several screws. Then the electric motor can be attached to the tank model.

The transformer is needed to power the tracking set. Most transformers available run off a 120-volt source, which means they can be employed with a field generator as well as with AC current inside.

The accompanying chart gives the length of track needed for given tracking periods and speeds. The lengths of track shown are for single straightaways only. The tracking times selected (17, 11, and 6 seconds) represent the time of flight for a TOW to ranges of 3,000, 2,000, and 1,000 meters. The maximum speed of 30 miles per hour is based on the probable cross-country and combat speeds for modern tanks. (These figures were obtained by multiplying the tracking time by the target speed and then that total by a conversion factor of .55. Other tracking times and speeds can be calculated the same way.)

The simplest track design is an oval. This presents the gunner with target runs of equal time and in different directions. Although the track design may be varied with additional curves and such, realistic lengths must be maintained.

| TRACKING TIME (seconds) | TARGET SPEED (mph) | LENGTH OF TRACK (in/ft) |
|---|---|---|
| 17 | 30 | 280.5/23.4 |
| | 20 | 187.0/15.6 |
| | 10 | 93.5/ 7.8 |
| 11 | 30 | 181.5/15.2 |
| | 20 | 121.0/10.1 |
| | 10 | 60.5/ 5.1 |
| 6 | 30 | 99.0/ 8.3 |
| | 20 | 66.0/ 5.5 |
| | 10 | 33.0/ 2.8 |

Terrain mockups such as hills, woods, buildings, and smoke can be used to supplement the track. These mockups can be simple cardboard cutouts in the shapes of typical obstructions, and can be varied in size and location to present different, realistic situations to a gunner and his crew.

If there is only enough track for an oval of minimum size, situations can be varied not only by changing the terrain mockups but by changing the speed of the target vehicle. This presents a gunner with a target that seems to stop, fire, and move out at a fast rate.

The cost of one of these sets is small -- about $250. This includes a tank model, 64 pieces of 9-inch track, 8 pieces of curved track, a heavy duty transformer, and a small locomotive. This cost is quite small compared to other TOW or Dragon training equipment. Ideally, each battalion should have at least one set.

A motorized scale tracking set is not a cure-all for the problem of keeping gunners proficient at tracking, but it does allow a unit to make the most of the time and space it has. Because of its small cost and its realistic training value, and because it can be used in garrison as well as in the field, the set is a valuable training resource.

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# Deflection Scale Board

MAJOR MARK S. FLUSCHE

On the future AirLand battlefield, the 81mm mortar section can expect to move frequently. Hipshooting will probably be the rule rather than the exception, and a highly trained fire direction center will be an absolute necessity.

Unfortunately, the present M16 Plotting Board is slow to use and hard to understand; soldiers frequently have difficulty solving a gunnery problem on its rotating disc.

But there is a rather simple solution to this problem: A field artillery deflection scale board can be modified so that it can be used with mortars. The only things needed are a sheet of plywood about 19 inches wide and 21 inches long, a Graphic Training Aid (GTA) 6-5-1 (Multipurpose Protractor), a DA Form 4176 (target grid), a small nail, map tacks, masking tape, frosted contact acetate, flat white paint, a Graphical Firing Fan (GFF), and a vertex pin. (The latter two items can be borrowed from a 4.2-inch mortar section.)

Just about anyone can make one of these boards by following these instructions:

First, paint the working surface of the board with the flat white paint. Once the paint is good and dry, place the left edge of the GFF roughly parallel to the long side of the board and secure it with the vertex pin midway along and one and one-half inches in from either 19-inch side.

Draw two 1,000-mil-wide deflec-

tion arcs, graduated in 10-mil increments, at distances of 6 and 17½ inches from the vertex pin. (All 50- and 100-mil increments should be indicated by strokes longer than the 10-mil graduations.) Mark the 100-mil graduation with the base deflection of the weapon system (2800 mils), and label the remaining 100-mil increments, with the left-hand increments as 3300 mils and the right-hand as 2300 mils.

Carefully separate the GTA azimuth disc from the range arm, and select a nail that closely fits the vertex hole of the range arm. Remove the GFF and the vertex pin and drive the nail exactly into the hole left by the pin.

Prepare the range deflection arm by taping over the numbers printed on the range arm of the multipurpose protractor, and then renumber the scale to 1:12,500. (This renumbering is quite simple, since the scale was originally graduated every 100 meters and these graduations now become 25-meter increments at 1:12,500.) Mark the maximum range of each desired charge and cartridge combination on the range deflection arm to make it easier to select the charges. Cover the deflection scale board, the range deflection arm, and the target plotting grid with frosted contact acetate to protect them from the weather and to permit penciled notes to be made on them.

Once the deflection scale board has been constructed a mortar section conducting an emergency fire mission can use it for both of its primary technical fire direction tasks: To determine initial firing data to the target, and to compute subsequent data based upon the observer's corrections. Here is how to do it:

For the initial round, select the mounting azimuth based either on the measured azimuth from the firing position to the map grid location of the target or on the azimuth to the center of sector. (Grid location is preferred because the first round engages the target directly.) Announce the mortar base deflection (2800 mils) and the elevation corresponding to the range from the firing point to the target or the center of sector as elements of the initial fire command.

To use the deflection scale board to compute subsequent corrections, first place the vertex of the range deflection arm over the nail to represent the center of the section's firing position and align the left edge of the arm on deflection 2800 on either deflection arc.

Stick a pin next to the range deflection arm opposite the range to the target or the center of sector. This pin represents the location of the first round and, ideally, the target. Then center the target grid over the first round pinhole and align the 0-3200 line with the left edge of the range deflection arm. The arrow on the target grid points away from the vertex in the direction of fire.

Place a second pin opposite the graduation on the scale of the target grid corresponding to the mounting azimuth. This pin represents grid north with respect to the mounting azimuth and is used as the north index. It may be necessary to move the range deflection arm to place the pin.

Finally, rotate the target grid until the graduation corresponding to the observer-to-target direction is opposite the north index point, and tape the grid in place. Read Angle T off the target plotting grid under the left edge of the range deflection arm. To determine firing data for subsequent corrections, plot the observer's corrections on the target plotting grid, move the left edge of the range deflection arm to the new pin location, and read a new deflection, range, and charge. Visually interpolate, as necessary, to determine the deflection and the range. (Accuracy within 3 mils and 25 meters of M16 Plotting Board data is easily attainable.) Extract the elevation from the tabular firing table (FT 81-AI-3) for the determined charge and range combination, and announce the new firing data to the guns.

To use the deflection scale board for a subsequent mission, tick-mark the final pin location for the target and construct a north index. Center the target grid over the final pin location, realign the 0-3200 line with the left edge of the range deflection arm, convert the final deflection to azimuth, and construct the north index opposite the final azimuth. This allows future targets to be located by shifting from a known point.

The deflection scale board cannot compute all fire missions, of course, because it lacks a 6400-mil capability, and it has obvious problems with durability. But it does offer definite advantages as a supplementary means of fire control and as a tool in classroom instruction. In action, mortars can be mounted on the exact azimuth to the target; there is no need to round the azimuth to the nearest 50 mils as is required with the M16 Plotting Board. The elimination of this rounding procedure results in a more accurate first round and a faster fire-for-effect.

In a training class, each soldier can use expendable material to construct his own board and then he can keep it for training. The deflection scale board provides him with a solution to a gunnery problem that is easier to understand than the M16 Plotting Board is, since the locations of the gun, the target, and the observer-to-target direction are shown in their proper perspective. The soldier's future training with the firing chart is also improved because of similarities between the deflection scale board and the chart.

Anyone who is having problems with slow "hipshoot" times or with student learning difficulties in their fire direction center training should try using one of these modified deflection scale boards.

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