Suggestions for Effective Railroad Tank Car Loading/Unloading Training Programs:

Compatibility of Training Materials and Trainee Reading Skills

Proper training is an important factor in preventing non-accident release (NAR) of hazardous materials from railroad tank cars. The effectiveness of a training program can be compromised if the written materials used in the program are not consistent with the reading skills of the trainees.

A recent FRA-sponsored study found some level of inconsistency between the reading skills of the trainees and the instructional materials used at four chemical companies. Some substances are so hazardous, and the potential consequence of a serious NAR is so great, that chemical companies should consider assessing their programs and making any necessary modifications to their training materials. This document provides guidance to chemical companies wanting to review and improve their written training materials.

Federal Railroad Administration
Office of Research and Development

Fry graph

Average number of syllables per 100 words

Fry graph

How to Assess Trainee's Reading Skills

The number of years of schooling provides a rough indication of a trainee's reading skills. Because attained educational level is not a reliable predictor of actual reading skill, the recommended method for assessing a trainee's reading skills involves use of a test instrument along with years of schooling.

The Multidimensional Aptitude Battery (MAB) is suitable for this purpose. Administration of the comprehension and vocabulary verbal subtests takes 15 minutes and will provide an adequate measure of reading skill.

The MAB produces an IQ score, which is a standard score relative to the individual's age. Divide the MAB score by 100 and then multiply the result by the individual's years of schooling. The result is an estimate of reading skill level. This adjusted educational level is referred to as an individual's *instructional reading level*. For example, an individual with an MAB IQ of 90 and 12 years of schooling would have an instructional reading level of 10.8.
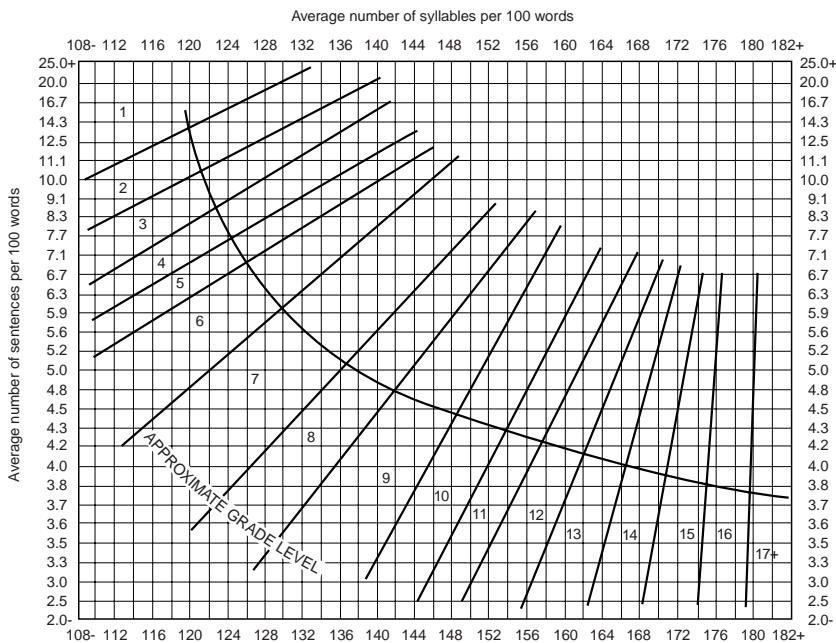
How to Evaluate Readability of Training Materials

A readability formula is a mathematically obtained rating of the grade reading level of written materials. The Fry method is a widely used method to assess the readability of adult level text and is suitable for training materials.

The Fry estimation method requires that the average number of syllables and the average number of sentences be determined for three 100-word

passages taken from a text selection. The Fry procedure involves the following steps:

1. Select three 100-word passages from different parts of the material.

2. Count the number of sentences in each 100-word passage, rounding to the nearest tenth of a sentence. Average these three numbers.

3. Count the total number of syllables in each passage. Compute the average number of syllables for the three passages.

4. Plot the word and syllable averages on the Fry graph, shown in the accompanying figure, to determine the corresponding grade level for the document.

If the three selections vary considerably in grade level, analyze additional 100-word sections until the variability is reduced.

Jamestown Publishers, Lincolnwood, IL, offers a copy of the graph in slide rule form.

Comparing Trainees' Reading Skills with Readability of Materials

Depending upon the nature of the training program and the availability of data on trainees' reading skills, several types of comparisons are possible. The following steps are recommended:

• At a minimum, compute the percent of trainees whose completed years of schooling is below the Fry Index. This analysis provides a rough measure of the compatibility of the trainees and written training materials.

If results of the MAB or another standardized verbal skills test are available, then compare the MAB-adjusted estimate of reading skills, the *instructional reading level*, with the Fry Index of the materials. Again, compute the percent of trainees whose reading skill level falls below the Fry Index.

• If the training program involves considerable self-study, it may be appropriate to adjust the instructional reading level. When the need arises for students to read materials independently, instructors typically select reading materials that are at least two years lower than the instructional reading level. The result is called the *independent reading level*. To compute the *independent reading level* of each trainee, simply subtract two years from the trainee's *instructional reading level*.

• Some adjustment to the Fry Index is possible. Statements of objectives and self-study questions embedded in the training materials increase reading comprehension by focusing the reader's attention. Subtract one-half year from the Fry Index for each of these features that are present in the text.

Once again compare the years of schooling, instructional reading level and independent reading level with the adjusted Fry Index.

The instructional designer must decide what level of incompatibility is acceptable. If resources are available to assist students whose reading skills fall below the level of the materials, then a higher degree of incompatibility may be acceptable. Similarly, if demonstration and supervised practice re-enforce what is covered in written materials, then some degree of incompatibility may be tolerable.

Guidelines for Improving the Readability of Text

Both physical attributes of text materials and the composition of those materials contribute to their readability. The following guidelines offer ways to improve readability.

Physical attributes of text materials

• Text lines of equal length (justification) have no demonstrable benefit. Conventional, left-justified text reduces reading errors and may assist in comprehension.

• The use of headings and underlining to indicate central and important concepts can increase learner retention and reduce errors.

• Readers prefer double columns on a page.

• Generous use of open space in page layout can aid comprehension.

• Variations in layout design, including text blocking and the use of color, do not seem to hinder comprehension, although low text to background color contrast can reduce reading accuracy.

• Avoid use of all capitalization ("Caps") as this decreases text readability. Bolding, italics and underlining can be used for emphasis.

Composition of text materials

- The keys to reducing the reading level of training materials involve employing straightforward sentence structure and using vocabulary that is familiar to the reader. (See *Guidelines: Writing For Adults With Limited Reading Skills* by Nancy Gaston and Patricia Daniels on www.cyfernet.org/writeadult .html.)

- Presentation of instructional objectives at the start of each section helps to improve comprehension.

- Self-study questions interspersed in the text can focus reader attention and influence comprehension.

References

D. Jackson, *Multidimensional Aptitude Battery Manual*, Research Psychologists Press, Inc., 1984.

E. Fry, "A Readability Formula That Saves Time," *Journal of Reading*, 1968, V11, 513-16, 575-78.

J. Gertler, S. Reinach and G. Kuehn, *Non-Accident Release of Hazmat from Railroad Tank Cars: Training Issues*, FRA/ORD-99/05, July 1999.