All that was discussed exists in training devices today. Where do we go tomorrow? We are always receptive to new ideas and breakthroughs in the field of testing as you submit proposals on new training devices. First, train your designers to be conscious of the maintenance problem and help them become familiar with the latest techniques in BIT. Then the bids will tend to be reasonable and trainer BIT capabilities will grow. One of the most outstanding sources of up-to-date information in the realm of BIT and automatic testing is PROJECT SETE which is conducted by New York University School of Engineering and Science. The project director's name is David M. Goodman. You can obtain a wealth of information from Mr. Goodman in the form of study reports, lecture papers, and actual instruction classes. You're missing a good source of information if some of your key people aren't on-board with Project SETE.

THE DRAGON ANTITANK MISSILE SYSTEM TRAINING EQUIPMENT AND GUNNER TRAINING

MR. C. J. WHITMAN
Supervisor, Training and Field Service
McDonnell Douglas Astronautics Company TI-CO

The requirement for a medium range antitank/assault weapon that would provide the infantryman with an improved capability against tanks and hard targets over that provided by its predecessor, the 90MM recoilless rifle, was stated in a Qualitative Development Requirement Information document released by Ballistic Research Laboratories in October 1962. A United States Army Combat Developments Command Small Development Description, dated October 1968, identified the requirement for a Conduct-of-Fire Trainer to be used with this system. To meet these requirements, McDonnell Douglas Astronautics Company, TI-CO, developed the DRAGON Weapon System and its allied training equipment.

Prior to describing the training equipment, it is necessary to briefly describe the weapon system.

THE DRAGON WEAPON SYSTEM

The DRAGON is a one-man portable and operable, command to line of sight wire guided missile system. It consists of a tracker and a round.

ROUND. The DRAGON round consists of a launcher and a missile, packaged together, and is the expendable portion of the system.

1. The Launcher - The Launcher consists of a smooth bore fiberglass tube, breech, canister assembly, tracker mount, support stand, launcher wiring harness assembly and tracker battery, carrying strap, forward and aft shock absorbers. It is disposed of after the missile has been fired. The Launcher has an overall length of 44.10 inches and weighs approximately 8.9 pounds, without the missile. The high pressure canister and low pressure breech configuration supplies the required muzzle velocity without exceeding the permissable acceleration levels and with a minimum of recoil. The Launcher also serves as a storage and carrying case for the missile prior to launch.

2. The Missile - The Missile is the second item of the round. The missile consists of three major sections. The forward section contains the warhead and fuze system. The center section contains 30 pairs of side thrusters and their firing circuit boards. The aft section contains the electrical components assembly, control system electronics package, flare assembly, bobbin assembly, and three folding fins mounted on the sleeve assembly. The missile is approximately 28.5 inches in length, has a diameter of approximately 5 inches, and weighs approximately 14 pounds at launch.

TRACKER. The Tracker is the reusable component of the DRAGON Weapon System. It consists of an optical sight and infrared sensor, which are boresighted to each other, an electronics package, trigger, and a structure assembly. The tracker measures the displacement of the missile from the line of sight established by the gunner. Missile displacement measurements made by the tracker are converted to guidance commands which are transmitted to the missile by a wire link. The guidance commands produce horizontal and vertical missile control forces generated by small thrusting rockets which are mounted canted in the missile so that longitudinal thrust is also produced, thereby increasing the missile's forward velocity. The tracker determines missile position from the IR flare assembly at the aft end of the missile. A typical test launch is shown in figure 1.

Figure 1. Dragon Weapon System Firing

The simple but sophisticated DRAGON Weapon places the gunner in a new environment as compared to the 90MM recoilless rifle which it replaces. The gunner functions can be divided into four separate events:

1. The prefire function; i.e., the preparation of the weapon and the acquisition of the target.

2. The launch function; i.e., the trigger squeeze and control of launch reaction.

3. The post launch function; i.e., maintain a proper sight picture while tracking smoothly.

4. Post impact function; i.e., the removal of the tracker from the "spent" round and the preparation for refire if necessary.

The functions that occur in event one and four do not depart appreciably from the operation of other weapons. However, the functions which are required in events two and three are a radical departure from earlier systems. The student gunner must become accustomed to the time delay between trigger pull and launcher firing and must also learn to control his reactions to the large percentage of system weight loss during launch. After launch, function three, the gunner must suppress the natural reaction to put the weapon down, and continue to track the target with a smooth and steady motion regardless of the events which are taking place around him.

THE DRAGON TRAINING EQUIPMENT

The "Training Package;" i.e., the training equipment and the training plan, is an important element of a weapon system development. The value of the training package is dependent upon proper assessment of two areas:

1. What is necessary to be learned by the trainee ?

2. What technological abilities; i.e. skill and knowledge does the prospective trainee possess which can be used during his training?

The training package should create a realistic environment for maximum effective learning to take place. Galileo said, "You cannot teach a man anything...you can only help him find it within himself." We are no longer satisfied just to teach a man something. If we are to have effective learning, we must use new and imaginative training equipment and techniques to help him find the skills within himself.

The DRAGON Training Equipment does create a realistic handling and launch environment. It also employs immediate feedback techniques in terms of gunner performance. The DRAGON Training Equipment provides the tools for developing and maintaining the gunner's proficiency, reduces the need for expending live missiles for training purposes, and evaluates the gunner's performance instantaneously.

The training equipment consists of the Launch Effects Trainer (LET), Infrared Transmitter, and the Monitoring Set as shown in figure 2. During training exercises the LET uses a tactical tracker for gunner sighting, and provides a launch recoil comparable to that of the weapon.

Figure 2. Dragon Training Equipment with Infrared Transmitter Mounted on Jeep

Launch Effects Trainer (LET). The Launch Effects Trainer simulates the Weapon Round in appearance, prefire weight and center of gravity and therefore can be used for handling and set-up exercises. The LET employs the energy of a 7.62 blank cartridge to produce an audible blast as well as the recoil and the weight shift effects of the tactical round. The internal arrangement of the LET is shown in figure 3.

For a training exercise, the student gunner executes the same prefire functions in using the LET as are required by the tactical weapon. These functions consist of the following:

1. Mount the tracker on the round
2. Lower the support stand
3. Assume firing position
4. Acquire target with tracker telescope.

A training assistant sets and locks the weight shift assembly into firing position and then opens the breech and inserts the cartridge. This requires removing the access portion of the aft shock absorber and opening the breech. Opening and closing of the breech cocks the firing mechanism and automatically sets the safety cam to the safe position. The complete sequence of events for LET firing is shown in figure 4.

LAUNCH EFFECTS TRAINER SUB-ASSEMBLY

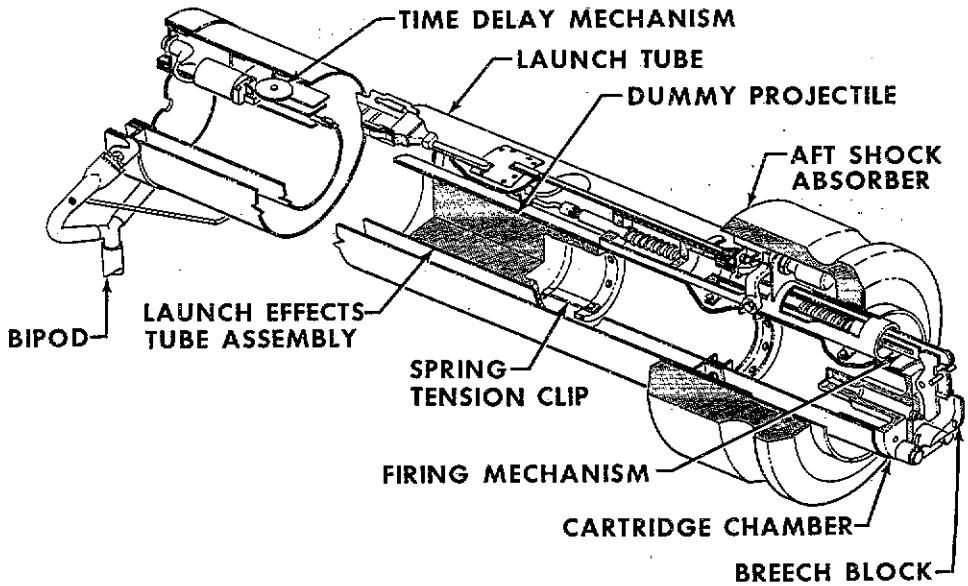

Figure 3. Launch Effects Trainer Subassembly

LET OPERATION

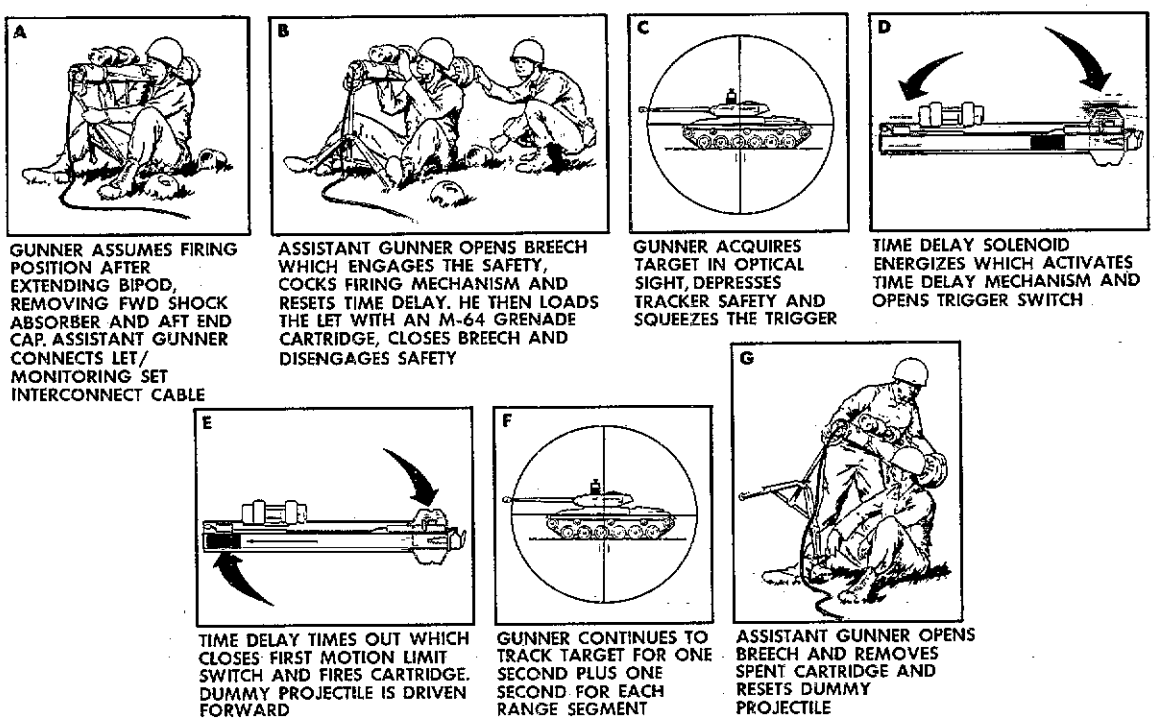

Figure 4. LET Operation

Infrared Transmitter. The Infrared Transmitter provides the necessary energy for establishing tracker sensor contact with the target. In so doing the Infrared Transmitter effectively simulates the missile flare. All visible wavelength infrared energy is filtered out to insure that the gunner tracks a target of realistic contrast and not the transmitter. Displacement of the transmitter beacon from the target aim point is compensated for at the Monitoring Set. Consequently, angular displacement between the sensor optics line of sight and the transmitter is detected as a gunner aiming error during a tracking exercise. The IR Transmitter can be vehicle mounted or stationary mounted to provide simulated stationary or moving targets.

Monitoring Set. The Monitoring Set consists of a control and indicator panel, control logic, error detector, function generator, battery and battery charger. A tracking indicator is provided to enable the instructor to instantaneously monitor the gunner's performance. A target range switch enables the instructor to compensate for target range and to review the various increments of the tracking period. An off target indicator, divided into four quadrants, indicates the direction of the error. Hit and miss indicators provide a readout at the end of a tracking period. Other controls are provided for recorder, target size, horizontal and vertical bias adjustments, an IR transmitter and trigger indicators. The bias adjustments are used during trainer set-up boresighting procedures to null error signals due to displacement of the aiming point from the Infrared Transmitter beacon.

Gunner tracking data is obtained from the tactical tracker, mounted on the LET, which measures the angular deviation from line-of-sight to the IR transmitter located on the target. The Monitoring Set processes, evaluates and displays the angular data received from the tracker. The instantaneous angular deviations from the correct aim point are evaluated by comparing these error signals to a programmed acceptance curve. When a gunner stays totally within the acceptance curve, in both horizontal and vertical throughout the tracking exercise, he is considered as having hit the target. If he exceeds the curve at any time, he is considered as having missed the target, with the approximate time and direction of the error being recorded and displayed at the end of the exercise. A score (0 to 100%), which is based on the gunner's average tracking error, is also displayed. These displays help the instructor evaluate the gunner's performance immediately and can be used to instruct the gunner on methods of improving his skill before his next firing.

THE DRAGON GUNNER TRAINING PROGRAM

The DRAGON Training Equipment has been integrated into and is being utilized in a gunner training program. The training program is divided into four phases of instruction which are presented in an order which reinforces the training objective.

The four phases consist of the following:

1. Technological Knowledge Development
2. Primary Skill Development
3. Instructional Firing

4. Marksmanship Skill Development.

During the development of the student gunners technological knowledge he learns the general characteristics of the DRAGON in terms of the requirement for the weapon, where it will be found in the Army TO&E as well as the DRAGON's physical characteristics and performance. The introduction to the training equipment, including assembly, disassembly, and malfunction immediate action, is also covered.

The Primary Skill Development phase begins with the identification of the motor skills which the gunner must employ to properly utilize the DRAGON System effectively. Each step required to prepare for an engagement of a target (target acquisition, range assessment, target tracking before and after fire) is demonstrated and then practiced to perfection by the student. The pros and cons of each of the firing positions are also discussed and demonstrated during this phase. The look alike, function alike features of the Launch Effects Trainer allows the student to practice in a realistic environment without the potential hazards of the tactical round.

During the Instructional Firing phase the student gunner begins to put into practice those safety procedures, which must be observed, with the tactical weapon when operating in the real launch environment. While serving as an assistant instructor the student becomes thoroughly familiar with the operation of the LET. That is, he learns those functions which are required to operate the LET, but are not gunner functions, when firing a tactical round. He also learns to operate the Monitoring Set.

During Marksmanship Skill Development which is the final phase of the training program, the gunner is scored on each of the simulated firings with the LET. The Monitoring Set provides the instructor with instantaneous indications of the gunner's performance in terms of the gunner's ability to recover from the launch environment, steady state tracking ability, and the instructor and student the ability to take the necessary corrective action on each shot. As a conclusion to this training program the last twenty firings are for a qualification score.

CONCLUSION

The simplicity of operation of the DRAGON Weapon System, excellent positive transfer characteristics of the DRAGON Training Equipment combined with a well developed training program have made it possible to demonstrate that more than 99 percent of the selected gunner candidates can qualify as Army "DRAGON" Gunners.