Moving Armor Target

(MAT)

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General

The Moving Armor Target (MAT) presents moving and stationary vehicle target silhouettes, including friendly and foe targets; heavy, medium, and light armor vehicles; technical trucks, etc. It can support vehicle, dismounted, and low angle aerial gunnery training. The standard MAT track is 350m (1,148ft); some standard ranges call for longer or shorter ones. Coordinate non-standard MAT lengths with TPO Range and the RTLP-MCX.

The Entry Control Point station of the Convoy Live Fire Range (CLF) uses a 225m (738ft) long serpentine moving target (ECPMT).

The MAT has space behind the berm for electrical equipment, including an optional electrical power center. The MAT target, provided by OPA, consists of a track, carrier, target lifter, battle effects simulator, and charging station. The "home" end of the MAT is the location of the electrical equipment and charging station. In most cases, place the home end closest to the engagement point for better protection. However, also consider training scenarios and the location of power. Refer to the standard Civil and Electrical detail drawings for additional details.

Range designers should refer to the Inspection Checklists provided in the RDG to ensure that all required items are included.

Civil/Siting

This section covers the Civil Engineering and Siting issues unique to this type of emplacement for all types of ranges. The sections below address the standard MAT; a separate paragraph at the end of the document addresses the ECPMT. Refer to the specific range section of the RDG for siting issues specific to a particular range.

Emplacement

The MAT emplacement includes a track bed, target protection berm, berm retaining wall, electrical equipment, and service road. The minimum horizontal curve allowed on a MAT is 152m (500ft). The MAT target carrier is required to be able to traverse a 10% grade. However, whenever possible limit the grade to 3% with a maximum of 5% to allow for use in adverse weather conditions. The last 40m (131ft) at each end must have a slope of less than 1%. A 3-meter area is provided at the home end for placing electrical equipment. See Civil Details for additional detail.

Drainage

Ensuring proper drainage is critical in the design and construction of target emplacements. Even though the electrical and target equipment is designed for outdoor installation, many of the issues with range targetry can be avoided with proper emplacement drainage. MAT berms are large structures that can affect drainage patterns causing damage in heavy rain events. Avoid placing the MAT across significant drainage features. The ground should slope away from the emplacement whenever possible; add swales as necessary to ensure positive drainage. Ensure proper compaction under the emplacement to avoid differential settlement. Drainage is especially critical on newly constructed ranges before vegetation is fully established.

Target Clearance

No obstruction may be present which interferes with travel of the target along the entire length either in the up or down position. Provide a minimum of 5.2m (17ft) clear space, in addition to the service road, from the face of the emplacement wall along the entire length of the MAT.

Configuration

The Civil Details and Electrical Details show the standard MAT emplacement configuration. The emplacement design supports the ballistic characteristics of armor, anti-armor, and low-hover helicopters. The emplacement does not provide protection from helicopter running and diving fire.

Wall Height

The front wall and berm must be high enough to protect the targetry equipment while still allowing target visibility from the firing position. The standard wall height is 1.53m (5ft), 1.83m (6ft) for aerial gunnery, measured from the top of the aggregate pavement. The height has been coordinated within the program as the minimum that hides both the electrical equipment and the targetry based on a relatively flat angle of fire from the shooter to the target, generally +/- 2 degrees.

Angle of Fire

The angle of fire (AOF) from the gun barrel to the target is a critical parameter on a range that affects the functionality in several ways. Certain range and weapon types have a limit on the allowable angle of fire, e.g. a Known Distance range limits the AOF to +/- 2 degrees. Refer to the installation trainers, applicable training manuals, and the RDG section for specific range types for additional information and guidance. In addition, the amount of the target that is visible to shooters can affect the ability to qualify, e.g. it is harder to qualify when only half of the target is visible. Finally, rounds can hit and damage targetry and electrical equipment on higher angles of fire.

The standard MAT emplacement with a 60-inch front wall and a 2-percent slope on the berm provides adequate protection for AOF of +/- two degrees. Greater angles require special design consideration. Higher negative angles may require increasing the front wall height, adjusting the slope of the berm to match the AOF, or some other method. Theoretically, the minimum wall height hides the electrical equipment, including the target arms and clamps, up to a -10° AOF, higher with the aviation wall height. In situations with a positive AOF, greater than 2 degrees, the berm itself begins to hide the target. Adjustments to the berm slope may be necessary.

On ranges where target engagement is from multiple points, the designer must coordinate closely with the installation and the targetry provider to determine the correct front wall height. The emplacement protection is also critical for aviation gunnery.

Wall Design

Typical retaining walls are designed using concrete gravity block or wood timbers and steel piles. Design the wall so that the top section is replaceable in case of damage. Filter fabric is normally required. The design of the MAT walls must take in consideration the stability of the

wall, including site-specific geotechnical conditions. The design must include overturning, sliding, and settling.

Berm Criteria

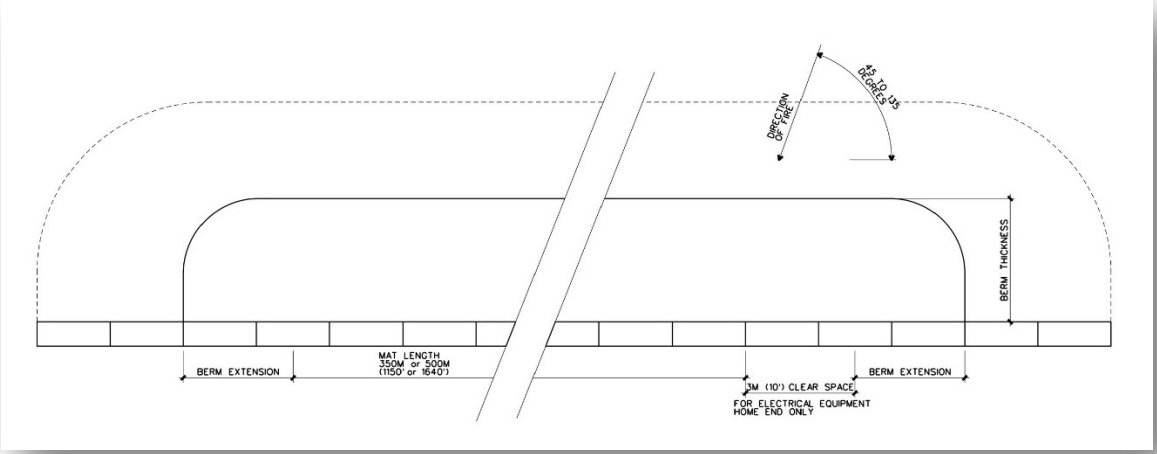
The Target Protection Design Curves in the RDG provide the recommended thickness for emplacement protective berms. The berm must protect the emplacement from all anticipated directions of fire. The berm should be thickest in the expected direction of fire. Use thinner berms to protect the emplacement from occasional directions of fire and ricochets.

Determine the berm thicknesses based on projectile type, soil compaction, and the in-place soil density. However, the designer must also coordinate with the range trainer or user to determine the appropriate berm thickness for each target, since individual target siting may dictate added target protection. For example, when a target is in the beaten zone of another target. At a minimum, berm widths will be at least 4 feet to facilitate ease of maintenance.

Historical experience shows that, under normal usage, well-compacted berms, designed with the recommended widths require maintenance on 6-month cycles. Heavily used ranges and individual targets often require increased berm thicknesses.

Direction of Fire

The direction of fire (DOF) is the horizontal angle to the target. The standard MAT berm configuration provides protection for DOF up to 45 degrees from perpendicular. Where angles of fire are less than that, the berm extension can be reduced, similar the SAT. Delete the berm extension entirely on an end from which the MAT is not engaged.



MAT Emplacement (Not to Scale)

Service Road/Track Bed

The area behind the berm includes a 5.2m (17ft) wide area for the MAT track, lifter, and silhouette and a 3m (10ft) wide service road. Design the track bed and service road for local

conditions per the site-specific geotechnical report. Typically, the top 300mm (1ft) of the subgrade is compacted as specified in ASTM D1557, Method D, 90-percent laboratory maximum dry density for cohesive soils and 95-percent laboratory maximum dry density for cohesionless soils. Slope the top of the subgrade away from the protective wall to facilitate drainage. Place an additional 150mm (6in) aggregate pavement above the subgrade; use filter fabric when required. The final subgrade and aggregate pavement should not show deviations greater than 13mm (1/2in) when tested with a 3.7m (12ft) straightedge after compaction. The targetry equipment contractor is responsible for all construction above aggregate subgrade including anchoring for the specific targetry system.

REPRESENTATIVE MAT PHOTOS

Electrical/Communications

This section documents the electrical/communication requirements and equipment installed in a MAT emplacement. It primarily focuses on standard targets with hardwired power and data; a paragraph below has information on battery-operated targets. The Downrange Power & Data Distribution Sections of the RDG describe requirements for downrange power distribution, data networks, transformers, trenching, etc. Use those sections in addition this document to design a complete range. In addition, since some range types have power and data requirements that differ from the standard, refer to the specific range section for details.

Target Emplacement Wall Configuration

The figure below represents a standard MAT wall configuration. The electrical equipment required in a typical MAT emplacement can include:

1) Load Center (LC),

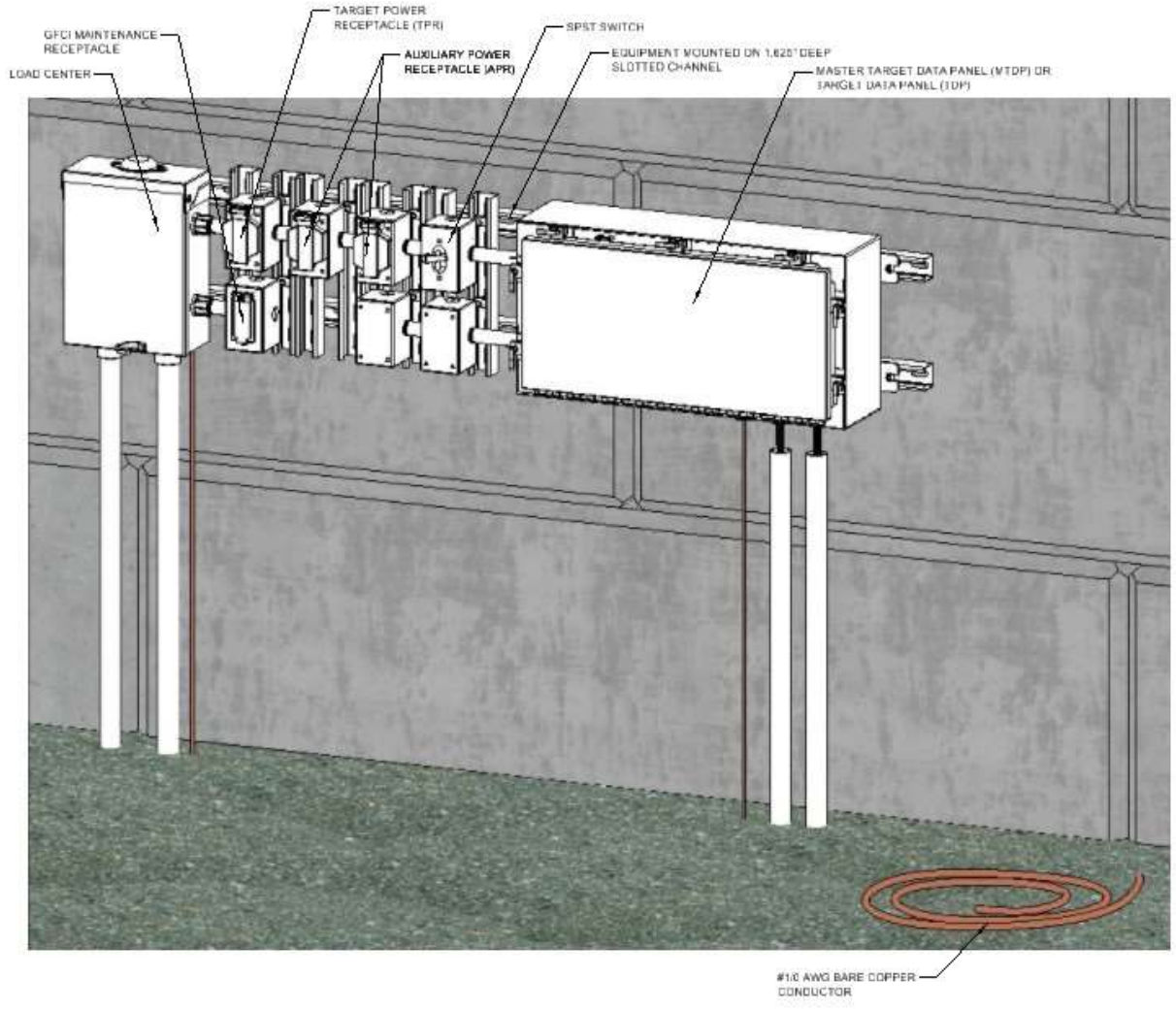
2) Target Power Receptacle (TPR),

3) Auxiliary Power Receptacle(s) (APR),

4) GFCI Maintenance Receptacle (MR), and

5) Data Enclosure (MTDP or TDP).

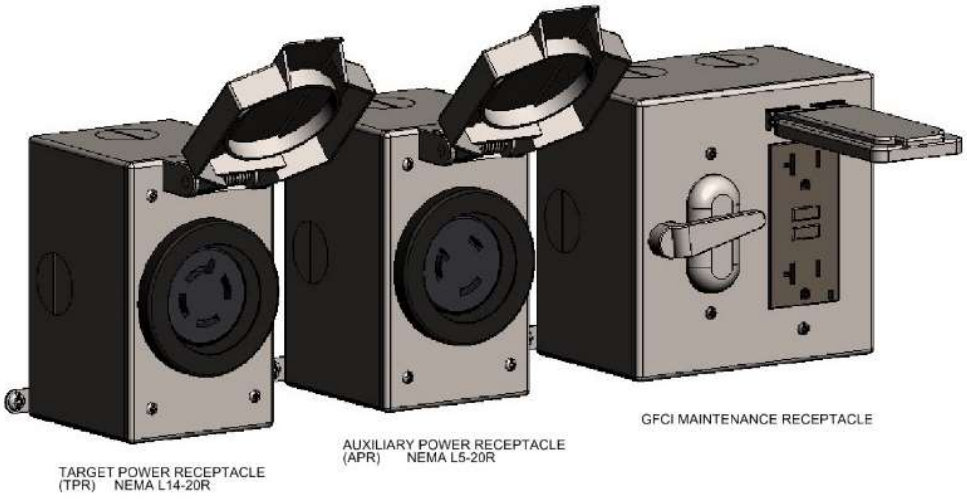
The number and size of the boxes and outlets can vary dependent on the type of MAT and particular range. Mount all boxes and receptacles on slotted strut channel attached to the front wall of the emplacement**. All installed equipment must be a minimum of two inches below the top of the emplacement wall to minimize damage during range use**; preferably lower, see Detail Drawing. The associated wiring and conduits are detailed in other sections of the RDG.



REPRESENTATIVE MAT ELEVATION DRAWING (NOT TO SCALE)

Standard Target Interface

Power is supplied to the target through a cord and plug connection. The target emplacement includes a standard 120/240V **Target Power Receptacle (TPR)**, supplied power via the **Load Center**. There is also a minimum of one - 120V **Auxiliary Power Receptacle (APR)** for additional devices or training aids. Thermal blankets are the most common devices that use this power outlet. Target Power Receptacles and Auxiliary Power Receptacles must be equipped with a waterproof enclosure approved for use with the power plug inserted and unattended, according to NEC 406.8(B) (2). The **GFCI Maintenance Receptacle** is not intended to be used for any unattended devices or training aids. The figure below shows emplacement outlet configurations.



TARGET POWER RECEPTACLES (NOT TO SCALE)

The range data infrastructure consists of data cables installed to the target emplacement and properly terminated inside the target emplacement data enclosures; called the **Master Target Data Panel (MTDP) or Target Data Panel (TDP)**. The MTDP and TDP must be rated NEMA 4, 4X, or 6P depending on environmental conditions. The MTDP/TDP contains the data cable splicing and terminations and the electronics for local target operation. The MTDP and TDP provides space for OPA procured and installed equipment. Target and training device communication is accomplished by this equipment installed inside these data enclosures. The target mechanism installer will connect to the data cables inside these enclosures during the installation of the targets. All networking equipment will be provided with the target mechanism when the target mechanism is purchased. OPA equipment is provided by others and not the MILCON contractor. Refer to the MTDP/TDP details for additional information.

120-volt power is provided in the MTDP/TDP for the OPA installed equipment. The MTDP/TDP and the GFCI maintenance receptacle may utilize the same power circuit, but the MTDP/TDP equipment must be wired ahead to minimize nuisance tripping. 120-volt power is

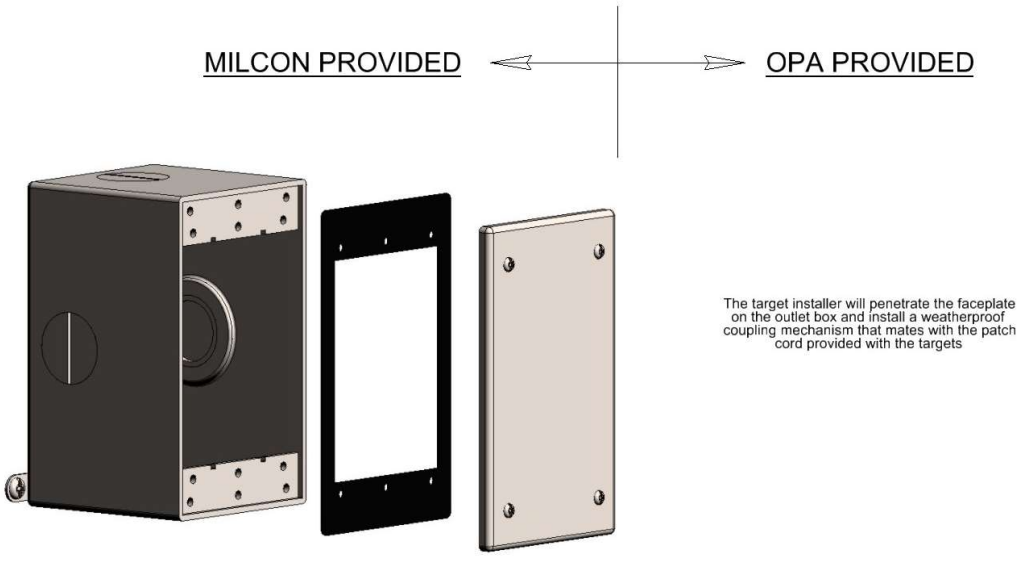
routed through a single pole single throw (SPST) switch adjacent to the MTDP/TDP to allow power to devices installed in the data enclosures to be reset without having to open the NEMA 4 enclosure.

EMPLACEMENT TYPE	POWER FEED TYPE	PEAK	STATIC LOAD	DESIGN LOAD
MAT with Thermal Blanket	120/240VAC Single Phase	3.8kVA during system charging.	100VA	3.8kVA
				Total Design Load 3.8kVA

MAT Emplacement Power Table

Target Data Connection

All automated targets are connected to the data cable infrastructure through copper patch cables provided by the target vendor. The interface point between the facility infrastructure and the target installation occurs through the faceplate in the weatherproof outlet box installed immediately adjacent to the MTDP or TDP enclosure. The MILCON installation includes the weatherproof box, sealing gasket, and solid faceplate. The target installer will penetrate the faceplate on the outlet box and install a weatherproof coupling mechanism that mates with the patch cord provided with the targets.



Target Data Connection

Conduit and Cable Fittings

All penetrations into the MTDP or TDP must be made with fittings approved for use with a NEMA 4, 4X or 6P enclosure. Non-compliance with this requirement will result in equipment failure. The standard electrical detail drawings in the RDG illustrate the preferred sealing method. **Foam filled conduits are not acceptable.** The MAT load center only requires a NEMA 3R rated enclosure. Provide fittings approved for use with a NEMA 3R enclosure for connection to the load center.

Routing

All conduits and/or cables should enter and exit from the side or rear of the emplacement. This cable routing helps to minimize damage to the cables from range operations and maintenance crews performing berm repair.

Grounding

Grounding is required for safety at each downrange emplacement or equipment location. Install a 19mm (3/4 in) by 3,050mm (10ft) copper-clad steel ground rod to a depth of 305mm (1 ft) below finished grade at each emplacement or equipment location. Connect the MTDP/TDP and load center equipment to the emplacement's single ground rod with a #6 AWG bare copper conductor using exothermic welded or mechanical connections (where accessible). Bond all data cable armor or shields to the ground bar in the MTDP/TDP. The design includes a 4,572 mm (15') coil of #1/0 AWG bare copper wire for the target installer to ground the target track.

Surge Suppression

Provide surge protective devices (SPD) in the load center of all target emplacements. The surge suppression for the data communication cables will be provided by the target vendor during the installation of targets.

Environmental Limits

The temperature and humidity limits for electronic equipment are as follows:

- Non-operating and operating temperature: -34°C (-30°F) to 60°C (140°F).
- Humidity: 5% to 95% RH (non-condensing).

Entry Control Point Moving Target (ECPMT)

The ECPMT, or Serpentine Mover, has a different electrical interface than the standard MAT. It requires a 30-amp, 120/240 circuit with a L14-30R receptacle for the ECPMT charging station. The charging station is placed behind a protective berm at the downrange end of the track. Refer to the Convoy Live Fire Range detail drawings for additional details.

The ECPMT is used to simulate a vehicle entering an access control point. The vehicle has SIT targets inside to simulate occupants and a hit sensor to simulate an engine disabling shot. The track and mechanism are protected using concrete walls and berms. A Line of Sight analysis

must be done to ensure that the track and mechanism are protected from all firing positions while the target is visible along the entire length. A berm with retaining wall is placed at the far end of the track to protect the electrical tie-in and charging station. The track has a nominal radius of 7.62m (25ft) and a sweep of 26 degrees.

REPRESENTATIVE ECPMT PHOTOS