

SEMI E150-1107

GUIDE FOR EQUIPMENT TRAINING BEST PRACTICES

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NOTICE: Paragraphs titled NOTE and sections entitled RELATED INFORMATION are not official parts of this document and are not intended to modify or supersede it.

1 Purpose

1.1 The purpose of this standard is to provide recommendations for developing and delivering equipment training so that it is performance-based. Performance-based equipment training (PBET) improves the likelihood that the workforce of semiconductor equipment owners can successfully install, use, maintain, and repair their equipment. In so doing, PBET improves the equipment owner's ability to attain reliability, availability, and maintainability (RAM) goals. As such, PBET helps to increase productivity and reduce costs.

2 Scope

2.1 This standard applies to any company that must develop equipment training.

2.2 The standard is applicable to training for anyone that works with equipment, including operators, maintenance technicians and engineers, service personnel, and applications/process technicians and engineers.

2.3 This standard provides guidelines for both the process of developing and delivering equipment training that is performance-based, as well as the essential characteristics of the resulting performance-based training product.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This standard does not attempt to address all aspects of equipment training, but rather addresses those practices that help to ensure that equipment training is performance-based.

3.2 This standard is an overview of the process and characteristics of PBET, and therefore just an introduction. Actual implementation of PBET will require competencies from the field of human performance technology beyond what is stated in this standard.

4 Referenced Standards and Documents

4.1 SEMI Standards

SEMI E10 — Specification for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM)

SEMI E149 — Guide for Equipment Supplier-Provided Documentation for the Acquisition and Use of Manufacturing Equipment

SEMI S19 — Safety Guidelines for Training of Semiconductor Manufacturing Equipment Installation, Maintenance and Service Personnel

4.2 SEMATECH/TECHNICIAN PERFORMANCE IMPROVEMENT COUNCIL (TPIC)¹

95102995A-TRG — Performance-Based Equipment Training (PBET) Participant Guide

TPIC Instructor-Led Technician Training Guidelines 2003

¹ Technician Performance Improvement Council (TPIC), 2200 Panther Trail, #216, Austin, TX 78704, USA. Telephone: 512.632.2361; <http://www.tpik.org>

NOTE 1: SEMATECH stopped support of the SEMATECH – SEMI/SEMATECH Technician Training Council in 2003. TPIC incorporated as an independent organization in 2004 to continue technician training-related activities. SEMATECH transferred ownership of this document to TPIC and removed it from the SEMATECH website.

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *ILT* — Instructor Led Training

5.1.2 *PBET* — Performance-Based Equipment Training

5.1.3 *RAM* — Reliability, Availability, and Measurability

5.1.4 *TPIC* — Technician Performance Improvement Council

5.2 Definitions

5.2.1 *Analyze step* — the second step in the performance improvement process. There are several possible procedures that can be used during this step, but these are the ones that PBET considers to be essential: job analysis, (business) goal analyses, task analyses, target performer (audience) analysis, writing performance objectives, and creation of a learning hierarchy.

5.2.1.1 *Discussion* — Some would combine step 1 and 2 of the performance improvement process into a single step called, “Analyze.” See performance improvement process. The expression “front-end analysis” emphasizes the idea that steps 1 and 2 of the performance improvement process must be done before “Design” and “Development.”

5.2.2 *availability* — the probability that the equipment will be in a condition to perform its intended function when required. [SEMI E10]

5.2.3 *business goal analysis* — a procedure used during the Analyze step of the performance improvement process to (a) identify, where possible, one or more new tasks or steps to be performed from vaguely worded business goals, and/or (b) modify the conditions and standards of existing performance objectives to accommodate the meaningful components, where applicable, of business goals.

5.2.4 *competence* — a level of performance determined by a performer’s accomplishment of a task to the degree stated in the standards of the performance objective, particularly the qualitative measures.

5.2.4.1 *Discussion* — Competence (competency) refers to when a performer does a task “right,” meaning it was done the way it was supposed to be done and when the task was completed, it was done as required by the standard. “Mastery of a performance objective” when the performance objective has no speed requirement, means the same thing as competence. Some use mastery to mean fluency; fluency refers to when a task can be done competently, as well as quickly and almost instinctively; consequently, fluency inevitably contains a speed component. Attaining fluency requires continued and/or frequent practice of the task after the attainment of competence.

5.2.5 *conditions (of an objective)* — describes (a) where the performer performs the task and (b) what the performer is allowed to use (“given” to use) in order to perform the task. Conditions can include (or exclude), among other things: equipment, equipment readings and displays, documentation, tools, replacement parts, recipes, job aids, personal protective clothing, and more.

5.2.6 *content (of a lesson)* — what a performer needs to know or understand in order to practice a task successfully. Often this part of the lesson is labeled theory, information, data, description, concepts, or background.

5.2.6.1 *Discussion* — A procedure (i.e., the step by step sequence of how to perform a particular task) is not an example of content. It is not something one needs to know; it is rather something that is done. However, for many tasks, especially tasks that are more process than procedure, learning certain content is prerequisite to performance.

5.2.7 *delivery methods (delivery system)* — the way in which the parts of a lesson are transferred and presented to a learner.

5.2.7.1 *Discussion* — In general, there are two types of delivery systems: typical and alternate. The “Typical” method is instructor led training (ILT) in which the trainer is physically present and, during the demonstration, practice, and test, the actual machine (equipment) is physically present. “Alternate” delivery methods are everything

else. When both types of delivery are used in the same lesson or course, it is called blended learning. Alternate delivery methods include e-learning, distance learning, and, when used while the instructor is not physically present, materials like programmed booklets, flashcards, and written assignments. The virtual classroom is an alternate delivery method because the instructor is not physically present.

5.2.8 *demonstration* — an essential part of every lesson in which the learner observes the task required by the lesson's objective. Also called, modeling.

5.2.8.1 *Discussion* — Typically the instructor performs the demonstration; but there are many alternate methods, such as a video demonstration. A demonstration includes showing and explaining the steps of either (1) the same exact task (e.g., Adjust the elevator height), or (2) one sample among many for that task (e.g., Find the open interlock).

5.2.9 *Design step* — the third step in the performance improvement process, as applied to a training solution: This step focuses on creating a lesson design plan for each performance objective established during the "Analyze" step.

5.2.9.1 *Discussion* — Every lesson plan has common elements such as an introduction, a demonstration of the task, an opportunity for each learner to practice the task while receiving feedback, and a performance test. Some lessons also include content, but not all. See content. The design of each lesson includes selection of appropriate delivery methods for each lesson element. See delivery methods.

5.2.10 *Develop step* — the fourth step in the performance improvement process, as applied to a training solution: This step focuses on creating all the instructional aids, practice aids, test materials, and delivery system materials listed and described in the "Design" step.

5.2.11 *distance learning* — the desired outcome of training courses delivered to remote locations via delivery methods such as (a) physically mailing materials like written correspondence, audio- and videotape, and CD-ROM, or (b) using online learning including the virtual classroom, audio- and videoconferencing, interactive TV, and FAX. Training from a distance does not preclude the use of the traditional classroom. The definition of distance learning is broader than and entails the definition of e-learning.

5.2.12 *embedded solution* — a type of performance solution (intervention); a job aid that is integrated into the equipment (e.g., labels, ergonomic designs, color-coding, mistake-proofing, expert systems, on-line help systems).

5.2.13 *entry lesson* — the first lesson in a course; the entry lesson is typically shown at the bottom of a learning hierarchy and stated as a task.

5.2.14 *e-learning (electronic learning)* — a category of delivery methods that covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes delivery via internet, intranet/extranet (LAN/WAN), CD-ROM, and more. Some would extend the definition to include audio- and videotape, satellite broadcast, interactive TV, and more.

5.2.15 *equipment* — the combination of hardware and software required to perform an operation or activity (e.g., processing, transporting, storing), including all direct auxiliary support or peripheral equipment (e.g., vacuum pumps, heat exchangers, effluent/exhaust treatment equipment). [SEMI E149]

5.2.16 *equipment documentation* — recorded information in any form (e.g., text, video, audio) or media (e.g., electronic, paper) intended to assist the user with equipment tasks (e.g., installation, operation, preventive maintenance, corrective maintenance, application).

5.2.17 *Evaluate step* — the seventh step in the performance improvement process, as applied to a training solution: This step determines whether the training works, by looking at two or more of these examples of evaluation criteria: (1) the reaction/opinion of the students, (2) the degree to which members of the target group are able to be "signed off" as competent, (3) the reaction of students and their supervisors to the training several months after training, (4) the degree to which members of the target group perform as expected on the job several months after training, (5) any measurable benefits that accrue to the business as a result of the training.

5.2.18 *feedback (during practice)* — information provided to learners during and after their practice of a task, providing both supportive (positive) information about what has been done correctly as well as corrective feedback about what needs to be done differently. Feedback is essential in order for learners to develop competence and confidence regarding the task, whether it is provided verbally by an instructor or whether it is provided by alternate means.

5.2.19 *flexible scheduling* — arranging the daily schedule for instructor led training so as to minimize the number of people around a machine during practice activities (e.g., half the class begins the day at 8 am while the remaining students begin at 12 noon, half the class takes lunch from 11 am to 12 noon while the remaining students take lunch from 12 noon to 1 pm).

5.2.20 *fluency* — a level of performance determined by a performer's ability to meet the standards of a performance objective quickly and instinctively. Also called, automaticity.

5.2.20.1 *Discussion* — When this level of performance is required it should be incorporated into the performance objective; this will impact the nature and duration of the practice sessions and performance test.

5.2.21 *goal* — an intended outcome not stated in measurable terms.

5.2.22 *goal analysis* — see business goal analysis.

5.2.23 *Identify step* — the first step in the performance improvement process. During this step, procedures are used to identify four things: (1) the performance requirements, (2) any factors that prevent performers from performing as required, (3) the most cost-effective performance solution (intervention) that will enable performers to perform as expected, and (4) the evaluation criteria that will enable performance improvement stakeholders to determine the effectiveness of the performance solution.

5.2.23.1 *Discussion* — Since training is one of the most costly interventions, this is the step where it is determined whether training should be designed as the solution. See performance solution. The first two "Identify" procedures are sometimes called cause analysis, root cause analysis, or gap analysis. Another name for the entire "Identify" step is performance analysis. Some would combine step 1 and 2 of the performance improvement process into a single step called, "Analyze." See performance improvement process.

5.2.24 *Implement step* — the sixth step in the performance improvement process, as applied to a training solution: This step is about taking whatever action is required to support the personnel that will deploy the training so that the training delivery is (a) effective and (b) standardized. "Effective" delivery requires that personnel are equipped with the appropriate skills (e.g., presentation skills, facilitation skills, questioning skills, feedback skills, PBET class management skills). "Standardized" delivery requires that personnel be given written guidance for each lesson.

5.2.24.1 *Discussion* — Written material for purposes of standardization may have been created during the "Design" step, since detailed lesson plans can, when done well, serve as delivery notes for instructors. Others will find it convenient to create student manuals and instructor support materials at the same time (i.e., during the "Development" step). Yet others will create their materials, ensure that they work (i.e., pilot and revise), and then create an Instructor Guide or alternate support materials for instructors and/or facilitators as part of this "Implement" step. Any such variation is an acceptable interpretation of the performance improvement process.

5.2.25 *instructional aid* — any object required for delivery of training but not needed by the performer on the job (e.g., whiteboard, sample faults for troubleshooting, demonstration video, slides). Also called a training aid.

5.2.25.1 *Discussion* — Objects needed by the performer for reference, during training and on the job, are called job aids.

5.2.26 *instructor* — an individual with appropriate technical expertise and experience, authorized by the employer to deliver, or facilitate the delivery of, a course module or set of modules and capable of addressing student questions in a timely manner. [SEMI S19] See also, trainer.

5.2.27 *Instructor Guide* — provides written information to an instructor on how to teach a lesson or series of lessons. A book, in which all of the right-side pages are annotated reproductions of the student manual and the left-side pages are detailed lecture notes, questions to ask the students, and directions for class activities is one example of a formal instructor guide.

5.2.28 *instructor led training (ILT)* — any training delivery method in which a human instructor is present at the same time as the student (even if not the same location) to present information or direct the learning activities (e.g., classroom lectures, discussion groups, instructor demonstrations at the equipment, instructor feedback during practice activity, virtual classroom).

5.2.29 *job* — the collection of tasks to be performed by an individual, in support of a process. The job (or performer of the job) is usually identified with a particular function (e.g., equipment operator, process engineer).