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DETERMINATION OF COMMUNICATION PERFORMANCE TEST FOR SPEECH CONVEYANCE
AND INTELLIGIBILITY OF POWERED AIR-PURIFYING RESPIRATOR (PAPR) SERIES PAPR100
STANDARD TESTING PROCEDURE

1. PURPOSE

- 1.1. This test establishes the method for ensuring that the level of speech conveyance and intelligibility provided by the Communication Performance Test on Powered Air-Purifying Respirator (PAPR) Series PAPR100 meet requirements set forth in 42 CFR Part 84, Subpart K, Section 84.181.
- 1.2. The purpose of this test is to quantify the performance of a respirator in transmitting intelligible speech of a human test subject. This is accomplished by determining a listener's ability to comprehend single-syllable words spoken by a subject wearing the respirator.

2. GENERAL

- 2.1. This STP describes the Communication Performance Tests for Speech Conveyance and Intelligibility of a PAPR100 in sufficient detail that a person knowledgeable in the appropriate technical field can select equipment with the necessary resolution, conduct the test, and determine whether or not the product passes the test.
- 2.2. The Communication Performance Test shall be performed using the Modified Rhyme Test (MRT) to evaluate a listener's ability to comprehend single-syllable words from a speaker. Both listeners and speakers shall be in combinations of masked and unmasked postures during the MRT to provide an indication of speech transmission and intelligibility.
- 2.3. This test is considered a human factors test that requires participation of 8 test subjects to quantify the overall performance rating of a PAPR100 system.
- 2.4. Two (2) Test Administrators are necessary to properly conduct this test.

3. EQUIPMENT/MATERIALS

- 3.1. Laboratory space that permits an unobstructed 10 \pm 0 ft distance between test speaker and the listener group when facing one another. Refer to Figure 1. for the subject and equipment positioning for the Modified Rhyme Test setup.
- 3.2. Noise Plug, Precision Pink Noise Test Generator (GTC Industries) or equivalent for producing pink noise in the frequency range of 20.0 Hz to 50.0 kHz. Accuracy: 3dB per octave rolloff from 20 Hz to 20 KHz. Pink noise is defined as an audio test signal that

contains all the frequencies in the audio spectrum with equal energy at each octave. Pink noise contains less energy at the higher audio frequencies than at the lower ones - See Figure 1.

- 3.3. A stereo amplifier used to transmit and amplify the signal for the pink noise background.
- 3.4. The two loudspeakers positioned midway between the test speaker and listeners. Details of the exact positioning of the speaker equipment are further defined in Section 5.3.2.
- 3.5. Two Type 2 digital sound level meters (Sper Scientific, LTD, Model 840029 – See Figure 3.) with an “A” weighting decibel scale of 30 to 130 dB or equivalent. One sound level meter will be positioned in front of the Test Speaker and the second sound level meter will be positioned at head level beside listener L2- see Figure 1.
- 3.6. Sper Scientific, LTD Acoustical calibrator (model 840031) or equivalent is used to calibrate the sound level meters – See Figure 4.
- 3.7. Twelve word lists from the Modified Rhyme Test (MRT). These twelve word lists are separated onto individual sheets to be used by the test speakers during the test – See Appendix A.
- 3.8. Test listeners’ multiple-choice answer pages on laptops or equivalent. Modified Rhyme Test listener responses are recorded and scored using laptops that have been programmed for this application; otherwise, the manual method using multiple-choice answer sheets can be used – See Example Data Sheet 8.1.
- 3.9. Sound and/or audiovisual recording device for recording speech.
- 3.10. Human Test Subjects
 - 3.10.1. Test Administrators shall have successfully completed the CDC/ATSDR Scientific Ethics Training, the DHHS/NIH Human Participant Protections Education for Research Teams, or equivalent course.
 - 3.10.2. At least eight (8) volunteer test subjects are required for this test.

4. TESTING REQUIREMENTS AND CONDITIONS

- 4.1. Prior to beginning any testing, confirm that all measuring equipment being used has been calibrated in accordance with the testing laboratory’s calibration procedure and schedule. All measuring equipment utilized for this testing must have been calibrated using a method traceable to recognized international standards when available.
- 4.2. Administrator 1 will monitor the test speakers’ speech and the actions of the listener group to make sure they are responding to the test speaker.

- 4.3. Administrator 2 will monitor the dBA level of the test speaker and give verbal or nonverbal feedback as to loudness of his/her speech and record the dBA level on the data sheet – see Example Data Sheet 8.2.
- 4.4. The eight test subjects will be divided into two groups, a listener group comprised of three subjects (at least one female and one male) and a speaker group comprised of five subjects (at least one female and one male).
- 4.5. All subjects shall be fluent in English. In addition, these subjects shall have no obvious or strong regional or foreign accents.
- 4.6. The eight test subjects shall be trained in the donning and use of the respirator per manufacturer's instructions by the test administrator.
- 4.7. Each subject shall be sized and fitted for the respirator per manufacturer's instructions. Where an individual is qualified to wear multiple sizes of the respirator, the subject shall select the respirator size that provides the most comfortable fit.
- 4.8. The subjects shall have normal hearing.
- 4.9. The test subjects shall not have any facial hair or conditions that may cause interference with the seal of the respirator facepiece.
- 4.10. Test Equipment Set-Up.
 - 4.10.1. Room selected to perform the MRT shall be of ample size to comfortably house all the test equipment indicated and the personnel associated with the test. It shall be free of external noise interference.
 - 4.10.2. The loudspeakers shall be positioned opposite each other at a height of approximately 29.5 inches from the floor and $9 +0.5/-0$ ft from the center of the sound field between the test speaker and listeners. The laptops will be placed directly in front of the listeners at a convenient distance away – See Figure 1.

5. PROCEDURE

- 5.1. Fill in the Pretest data on the data sheet – See Example Data Sheet 8.1.
- 5.2. Record the background noise of the room, assuring no external noise, at the center listener's head position.
- 5.3. Training of the Test Speakers.
 - 5.3.1. Without the listeners in the room, one subject at a time will be seated in the test speaker's position and given an MRT word list – See Appendix A. A sound level meter will be positioned in front of the test speaker to assess the volume of their voice as the word list is read. The sound level meter shall be set to display "A"-weighted sound levels.

- 5.3.2. Test administrator 1 shall be seated beside the test speaker to monitor the reading of the word list. The administrator shall instruct the test speaker to read, without placing any unusual emphasis on any stimulus word, at a rate of approximately one phrase every 6 seconds, using the introductory phrase “The word is (list word)”. In addition, the test speaker shall be directed to communicate each word without using any visual gestures, such as hand signals, and without repeating any of the list words.
 - 5.3.3. Test administrator 2 shall be seated in the center test listener’s position and will instruct the test speaker to begin reading the word list at a voice level of 75 to 85 dBA.
 - 5.3.4. During the reading of the word list, test administrator 2 will monitor the “A”-weighted output volume of the speaker and provide feedback as to the loudness of the speaker’s performance throughout the reading of the word list. Test administrator 1 will provide feedback to the test speaker regarding the pronunciation of the list words and the rate of performance. Additional training will be done if warranted per the judgment of the test administrators. These procedures will be completed without the use of a respirator and without any background noise above ambient conditions.
 - 5.3.5. Additionally, training with background noise of 60 ± 2 dBA (consisting of pink noise), will also be completed according to the above procedures.
 - 5.3.6. This will be repeated for all subjects in the speaker group.
- 5.4. Training of the Test Listeners.
- 5.4.1. The three test listeners are seated facing a single test speaker at a distance of 10 ft. The listeners are seated next to one another with approximately one foot between them. Each listener will be given a laptop with a list of multiple-choice words for recording his or her responses.
 - 5.4.2. An MRT word list will be provided to a trained test speaker. The test speaker will be instructed to communicate the word list to the test listeners as was done during speaker training.
 - 5.4.3. As a group, listeners will be instructed to listen attentively as the test speaker reads 50 words to them each with the introductory phrase “The word is (list word).” The test listeners shall be directed to select, or make a best guess of the word, that was perceived to be spoken from the six possible response words provided to them on the laptops. Test listeners are instructed to provide a “thumbs-up” hand signal to the speaker as a cue to say the next phrase.
 - 5.4.4. During the reading of the word list, administrator 2 will monitor the A-weighted output volume of the speaker at the listening position and provide feedback as to the loudness throughout the reading of the word list. In addition, test

administrator 1 will provide the test speaker feedback regarding the rate of performance. Administrator 1 will also monitor the actions of the listener group and provide additional instructions as needed. Test administrators will determine if additional training is required. These procedures will be completed without the use of a respirator and without any added background noise (pink noise) above ambient conditions.

5.4.5. Additionally, training with added background noise of 60 ± 2 dBA (consisting of pink noise), will also be conducted according to the procedures above.

5.5. Conducting the Test.

5.5.1. The noise generator shall be turned on and set to produce 60 ± 2 dBA of pink noise, as measured by the sound level meter at the center test listener's head position without listeners present. This value shall be recorded on the Respirator Communication Performance Test Data Collection Sheet.

5.5.2. The three test listeners shall be seated in the listening position with a laptop located conveniently in front of them.

5.5.3. A test speaker will then be positioned in the speaking position and present one complete MRT word list to the listening panel. A different test speaker shall then be used to present the next MRT trial. Test speakers will continue to rotate among the speaker test panel until all trials have been completed.

5.5.4. Data will be obtained without the respirator (unmasked) and with the respirator (masked) worn and operated per the manufacturer's instructions by both speakers and listeners. All conditions shall be randomly assigned, and a different word list shall be used for each test. A test matrix of the MRT conditions is provided in Table 2 to assist the test administrator in establishing the sequence of testing.

5.5.5. Background noise levels shall be monitored at the center test listener's head position and recorded, on the Respirator Communication Performance Test Data Collection Sheet, at the beginning, middle, and end of each MRT session by administrator 2.

5.5.6. The test speakers shall be monitored and recorded during the test to determine if the test speakers conform to the word list specified for each trial by test administrator 1. Test administrator 1 shall also make note of any improperly pronounced or misspoken words by the test speakers.

5.5.7. A total of 10 MRT trials shall be performed; 5 unmasked and 5 masked. This will result in a total of 15 MRT scores (five per listener) for the unmasked condition and 15 scores for the masked condition.

5.6. Data Analysis.

- 5.6.1. Use the Respirator Communication Performance Test Data Collection Sheets to assist with the analysis of the 10 MRT scores for each listener.
- 5.6.2. The number of correct responses shall be adjusted for chance or guessing made possible by the multiple-choice answers using the equation:

$$\text{Adjusted Score} = \frac{\text{Number of Correct Listener Responses} - \frac{\text{Number of Wrong Listener Responses}}{5}}$$

- 5.6.3. Determine the Number of Words Spoken Correctly by the speakers from either the Test Administrators notes or if necessary, by listening to the Audio recorder tapes.
- 5.6.4. Listener performance on the MRT shall be scored in terms of the percentage of words correctly identified using the equation for both the masked and unmasked posture:

$$\% \text{ Correct} = (\text{Adjusted Score} / \text{Number of Words Spoken Correctly}) * 100$$

- 5.6.5. Average Unmasked and Average Masked % Correct Scores shall be calculated for each individual listener.
- 5.6.6. Each individual listener's Average Masked % Correct Score shall be divided by their Average Unmasked % Correct Score to calculate a Performance Rating using the equation:

$$\text{Performance Rating (\%)} = \left(\frac{\text{Average Masked \% Correct Score}}{\text{Average Unmasked \% Correct Score}} \right) \times 100$$

- 5.6.7. Performance Rating (%) =
- 5.6.8. The performance rating of all listeners shall then be averaged to determine the Overall Performance Rating of the PAPR100 using the following Equation:

$$\text{Overall Performance Rating (\%)} = \frac{\text{Performance Rating (\%)}_{L1} + \text{Performance Rating (\%)}_{L2} + \text{Performance Rating (\%)}_{L3}}{3}$$

6. PASS/FAIL CRITERIA

- 6.1. The requirement for passing this test is set forth in 42 CFR, Part 84, Subpart K, Section 84.181.
- 6.2. A candidate PAPR100 must obtain an Overall Performance Rating greater than or equal to 70% to meet the Communication requirement.

7. RECORDS/TEST SHEETS

7.1. All test data shall be recorded on the Respirator Communication Performance Test Data Collection Sheets.

8. ATTACHMENTS

8.1. Example Data Sheet - Communication Performance Test Listener Data Sheet

8.2. Example Data Sheet - Communication Performance Test Data Collection Sheet

8.3. Table 1. MTR Trial Matrix

8.4. Figures

8.4.1. Figure 1. Modified Rhyme Test Setup

8.4.2. Figure 2. Photograph of Noise Plug, Precision Pink Noise Generator (GTC Industries)

8.4.3. Figure 3. Photograph of Sper Scientific LTD digital sound level meter, Model 840029

8.4.4. Figure 4. Photograph of Acoustical calibrator (Sper Scientific model 840031)

8.5. Appendix A. Communication Performance Word List Test Sheets

8.1. Example Data Sheet – Communication Performance Test Listener Data Sheet

NIOSH Application Number _____ Date: _____
 Respirator Manufacture: _____; MRT/Sheet# _____
 Respirator Type: _____; Speakers Respirator Number, if worn _____ (Indicate if unworn)
 Listener's Respirator (circle one): Unworn Worn If Worn, Listeners Respirator Number _____
 Listener # _____ Listening Position: _____ Speaker #: _____ MRT Word List#: _____

| | | | | | | | |
|----|------------------------------------|----|------------------------------------|----|----------------------------------|----|------------------------------------|
| 1 | but bug bus buff bun buck | 14 | map mat math mad mass man | 27 | wed fed bed led shed red | 40 | cake came Cave cane case cape |
| 2 | kin kid kick king kit kill | 15 | hop cop shop mop pop top | 28 | sane sake safe save same sale | 41 | fang bang hang sang gang rang |
| 3 | peak peach peas peal peace peat | 16 | sack sad sap sag sat sass | 29 | pit pin pig pill pick pip | 42 | law saw paw jaw raw thaw |
| 4 | dig wig big fig pig rig | 17 | say pay may gay way day | 30 | heel peel keel feel eel reel | 43 | rake rate ray raze race rave |
| 5 | fold sold gold hold cold told | 18 | heath heave heap heat heal hear | 31 | toil boil foil coil oil soil | 44 | dip dim din dill did dig |
| 6 | kick lick sick tick wick pick | 19 | tame came fame same name game | 32 | fig fizz fit fib fin fill | 45 | tear teal teak team tease teach |
| 7 | path pack pass pat pad pan | 20 | page pane pace pave pale pay | 33 | mark bark dark lark hark park | 46 | tin fin sin win pin din |
| 8 | beat beak beach beam bean bead | 21 | dust gust must bust just rust | 34 | bash bat ban back bath bad | 47 | seethe seek seen seed seep seem |
| 9 | pot hot lot not tot got | 22 | pun puff pup pub pus puck | 35 | will hill kill bill fill till | 48 | run bun fun sun nun gun |
| 10 | fit hit bit sit kit wit | 23 | then den ten pen hen men | 36 | pale sale bale gale male tale | 49 | neat beat seat meat feat heat |
| 11 | sup sub sud sum sun sung | 24 | cuss cud cup cut cub cuff | 37 | duck dud dung dun dug dub | 50 | lip hip dip sip rip tip |
| 12 | dent tent rent went sent bent | 25 | hook shook book took cook look | 38 | sit sip sill sick sin sing | | |
| 13 | best west nest vest test rest | 26 | late lake lay lame lane lace | 39 | tack tan tab tang tam tap | | |

| |
|--------------|
| Score |
|--------------|

8.2. Example Data Sheet – Communication Performance Test Data Collection Sheet

TN #: _____ MRT Trial #: _____ Speaker ID #: _____

Word List #: _____ Please Circle: Masked Unmasked

Number of words correctly spoken by the MRT Speaker: _____

Listener #1 ID: _____

1. % of Words Answered Correctly = _____
2. Adjusted Score = _____

Listener #2 ID: _____

1. % of Words Answered Correctly = _____
2. Adjusted Score = _____

Listener #3 ID: _____

1. % of Words Answered Correctly = _____
2. Adjusted Score = _____

Background Noise (w/o pink noise): _____

Pink Noise Before Session: _____

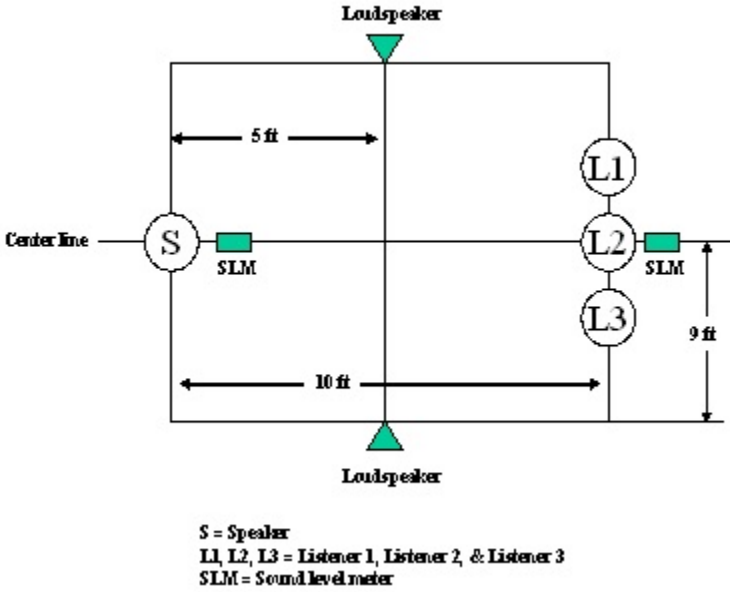
Pink Noise Middle of Session: _____

Pink Noise After Session: _____

8.3. Table 2. MRT Trial Matrix

| Trial # | Speaker | With or Without Mask | Word list |
|---------|---------|----------------------|-----------|
| 1 | 1 | No mask | 11A |
| 2 | 2 | No mask | 3A |
| 3 | 3 | Masked | 5A |
| 4 | 4 | Masked | 7A |
| 5 | 5 | No mask | 4A |
| 6 | 2 | Masked | 12A |
| 7 | 4 | No mask | 5A |
| 8 | 1 | Masked | 1A |
| 9 | 5 | Masked | 8A |
| 10 | 3 | No mask | 6A |

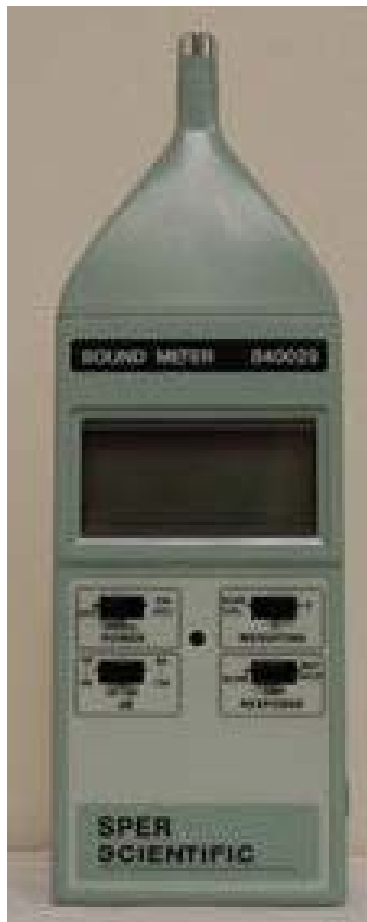
8.4. Diagram 1. Modified Rhyme Test Setup



8.5. Figure 1. Noise Plug, Precision Pink Noise Generator (GTC Industries)



8.6. Figure 2. Sper Scientific LTD digital sound level meter, Model 840029



8.7. Figure 3. Acoustical calibrator (Sper Scientific model 840031)



8.8. Appendix A. Communication Performance Word List Test Sheets

Appendix A

Modified Rhyme Test Word Lists

List 1A

1. The word is **but**
2. The word is **kit**
3. The word is **peak**
4. The word is **pig**
5. The word is **cold**
6. The word is **sick**
7. The word is **pat**
8. The word is **beat**
9. The word is **hot**
10. The word is **fit**
11. The word is **sung**
12. The word is **sent**
13. The word is **rest**
14. The word is **mat**
15. The word is **top**
16. The word is **sack**
17. The word is **day**
18. The word is **heal**
19. The word is **name**
20. The word is **pay**
21. The word is **must**
22. The word is **pun**
23. The word is **hen**
24. The word is **cud**
25. The word is **book**
26. The word is **late**
27. The word is **led**
28. The word is **same**
29. The word is **pin**
30. The word is **feel**
31. The word is **soil**
32. The word is **fizz**
33. The word is **park**
34. The word is **bash**
35. The word is **till**
36. The word is **male**
37. The word is **dud**
38. The word is **sin**
39. The word is **tack**
40. The word is **case**
41. The word is **bang**
42. The word is **thaw**
43. The word is **ray**
44. The word is **dig**
45. The word is **team**
46. The word is **win**
47. The word is **seek**
48. The word is **bun**
49. The word is **feat**
50. The word is **sip**

List 2A

1. The word is **bus**
2. The word is **kick**
3. The word is **peas**
4. The word is **fig**
5. The word is **hold**
6. The word is **lick**
7. The word is **pass**
8. The word is **beach**
9. The word is **pot**
10. The word is **bit**
11. The word is **sub**
12. The word is **went**
13. The word is **west**
14. The word is **map**
15. The word is **cop**
16. The word is **sap**
17. The word is **pay**
18. The word is **heath**
19. The word is **tame**
20. The word is **pale**
21. The word is **gust**
22. The word is **pus**
23. The word is **then**
24. The word is **cuss**
25. The word is **cook**
26. The word is **lace**
27. The word is **bed**
28. The word is **save**
29. The word is **pit**
30. The word is **reel**
31. The word is **boil**
32. The word is **fib**
33. The word is **bark**
34. The word is **bad**
35. The word is **fill**
36. The word is **gale**
37. The word is **duck**
38. The word is **sit**
39. The word is **tap**
40. The word is **cane**
41. The word is **sang**
42. The word is **saw**
43. The word is **race**
44. The word is **dim**
45. The word is **teak**
46. The word is **din**
47. The word is **seethe**
48. The word is **run**
49. The word is **meat**
50. The word is **dip**

List 3A

1. The word is **bug**
2. The word is **kin**
3. The word is **peach**
4. The word is **rig**
5. The word is **gold**
6. The word is **tick**
7. The word is **pan**
8. The word is **beak**
9. The word is **got**
10. The word is **hit**
11. The word is **sup**
12. The word is **rent**
13. The word is **best**
14. The word is **math**
15. The word is **hop**
16. The word is **sad**
17. The word is **gay**
18. The word is **heap**
19. The word is **fame**
20. The word is **page**
21. The word is **bust**
22. The word is **puff**
23. The word is **ten**
24. The word is **cup**
25. The word is **took**
26. The word is **lake**
27. The word is **shed**
28. The word is **safe**
29. The word is **pig**
30. The word is **eel**
31. The word is **toil**
32. The word is **fill**
33. The word is **lark**
34. The word is **bath**
35. The word is **will**
36. The word is **tale**
37. The word is **dung**
38. The word is **sill**
39. The word is **tang**
40. The word is **cave**
41. The word is **rang**
42. The word is **jaw**
43. The word is **raze**
44. The word is **dip**
45. The word is **teal**
46. The word is **pin**
47. The word is **seem**
48. The word is **fun**
49. The word is **heat**
50. The word is **rip**

List 4A

1. The word is **bun**
2. The word is **kill**
3. The word is **peace**
4. The word is **big**
5. The word is **told**
6. The word is **kick**
7. The word is **pad**
8. The word is **bean**
9. The word is **lot**
10. The word is **kit**
11. The word is **sum**
12. The word is **bent**
13. The word is **vest**
14. The word is **man**
15. The word is **mop**
16. The word is **sat**
17. The word is **say**
18. The word is **hear**
19. The word is **game**
20. The word is **pave**
21. The word is **dust**
22. The word is **puck**
23. The word is **men**
24. The word is **cuff**
25. The word is **hook**
26. The word is **lane**
27. The word is **fed**
28. The word is **sale**
29. The word is **pip**
30. The word is **peel**
31. The word is **coil**
32. The word is **fit**
33. The word is **mark**
34. The word is **bat**
35. The word is **bill**
36. The word is **bale**
37. The word is **dub**
38. The word is **sing**
39. The word is **tam**
40. The word is **cape**
41. The word is **hang**
42. The word is **law**
43. The word is **rake**
44. The word is **dill**
45. The word is **tease**
46. The word is **fin**
47. The word is **seen**
48. The word is **gun**
49. The word is **seat**
50. The word is **hip**

List 5A

1. The word is **buck**
2. The word is **king**
3. The word is **peat**
4. The word is **dig**
5. The word is **fold**
6. The word is **wick**
7. The word is **pack**
8. The word is **bead**
9. The word is **not**
10. The word is **wit**
11. The word is **sun**
12. The word is **tent**
13. The word is **test**
14. The word is **mad**
15. The word is **pop**
16. The word is **sass**
17. The word is **way**
18. The word is **heat**
19. The word is **same**
20. The word is **pane**
21. The word is **just**
22. The word is **pup**
23. The word is **pen**
24. The word is **cut**
25. The word is **shook**
26. The word is **lay**
27. The word is **red**
28. The word is **sane**
29. The word is **pill**
30. The word is **keel**
31. The word is **oil**
32. The word is **fig**
33. The word is **hark**
34. The word is **ban**
35. The word is **hill**
36. The word is **pale**
37. The word is **dun**
38. The word is **sick**
39. The word is **tab**
40. The word is **cake**
41. The word is **fang**
42. The word is **raw**
43. The word is **rate**
44. The word is **did**
45. The word is **teach**
46. The word is **sin**
47. The word is **seed**
48. The word is **sun**
49. The word is **neat**
50. The word is **tip**

List 6A

1. The word is **buff**
2. The word is **kid**
3. The word is **peal**
4. The word is **wig**
5. The word is **sold**
6. The word is **pick**
7. The word is **path**
8. The word is **beam**
9. The word is **tot**
10. The word is **sit**
11. The word is **sud**
12. The word is **dent**
13. The word is **nest**
14. The word is **mass**
15. The word is **shop**
16. The word is **sag**
17. The word is **may**
18. The word is **heave**
19. The word is **came**
20. The word is **pace**
21. The word is **rust**
22. The word is **pub**
23. The word is **den**
24. The word is **cub**
25. The word is **look**
26. The word is **lame**
27. The word is **wed**
28. The word is **sake**
29. The word is **pick**
30. The word is **heel**
31. The word is **foil**
32. The word is **fin**
33. The word is **dark**
34. The word is **back**
35. The word is **kill**
36. The word is **sale**
37. The word is **dug**
38. The word is **sip**
39. The word is **tan**
40. The word is **came**
41. The word is **gang**
42. The word is **paw**
43. The word is **rave**
44. The word is **din**
45. The word is **tear**
46. The word is **tin**
47. The word is **seep**
48. The word is **nun**
49. The word is **beat**
50. The word is **lip**

List 7A

1. The word is **lick**
2. The word is **beat**
3. The word is **puff**
4. The word is **cook**
5. The word is **tip**
6. The word is **rave**
7. The word is **hang**
8. The word is **till**
9. The word is **math**
10. The word is **sale**
11. The word is **same**
12. The word is **peal**
13. The word is **kit**
14. The word is **sat**
15. The word is **sin**
16. The word is **gold**
17. The word is **buff**
18. The word is **lay**
19. The word is **nun**
20. The word is **must**
21. The word is **pad**
22. The word is **din**
23. The word is **sit**
24. The word is **win**
25. The word is **teak**
26. The word is **dent**
27. The word is **sub**
28. The word is **led**
29. The word is **tot**
30. The word is **dub**
31. The word is **pip**
32. The word is **seen**
33. The word is **way**
34. The word is **west**
35. The word is **pace**
36. The word is **bat**
37. The word is **mop**
38. The word is **big**
39. The word is **tab**
40. The word is **case**
41. The word is **name**
42. The word is **soil**
43. The word is **fin**
44. The word is **cuff**
45. The word is **heal**
46. The word is **hark**
47. The word is **heat**
48. The word is **then**
49. The word is **law**
50. The word is **bean**

List 8A

1. The word is **wick**
2. The word is **neat**
3. The word is **puck**
4. The word is **took**
5. The word is **rip**
6. The word is **ray**
7. The word is **sang**
8. The word is **will**
9. The word is **man**
10. The word is **gale**
11. The word is **safe**
12. The word is **peas**
13. The word is **kid**
14. The word is **sass**
15. The word is **sick**
16. The word is **hold**
17. The word is **but**
18. The word is **lane**
19. The word is **bun**
20. The word is **just**
21. The word is **pan**
22. The word is **dig**
23. The word is **bit**
24. The word is **pin**
25. The word is **tease**
26. The word is **sent**
27. The word is **sup**
28. The word is **red**
29. The word is **not**
30. The word is **dung**
31. The word is **pig**
32. The word is **seem**
33. The word is **day**
34. The word is **rest**
35. The word is **page**
36. The word is **bash**
37. The word is **shop**
38. The word is **fig**
39. The word is **tam**
40. The word is **cane**
41. The word is **same**
42. The word is **toil**
43. The word is **fill**
44. The word is **cuss**
45. The word is **feel**
46. The word is **bark**
47. The word is **heath**
48. The word is **ten**
49. The word is **thaw**
50. The word is **bead**

List 9A

1. The word is **pick**
2. The word is **meat**
3. The word is **pub**
4. The word is **look**
5. The word is **sip**
6. The word is **rake**
7. The word is **fang**
8. The word is **bill**
9. The word is **mat**
10. The word is **male**
11. The word is **sane**
12. The word is **peach**
13. The word is **kill**
14. The word is **sack**
15. The word is **sill**
16. The word is **cold**
17. The word is **bug**
18. The word is **lace**
19. The word is **sun**
20. The word is **gust**
21. The word is **pass**
22. The word is **dim**
23. The word is **fit**
24. The word is **fin**
25. The word is **teach**
26. The word is **went**
27. The word is **sum**
28. The word is **wed**
29. The word is **hot**
30. The word is **dud**
31. The word is **pill**
32. The word is **seethe**
33. The word is **pay**
34. The word is **vest**
35. The word is **pace**
36. The word is **back**
37. The word is **top**
38. The word is **rig**
39. The word is **tap**
40. The word is **cave**
41. The word is **game**
42. The word is **foil**
43. The word is **fit**
44. The word is **cup**
45. The word is **eel**
46. The word is **park**
47. The word is **heap**
48. The word is **pen**
49. The word is **paw**
50. The word is **beam**

List 10A

1. The word is **kick**
2. The word is **feat**
3. The word is **pup**
4. The word is **book**
5. The word is **lip**
6. The word is **rate**
7. The word is **bang**
8. The word is **fill**
9. The word is **mass**
10. The word is **tale**
11. The word is **sale**
12. The word is **peak**
13. The word is **king**
14. The word is **sag**
15. The word is **sip**
16. The word is **told**
17. The word is **bun**
18. The word is **lake**
19. The word is **gun**
20. The word is **bust**
21. The word is **pat**
22. The word is **did**
23. The word is **kit**
24. The word is **tin**
25. The word is **tear**
26. The word is **bent**
27. The word is **sun**
28. The word is **shed**
29. The word is **pot**
30. The word is **duck**
31. The word is **pin**
32. The word is **seed**
33. The word is **gay**
34. The word is **test**
35. The word is **pave**
36. The word is **bath**
37. The word is **pop**
38. The word is **pig**
39. The word is **tan**
40. The word is **cape**
41. The word is **came**
42. The word is **boil**
43. The word is **fib**
44. The word is **cud**
45. The word is **keel**
46. The word is **lark**
47. The word is **heave**
48. The word is **den**
49. The word is **saw**
50. The word is **beat**

List 11A

1. The word is **tick**
2. The word is **heat**
3. The word is **pus**
4. The word is **hook**
5. The word is **dip**
6. The word is **raze**
7. The word is **gang**
8. The word is **hill**
9. The word is **mad**
10. The word is **bale**
11. The word is **save**
12. The word is **peace**
13. The word is **kin**
14. The word is **sad**
15. The word is **sit**
16. The word is **fold**
17. The word is **bus**
18. The word is **late**
19. The word is **run**
20. The word is **rust**
21. The word is **pack**
22. The word is **dill**
23. The word is **wit**
24. The word is **din**
25. The word is **teal**
26. The word is **rent**
27. The word is **sung**
28. The word is **bed**
29. The word is **lot**
30. The word is **dug**
31. The word is **pick**
32. The word is **seek**
33. The word is **say**
34. The word is **best**
35. The word is **pay**
36. The word is **ban**
37. The word is **hop**
38. The word is **dig**
39. The word is **tang**
40. The word is **cake**
41. The word is **fame**
42. The word is **coil**
43. The word is **fig**
44. The word is **cut**
45. The word is **peel**
46. The word is **mark**
47. The word is **heal**
48. The word is **men**
49. The word is **jaw**
50. The word is **beach**

List 12A

1. The word is **sick**
2. The word is **seat**
3. The word is **pun**
4. The word is **shook**
5. The word is **hip**
6. The word is **race**
7. The word is **rang**
8. The word is **kill**
9. The word is **map**
10. The word is **pale**
11. The word is **sake**
12. The word is **peat**
13. The word is **kick**
14. The word is **sap**
15. The word is **sing**
16. The word is **sold**
17. The word is **buck**
18. The word is **lame**
19. The word is **fun**
20. The word is **dust**
21. The word is **path**
22. The word is **dip**
23. The word is **hit**
24. The word is **sin**
25. The word is **team**
26. The word is **tent**
27. The word is **sud**
28. The word is **fed**
29. The word is **got**
30. The word is **dun**
31. The word is **pit**
32. The word is **seep**
33. The word is **may**
34. The word is **nest**
35. The word is **pane**
36. The word is **bad**
37. The word is **cop**
38. The word is **wig**
39. The word is **tack**
40. The word is **came**
41. The word is **tame**
42. The word is **oil**
43. The word is **fizz**
44. The word is **cub**
45. The word is **reel**
46. The word is **dark**
47. The word is **hear**
48. The word is **hen**
49. The word is **raw**
50. The word is **beak**

Revision History

| Revision | Date | Reason for Revision |
|-----------------|---------------|----------------------------|
| 0.0 | 21 March 2020 | Original release |
| | | |