CONTACT | 31 | | | | |
| chuy | 1 | CONTINUE | AA | | | | |
| chum | 4 | cope | 10 | | | | |
| chunk | 3,P | core | 7 | | | | |
| churn(ed) | 4 | cork | 11,P | | | | |
| chute(s) | 2 | cost | AA,P | | | | |
| CIGAR | 16 | cough(ed) | 18 | | | | |
| cinch | 1 | could | AA | | | | |
| cite | 1 | count | AA | | | | |
| clamp(ed) | 10 | course | AA,P | | | | |
| clancy | – | cove | 5 | | | | |

EXHIBIT 26 (Continued).

| | | | | | |
|---|---|---|---|---|---|
| cut(s) | AA, P | down | AA, V | end | AA, P |
| cycle(d) | 8 | dreg(ged) | A | ENGAGE | A |
| DADCAP | - | draw(n) | AA | enter | AA |
| damp | 27 | dread | 45 | entry | 17 |
| DANGER | AA | drench(ed) | 7 | equal | A |
| dark | AA, F, M | dried-(s) | 26 | error | 36 |
| darn | 12, P | drifts(s) | 36 | ESTIMATE | 40 |
| dart | 33, P | drink(s) | AA | even | AA |
| dash | A, P | drive | AA | ever | AA |
| date(s) | AA, F | drizzle | 1 | EVERGREEN | 9 |
| dawn(ed) | A, V | drone | 7 | eye | AA, P |
| day | AA, P, F, M | drop(ped)(s) | AA, P | | |
| DAYRECCO | - | drove | A | face | AA |
| dead | AA, P | drug | 24, P | fact(s) | AA, P |
| deaf | 19, P | drum | 40 | fade(s)(d) | 41, P |
| deal | AA, F | dry | AA | fag(ged) | 3 |
| DECIMAL | 1 | dual | 2 | fail(s) | AA, F, V |
| deck | A, P, D | duck(ed) | 49, F, M | faint | A |
| DECOY | 3 | duct | 1 | fair | AA, V |
| deep | AA, P | DUCKBUTT | - | fall | AA, P |
| DELTA | 8 | dud(s) | M | false | A |
| dense | 19, D | due | AA | FAMISHED | 4 |
| DETACH | 8 | dug | 26, M | fan | 38, P, D |
| dew | 30 | dull(ed) | 48, P, M, V | far | AA, P, V |
| dial(s) | 8 | dumb | 34, P, V | fast | AA, P, F, D |
| did(n't) | AA, P, F, M, D | DUMBO | - | fault | A, D |
| die | AA | dump(ed) | 10, F | FEAR | AA, V |
| differ | 30 | during | AA | feat | 13, M |
| digit | - | dusk | 14, F, M | fed | 41, P, F, M |
| dim(ed) | 37, M | dust | A | feel(s) | AA, P, F, M, D |
| dime | 11, P, V | duty | AA | feet | AA, P |
| dip(s) | 34, P, F, M, D | dwell(ed)(s) | 44 | fell | AA, P, F, V |
| disk | 8 | dye | 23 | felt | AA |
| ditch(ed) | 28, P | | | fence | A, D |
| ditching | 28, P | each | AA, P | FERRET | 2 |
| dive | 21, P | eager | 39 | few | AA, P |
| DIVERT | 11 | eagle | 38 | field(s) | AA |
| do | AA | early | AA | fifth | A, P |
| dodge(d) | 16, P | earth | AA, P | fifty | AA |
| does(n't) | AA | ease(d) | A, P | fight | AA, F, V |
| dog | AA, P | east | AA | file | 43, F, V |
| DOLLY | 8 | easy | AA | fill(ed) | AA, P, F, M, V |
| dome | 15, V | eat | AA, P, V | film | 31 |
| done | AA, P | echo | 42 | fin | 6, P, M, D |
| don't | AA | edge | AA, P | FINAL | A |
| door(s) | AA | eight | AA | find | AA, P |
| dot(s) | 38, P, D | ELEVATOR | 15 | fine | AA, P, F |
| doubt | AA, P | else | AA, P | fire | AA, F |
| dove | 19, P | EMERGENCY | 19 | firm | A |

EXHIBIT 26 (Continued).

| Word | Code | Word | Code | Word | Code |
|------|------|------|------|------|------|
| first | AA | frame | A | good | AA,P |
| fit | AA,P,F,M,V,D | free(d) | AA | GOODYEAR | 1 |
| five | AA,P | freeze | 32,P | goof(ed) | – |
| fix | A | friend(s) | AA | goose | 45,P,D |
| FI-YIV | – | FRIENDLY | A | got | AA,P,F,M,V,D |
| flag | A,P | fringe | 17 | grab(s) | 18,P |
| flair | 1 | from | AA | grade | 44,P |
| flame | A,P | front | AA,P | grand | A |
| flank(ed) | 15,P | frost | 41 | GRANDSLAM | – |
| flap | 16,P | froze(n) | 5 | grant | AA |
| flare | 10,P | fuel(ed) | 21 | GRAPHIC | 3 |
| flash(ed) | A,P | full | AA | grasp(ed) | 36 |
| flat | A | fume(s) | 8,P | grass | AA |
| flaw | 6 | funny | A | gray | AA,P |
| fled | 35 | fuse | 7,P | graze(d) | 16 |
| fleet | A,P | gab | P,D | grease | 16 |
| flew | A | GADGET | 2 | great | AA |
| flick | 4,P | gage | 2,P | green | AA |
| fling | 15,P | gain | AA,F | greet | A,P |
| flip(ped) | 3,P | gale(s) | 15,M | grew | AA,P |
| float | A,P | game(s) | AA,F,M | grey | 19 |
| flock | 44 | gang | 25,P,F,M | grid | – |
| flood | A,P | gap(s) | 17,P | grim | 22 |
| floor | AA | gas(ed) | A,P | grip | 35 |
| flop | 5,P | gate | AA,P,F,V | grope | 10,P |
| flow(ed)(s)(n) | AA | gauge | 5 | group(s) | AA,P |
| flung | 31 | gave | AA | grove(s) | 31,P |
| flush(ed) | 23,P | gay | A | grow | AA |
| fly | AA | gaze | A | guard | AA |
| foam(ed) | 21,P | gear(s) | 9 | guess | AA,P |
| foe | 23,P | GEIGER | – | GUESSER | – |
| fog(s)(gy) | 18 | GERONIMO | – | guest | A,D |
| fold | A,P,M | get | AA,P,F,V | guide | AA |
| foot | AA,P,V | giant | A | gulch | 3 |
| for | AA,P,V | gird | 6 | gulf | 33 |
| force(d) | AA,P | girl | AA | gull | 5,P |
| fore | 11 | give | AA,P | gun(s) | |
| fork(ed) | 31 | glad | AA | gust | 6,M |
| form(s) | AA,P | glare | 26 | GYRO | – |
| forth | AA,P | glass | AA | | |
| forty | A | glaze | 9 | hack | 7,P |
| foul | 27,V | gleam | 35 | had(n't) | AA,P,V |
| fould | – | glide | 24 | haft | – |
| found | AA | gloom | 18 | hail | 40,V |
| four | AA | glove | 43,P | half-ve | AA |
| fourth | A | glow | A | halt | 29 |
| FO-WER | – | go(ne) | AA,D | hand | AA |
| FOX | 25 | goal | 21 | hang | AA,M,V |
| FOXTROT | – | GOBLIN | 14 | hard | AA |
| | | GOLF | 26,P | harm | A |

EXHIBIT 26 (Continued).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| harsh | 17 | HOTEL | A | keep(s)(t) | AA,P,D |
| has | AA | hours | AA | KEEPER | 23 |
| hatch(ed) | 19,P | how('d) | AA,P | kill | AA,P,F,M |
| hate | A,P,F | howl | 34,P,V | KILO | - |
| haul | 21 | hue | 12 | kind | AA,P |
| have(n't) | AA,P | huge | A | kink | 1 |
| hawk(s) | 22 | HUGO | 5 | knife | A,P |
| haze, -y | 5 | huh | 3 | knob | 7 |
| he('d) ('ll) | - | hull | 8,P | knock | A,D |
| ('s) | AA | hum | 20,P,V | knot | 26 |
| head(ing) | AA,V | hump | 5,P | know | AA |
| heap | 46,P,M | hunch | 5,P | lace | 32,M |
| hear | AA,P,M | hung | A | lack | A,F |
| heat | AA,P,F,M,V | hunt | A,P | lag | 9,P |
| heave | 18,M | HUNTSMAN | 6 | laid(-n) | AA,V |
| HECKLERS | - | hurl | 20,P | lakes | AA |
| hedge | 32,P | hurt | AA,P,V | lame | 29,M,V |
| heed | 21,P,V | HUSH | 26,P | lamp(s) | A,D |
| held | AA | | | lance | 16 |
| hell | 31 | ice(d) | AA,P | land(s) | AA |
| helm | 13 | I('d)('ll) | | lane | 32,M |
| HELOT | 1 | ('m) | AA | lap | 36,P,D |
| help(ed) | AA | IDENT | - | lapse(d) | 8 |
| hen | 49,F,M | IDENTIFY | 20 | large | AA |
| her(s) | AA | ill | AA | lash | 22,P |
| here | AA | in | AA,P | last | AA, P,F,V |
| hex(ed) | - | INDIA | 46 | latch(ed) | 8,P |
| hid(e) | A,P,F,V | INTERFERENCE | 11 | launch(ed) | 18 |
| high | AA,P | INTRUDERS | 6 | lay | AA,P,M,V |
| hight | 5 | isle | 28,P | LAZY | 25 |
| hill(s) | AA,P,M,V | isn't | AA | lead | AA |
| hind | 26 | it('d)(s) | AA,V | leak | 8,D |
| his | AA,P | jab | 2,P,D | leap(ed) | A,D |
| hiss | 16,P | jam | 16,P | least | AA,V |
| hit(s) | A,P,F,M,V,D | jerk(ed) | 18 | leave(s) | AA,P |
| hitch | 9,P | jet | 9 | led | AA,P,F,M,V |
| ho | 16 | jinx | - | lee | 28,V |
| hoist | 10 | joy | 4 | left | AA,P |
| hold(s)(ing) | AA,F,M | join(ed)(s) | AA | leg | AA,P |
| hole(s) | AA,F,V | joint | 36 | less | AA,P |
| home(s) | AA,V | jolt | 5,P | let(s) | AA,F,V |
| HOMER | - | joy | AA | LEVEL | A |
| hood | 21,P,V | judge(d) | AA,P | lie | AA |
| hook | 47,P,F,M | JUDY | 9 | LIFEGUARD | - |
| hop | 35,F,M,D | JULIETT | 7 | lift | AA |
| hope(d) | AA | jump | A,F | light(s) | AA,F,V |
| horn | A,F | just | AA,F,M | like(d) | AA,V |
| HOSTILE | 20 | jut | 6 | LIMA | 2 |
| hot | AA,P,F,M,V | | | limb | 38,V |

EXHIBIT 26 (Continued).

| | | | | | |
|---|---|---|---|---|---|
| line(d)(s) | AA,P | meet(s)(-t) | AA,V | neck | AA,P,D |
| LINER | 4 | melt(ed)(s) | A | NEGATIVE | 10 |
| link(ed) | 24,F | men | AA,F,M | need(n't) | AA,P,D |
| lip | AA,P,F,M,D | merge(d) | 6,P | nest | A,P,F,M |
| list | A,V | mesh | 6,P | net | A,P,V,D |
| lit | 16,P,V | mess | 17,V | new | AA,P |
| live | AA | mid | 11 | next | AA,P |
| load(s) | A,V,D | MIDDLEMAN | 2 | nice | AA,P |
| lob(bed) | – | MIDNIGHT | A | night | AA,P,F,V |
| lobe | 2 | midst | 44 | NIGHTCAP | 2 |
| LOCAP | – | might | AA,F,V | NIGHTRECCO | – |
| lock(ed) | A,F,V,D | mike | – | nil | – |
| lodge | 48 | mil | 1 | nine(r) | AA,P,F |
| loft | 8 | mild | 32 | ninth | 22,P |
| lone | 22 | mile(s) | AA | nip | 6,P,D |
| long | AA,D | mind | AA | no | AA,P |
| look(ed) | AA,P,F,M,V | MINUS | 2 | NOCOP | – |
| loom(ed) | 21,V | mirk | – | NODUB | – |
| loop(ed)(s) | 15 | miss(ed) | AA,V | noise | A |
| loose | A,P | mist | 29,P | none | AA |
| lose(-t) | AA,P,V | mix(ed) | A | noon | A,F,D |
| loss | AA,P | MIXUP | – | nor | AA |
| lot | AA,F,M,V,D | mock | 31,F | norm | – |
| loud | A,P,V | mode | 23,P | NORMAL | 41 |
| low | AA,P,V,D | moist | 19 | north | AA |
| luck | 46,F | moon | AA,F,D | not | AA,P,F,M,V |
| lull | 11 | mop | 5,P,F,M | notch(ed) | 11,P |
| lunge | 2,P | more | AA,F,V | note(s) | AA,P,V,D |
| lurch(ed) | 3 | morse | 7 | NOVEMBER | A |
| lurk | 15 | most | AA,P | now | AA |
| | | mound | 17 | nudge(d) | 2,P |
| main | A,F | mount | AA | null(ed) | 1 |
| make(-de) | AA,P,F | mouth | AA,P | numb(ed) | 5 |
| MAKER | 27 | move(d)(s) | AA,P | nurse(d) | A |
| many | AA | mow | 6,P | O'CLOCK | A |
| map | A,P,M | much | AA | OCTOPUS | 2 |
| MAPPO | – | muck | 5,P | odd | 38,P |
| mark(ed) | AA,F,M | mud | 47,P | of | AA |
| marsh | 16 | murk | – | off | AA,P |
| mask | 17 | mush | 2,P | oh | AA |
| mass | A,P,M | MUSHROOM | 10 | oil | AA,M |
| mat | 18,M,V | must | AA,F,M | OKAY | 3 |
| match | A | my | AA,P | old | AA |
| may | AA,P,F,M | | | on | AA,P |
| MAYDAY | – | name | AA,F,M | once | AA |
| maze | 6,P | NANCY | 15 | one | AA |
| me | AA,P | near | AA | or | AA,P |
| mean | AA | neat | 29,P,F,M | ORANGES | A |
| meant | A | 'neath | – | ORBIT(ING) | 10 |
| MEDIUM | 23 | | | | |

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**EXHIBIT 26 (Continued).**

| | | | | | |
|---|---|---|---|---|---|
| OSCAR | 2 | plan(ned) | AA | quick | A,P |
| other | AA | plane | A | quiet | A |
| ought(-to) | AA,P | plant | AA | quit | 49 |
| our | AA,P | plate | A | quite | AA |
| out(er) | 23,P,V | PLAYBOY | – | rack(ed) | 29,P |
| over | AA | please(d) | AA,P | raft | 7,P |
| own | AA,P | plight | 11 | raid | 11,P,V |
| | | plod | 5,P | rain | AA,F |
| pace(d) | A,M | plop(ed) | – | raise(d) | AA,P |
| pack | A,P,F | plot | 36 | ram(med) | 16 |
| pad | 17,P,M | plow(ed) | 35,P | ramp | 1,P,D |
| paint | AA | plunk | – | RAMROD | 1 |
| pair | AA,V | plus | 10,P | ran | AA |
| pale | A,F,M,V | plush | 1,P | rang | 25,F,M |
| PAN | A,P,M,V,D | PLUTO | 3 | range(d) | A,P |
| PANCAKE | 6 | pod | 3,P | rank | A |
| PAPA | 34 | POGO | – | rap | 10,P,D |
| par | 5 | point | AA | RAPCAP | – |
| park(ed)(s) | A,P,F,M | role | A,V | rare | 43 |
| PARROT | 9 | pond | 30,P,D | rate | AA,P,F,M,V |
| part(s) | AA,P | pool | 34,V,D | raw | 46,P,F,M,D |
| PARTNER | 32 | poor | AA,V | ray | A,P,M |
| pass | AA,P,M | pop(ped) | 21,F,M,V | reach(ed) | AA,P |
| past | AA,P,F | POPEYE | – | read(past) | AA |
| patch(ed) | 34,P | pore | 8 | READY | AA |
| path(s) | AA,P,M | port | A | real | AA,P |
| pause(d) | A | POSITION | AA | rear | A,P |
| pave(d) | 14,M | post | AA | RECCO | – |
| pay | AA,F,M,V | POUNCE | 6,P | reck(ed) | 2 |
| peak(ed) | 28,M,D | prang(ed) | – | RECKON | 21 |
| peal | 9,M | press(ed) | AA,P | red | AA,F,M,V |
| PEDRO | 4 | prey | 28 | reef | 6,P |
| peg(ged) | 9,P,D | prime(d) | 17,P | reel(ed) | 19,F,M |
| per | A | prior | 15 | RELIABLE | 10 |
| phase(d) | 15,P | prone | 6 | REPORT | AA |
| pick(ed) | AA,P,F,M | PRONTO | – | RESCUECAP | – |
| piece(d) | AA | prop(s) | – | RIALTO | – |
| PIGEONS | 34,P | prowl | 7 | rich | AA |
| pile | A,P,F,V | puff | 28,P,M | rid | 33,P,F,V,D |
| pin(ned) | 43,F,M,V | pull(ed)(s) | AA | ride | AA,P,F |
| pinched | 20 | pump(ed) | 29,P,F | ridge | 31,P |
| pine | A | punch(ed) | 17 | right | AA,F,V |
| ping | | punt | P | rim | 12 |
| pink | A,P,F | purge(d) | 6,P | ring | AA |
| pip | M | PURPLE | 37 | rip(ped) | 19,P,F,M,D |
| pit | 29,P,M,V | purr(ed) | 6 | rise(s) | AA,P |
| pitch(ed) | 43,P | push(ed) | A | risk(ed) | 40,P |
| place(d) | AA | put | AA,P | road | AA,V,D |
| plain | AA | QUEBEC | 7 | roar | A,P |

**EXHIBIT 26 (Continued).**

| | | | | | |
|---|---|---|---|---|---|
| roll(ed) | AA,P | send(s)(-t) | AA,F,M | sky(-ies) | AA,P |
| ROMEO | 5 | sense | AA,P | SKYROCKET | – |
| roof | AA | serf | 4 | slab | 7,P |
| room | AA | set | AA,P,F,V | slack | 7 |
| rough | A,P | SEVEN | AA | slam(med) | 11 |
| round | AA | shock | 7,P | slant(s) | 10 |
| route | A | shade | AA,P | slap(s) | 13,P |
| row(s) | A,D | SHADS | 1 | slash | 8,P |
| ruin(ed) | A | shaft | 25,P | sleet | 5 |
| run(s) | AA,F,M | shake | A | slice(d) | 30,P |
| rush(ed) | AA,P | shall | AA | slick | 3 |
| rut | 3,P,V | shape(d) | AA | slide | 36,P |
| safe | AA,M | share | AA,P | slight | A,V |
| said | AA,V,D | sharp | A | slim | 14 |
| sail | AA,F | she('d)('ll) | | sling | 8 |
| SALVOS | – | ('s) | AA | SLINGSHOT | – |
| same | AA,F,M | shear | 12 | slip(ped) | A,P |
| sand | A | SHECAT | | slosh(ed) | – |
| sank | 32,D | sheet(s) | A,V,D | slot | 3,V |
| SAPPHIRE | 6 | shell(ed) | A | slow(ed) | A |
| sat | AA,P,M,V | shift | 35 | slug | 5,P |
| SAUNTER | 4 | ship | AA,P | slung | 3 |
| save(d)(s) | AA,M | shook | A,P,M | small | AA |
| saw | AA,M,D | shoot | A,V | smash(ed) | 12,P |
| say(s) | AA,F,M | shore | AA | small | A |
| scan(ned) | 8,P | short | AA | smoke(r) | AA |
| scoop | 8 | shot | AA,P,V | snap(ped) | 49 |
| scope | 11 | should(n't) | AA | snatch(ed) | 27 |
| score(d)(s) | A | show(n) | AA,D | sneak | 10 |
| scout | 37,P | shower(s) | 41 | SNOOPER | – |
| scram | – | shroud | 9 | snow(ed) | AA,P |
| SCRAMBLE | 17 | shut(s) | A,P | snub | 2 |
| scrap(ped) | 18 | sick | AA,P,F,M,V | so | AA,P,D |
| scrape(d) | 18 | side | AA,P,F,V | soar | 12,P |
| scratch | 30,P | SIERRA | 3 | sod | 10,P,F,V |
| screen(ed) | 39 | sight | AA | soft | AA |
| screw | 20 | sign | AA,P,V | sole | 25,D |
| scrub(bed) | 14,P | silk | A | solve(d) | 33,P |
| sea | AA | since | AA | some | AA |
| seal(ed) | 45,F | SINGLE | AA | soon | AA,F,V |
| search(ed) | A | sink(s) | A,F | sought | – |
| seat(s) | AA,F,M,V | sit(s) | AA,P,F,M,V | sound | AA |
| SECTOR | 2 | site(s) | 21 | soup(ed) | 36 |
| SECURITE | – | SITREP | – | SOUR | 15,P |
| see | AA | six(th) | AA | source | A |
| seek | AA,M | size | AA,P | south | AA,P |
| seem(ed) | AA,M | ship(ped) | 17 | space(d) | AA |
| seen | AA,M | skirt | A | span | 13,V |
| seize | A | SKUNK | 13 | spare | A |
| self | A | | | | |

**EXHIBIT 26 (Continued).**

| | | | | | |
|---|---|---|---|---|---|
| speck | 13 | strap(s) | 15,P | TALLY-HO | - |
| speech | AA | stray(ed) | | TANGO | - |
| speed(s)(-d) | A | (s) | 18 | tank(ed) | 19 |
| spent | A | streak(ed) | 15 | tap(ped) | 32,P,M,V |
| spill | 12 | steam(ed) | AA | tape | 8,V |
| spin | 24,V | street | AA | TARCAP | - |
| splash(ed) | 20,P | strength | AA | TARGET | 9 |
| split(s) | | stress(ed) | 13,P | task | A |
| (ting) | 26 | stretch(ed) | A | TASP | - |
| spoke | AA | strict | 12 | tear | AA,M |
| SPOOFER | - | strike | AA | tease | 14,M |
| spool(ed) | 7 | string | A | tell | AA,P,F,V |
| spot(ter) | | strip | A | ten | AA,P,F,M,V |
| spout | 6 | stripe(d) | 14 | tend | A,F |
| spread(s) | AA | strive | 19 | tenth | 23 |
| spring | AA | strong | AA | test(s) | A,P,F,M,D |
| sprint | 1 | stuck | 34 | than | AA,P,D |
| spun | 12,V | strung | 2 | tnank(s) | AA,P,D |
| spur | 23 | strut | 8 | that | AA,P |
| squall(s) | 4 | stuck | 34 | thaw(ed) | 8,P,M,D |
| SQUAWK(ING) | 4 | stud | 8 | the | AA |
| square | AA | stuff | A,P | their(s) | AA |
| squeal | 5 | sub | 1,M | them | AA,P |
| squelch(ed) | - | SUBCAP | - | then | AA,P,M,D |
| squib | - | suck | AA,P | there('s) | AA,P |
| stack | 11,V | sun | AA,F,M | these | AA |
| stalk(ed) | 27,V | sunk | 17 | they('d)('ll) | |
| stall | 19,V | sure | AA | ('re)('ve) | AA |
| stand(s) | AA | surf | 4 | thick | A,P,D |
| star(s) | AA,V | surge(d) | 12 | thickened | 5 |
| STARBOARD | 3 | swamp | 29 | thin | AA,P,D |
| start(s) | AA,P | swap | 2 | thing | AA,D |
| state | AA | sway(ed) | 36 | think | AA |
| stay(s)(ed) | AA | sweep | 44 | third | AA |
| STEADY | A | sweet | AA | this | AA,P |
| steep | 40 | swell | A | those | AA,P,D |
| steer | 33,V | swift | 43 | though | AA,P,D |
| stem | 39 | swing | A | thought | AA |
| stick(s) | AA,V | swirl | 7 | thread | A,P |
| stiff | 44,P | switch(ed) | 15 | threat | 17 |
| still(ed) | AA,V | swoop(ed) | | three | AA,P |
| stink(s) | 4 | (s) | 7 | throw | A |
| stood | AA | | | thrust | 40 |
| stop(ped) | AA | tab(s)(bed) | 1,P,M | thud | 4,P |
| store | AA,V | tad | - | THU-REE | - |
| storm | AA | tag | 7,P | tide(s) | 46,F |
| straight(en) | AA | tail | A,F | tie(d) | AA,V |
| strain(ed) | A | take | AA,P,F | tight | 35, |
| STRANGER | A | talk(ed) | AA | till | AA,F,M,V |
| STRANGLE | 3 | tall | AA,V | | |

EXHIBIT 26 (Continued).

| | | | | | |
|---|---|---|---|---|---|
| tilt | 12,P | two | AA | WEATHER | AA |
| time | AA,P | type | AA,V | weave | 22,P |
| tip(s) | A, P,F,M,V | | | week | AA |
| tire | AA,P,F | UNABLE | 37 | weigh | A |
| t'll | – | UNIFORM | A | weight | AA |
| to | AA,V | UNKNOWN | A | well | AA,F |
| told | AA,F,M | up | AA,P | went | AA,F,M |
| ton(s) | 49,P | us | AA,P | were | AA |
| tone | A,V | use(d) | AA,P | west | AA,F,M |
| too | AA | | | wet | A |
| took | AA,F,M | vague | 20,P | what | AA |
| TOOL | 40,V,D | van | 29 | wheel(s) | A,P |
| top(ped)(s) | AA,F,M,V | vane | 3 | when | AA |
| torque | – | vary | A | where | AA |
| toss(ed) | 46 | vast | A,P,D | which | AA |
| touch(ed) | AA,P | VECTOR | – | while | AA |
| tough | 18 | veer | 3 | whine(d) | 11 |
| tow(ed) | 9 | vent(s) | 7 | whip | 41 |
| toward | AA | verge | 9 | whirl | 31 |
| tower | A | VERY | AA | WHISKEY | 9 |
| town | AA,V | via | 8 | white | AA,P |
| trace | A | VICTOR | 11 | who | AA,P |
| track(ed) | A | view(ed) | AA | whole | AA |
| TRACTORS | 12 | VISIBILITY | 1 | whose | AA |
| trait | 7 | voice | AA | why | AA,P |
| trade | AA,P | void | 12,P | wide | AA,P,F |
| TRAILOR | – | volt(s) | 2 | width | 28 |
| train | AA | | | wield | 6,P,D |
| TRANSPONDER | – | way | 12,P | wild | AA,P |
| trap(ped) | 42 | wait | AA,P | will(-on't) | AA,F,M |
| trash | 3,P | wake | A, P,F | win | AA,M |
| TRIDENT | 1 | wall(ed) | AA,D | wind | AA |
| tried | AA | wane(d) | 7 | wind | AA |
| trim(med) | 42 | want | AA | wing | AA |
| trip(ped) | AA,P | warm(ed) | AA | wipe | 45,P |
| troop | A,P | warn | A | wire | A,P,F |
| TROT | 21 | warp | 12 | wish(ed) | AA,P |
| true | AA,P | was | AA | with | AA,P |
| trunk | 48 | wash(ed) | AA,P | word | AA |
| try | AA | waste | AA,P | work(ed) | AA |
| tuck | 22,P,F | watch | AA,P | worn | A,F |
| tug | 16,P | watt(s) | 2 | worse | A |
| tune(d) | 32,D | wave(s) | AA,P | worst | A |
| turn(ed)(s) | AA,P,V | way | AA,F,M | worth | AA |
| twelve | AA | we('d)('ll) | | would(n't) | AA |
| twice | A | ('re)(ren't) | | wreck | 41,P |
| twin | 25 | ('ve) | AA | write | AA |
| twirl | 3 | weak | A,P | wrong | AA,D |
| twist | 42 | wear | AA | WUN | – |

**EXHIBIT 26 (Continued).**

| | |
|---|---|
| X-RAY | 2 |
| yank | 2 |
| YANKEE | 12 |
| yaw(ed) | – |
| YELP | 5 |
| yes | AA |
| yet | AA,P,F |
| yield | A,P,D |
| you('d)('ll) ('re)('ve) | AA,P,D |
| your(s) | AA |
| | |
| ZERO | 11 |
| zone | 26,P |
| zoom(ed) | – |
| ZULU | 1 |

EXHIBIT 26 (Continued).

## B. PHRASES

| | | | |
|---|---|---|---|
| air borne | creep by | form right | IN THE DARK |
| air brake | crew rest | form up | I STAY |
| air line | | four miles | |
| air plane | DAVEY JONES | FREE LANCE | join up |
| air speed | day break | freeze line | joy stick |
| air start | DECK CLEAR | front side | |
| aisle seat | DECK FOUL | fuel dump | keep clear |
| alls calm | dense fog | fuel feed | keep pace |
| ANY FACE | dim lights | fuel flow | |
| arm guns | dive time | fuel gauge | lap belt |
| | dog leg | fuel pod | lead ship |
| bank left | dome light | fuel pump | left flank |
| bank right | down hill | full flaps | left side |
| base leg | down wind | full speed | left turn |
| BENCH MARK | drag chute | fuze box | light haze |
| BAY RUM | draw fire | | light mist |
| big blow | drink fuel | G-force | light rain |
| BINGO FIELD | drop down | gas gauge | light snow |
| BINGO STATE | drop tanks | gear down | link up |
| blade pitch | dry tank(s) | gear up | live fuze |
| bleed air | dump fuel | glide path | locked down |
| block time | dump stores | good by | low boost |
| boards out | | ground fire | low pitch |
| bomb bay | EASE TURN | gun fire | low run |
| bomb run | east bound | guns free | low side |
| brake out | east side | guns tight | low tide |
| break left | EMERGENCY SPACE | half flaps | |
| break off | exit time | hand crank | MACK NO |
| break right | | hatch closed | MACK YES |
| break up | face mask | head wind(s) | main gear |
| bright light | face plate | heads up | main switch |
| brisk wind | fan jet | high boost | marsh land |
| build up | far side | high gain | mid course |
| burned out | fast cruise | high pitch | mild chop |
| buss box | FEET DRY | high side | |
| | FEET WET | high tide | new course |
| call back | fill tanks | high wind | next turn |
| call sign | class | hold course | no joy |
| calm sea | 's | hold fire | north bound |
| calm wind | flame out | hold line | north east |
| CEASE REPORTING | flaps down | home plate | north west |
| change speed | flaps up | home stretch | nose gear |
| charge guns | flat tire | hook down | |
| chase plane | flight deck | HOTEL FIRE | off course |
| clear air | flight path | hot mike | on course |
| cloud deck | flight plan | | ON THE CLOCK |
| cloud layer | flood light | ice berg | on top |
| coast line | fly at | iced up | ON STATION |
| code book | FLYING AT | I GO | ON TARGET |
| code three | form left | in range | |

EXHIBIT 26 (Continued).

| | |
|---|---|
| pins in | test flight |
| pins out | thank you |
| port side | thick clouds |
| PREP CHARLIE | three lights |
| prop jet | TIED ON |
| prop wash | tight turn(s) |
| purge tanks | time hack |
| | tip tank(s) |
| right flank | touch down |
| right side | tree top(s) |
| right turn | trim pad |
| run up | turn left |
| | turn right |
| safe guns | |
| SAINT BERNARD | warm up |
| SCENE COMMANDER | WARNING RED |
| SEE YOU | WARNING WHITE |
| set course | WARNING YELLOW |
| shore line | WAVE OFF |
| shut down | WEAPONS FREE |
| side slip | WEAPONS TIGHT |
| sign off | west bound |
| sink rate | WHAT LUCK |
| skip bomb | WHAT STATE |
| SKIP IT | wheels down |
| slow count | wheels up |
| slow cruise | wheels well |
| slow down | WHICH TRANSPONDER |
| slow flight | wide turn |
| slow roll | wing man |
| snap roll | wing tank(s) |
| south bound | |
| south east | YELLOW JACKET |
| south west | you're hot |
| speed brake | |
| spin out | |
| split-S | |
| spool down | |
| squall line | |
| STATE CHICKEN | |
| STATE LAMB | |
| STATE TIGER | |
| STATE WEAPONS | |
| steep turn | |
| steer course | |
| storm line | |
| stow pins | |
| tail hook | |
| tail wheel | |
| take care | |

### QUESTION TYPE

Q 1. What is the condition of the team?

Q 2. What is size of enemy force?

Q 3. Are elements in position?

Q 4. What is fire mission?

Q 5. How copy?

Q 6. What is sit-rep?

Q 7. Request log-stat.

Q 8. Have you reached the objective?

Q 9. What is your location?

Q 10. Do you need air support?

Q 11. What is your position?

Q 12. Are you ready to move into position?

Q 13. Is your area secured?

Q 14. Do you need rations?

Q 15. Are you in contact with the other team?

### ANSWER/INSTRUCTION TYPE

A 1. We need a resupply of ammunition.

A 2. Move to LIMA ZULU vicinity 679703.

A 3. You will be extracted at 1600 hours tomorrow.

EXHIBIT 27 (Continued).

A 4. Am in contact with the platoon sized element.

A 5. We drew heavy ground fire on the alternate LIMA ZULU.

A 6. Abort the mission.

A 7. We have reached the objective - in process of surrounding it.

A 8. First insert ship shot out.

A 9. My position from reference point is right one, down four.

A 10. Need dust off. From check point one down two, left three. Will throw smoke. Have him come up on Battalion Command.

A 11. I see your smoke. You are approximately one thousand meters from the LIMA ZULU.

A 12. Am receiving heavy fire from the ridge line to the North.

A 13. Put the napalm in the bottom of the valley.

A 14. Ready with smoke - the first stick on final now.

A 15. Fire for effect.

A 16. Proceed immediately to point ZULU for extraction of element. Upon completion of extraction, initiate plan CHARLIE.

A 17. Sit-rep negative.

A 18. Attack enemy at 532714 at 0600 hours.

A 19. Need interpreter and MI team at 546823 at 2100 hours.

A ). Move your unit to 633721 and defend. Prepare to attack.

A 21. Be prepared for a CHARLIE ALPHA. Will give details later.

A 22. Estimated ECHO TANGO ALPHA of resupply is 2200 hours.

A 23. We are moving into NOVEMBER DELTA PAPA.

A 24. Switch over to alternate frequency.

A 25. From target ALPHA FOXTROT 2011, direction 1540, right 400, add 200, up 30. Infantry platoon in trenches. VT in effect. Adjust fire.

A 26. Grid 627938, ranging rounds, adjust fire.

EXHIBIT 27 (Continued).

A 27. From registration point 1, direction 1200, right 400, add 150. Enemy convoy, WHISKEY PAPA and HOTEL ECCO. Fire for effect.

A 28. Search and destroy area 720650.

A 29. Have discovered an enemy bunker system.

A 30. Registration point 2, direction 2600, registration adjust fire.

A 31. Hold enemy at 630725.

A 32. Command post located at 722804.

A 33. Friendly casualties KIA 9, WIA 13, MIA 2.

A 34. Need airborne psywar team at _____.

A 35. This frequency compromised. Change to alternate.

A 36. We need immediate air support. Our situation is critical.

A 37. We need 3 cases of Charlie 4 to destroy tunnel system.

A 38. Need ammunition.

A 39. Aircraft in vicinity.

A 40. Observe radio silence.

A 41. Call me on land line at 2000 hours.

A 42. Have located large cadre consisting of food and ammunition.

A 43. Have started to reach village.

A 44. Trains located at 543202.

A 45. Have consolidated as of 1500 hours.

A 46. Grid 233629, Enemy patrol, fire for effect at my command.

A 47. Maintain 75% until 0930 hours.

A 48. Report to my location by 2100 hours.

A 49. Send chaplain.

These 150 phrases were fabricated by Roy Klumpp to
obtain speech material which would be similar to that which
might be delivered over the Flight Deck Radio Link System.

1. USE THE OTHER CREW
2. THE PILOT SAYS IT'S DOWN
3. KNOCK OFF THE CHATTER
4. THE FORE IS OUT NOW
5. WHERE IS THE PLANE CAPTAIN?
6. I CAN'T HEAR YOU
7. TRY TO FIX IT FORWARD
8. THE DECK IS SLIPPERY
9. HE LOST HIS GOGGLES
10. SEND FOR THE MEDIC
11. TAKE 103 AFT
12. WE NEED AN AIR STARTER
13. WHAT IS THE WIND?
14. BRING 6 BRIDLES
15. DROP IT DOWN #1
16. WAVE ONE HAND
17. ARE YOU READY?
18. HE BROKE HIS ARM
19. SEND FOR A PUSHER CREW
20. THE WIND IS 33 KNOTS
21. HAUL IT BACK HERE
22. FIRE IN THE PORT CATWALK
23. THE COD IS READY
24. HYDRAULIC LEAK ON THE F4J
25. MAKE IT TWO FEET LONG
26. RAISE YOUR RIGHT FOOT
27. A MIRROR LIGHT IS OUT
28. FUEL LEAK ON THE A7
29. WHERE IS THE FLIGHT DECK CHIEF?
30. MY RECEIVER IS DOWN
31. OUR JOB IS DONE
32. GIVE ME A SLOW COUNT
33. READY TO LAUNCH NOW
34. TIE DOWN 204
35. NUMBER TWO IS FLYING
36. SEND US A MAN
37. PRI FLY SAYS NO
38. BRING UP # 1 ELEVATOR
39. BRING A HAMMER
40. BOMB CRATER AT FRAME 62
41. SECURE THAT FIRE HOSE
42. WHAT PLANE IS NEXT?
43. CALL ME LATER
44. GET BEHIND THE ISLAND
45. PULL OUT 005
46. FLAT TIRE ON 211
47. PULL OUT THE PIN
48. WHAT WAS THE MESSAGE?
49. CRASH ON THE FAN-TAIL
50. WHAT CHANGE SHOULD WE MAKE?
51. NUMBER ONE IS NOT WORKING
52. WHERE IS THE BEST PLACE?
53. SEND 10 MEN FORWARD
54. FIRE THE PORT CAT
55. CUT THE LINE
56. CALL THE ARMAMENT PARTY
57. WATCH OUT FOR JET BLAST
58. TWO AD'S AT FRAME 51
59. WE NEED THREE BRIDLES
60. THE TAIL HOOK WON'T RETRACT
61. SPOT IT NEXT TO 107
62. TRY OUT THE FORWARD ONE
63. CHECK FOR FUEL LEAKS
64. WE NEED A HOSE
65. LOAD ROCKETS ON 120
66. JONES SAYS 212 IS DOWN
67. HOLD THE NEXT PLANE
68. WATCH OUT FOR THAT WIRE
69. FLY 2 IS HURT
70. NUMBER 110 IS DOWN
71. USE NUMBER 3 ELEVATOR
72. HOW MANY DID YOU SAY?
73. HURRY UP FORWARD
74. SEND US TWO TRACTORS
75. LAUNCH AT 0910
76. WHERE IS MR. JOHNSON?
77. RAISE YOUR RIGHT HAND
78. ITS AT THE NUMBER 3 SPOT
79. HOW MANY DID YOU WANT?
80. CARRY IT UP HERE
81. CASUALTY AT THE MIRROR
82. BRING US SOME GLOVES
83. SEND Mr. AVERY DOWN
84. FIRE DRILL AT 0700
85. WHAT COLOR IS IT?
86. OUR TRACTOR IS DOWN
87. CHANGE THE REAR TIRE
88. COVER IT WITH SAND
89. FIRE NUMBER 2 FIRST
90. GAS UP THE AD'S
91. HOW MANY ARE LEFT?
92. START UP 607

EXHIBIT 28 (Continued).

93.  THE TIME IS 1000
94.  WHERE'S 102 AT NOW?
95.  BRING 3 FLASHLIGHTS
96.  OPEN UP THE BOX
97.  NUMBER 27 IS FUELED
98.  LAUNCH THEM NOW
99.  START ENGINES IN FIVE MINUTES
100.  101 MADE A TOUCHDOWN
101.  FLY-1 IS GONE
102.  90 POUNDS OF AIR PRESSURE
103.  BOMB HOIST NUMBER 2 IS OUT
104.  PORT CAT IS NOW WORKING
105.  HOW MANY HELMETS?
106.  HOLD HIM FOR 6 SECONDS
107.  GET THE FIRE HOSE OUT
108.  TURN ON YOUR LIGHT
109.  PREPARE FOR BOMB LOADING
110.  FIND OUT WHAT THE FUEL STATUS
      IS
111.  HOLD 105 FOR 2 MINUTES
112.  FUEL LEAK ON 111
113.  PREPARE FOR LAUNCH.
114.  FIRE DAMAGE PARTY AFT
115.  ERECT THE CRASH BARRIER
116.  TRACTOR 5 IS BELOW DECK
117.  SEND ME A RUNNER
118.  SET FOR 40,000 POUNDS
119.  TURN OFF THE LIGHTS
120.  FIND OUT WHAT TIME WE LAUNCH
121.  HE BROKE A LEG
122.  BOMB HOLE IN NUMBER 2 ELEVATOR

123.  FOUR MEN ARE NEEDED
124.  CHECK FOR STICKING CONTROLS
125.  HOW MUCH FUEL IS LEFT?
126.  BOTH WINGS ARE GONE
127.  SEND FOR MORE BATTERIES
128.  THE PORT WING IS DAMAGED
129.  713 IS DUE NEXT
130.  WHY IS IT DOWN?
131.  HOW MANY DO YOU WANT?
132.  WHAT WAS THE PRESSURE?
133.  THE WIND IS 41 KNOTS
134.  CHANGE THE TIRE NOW
135.  SEVEN JACKETS, TWO HELMETS
136.  DROP THAT WIRE
137.  BOMB LOADING IN 10 MINUTES
138.  FRAYED ARRESTING GEAR WIRE
139.  THE TAIL FIN IS DAMAGED
140.  THE BULL HORN ISN'T WORKING
141.  WHERE IS THE ARMAMENT CREW?
142.  GIVE ME A WAND
143.  GET THAT PLANE MOVED
144.  NUMBER 3 ARRESTING WIRE IS
      BROKEN
145.  IT'S AT FRAME 103
146.  BRING FOUR CHOCKS ALONG
147.  G. Q. IN 10 MINUTES
148.  CHECK THE BLAST DEFLECTOR
149.  PULL OUT THE CHOCKS
150.  WHAT IS THE WIND?

1) The Flight Deck Words were taken from the Flight Deck Phrases listed in the preceding section.

2) No proper names or station identification names were used.

3) No word appears more than once.

4) Each order is a different randomization of the same 100 Flight Deck Words.

5) There is a total of 10 orders.

## ORDER 1

| | | | |
|---|---|---|---|
| 1. spot | 26. frame | 51. elevator | 76. degrees |
| 2. launch | 27. you | 52. have | 77. send |
| 3. tractor | 28. wing | 53. starboard | 78. off |
| 4. take | 29. flight | 54. clear | 79. island |
| 5. bay | 30. next | 55. tell | 80. forward |
| 6. time | 31. fuel | 56. feet | 81. facing |
| 7. ready | 32. number | 57. mirror | 82. airborne |
| 8. room | 33. position | 58. pulled | 83. standby |
| 9. call | 34. port | 59. spotted | 84. by |
| 10. fly | 35. control | 60. repeat | 85. back |
| 11. pilot | 36. same | 61. topside | 86. helicopter |
| 12. secured | 37. up | 62. hop | 87. minute |
| 13. catapult | 38. gear | 63. fire | 88. line |
| 14. behind | 39. hydraulic | 64. phrase | 89. sitting |
| 15. right | 40. radio | 65. tail | 90. side |
| 16. nose | 41. rudder | 66. down | 91. where |
| 17. when | 42. cat | 67. knots | 92. lit |
| 18. low | 43. leak | 68. center | 93. place |
| 19. alongside | 44. what | 69. pusher | 94. wind |
| 20. taxi | 45. outboard | 70. inform | 95. between |
| 21. check | 46. aircraft | 71. cable | 96. moving |
| 22. deck | 47. go | 72. angel | 97. belay |
| 23. aft | 48. manned | 73. blue | 98. we |
| 24. gave | 49. demon | 74. drop | 99. now |
| 25. never | 50. standing | 75. crew | 100. is |

**EXHIBIT 30: TYPICAL MESSAGES IN THE SHIPBOARD AVIATION MAINTENANCE/ SUPPLY RESPONSE LOOP, FROM NAVSHIPS (1972).**

Link 4   "Stop work on tail 104 and
         go to work on tail 108
         located at     ."

         P/N_____not in pool          P/N = Part Number
         or need non-pool
         P/N_____."

         (Initial removal action,
         bad part from Supply
         or after QA.)                QA = Quality Assurance

Link 5   "Part required with
         priority_____, P/N_____."

         "Exchangeable part will be
         ready for pick-up at    ."
         (bulky items)

         "P/N_____obtained from pool."

         "P/N _____ is available at
              [location]."

Link 6   "P/N_____ __(required/obtained from pool)
         with PRI_____and Requisition_____."  PRI = priority

         "Part not available. Status is (AIMD, NIS). Due
         in on_____."                  NIS = Not in Stock

         "Reminder to turn in defective items."
         "FIN for Requisitions_____." (Items which
         require lock-up.)             FIN = Federal Index Number

         "AWP part has arrived."

Link 7   "Part is/is not available."

         "AWP has arrived."

         "Part Requisition
         with PRI_____
         and P/N_____."

         "Part available         "Part not available"
                         or
         at_____."               and status.

         "AWP material is available."

Link 8   "AWP material is available at_____[location]."
         "Material available/not available; delivery
         instructions and part status."

         "Requisition P/N_____, Requisition Number_____,
         JCN_____."  (SRA and bits and pieces not
         in MSP.)

# TYPICAL NAVAL NOISES

Unless an equipment is to be tested in its actual environment, as specified in the U. S. Army report (1971), simulated or recorded noises must be added to the test environment. Except for tests in the actual environments using operational personnel, the most valid tests are with talker(s) and listener(s) communicating naturally (no aids to constant voice level, etc.) using the test equipment(s) in a surrounding simulated ambient noise environment. Although records should be kept of talker and listener levels, the communicators should be allowed to choose their own levels. Exceptions to this occur when the talker or the listener level is a parameter under test. Expediency often dictates, however, that a tape recorder be used to record the talker and, at a later time, to play back to groups of listeners.

Feedback to the talkers, unless it is an experimental parameter, should be as it is in the system as actually used. This is highly important, as is the freedom given to the talker of adapting his own vocal effort level. Talkers adapt their levels (1) to the ambient noise levels they are in, (2) to the levels of sidetone (feedback) they receive in their own ears of their own voices, (3) to the contextual situations they are in (one or many listeners, routine or emergency communication scenario, etc.), and (4) to their emotional states (bored, fatigued, excited, angry, scared, fearful, etc.). To the extent possible, these factors must be accounted for.

## AIRCRAFT NOISES (COCKPIT)

Figure 3 shows "averaged" noise spectra of three types of aircraft, from Sutherland and Gasaway (1971) based on Gasaway (1969, 1970). In all cases individual cockpit noises of the noisier aircraft were between 10 and 15dB higher; see Gasaway (1969, 1970) for details and spectra on individual aircraft types. For typical worst-case conditions, these spectra should be reproduced at levels of about 110dB(A) at the position of the head of the talker and/or listener.
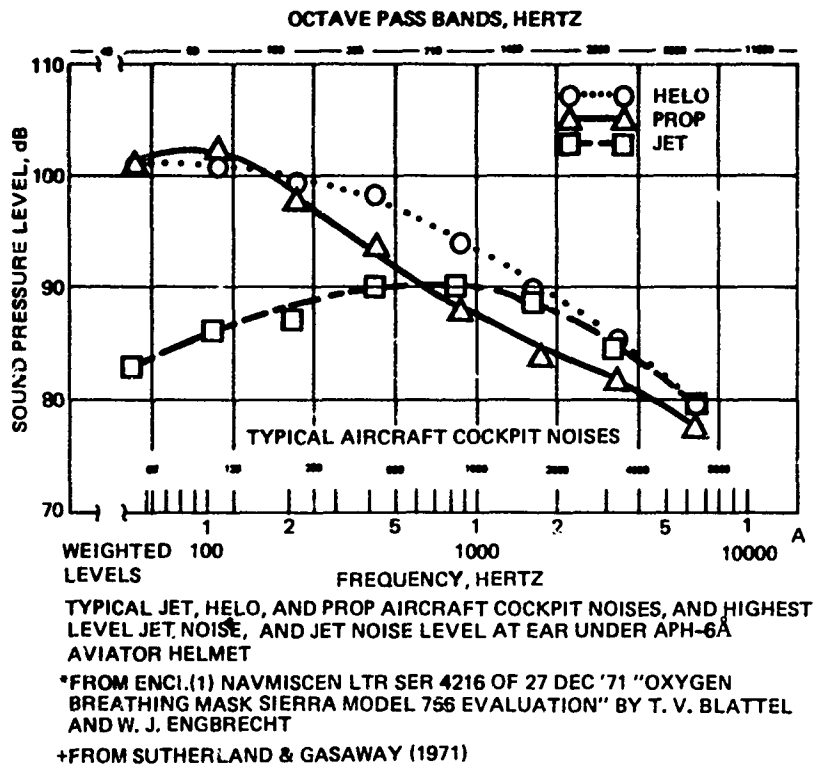
Figure 3. Typical aircraft cockpit noises.

## AIRCRAFT NOISES (EXTERNAL)

Figures 4 and 5 show the spectra of an F4 (Phantom) aircraft running at military power and in afterburner at measured distances of 12.5, 25, 50, 100, and 200 feet at an angle of 60 degrees off the nose. For levels at other angles around the aircraft and for spectra of other jet aircraft see Webster (1971) or the original data sources, Seltz (1961a, 1961b) and Abell (1963a, 1963b).
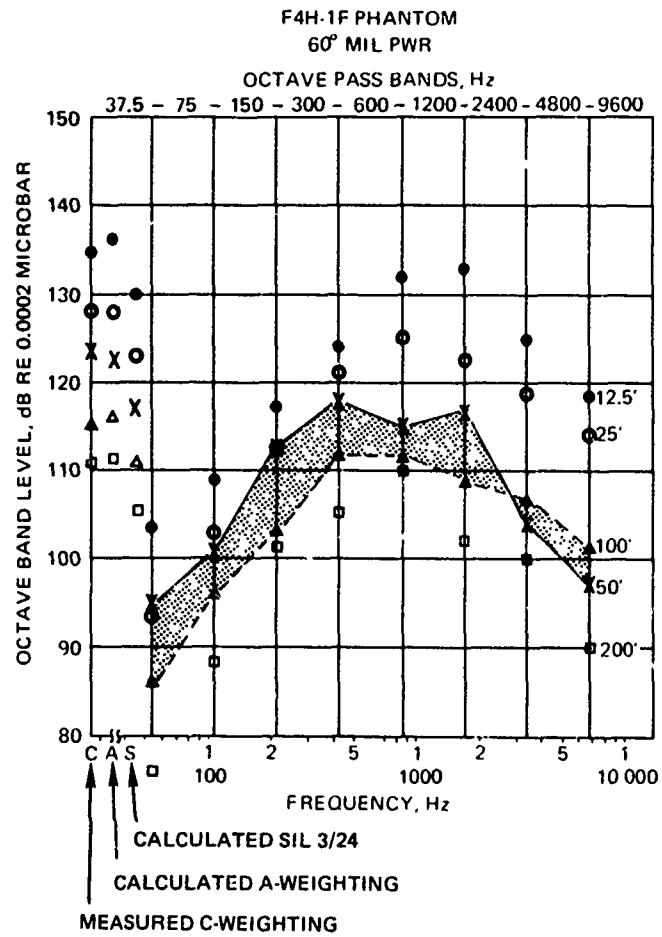
Figure 4. Octave-band noise levels of F4 aircraft running at military power.
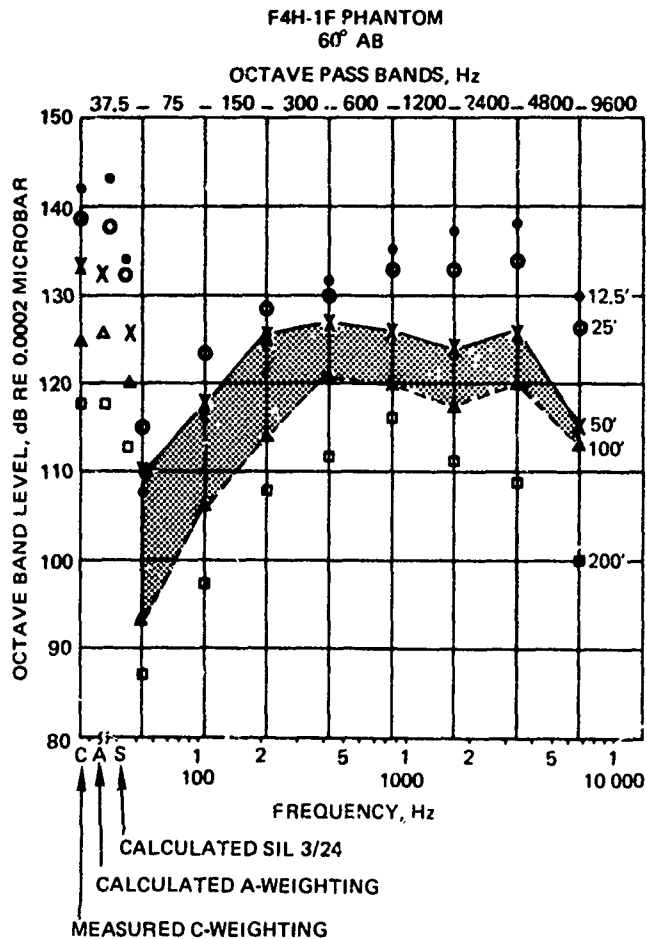
Figure 5. Octave-band noise levels of F4 aircraft running in afterburner.

## SHIP NOISES

Except for aircraft noises on ships with jet, propeller, or rotary wing aircraft, the primary ship noises are in the engine room, from ventilating blowers and ducts, from other people talking or listening to music, or from general ship rumble. Spectra of these noises are shown in figures 6-9 at levels that have been adjusted to be equally speech interfering (see Klumpp and Webster (1963)) but not necessarily typical of ship levels. Engine room noises are typically between 95 and 105dB(A); blowers and rumble from 55 to 70dB(A), depending on distance from source, ship speed, etc.; and voice babble from 55 to 80dB(A) depending on the ambient noise in the space in the absence of people.

To test equipment in these noises, use the worst-case or the highest levels just cited.

**OCTAVE PASS BANDS, Hz**

45 – 90 – 180 – 355 – 710 –1400–2800–5600–11200



80.7 | 84.0 | 78.2 | 74.5 | 69.9 | 54.1

63  125  250  500  1000  2000  4000  8000

FREQUENCY, Hz

**10 dB**

NO. 12
ENG RM
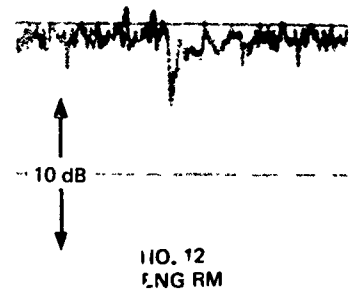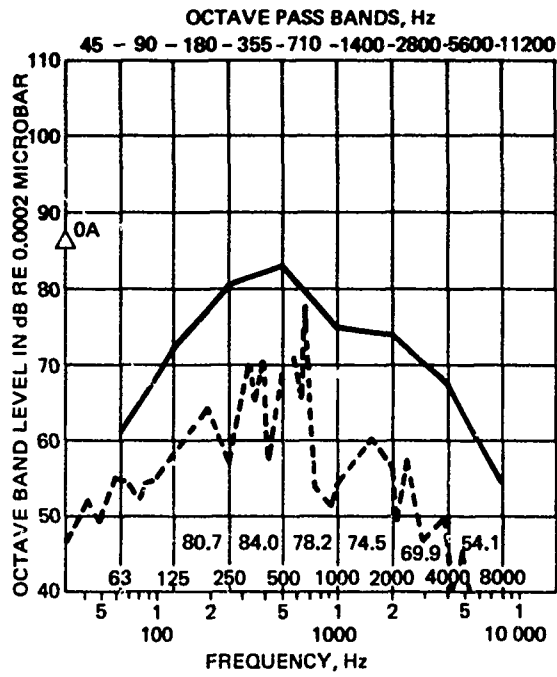
Figure 6. Octave-band and 20-Hz-band levels of engine room noise.

**OCTAVE PASS BANDS, Hz**

45   90   180   355   710   1400  2800  5600 11200



66.7 | 73.0 | 73.7 | 76.5 | 69.4 | 46.6

63  125  250  500  1000  2000  4000  8000

FREQUENCY, Hz

NO. 9
V. BABL
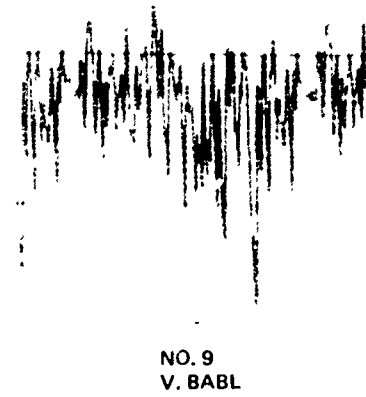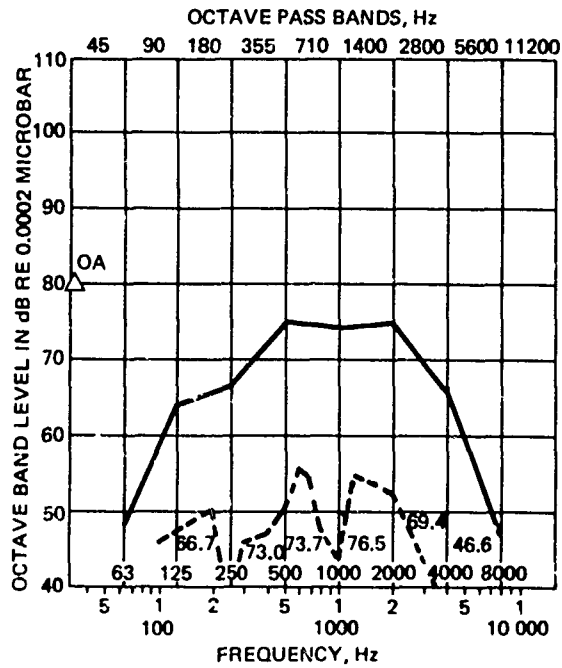
Figure 7  Octave-band and 20-Hz-band levels of voice babble.

90
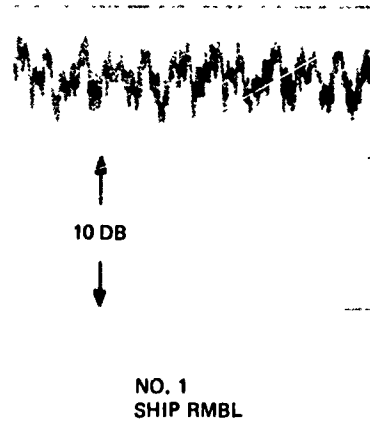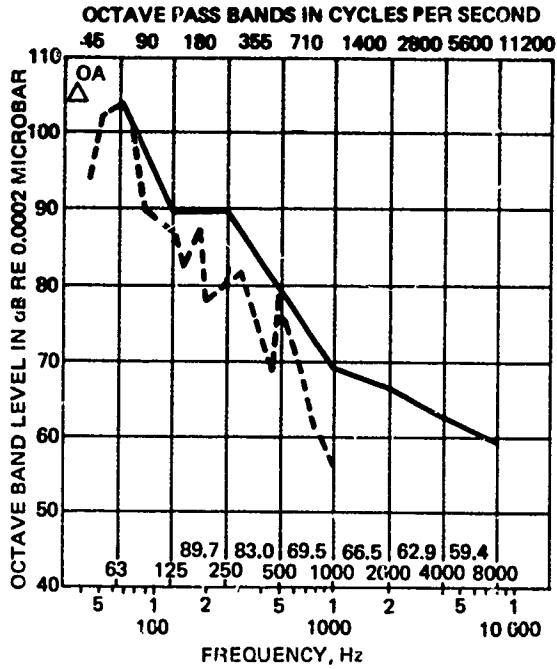
Figure 8. Octave-band and 20-Hz-band levels of ship's rumble.
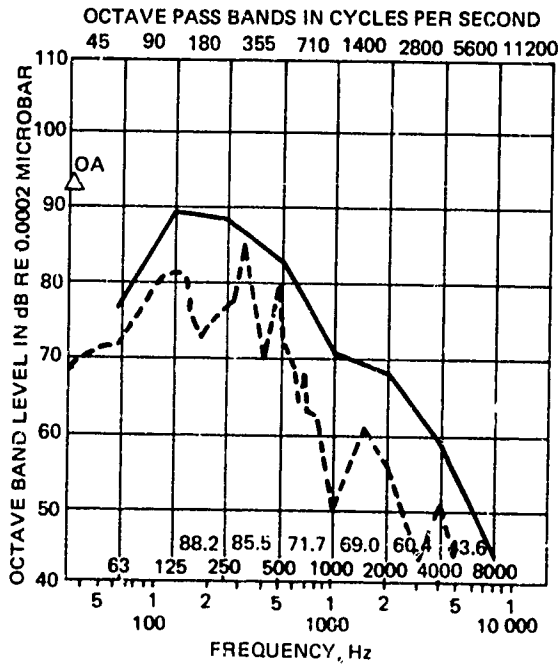


Figure 9. Octave-band and 20-Hz-band levels of blower noise.

# COMPARATIVE SCORES AMONG SPEECH MATERIALS

It is often (usually) the case that one speech test is the most appropriate (most efficient, least time consuming, requiring least training of talker/listeners, etc.) but the least amenable to interpreting the results to design engineers, systems managers, or sponsors. For this reason many tests have been run primarily to relate the scores on one type of test to those on others. A few of the results from some of these comparisons are cited here for quick and easy reference.

## WORD VOCABULARY SIZE VS SENTENCES AND NONSENSE SYLLABLES

Figure 1 from Kryter et al (1963), adapted from French and Steinberg (1947), shows why using PB words is a dangerous test procedure. For the same physical conditions of speech-to-noise ratio, expressed as Articulation Index (AI), PB word scores may vary from 23% to 85%, depending on vocabulary size. Since vocabulary size, amount of training, etc., are not easy to specify and usually are not specified in detail, the use of PB words should be limited to such things as on-the-spot comparisons between two competing equipments.

There are at least two points of interest: (1) 1000 PB words are nearly as difficult, or discriminating, as nonsense syllables and even though difficult to use are still preferable to nonsense syllables with regard to training time, etc. (2) 32 PB words are easier, even less discriminating than sentences, and to a first approximation it would probably be safe to generalize that scores on one or two PB lists (50 to 100 words) are equivalent to sentence, or everyday connected discourse, scores

## NAVY VS CIVILIAN SPEECH

Montague (1960) found that Pseudo Navy Sente           ' Harvard Sentences gave generally equivalent scores, as did Navy C.          .ication Words and Phonetically Balanced Words. Sentence scores were generally 10 to 20 percentage points higher than word scores. He also compared the Fairbanks Rhyme Test (FRT) word scores with the other scores and found FRT scores to be generally equal to sentence scores.

## RHYME TEST SCORES VS PB SCORES

Kryter and Whitman (1965), using data from Miller, Heise, and Lichten (1951) and Nickerson et al (1960), conclude that scores on Rhyme Tests (Fairbanks (1958) and House et al) are generally equivalent to scores on 256 PB words. Webster and Allen (1972) show that Rhyme Test scores are generally equivalent to scores on Brevity Code words (including digits and the ICAO phonetic spelling words). Combining the data of all these studies, with the addition of a few approximations, gives the relationships shown in figure 2

The relationships shown above allow generalizations from test words to actual operational words or phrases so that efficient tests can be administered and generalized interpretation can be made.

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