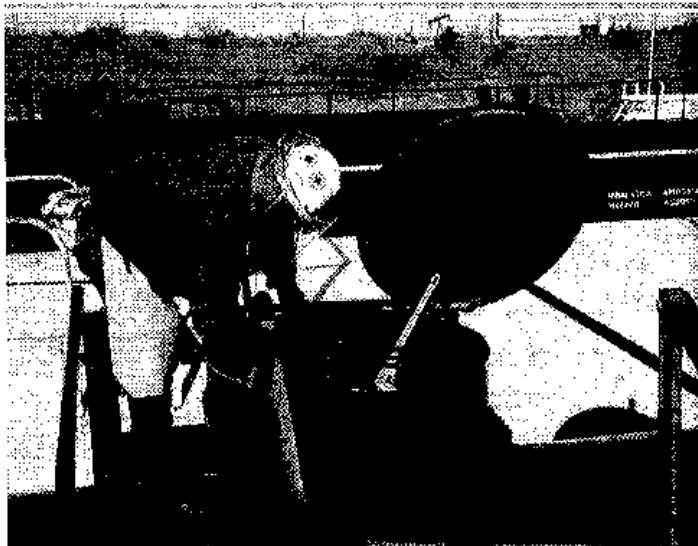


Suggestions for Effective Railroad Tank Car Loading/Unloading Training Programs:

Instructional Methods



Non-accident release (NAR) of hazardous materials from railroad tank cars is a source of concern for chemical manufacturers, railroads and the Federal Railroad Administration. An effective training program for individuals responsible for loading/unloading the substances from railroad tank cars helps to minimize the risk of an NAR.

This document offers guidelines for the preparation, format, and organization of instruction for hazardous material loading/unloading training. Anyone involved in the design and delivery of training to employees with this responsibility should find these guidelines helpful.



Instructors

Select instructors and on-the-job trainers based on pre-established and explicit selection criteria.

A formal procedure for selecting instructors will increase the effectiveness of training. The procedure might include one-on-one interviews and demonstrations of teaching ability. Though important, the instructor's years of experience on-the-job should be only one of the selection criteria. Other criteria may include the ability to effectively communicate to others both orally and through documentation, and the ability to lead others (interpersonal skills).

Use an instructor's guide to increase consistency of training across trainers and over time.

An instructor's guide serves as a job aid to instructors as they train individuals to load and unload hazardous materials into railroad tank cars. The existence of an instructor's guide is no guarantee of program quality, but the absence of one means that there is less likely to be consistency of training. Further, the lack of an instructor's guide can be especially problematic if a new instructor must step in to train.

Include trainer preparation and oversight.

Like an instructor's guide, train-the-trainer programs help to increase the consistency of training, and increase the likelihood of consistent training outcomes (i.e., trainee performance on-the-job).



Instructional Process

Explicitly state the skills that the trainee is expected to master in the training program.

At a minimum, the trainee should receive direct communication prior to any instructional sequence expressed in terms of the observable behaviors that they will be expected to master and subsequently produce. Usually the expected behaviors are explicitly conveyed in the form of training objectives, though the content and structure of the objectives vary widely. Some examples of relevant training objectives that address a range of activities, encompassing both factual and procedural information, include:

Objective 1. Name all of the component parts of a tank car's loading valve system.

Objective 2. List the steps involved in inspecting a tank car before it is loaded.

Objective 3. Demonstrate loading a tank car within acceptable limits specified in the standard operating procedures.

In the absence of explicit training objectives that are provided prior to instruction, programs that contain evaluation criteria or methods that call for specific behaviors that the trainees will have to produce by the end of instruction may be considered as having implicit training objectives.

To maximize the transfer of training, the skills, behaviors and activities required in practice and assessment should take the same form as those that are required when performing the actual skill.

Instruction and assessment should be designed and developed to be consistent with the desired outcomes. Reading or listening to an explanation of how a skill is to be performed is not a substitute for practicing the skill. Since it is likely that most hazardous material loading and unloading training programs include an OJT component, the issue becomes one of proportion of time spent in hands-on learning.

Trainee assessment should also take the same form as the desired outcomes. Thus, if the desired outcomes of the training are procedural skills, then the assessment should involve procedural demonstrations. Paper and pencil examinations are not likely to provide a reliable or valid measure of competency in the performance of a skill that does not involve paper/pencil responses. At best, paper and pencil exams for psychomotor or procedural skills convey only a measurement of a trainee's knowledge of a process. In the worst case, such tests are more influenced by language/reading skills than they are about the skills they purport to measure.

Use factual information to support procedural learning.

Lists, facts, figures and documented procedures are training aids that should be used to augment or supplement instruction. Since training hazardous material loaders involves application of procedural skills, lists, facts, figures and procedures should support

procedural learning, by providing factual information regarding when to use, or how to perform, a particular procedure.

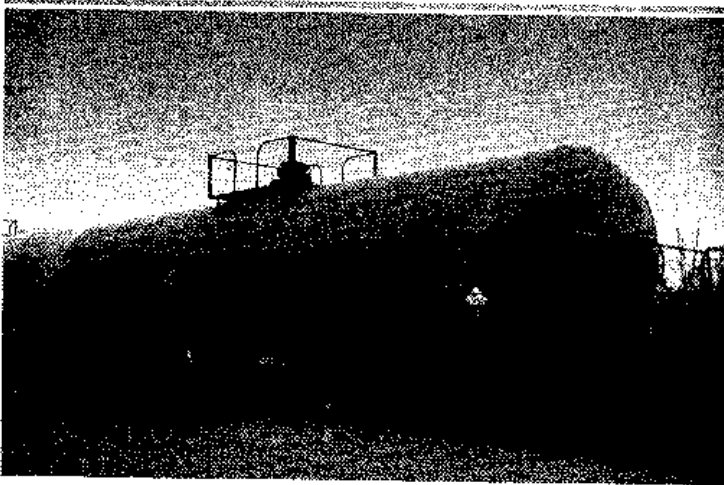
Help trainees visualize or anticipate the nature of the activity or procedure they are about to learn.

Instruction should begin with activities that help trainees visualize or anticipate the nature of the activity or procedure they are about to learn. Such "pretraining" has both cognitive and motivational benefits in that it prepares trainees for what they will be doing. In some situations, simply providing the trainees with an overview of the job and the conditions under which it is performed may be satisfactory. If the training will cover several related procedures, then some form of an "advance organizer" which relates all of the elements of the training may be more effective.

Instructors may also pretrain trainees by providing them with the course objectives before the training begins. Providing trainees with the objectives before training begins can help the trainees to focus on the relevant information and material during the training. Preparing the trainee will help him or her to learn more efficiently and thus make the instruction more effective.

Select or design instructional materials to be consistent with instructional methods.

The instructional materials that are used in the training program should support the instructional methods that are used. For example, when



teaching procedures, the instructor might first use printed step-by-step lists to convey what the trainee must do in the procedure, or a videotape that demonstrates the procedure to the trainee.

Some training approaches are sequential in that they build up layers of skills and understandings that are components of the desired learning outcomes, starting with simple outcomes and moving to more complex outcomes. The instructional materials that would be used with these approaches should reflect and support this methodological organization from simple to more complex learning outcomes.

Since tank car loading and unloading involves the application of procedural skills, instruction that involves factual information should be oriented toward its application in the appropriate procedure.

Both declarative knowledge and procedural knowledge are essential for learning procedural skills; typically procedural knowledge is built upon the foundation created by the acquisition of relevant declarative knowledge. For example, factual information may first be provided about tank car components, markings and fittings. Then, procedural information can build on such knowledge, for example, learning how to inspect a tank car prior to loading. The teaching of procedural knowledge should consist of a series of steps or activities that progresses logically to mastery of a desired outcome.

Training materials should provide everything the trainee needs to know to carry out the procedures.

The training materials should provide everything the trainee needs to know to carry out the procedures, including *what* to do, and *how* to do it. For example, an improper procedure may say, "tighten plug," while a proper procedure would say, "Using a 36 in. wrench, tighten valve by turning cap plug clockwise until plug no longer rotates."

Presentation of factual information should be integrated with hands-on practice to reinforce learning.

Hands-on practice enables the trainee to apply the new information to realistic situations and reinforces learning through such new association. A classroom presentation of information about personal protective equipment (PPE) might be followed immediately by examining, handling and trying on the equipment.

Offer a range of practice experiences that includes both supervised and independent practice.

Practice is an essential component of procedural learning. Supervised practice provides the trainee with immediate feedback during the early stages of learning, while independent practice enables the trainees to practice the skills they have previously learned under supervision. Independent practice requires the trainee to be able to judge, or regulate, his or her own performance, and affords the trainee the opportunity to seek assistance when he or she desires or when it is deemed necessary by the individual supervising the trainee.

First the instructor might lead the trainee through a procedure. Next the trainee might perform the procedure under the guidance of the instructor, an experienced employee, or OJT supervisor who can provide immediate feedback to the trainee. Then the trainee might practice the procedure independently but with a supervisor in the work area who is available to review the trainee's work and answer questions. OJT must be organized sufficiently so that both the trainee and the participating mentor understand the skills the trainee is to practice, and the level of proficiency that is to be achieved.

Spend the majority of the instructional time in supervised practice and on-the-job training.

Since loading hazardous materials into railroad tank cars involves primarily carrying out procedures, place emphasis on practicing the procedures. As a rule of thumb, the proportion of instruction that is presentation or instructor-led discussion should be limited to no more than one-third of the instructional time. Instructor presentation should consist of a mixture of factual information, procedural descriptions, visual materials and demonstrations since individuals differ markedly in their ability to learn from verbal, visual and auditory inputs. Good training provides a mixture of these types of presentation styles.

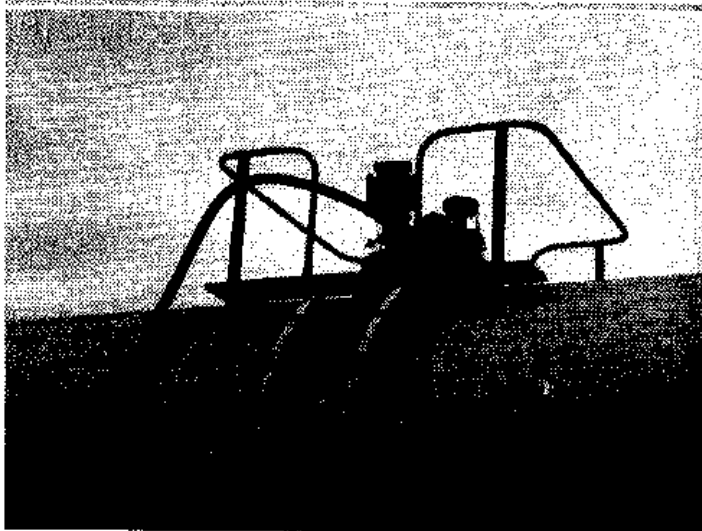
Provide feedback to trainees.

To enhance the effectiveness of the instruction throughout the program, trainees should be provided with feedback regarding the results of their performance in practice and during testing and assessment. Such knowledge of results will make learning more efficient by illuminating the difference between the trainee's behavior and the target behavior. Feedback may come in a variety of forms, including written comments and instructor demonstrations.

Provide guidance to trainees.

Guidance involves providing clear and unambiguous information to the trainee about what to do just prior to the activity or practice. Guidance is similar to feedback. The primary difference is when the information is provided to the trainee. Guidance is provided just prior to performance, while feedback is given after performance.

Guidance comes in many forms, including physical guidance, verbal guidance, demonstration, and cueing. Some are more appropriate for particular types of learning. For example, for procedural learning, demonstrations and verbal guidance (i.e., advice about what to do) may be the most suitable forms of guidance. Demonstrations involve showing the trainee what to do, while verbal guidance involves prompting an action, or involves some other form of verbal preparation or direction immediately before practice.



Motivate trainees.

When learners have a vested interest in the outcome of training, they become more focused, attend more carefully to activities and consequently are more likely to achieve the desired outcomes. Consequently, instructional methods and materials should address learners' interests in the training outcome.

The use of teams can be an effective means to increase trainees' involvement during training. External rewards may also be used to motivate employees already on-the-job and thus, serve to motivate trainees to learn as much as possible to benefit from the external rewards once they begin working. External rewards might range from a special recognition for the safest employee every year, to tangible goods such as a cash bonus or other benefits.

Elicit positive attitudes from trainees.

Positive attitudes toward instructional activities can strengthen a trainee's involvement in learning and can enhance a positive training outcome. Positive attitudes can be a by-product of instruction, or they may be desired learning outcomes for which instructional objectives are designed, such as to facilitate a "safety culture" in all aspects of the trainee's work. This may entail simple rules or procedures such as always holding a banister while ascending or descending stairs, or always looking both ways before crossing railroad tracks on-site.

Incorporate some self-paced learning to accommodate individual differences among trainees.

Self-paced learning is one form of a broader category of training called "adaptive training," in which individual differences are accommodated. Since individuals learn at different rates depending on their educational background and experience, self-paced learning is particularly beneficial when learning more difficult aspects of a job.

Self-paced learning may take one of several forms. For example, task difficulty while learning a particularly difficult procedure may be adjusted to accommodate individual differences in mastering the procedure. Fast learners may rapidly encounter more and more difficult steps when practicing a procedure while slower learners may encounter more gradual changes in task difficulty.

Another way to accommodate differences among individuals is to provide an opportunity for trainees to progress through training modules or components such as OJT at their own pace. Self-paced learning may be conducted through computer-based training (CBT), text self-tutorials, and self-paced progression of videotape training, to name but a few.

Allow for remedial instruction where trainees show deficiencies.

The training program should allow for remedial instruction as required for trainee deficiencies. The remedial instruction and its post-assessment should be consistent in form with the declared program outcome, instructing trainees on the procedure for loading hazmat into tank cars. Merely verbally "going over" a trainee's deficiencies and having the trainee acknowledge his or her mistakes is

inadequate, however. Post assessment should involve the trainee demonstrating the proper procedures. Since different trainees will have difficulty at different parts of the training, remedial instruction is a second form of adaptive training since it accommodates individual differences among trainees.

Overtrain.

There is some evidence that there are benefits to overtraining. Overtraining involves the continuation of training even after a trainee has achieved a pre-specified and often basic level of performance. Evidence of performance level may come from passing a one-time skill demonstration test. Even though the criterion level of performance has been achieved by demonstrating the skill once, additional learning can still take place. In particular, it appears that overtraining improves skill retention and speeds task re-learning after a period of time not performing the particular task. Overtraining also increases resistance to mental fatigue, stress and interference.

One form of overtraining might require trainees to encounter and complete multiple performance and final evaluation criteria, both in terms of breadth (the trainee must meet or exceed several criteria) and depth (high performance achievement or evaluations required). Trainees may face a variety of situations and may be expected to perform several different procedures while performing their job duties; the use of multiple performance criteria and final evaluation criteria better prepares trainees by exposing them to many different situations during their training.

Assign trainees to duties immediately after training.

Research has shown that procedural learning decays very rapidly if not used or applied. Thus, there should be no delay between the completion of training and assignment to duties.

Post Training

When determining the need for refresher training, consider the amount of time since the last assessment/training, and the amount of time spent away from the particular job.

In general, there is no formula with which to determine the frequency of refresher training. Rather, the time when refresher training should take place is typically dependent on the amount of time since the trainee was last trained, and the amount of time that the trainee has spent away from performing the critical duties required of the job. A general rule of thumb is to provide refresher training more frequently than not, to reduce the possibility that a trainee's knowledge and ability has lapsed or eroded.

Refresher training should address both new and existing procedures.

Refresher training is often used to apprise employees of a new or modified procedure, or a new policy that affects loading hazardous materials for transportation. However, another reason



for refresher training is to promote parity across different trainees who were trained at different times and/or by different instructors. Refresher training helps to ensure that the loaders practice the same methods and conduct the same procedures, even if initial training was dissimilar.

Procedures that are infrequently, if ever, used, (e.g., emergency procedures) should be the target of refresher training since procedures that have not been used since initial training are more susceptible to eroding.

Design periodic reassessment so that it takes the same form as assessment following initial training.

Since hazardous material loading training involves performance-oriented skills, reassessment should be performance-oriented. Failures or performance deficits observed in periodic reassessment should result in hands-on refresher training that reflects the actual performance of the skill area in question.

Periodically reassess training program effectiveness.

Exit testing and post-training evaluations of trainees by supervisors should be conducted periodically to evaluate the effectiveness of the training program and to identify aspects of the program that need to be improved.

References

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

For further information, contact:

William Schoonover at 202-493-6229
Federal Railroad Administration, Office of Safety

