ARL-TN-1121 • MAY 2022

DEVCOM ARMY RESEARCH LABORATORY

The Evolution of Target Mounting Fixtures Used for Ballistic Testing at Experimental Facility 14

by Allen Ducote

NOTICES

Disclaimers

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of manufacturer's or trade names does not constitute an official endorsement or approval of the use thereof.

Destroy this report when it is no longer needed. Do not return it to the originator.

ARL-TN-1121 ● MAY 2022

The Evolution of Target Mounting Fixtures used for Ballistic Testing at Experimental Facility 14

Allen Ducote
DEVCOM Army Research Laboratory

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED (From - To)
May 2022	Technical Note	1–26 April 2022

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The Evolution of Target Mounting Fixtures used for Ballistic Testing at Experimental Facility 14	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)	5d. PROJECT NUMBER
Allen Ducote	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
DEVCOM Army Research Laboratory ATTN: FCDD-RLW-PE Aberdeen Proving Ground, MD 21005	ARL-TN-1121

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release: distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report highlights an assortment of flexible, rigid target-mounting structures that accommodate the constant adjustments needed for satisfying sophisticated test requirements. The versatile arrangements described in this report are repetitively exercised at Experimental Facility 14 to support testing.

15. SUBJECT TERMS

original target stand, The Ram, 4 degrees of freedom, 4DOF, testing, Terminal Effects

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Allen Ducote
Unclassified	Unclassified	Unclassified	UU	15	19b. TELEPHONE NUMBER (Include area code) (410) 278-3061

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Contents

List of Figures

Acknowledgements

The author thanks David Schall, Thomas Quigg, Thomas O'Connor, Nathan Sturgill, Thomas Nellenbach, and Stephen Mink for their contributions to the information presented in this report, and Matt Burkins and Dan Hornbaker for their technical competence and expertise. The author also thanks Matt Wagner, Chris Porter, Curtis Morris, and Paul Chamberlin from the Aberdeen Test Center for assembling a full data package with drawings and tools of the design, fabrication, and completion of the 4DOF target fixture. Finally, I thank Eric Klier and Pat Swoboda for understanding the needs of the facility to acquire such a unique fixture and fund it for our benefit.

1. Introduction

On a gun range, site preparation and versatility are significant in conducting ballistic experiments. Aligning different target configurations while maintaining stability throughout testing is an infinite challenge. Various test results originate from specific guidelines to achieve solutions derived from target positioning. Occasionally, the positioning of the target may require getting attached to a unique structure or how it is fabricated for an experiment. The easiest way to cover that spectrum is to create a flexible, rigid structure that will accommodate the constant adjustments needed for satisfying multiple test requirements. The following showcases the versatile arrangements at Experimental Facility (EF) 14 that accommodate a wide variety of tests.

2. Target Stand

Figure 1 shows the original target stand, an adjustable table with vertical adjustments that range from 6 to 55 inches. The posts are all drilled with holes, on 3-inch centers, for a 1-inch pin that can retain shims. The tabletop is slotted from side to side, enabling adjustments for The Ram or other obliquity stands, which allow compound obliquity (combining azimuth and elevation) targets. Figure 2 shows shim placement for table alignment.

Fig. 1 Original target stand

Fig. 2 Shim placement for target alignment

Figure 3 shows the shim stock is made from half-inch rolled homogeneous armor steel plate. A 1-inch offset hole is drilled in the plate, designating the appropriate size shim by measuring the distance from the edge of the hole to the edge of the plate. Each set of plates is made in quarter-inch increments to cover the range that corresponds with the hole patterns drilled in the target stand's corner posts. Carefully choose the proper sized shim that lines up the target's hit point with the gun barrel's line of sight.

Fig. 3 Shim layout

3. The Ram

Figure 4 shows The Ram mounted to the tabletop of the test stand and properly spaced to affix a target or mounting plate. The target is mounted and then set to the proper obliquity for testing using a forklift, a sling (properly rated for the estimated overall weight of the moveable parts), a battery-powered impact gun with socket, and three operators. A forklift is also used to adjust the table to match the shot line of the gun with the vertical and horizontal hit point on the target. The horizontal corrections made with the forklift can get quite challenging when trying to maneuver the stand between precise hit points. These procedures often require assistance from several personnel directing adjustments from several sides and can be time consuming.

Fig. 4 Target assembly on The Ram

4. 4DOF Target Stand

To make the alignment process more efficient, EF14 acquired an additional system for mounting targets: a new 4 degrees of freedom (4DOF) target stand. The 4DOF target stand is a universal target fixture, made by Aberdeen Test Center, that can be handled by two people, offers complex positioning of compound angles, and easily travels in all spatial directions. This target fixture rests on a Presto XL48-60 electric scissor lift that is rated for 6000 lb, is powered by 120 V, has a hand-controlled pendant for vertical travel, and is manually rolled horizontally on large, lubricated bearings. Accessing angles from 0° to 90° is done by simply loosening a couple of bolts that tighten around trunnions while the frame tilts to the desired measured pitch as determined with a digital inclinometer. Currently, the 4DOF supplements The Ram when program requirements allow. Figures 5 and 6 show the front and back, respectively, of the 4DOF target stand.

Fig. 5 Front view of the new 4DOF target stand

Fig. 6 Rear view of the new 4DOF target stand

The window frame located on the face of the stand is where targets are fastened, as shown in Fig. 5. It conveniently accepts different sized targets by using a fabricated steel carrier plate that matches the hole patterns of the stand's framework. The steps to mounting a target are simple: Place the target on the fabricated ledge and tilt backward until it is flush and lined up with the bolting holes of the window frame. This process is easily done with two people. Once the target is mounted to the stand, one person sights the gun to the hit point while the other sets the target to its precise point with the handheld pendant.

5. Conclusion

Target stands at EF14 have evolved to keep pace with increasing test sophistication. Additionally, the techniques used by EF14 personnel have enabled testing to become more efficient, versatile, and safer through improved target mounting and fixturing.

List of Symbols, Abbreviations, and Acronyms

4DOF	4 degrees of freedom
EF	Experimental Facility

1 (PDF)	DEFENSE TECHNICAL INFORMATION CTR DTIC OCA
1 (PDF)	DEVCOM ARL FCDD RLD DCI TECH LIB
1 (PDF)	DEVCOM ARL FCDD RLW TE A DUCOTE