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30 x 173mm TPDS-T Development

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- **Project Objectives/Summary**
- **Cartridge Concept**
- **Cartridge Development**
- **Testing Summary**
- **Go Forward Plans**



Project Objective: Develop a 30 x 173mm TPDS-T training cartridge (MK317) that provides a ballistic match to the 30 x 173mm MK258 and MK268 APFSDS-T tactical cartridges. Deliver 1200 rounds to the USMC for qualification testing.

Project Summary:

- Evaluate projectile designs for function, ballistic match and producibility
- Evaluate tracer designs for retention, visibility and burn time
- Testing to refine and verify design
- Manufacture and deliver 1200 rounds to the USMC for MK317 qualification testing

30mm TPDS-T Design Requirements



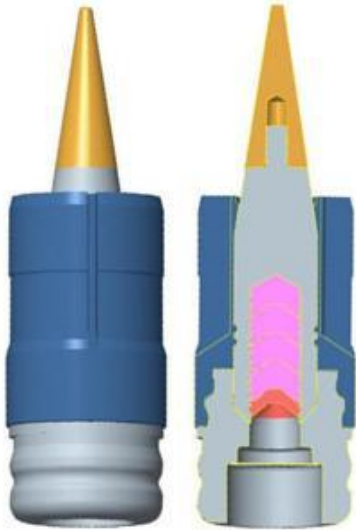
- **Muzzle Velocity** 1615 ± 15 m/s (+21C)
SD ≤ 12 mps (-54C/+71C)
- **Chamber Pressure** X-bar = 61.4 kpsi (+21C)
X-bar + 3SD = 66.6 kpsi (-54C/+71C)
- **Action Time** 5.3 msec (+21C/+71C)
7.7 msec (-54C)
8 msec max individual
- **Trace** 3.5 sec min (all temps)
Visible against light background
- **Dispersion** 0.40 x 0.40 milliradian (+21C @1000 inches)
- **Max Range** 8000 meters
- **Ballistic match to MK258/MK268 from 1500 to 2000 meter range**
- **Existing qualified ignition train**

30mm TPDS-T Cartridge Concept



- **M910E1 (25mm) projectile scaled to 30mm**
 - Aluminum pusher
 - Steel sub-projectile core w/tracer
 - Aluminum press-fit nose
 - Plastic molded sabot
- **Existing qualified 30x173 ignition system**
 - M36A2 primer
 - Flashtube assembly (IB52 pellets)
 - AFP-001 propellant
 - Aluminum cartridge case

30mm TPDS-T Projectile Baseline Concept



4-Petal Molded Sabot



M910E1 Steel Sub-Projectile with Tracer

- M910E1 steel sub-projectile with aluminum nose and tracer
- Solid aluminum pusher
- 4-petal (slot) molded sabot (20% glass filled nylon 6/6)
 - Different rotating band diameters and tapers were evaluated



Baseline Pusher



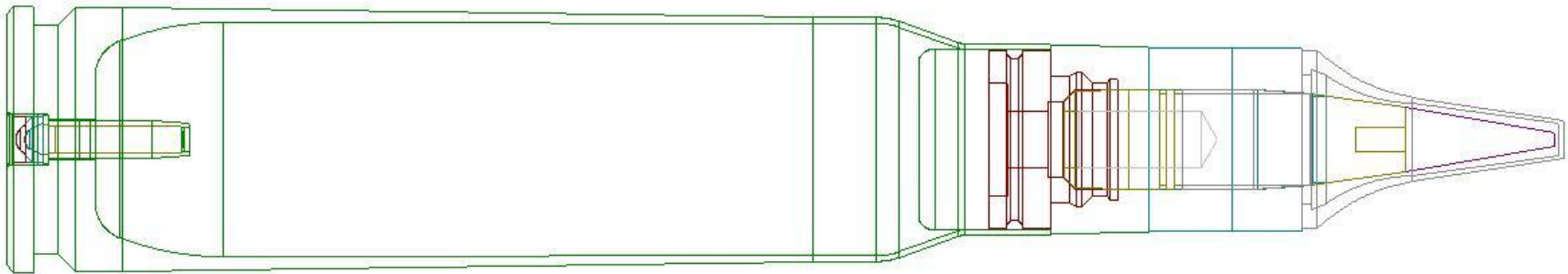
Scalloped 3-Petal Sabot



Segmented Pusher

- Stress analysis of scalloped 3-petal sabot design said that it would survive in-bore loads and discard but lower risk 4-petal design was incorporated.
- Segmented pusher yielded higher dispersion than solid pusher. This concept may be pursued in follow-on design optimization work.

Preliminary PRODAS model of cartridge as analyzed by Arrow Tech



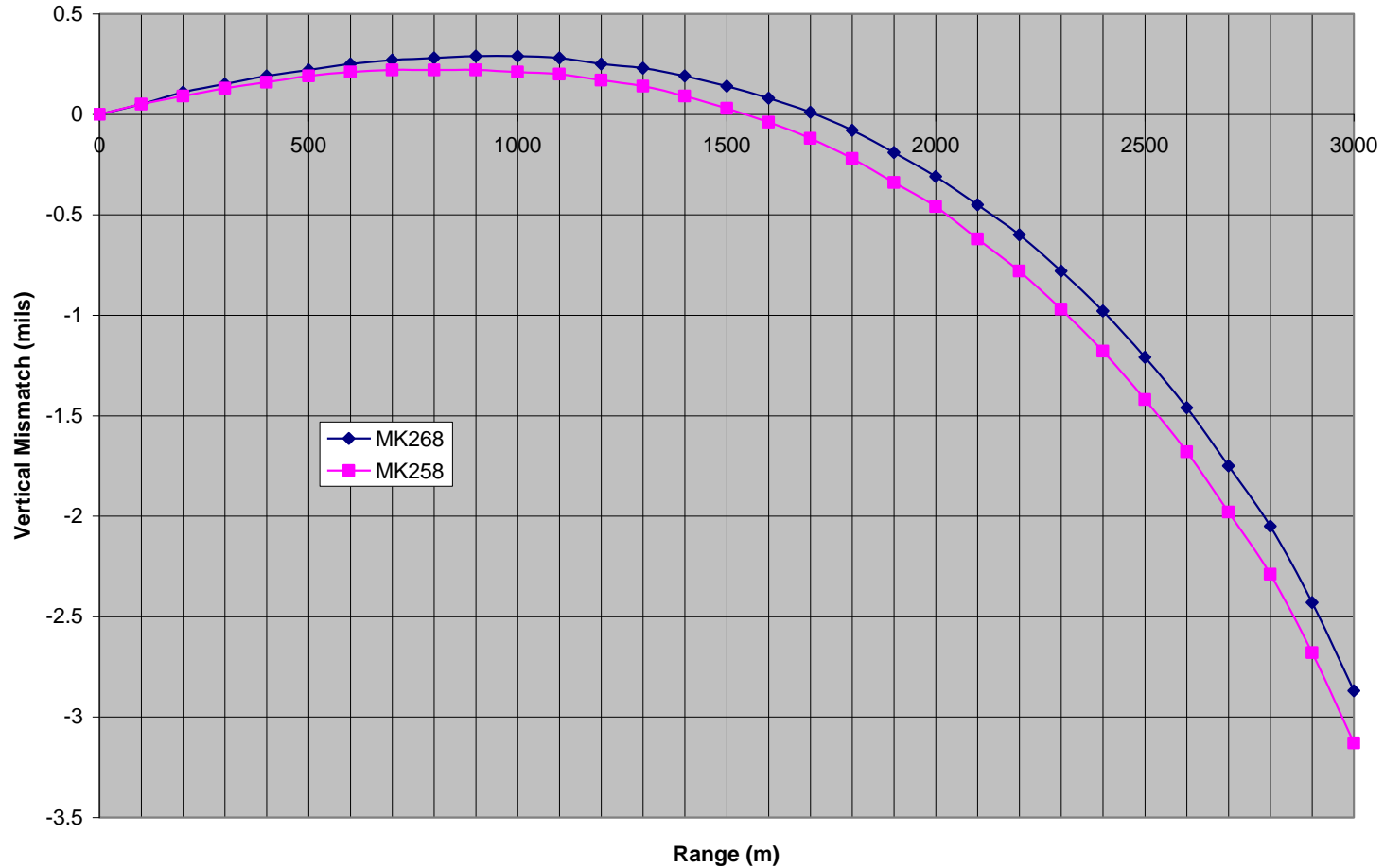
	Mass, gm.	Transverse Inertia, gm-cm ²	Axial Inertia, gm-cm ²	CG from Nose, cm.	Diameter, cm.
Projectile	123.5	497.5	93.6	6.06	
Sub-projectile w/tracer	66.3	170.3	21.5	5.24	1.62
Sub-projectile after burnout	62	157.4	21	5.16	

Table 1. Physical Properties of M910E1 (TPDS-T) Variant

1600 m/s Velocity Required for Ballistic Match



Vertical Mismatch 30mm TPDS-T at 1600 m/s vs MK258 and MK268 APFSDS-T USMC EFV



AFP-001 Propellant Could Not Achieve Velocity

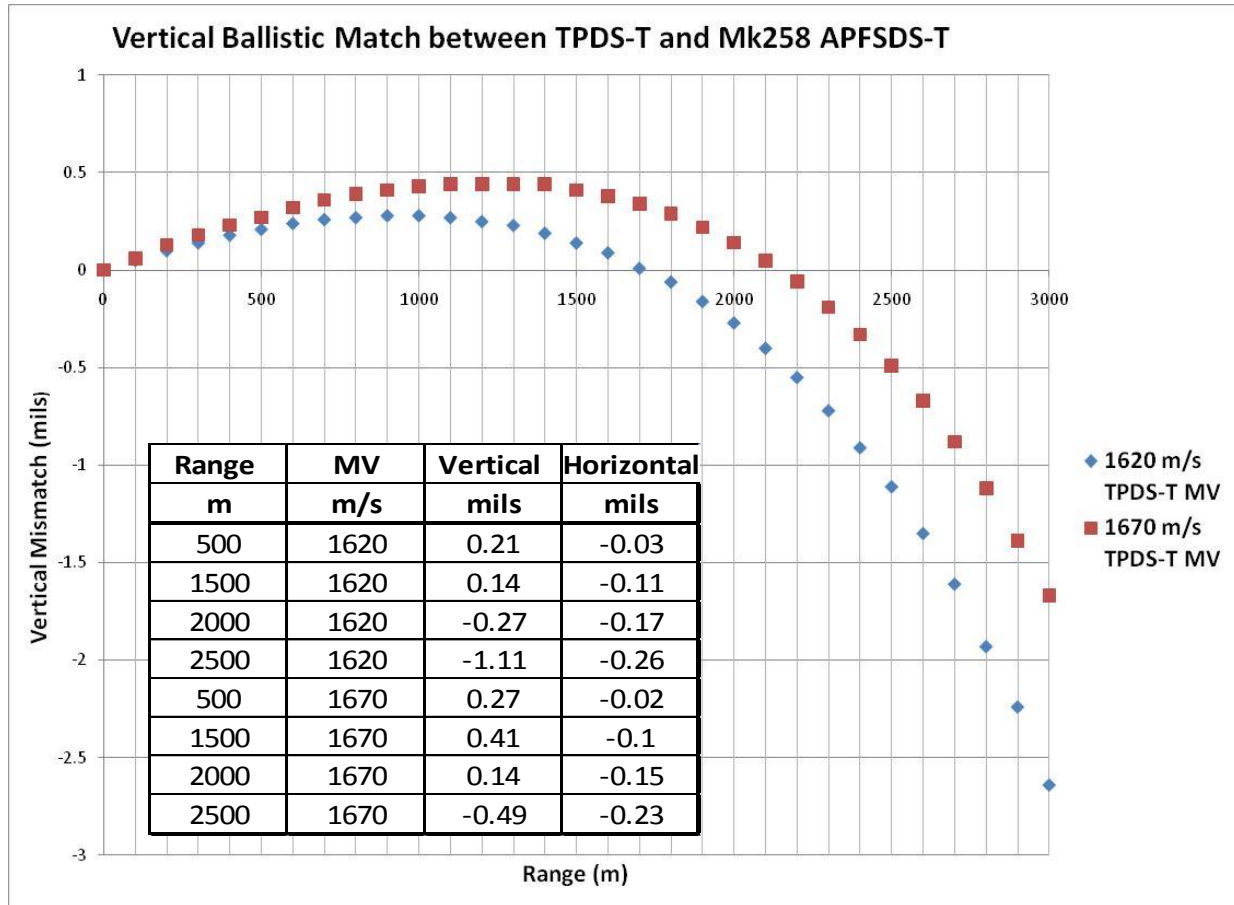


- Initial interior ballistic modeling of AFP-001 indicated that design goal of 1600 m/sec should be achievable.

Code Used	Projectile Weight Grams	Chamber Pressure Kpsi	Predicted Muzzle Velocity, m/s
PRODAS, Baer-Frankle model	128	60.9	1570
CONPRESS	122	58	1600

- Charge establishment testing was only able to achieve a max velocity of 1154 m/sec at 19.6 Kpsi case mouth pressure
- AFP-001 burn rate was too slow to develop adequate pressure with a 122 – 126 gram projectile.

Refined Model for Best Match to 2000 Meters



1620 m/sec muzzle velocity provided the best overall ballistic match to 2000 meters.

RP-910 Propellant Provided Velocity Solution



- A higher order interior ballistics analysis was conducted on alternate propellants using IBHVG-2.
- Radford RP-910, with tailoring of grain geometries, was recommended as a viable solution based upon the modeling.

Charge Weight	Velocity	Pressure
125 grams	1527 m/s	59.8 Kpsi
140 grams	1590 m/s	61.5 Kpsi
150 grams	1624 m/s	61.5 Kpsi

- Initial results still had lower velocity than model but pressures were also lower.
- Final charge establishment test results met the velocity design requirements with margin.

Group No.	Charge Weight, grams	Quantity	Muzzle Velocity, m/s	Pressure, Kpsi	Action Time, msec	Dispersion horizontal, mils	Dispersion vertical, mils
1	145	10	1571	41.2	3.44	0.33	0.27
2	151	10	1619	45.4	3.18	0.18	0.19
3	157	8	1670	50.3	3.04	0.33	0.31

Temp	Velocity	SD	Pressure	SD	DISP X	DISP Y	Trace Time	SD
21C	1630 m/s	6.4	46.6 Kpsi	0.7	0.42	0.55	-	-
-25F	-	-	-	-	-	-	7.11 sec	0.59
-65F	-	-	-	-	-	-	7.33 sec	0.58

LAT results for the first sub-lot met most of the design requirements.

- Velocity above target
- Pressure has significant margin
- Trace times were very good at extreme temperatures
- Dispersion slightly exceeded design requirements
- Autogun F&C had no metal parts security issues



- **Cartridge Weight (422 grams)**
- **Projectile (123 grams)**
 - Aluminum pusher
 - Steel sub-projectile core w/tracer
 - Aluminum press-fit nose
 - Plastic molded sabot
- **Ignition system**
 - M36A2 primer
 - Flashtube assembly (IB52 pellets)
 - RP-910 propellant (151 grams)
 - Aluminum cartridge case

ATK stands ready with our remaining 30mm TPDS-T hardware to support the USMC qualification effort whenever it resumes.

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