Environmental Security Technology Certification Program

Final Report

Powder Coating for Small-Arms Bullet Tip Identification

TACOM-ARDEC Picatinny Arsenal

July 26, 2002

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List of Acronyms

LCAAP	Lake City Army Ammunition Plant
VOC	Volatile Organic Compound
ODC	Ozone Depleting Chemical
HAPs	Hazardous Air Pollutants
TRI	Toxic Release Inventory
GOCO	Government Owned, Contractor Operated
CTC	Concurrent Technologies Corporation
M62	7.62 mm Tracer Bullet
PSI	Pounds per Square Inch
ECAM	Environmental Cost Analysis Methodology
PPM	Parts per Minute
OEM	Original Equipment Manufacture
AMC	Army Materiel Command
EPA	Environmental Protection Agency
ESTCP	Environmental Security Technology Certification Program
SARA	Superfund Amendments and Reauthorization Act OF 1986
IWTP	Industrial Waste Treatment Plant
CFR	Code of Federal Regulations
ATK	Alliant Techsystems
OSHA	Occupational Safety and Health Administration

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1. Introduction

1.1 Background Information

Currently, all small caliber tracer and incendiary ammunition is produced at the Lake City Army Ammunition Plant (LCAAP) located in Independence Missouri and is identified by applying a low Volatile Organic Compound (VOC) paint to the projectile tip. This marking system is designed to aid soldiers and Marines using the ammunition in identifying the type of round they employ in a combat or training mission. The paint, depending on caliber, is applied either by dipping or by spraying the projectile tip in one of the final cartridge assembly steps. There are several inherent problems associated with this operation. First, the surface of the bullet must be free of contamination and particulates in order for the paint to have maximum adhesion and to withstand subsequent handling operations. Currently either methyl chloroform, which is an Ozone Depleting Chemical (ODC) or acetone, which is a VOC, is currently used to clean the bullet surface prior to painting. Second, the process is very inefficient. For example, the spray application process used in the high speed manufacturing of 5.56mm ammunition is only 5-10 % efficient. The over-spray is captured in a filter hood, which is vented through the roof of the manufacturing building to the atmosphere, thus releasing the VOCs into the air. Paint passing through the filters and into the vent stack cures to the sides of the stack eventually clogging the vent. The effluent VOCs are then vented into the manufacturing area, rather than up the stack, creating a hazardous work environment. Nor is the alternate dip coating process used to coat the 7.62mm and Caliber .50 projectile tips performed in an environmentally controlled environment. The dip process is sensitive to temperature and humidity along with paint viscosity, paint level in the reservoir and equipment setup. The dip process uses ethyl acetate for pre-cleaning. VOCs enter into the work environments like in the spraying operation for the 5.56-mm cartridges. The dip coating process is also inefficient and costly, and it is difficult to maintain consistency in workmanship. Additionally, all of the waste streams (unused paint and dry paint residue) must be treated as toxic waste.

1.2 Official DoD Requirement Statement(s)

Need No. A(3.2.d)

Need Description: Manufacture, overhaul and maintenance of Army equipment requires the use of non-CARC coatings that have a high VOC content, and contain hazardous air pollutants (HAPs), Toxic Release Inventory (TRI) chemicals and heavy metals. Need to develop alternate materials that will be used as marking, silk screening, ammunition, high-temperature and low-detectability stealth coatings.

The current painting system at LCAAP uses a positive VOC content (approximately 3.5 lbs/gal) coating. As a result of the application process in the 5.56-mm operation, most of the paint is wasted as over-spray and collected in filters and the existing paint hoods. This waste must be disposed of in accordance with toxic waste regulations. The 7.62 mm and Caliber .50 painting operations also use the positive VOC content paint but employ a dipping process. This process is more efficient than the spraying process but still contributes to the total amount of toxic wastes the plant generates.

1.3 Objectives of the Demonstration

The goal of this project was to determine the feasibility of implementing an improved, environmentally sound methodology, for applying bullet tip identification paint in an economical and efficient manner. By replacing the current system with powder coating technology, the high VOC paint would be eliminated and replaced with powder paints (no solvents). The nature of the technology would allow complete recycling of the over-spray, thereby increasing efficiency close to 100%. In the event that any waste powder paint must be disposed of, the waste (pre-cured form) would be non-toxic, allowing the use of non-hazardous disposal operations. Powder coat application technology is versatile, allowing modifications from a baseline design to be employed throughout the plant in the different types of painting operations with minimal impact to the existing manufacturing operations.

Ideally, if the proposed powder paint system were applied to the projectiles immediately after bullet assembly or in place of the existing system by using an alternate application technology, the proposed painting operation can become part of the assembly operation and be controlled by the operators already in place. Thus, successful implementation of the technology provides an opportunity to eliminate/reduce labor costs as well as overall plants maintenance costs. Identification and implementation of a more efficient and environmentally conscious paint and application method would eliminate hazardous materials, and eliminate their disposal and treatment costs. The anticipated benefits include:

- Elimination of the current high cost of liquid based paints with its associated high percentage of waste
- Elimination of the current VOC-emitting painting process
- Identification of environmentally friendly solvents and lubrication for subsequent production operations.

- Increased paint adhesion as a result of powder coating technology.

1.4 Regulatory Issues

Two regulatory directives govern the reduction of LCAAP pollution.
On the federal level, guidance in this area is primarily determined by the TRI, which uses the following as reference:

AMC Pollution Prevention Plan
United States Environmental Protection Agency (EPA) 40 CFR
The Pollution Prevention Act of 1990
SARA Title III Form R
Clean Air Act of 1990
Executive Order 12856

On the state level, the Missouri State EPA regulations under 10 CSR and EPA Facility Pollution Prevention Guide; Document no. EPA/600-92/088 are the relevant directives.

LCAAP has met the federal and state guidelines for pollution prevention each year since they were enacted. However, the continual reduction of the TRI at LCAAP is a goal worthy of pursuit since each successive year finds stricter goals for the expected waste stream as dictated by evolving federal and state regulations.

In the cartridge tip identification process, the main pollutants are VOCs discharged into the atmosphere as a result of paint solvent flash-off and drying, and paint sludge, which is produced due to the inefficiency of the process. This waste is processed in one of two ways. Paint residue conveyed through the waste water system is processed through the plant's Industrial Waste Treatment Plant (IWTP). Filters and rags containing paint residue are disposed of by removing them off-plant to a toxic waste landfill. Appropriate environmental statutes regulate each of these systems.

1.5 Stakeholder/End-User Issues

The main stakeholder for this technology is the ammunition manufacturing plant, i.e. LCAAP, located in Independence, Missouri. The important issues for this facility include:

Decreased environmental exposure to the Army Toxic Release Inventory (TRI)

- Ease of implementation and operation of the proposed technology
- Equal or better paint finish quality
- No effect on ballistic performance, production performance or quality control systems.

For the depot representative and the end user, i.e. the soldier or Marine, the implementation of the proposed system must be transparent to the entire system. Specifically:

- The identification color scheme must be equivalent to the current scheme.
- No impact to weapon functioning
- Paint adhesion equal to or better than the current technology

1.6 Previous Testing of the Technology

Powder coating painting is a relatively mature technology that was originally developed in the 1960s as an alternative to liquid coatings. The applications of this technology in industrial coating are numerous – automotive, aircraft, marine, household appliance, sporting goods, and computers etc. The reasons for this growth are evident in that high quality finishes are obtained relatively easily while maintaining production line economy and environmental compliance. Virtually every industry that has a need to apply a coating for either corrosion resistance, aesthetic value or both has experimented with or is now employing powder coating. Although, powder coating has not been employed to identify small caliber ammunition, the extension of the technology to this specific area is not strained. The technological challenges in this program are similar with respect to every area powder painting has been successfully employed. For specific examples of successful implementation of powder coating, sources such as the Powder Coating Institute should be consulted at www.powdercoating.org.

Previous projects (Task N.110 and N.212) have shown that powder coating is a technically feasible alternative to wet spray application of paint for bullet tip identification at LCAAP. It was also shown that the process of curing the powder at an elevated temperature did not compromise the energetic mixtures inside the cartridges. Finally, laboratory test results indicated that the powder coating was able to meet the durability criteria and passed test firing.

2. Technology Description

2.1 Background and Applications

The powder coating process was originally developed in the late 1960s in an attempt to obtain a more durable coating technology and as an alternate to liquid coatings. What differentiates powder coating from familiar traditional liquid coatings is the lack of a solvent base in the preparation and application of powder materials. With no solvent content, powder coatings do not emit toxic gases when applied or cured. Powder coatings are composed of finely ground plastic particles consisting of pigments, resins, binders, fillers and hardeners. When exposed to heat, these plastic particles melt to form a continuous film of high durability and chemical resistance. Powder materials may be thermoplastic or thermoset. Thermoplastic powders do not chemically react in the cure phase. They are typically used for functional applications and applied in thick films (6 –

12 mils). The main advantage to thermoplastic is impact resistance and/or chemical resistance. Thermoset coatings are applied and then cured at a certain temperature for a certain time. The cure process causes crosslinking to take place, changing the powder into a continuous film that will not re-melt. Thermoset coatings are typically thinner (1 – 5 mils) and are usually applied to functional and decorative applications.

Most powder coatings are applied with electrostatic spray equipment. A charging system for electrostatic application has a voltage source that generates current through a voltage cable and carries it to the powder gun tip. The powder delivery system uses a pump to transport powder to the gun and out of the gun tip using compressed air. As the powder passes through the electrostatic field, it picks up a charge and is attracted to the grounded substrate. Following application, the part is conveyed to the proximity of a heat source for the curing of the powder. Under the heat exposure, the powder melts and becomes fully cured on the substrate. The general concept of powder coating using an electrostatic spray application system requires the following components: a pretreatment method to prepare the part surface for coating, an application system to apply the powder, a booth with recovery system to contain the process, a cure device to cross-link the material and a conveyor system to move the part between these systems.

Liquid paints (either high or low VOC) and powder paints share many similarities. The purpose of a coating is to form a plastic film over a substrate. To do so effectively, the coating must flow over the surface, cure in place and must attach itself to the surface with sufficient adhesion to be durable enough for the in-use criteria of the coated substrate. Generally, although there are exceptions, the best possible flow that results in a smooth consistent finish and the strongest adhesion is desirable.

Liquid and powders can also be similar in their chemistry of the paint type. Liquids are available in a wide variety of chemistries including thermosets, epoxies, urethanes, polyesters, acrylics, etc. These liquids are usually supplied as a two or three component system; a base resin (the actual plastic coating); a curing agent; and a cross-linking agent, is sometimes added. These components are mixed and must be applied before the curing agent decreases viscosity as crosslinking takes place. In general, the liquid paints incorporate some amount of carrier and /or solvent materials that must volatize and escape the polymer film while it is curing.

Powder materials are dry (resin only) and thus require no solvents or wet chemical carriers to be applied to the substrate. The thermoset powders are composed of two components, resin and curing agent, which are blended together and then quickly frozen. The thermoset material is then ground into the powder form. The powder materials also contain blocking agents that prevent chain–extensions from taking place until the materials reach an elevated temperature. The end result is that each individual particle of powder is, within itself, a complete paint system with pigments, resin and curing agent in the appropriate proportion. This aspect of the technology allows similar paint chemistries in both powder coatings and traditional liquid paints. The powder particles are sufficiently small that they can be fluidized and sprayed in a similar manner to liquids. However, for the powders to adhere to the substrate, the surface generally requires an

electro-static charge state be present on the powder particles, and the work-piece must be grounded.

The finished, cured films are somewhat similar and perform in similar manners whether applied by liquid or powder. For example, epoxies applied by either method are chemically resistant both are susceptible to ultra-violet radiation damage. The urethanes applied by either method have good abrasion resistance and the acrylics yield smooth surface finishes whether applied by liquid or powder.

2.2 Advantages and Disadvantages of Powder Coating Technology vs. Liquid Coatings

Mixing - Since the components of the powder are already mixed and in powder form, no additional mixing is necessary. Liquids often require mixing in proper ratios and in some cases must be used immediately following this procedure. Mixing tools must be cleaned or discarded. Most excess liquid paint must either be placed in storage that severely limits its effective use or discarded as toxic waste.

Ease of Application – Generally powders tends to be easier to apply and achieve more consistent coatings than liquids. When applied electrostatically, the powder coatings tend to be self-limiting and coat the work-piece with the same thickness in all areas. The electrostatic charge promotes a corona effect which forces powder particles to wrap around the part and coat the edges slightly better than flat surfaces. If a mistake is made during curing, the powder can simply be blown off or wiped away and a new coating applied (assuming the cure process was not already applied). Also with liquids coatings, edges are thin unless a concentrated effort is made to adequately cover these areas. Mistakes in liquid coating require stripping with solvents. The ambient environment is also less of a factor in the finish quality with powder coatings than with liquids.

Clean up – Powder equipment such as guns and hoses are blown clean with compressed air. A color change can be accomplished in a manner of minutes. Liquid guns must be solvent cleaned, even with water borne paints, generating more hazardous waste.

Storage of Unused Material – Unused liquid paint cannot be stored in the gun or paint reservoir for more than a few hours. The material would cure in place and ruin the equipment. Excess thermoset liquids that have been mixed will eventually cure and have to be disposed of as a hazardous waste. Powders require elevated temperatures to flow and cure, therefore they can be stored indefinitely in the spraying equipment without damage to either the material or equipment.

Storage of Bulk Materials – Most powders can be stored for years in normal manufacturing environments without damage. Most liquids have a limited shelf life and require flammable storage areas.

Curing Time – As compared with low VOC liquid paints, the curing time for the powders is very low: 10 –20 minutes with convection oven, 1- 5 minutes with infrared, as opposed

to hours or even days with some liquids. The disadvantage that powders have is that they must be heated to the 200 – 400°F range in order to force the cure mechanism to start. Most low VOC liquid paints cure at room temperature (65 – 75°F) if given sufficient time, or can be force cured at low temperature (120 – 160°F) for a few hours. Curing time can vary widely for both powders and liquids but, in general, powders are cured much faster than liquids.

Film Properties – Because liquid paints must be formulated to allow the escape of carrier or solvents materials while the polymer film is curing, they are inherently not as dense as powders, which therefore create a coating that is not as durable or resistant to attack from the surrounding environment. Adhesion of powder coatings to most substrates is also better than liquid paints, adding to the durability of powder coatings. To date, however, exceptionally smooth lustrous finishes are difficult to obtain with powder coatings. Liquid paints continue to excel in this area, which is the main reason they are considered the only choice for automotive exterior finishes.

Booth Operation – Liquid paint booths must be completely ventilated of paint solvents and VOCs to the exterior environment. These fumes are either released directly into the atmosphere or processed through a recovery system to diminish the emissions of toxic wastes. For large paint operations, this can result in enormous amounts of wastes and energy loss. Powder booths do not need to vent such volatiles and instead use high efficiency filters to remove powder particles from the air which are then returned directly into the powder reservoir or disposed of as a non-hazardous waste. No air is discharged into the surrounding environment or into the atmosphere.

Considering the LCAAP application, the main limitation in the regulatory arena is the additional presence of the heat cure. This aspect of the technology creates a major safety concern due to the close proximity of energetic materials to the heat source.

3. Site/Facility Description

3.1 Background

In 1938, Congress, forewarned of the situation in Europe, began a war modernization effort that included the construction of a network of heavy industrial plants strategically placed throughout the Untied States. This was politically favorable at the time since it created several thousand jobs for the local economy hit hard by the Great Depression. These plants were expected to produce armaments that would provide the entire US economy with a potential source of foreign revenue in the event war erupted elsewhere in the world (since the US expected to remain neutral). The Lake City Ordnance Plant was built in 1939 – 40 to accommodate this impending war effort as perceived by the US Department of War (later the Department of Defense). Today, this plant remains as the only active small caliber Army Ammunition Plant still owned by the Government – designated as a GOCO (Government Owned, Contractor Operated). Initially Remington Arms Corporation (later Remington – Dupont) was the first contractor to operate the

plant from its inception to 1988. Olin Corporation Winchester Division became the operating contractor beginning in 1988 to 2000. ATK became the operating contractor beginning in April 2000 to present. The plant was designated as the Lake City Army Ammunition Plant (LCAAP) in 1963.

3.2 Site/Facility Characteristics

3.2.1 Lake City Army Ammunition Plant (LCAAP)

The plant's basic structure and layout has not changed much since the 1940's. It is located on 3935 acres, which includes over 450 building with total of over 3.2 million square feet of floor space, a large ballistic testing range complex, a powerhouse, a fire station and a wastewater treatment plant. Production of ammunition occurs in eight major manufacturing buildings. Currently, the plant is staffed with approximately 34 government employees who act in a quality assurance and administrative capacity and 1200 ATK employees. The current production output of the plant is approximately 10 – 15 percent of the plant's original capability. The plant operates 4 days a week on a 10 hour a day shift, 49 weeks per year with a few processes operating 2 shifts per day.

The LCAAP produces small arms ammunition for military use only. This includes the 5.56 mm cartridge primary used in the M16 rifle, the 7.62 mm cartridge used in armor and aircraft mounted machine guns, the caliber .50 cartridge which is used in heavy machine guns and the 20 mm cartridges used in Naval and Airforce main attack gun systems. The total annual production varies as a result of many factors that include but are not limited to defense spending allowances, military logistics and level of reserves available etc. At two times in the plant's history (1941-45 and 1968-70) the plant produced over ten billion cartridges per year. This required over 4000 employees per shift with the plant working 24 hours a day seven days a week. Today, however, the plant is producing at its all time low (approximately 400 - 500 million cartridges per year), which accounts for the low plant utilization and the current 1200 employees.

The principal industry in ammunition production is metal forming. Raw materials in the form of brass cups enter the plant and undergo several forming operations using precision presses to form the material into cartridge cases and bullets. In some cases bullets are produced by outside sources. Each production step is carefully monitored to insure product consistency. Much of the manufacturing equipment used in these operations date from the plant's opening in the 1940's. For the 5.56-mm operations (by far the largest proportion of the plant's total production since the 1970's) a modern state-of-the-art high-speed process was implemented. With it the plant has an output of over 1200 parts per minute as compared to 60 parts per minute on the conventional equipment used to manufacture the 7.62 mm and Caliber .50 items. Following cartridge production, there are operations for loading, packing, inspection (both interim and final), testing, quality control and transportation.

3.2.2 Concurrent Technologies Corporation (CTC)

For the portion of the demonstration performed at CTC, Johnstown, PA, the application was performed at CTC's Manufacturing Technology facility. This facility is a state of the art facility that, for this purpose utilized the powder coating booth and oven. This operation is able to between various techniques and offers the ability to evaluate different coating characteristics. Many different configurations of parts have been coated at this facility.

4. Demonstration Approach

4.1 Performance Objectives

This project focused on the orange tip identification process for the 7.62mm tracer cartridge. The performance objectives were to meet or exceed current coating processes in terms of coating adhesion, quick and easy bullet identification, and eliminate hazardous waste associated with solvents. The following table summarizes this project's performance objectives, which was described in the demonstration plan (2).

Table 1: Performance Objectives *

Type of Performance Objective	Primary Performance Criteria	Expected Performance (Metric)
Quantitative	Standard 7.62mm Tracer Lot Acceptance Tests	Meet or Exceed Standard Lot Acceptance Test Criteria for 7.62mm Tracer Rounds
	Eliminate Toxins in Paint Application Process	VOC's Eliminated in Paint Application Process
Qualitative	Visual Inspection of Coated Projectiles	Same or Better Visual Identification when Compared to Current Dip ID Method

* Test results are listed in Appendix A

4.2 Demonstration Setup, Commencement, and Operation

During this project, CTC determined, with the help of ATK, that with all of the potential safety risks of coating the complete cartridge, coating of the projectile prior to being loaded into complete cartridges would be the focus. This removed the risk of a cartridge being ignited during the elevated cure stage temperature that would be required by a powder coating system.

One of the primary reasons that ATK is interested in evaluating powder coating technology is that the new loading/painting system for the 7.62mm cartridges has been found to be inconsistent and does not produce an acceptable coating on the cartridge tips. Also, powder coating is a technology that can be used to paint other types of cartridges (most notable 5.56mm and .50 caliber) produced by ATK. So, if it is found to be technically feasible, the technology can be used to replace all of the wet spray and dip processes at LCAAP. That would greatly favor the economic justification for powder coating at LCAAP.

CTC prepared a paint line consisting of a test jig, paint booth, oven and conveyor system. One operator sprayed the powder coating on the projectiles and the oven cured the paint on the pieces. The projectiles were then sent to LCAAP where further testing consisting of lot acceptance testing and material handling were conducted. The projectiles were then loaded into cartridges at LCAAP.

Since this was a powder coating, neither a wet spray nor a dip process was utilized. No pretreatment was used, as these projectiles were subjected to current normal conditions. The gun used was a Nordson Electrostatic Versa-Spray Corona Manual Powder Spray Gun. The paint used in the demonstration was an epoxy-based thermoset.

4.3 Sampling Procedures

For the Demonstration, a total of 50,000 7.62mm tracer projectiles were produced on the same machine, exposed to conditions that were not varied. Of these 50,000 7.62mm tracer projectiles, approximately 20,000 were held back at LCAAP as controls and the remainder (30,000) were sent to CTC for Demonstration. Once the projectiles were exposed to the powder coating, they were then shipped back to LCAAP. The powder-coated projectiles along with the controls were then loaded into complete cartridges on the Manurin® loaders. After loading, both the powder coated and control samples underwent Lot Acceptance Testing.

4.4 Analytical Procedures

Analyzing the test data was routine procedure and the pass/fail criteria for ballistic Lot Acceptance Testing is well documented and straightforward. The complete testing performed at LCAAP is listed in Appendix A.

5. Performance Assessment

5.1 Performance Data

All performance data is listed in Appendix A. A summary of the tests and the relevant results is listed below.

Table 2: Test Results for Powder Coated Projectiles

Test		Result	Acceptance
7.62mm Function and Casualty Acceptance Test	Ambient (70ºF)	All 200 rounds functioned without incident	Passed
	Hot (125ºF)	All 200 rounds functioned without incident. There was 1 observed large primer leaker at this temperature.	Passed
	Cold (-65ºF)	All 200 rounds functioned without incident	Passed
M62 Accuracy	Ambient	Average Mean Radius of 5.15 inches at 600 yards. Sample met requirement.	Passed
M62 Bullet Integrity	Ambient	Sample met requirement as all 200 rounds tested showed no signs of fragmentation	Passed
M62 Trace Test	Ambient Outdoor Range	Of the 200 rounds tested (100 in M60 gun and 100 in T65 gun), there were 4 visual defects that were observed not exhibiting the desired trace performance at either 15 yards, 100 yards or 850 yards downrange (all M60 gun)	Passed
Velocity	78' from muzzle	2670 ft/s with 11 ft/s Standard Deviation	Passed
Chamber Pressure	PSI	All were within average and maximum acceptable values	Passed
Port Pressure	PSI	Within average acceptable values	Passed
Action Time		Within acceptable value	Passed
Waterproof	Testing for observable leakages	First sample of 50 rounds had 8 failures (accept on 3 failures, retest on 4-9 failures). Second sample retest had 13 failures (pass on 9 cumulative failures, reject on 10 cumulative failures). 21 total failures out of 100 rounds tested.	Failed
Case – Residual Stress	Mercurous Nitrate	All rounds exhibited no case splits after treatment	Passed
Bullet Extraction	60 lb threshold	All rounds tested met requirement	Passed
Gauge and Weigh	Cartridge dimensions	1 major defect out of 200 (overall length) for the first sample and 1 out of 200 (length to shoulder) for retest.	Passed

Table 3: Test Results for Control Sample

Test		Result	Acceptance
7.62mm Function and Casualty Acceptance Test	Ambient (70ºF)	All 200 rounds functioned without incident	Passed
	Hot (125ºF)	All 200 rounds functioned without incident	Passed
	Cold (-65ºF)	All 200 rounds functioned without incident	Passed
M62 Accuracy	Ambient	Average Mean Radius of 5.71 inches at 600 yards. Sample met requirement.	Passed
M62 Bullet Integrity	Ambient	Sample met requirement as all 200 rounds tested showed no signs of fragmentation	Passed
M62 Trace Test	Ambient	All 200 rounds tested (100 in M60 gun and 100 in T65 gun) were observed exhibiting the desired trace performance at 15 yards, 100 yards and 850 yards downrange	Passed
Velocity	78' from muzzle	2680 ft/s with 12 ft/s Standard Deviation	Passed
Chamber Pressure	PSI	All were within average and maximum acceptable values	Passed
Port Pressure	PSI	Within average acceptable values	Passed
Action Time		Within acceptable value	Passed
Waterproof	Testing for observable leakages	First sample of 50 rounds tested had 3 failures. No need to retest as 3 failures was within the acceptable limits. The number of maximum cumulative failures for 50 rounds tested is 3.	Passed
Case – Residual Stress	Mercurous Nitrate	All rounds exhibited no case splits after treatment	Passed
Bullet Extraction	60 lb threshold	All rounds tested met requirement	Passed
Gauge and Weigh	Cartridge dimensions	All rounds met requirement. No major defects: no retest required.	Passed

We also conducted some more quality spot checks. In order to get a better feel for what the level of acceptance is, we took a 100-bullet sample of both powder-coated bullets and controls. We then categorized them into four different piles: bullets we thought were good, bullets that had some inconsistencies (scratches), bullets that had ~ 25% loss of paint and bullets that had 50% loss of paint or greater. The ratios for each were very similar and suggested that the same criteria was applied to each sample. A comparison of these coatings side by side is shown below. The powder-coated bullets are below the control bullets.

The paint integrity of both samples was compared. Basically, the powder coating was very resilient and a strong improvement compared to the current process. No flaking off was evidenced in any stage of the process. The water based dip process on the other hand, flakes off consistently and does not adhere very well to the bullet tip. Also, apparently orange paint is especially difficult to deal with in this application.

5.2 Data Assessment

All testing was performed in accordance with the standard testing procedures for every similar lot of ammunition produced at LCAAP. Comparing the two samples tested in this way offers a baseline for performance that is reliable and competent. There were some deviations evidenced between the samples. Tests having to do with Trace performance, gauge and weigh, residual stress and primer leakage were independent of the method of coating the projectiles. These tests had to do with: incendiary tracer mixture, Cartridge case dimensions, Cartridge case dynamics, and the primer mixture inserted into the cartridge respectively. These tests are routinely done and vary from sample to sample within acceptable limits quite frequently.

The accuracy and velocity tests on the other hand, were the two tests thought most likely to exhibit variation and would be closely looked at to determine product reliability between samples tested. Accuracy and velocity results only varied slightly and were indistinguishable; either result could have passed for either sample. The results of these tests strongly supports the contention that powder coating technology is a viable method of tip identification for small caliber ammunition.

The one test that failed in either sample was the Waterproof test on the powder coated sample. This tests for leaks in the cartridge through the bullet/cartridge interface. Basically, a sample of 50 is taken and if there are four or more “leakers” the lot will be retested with a double sample size. The control sample had 3 leaks out of 50. However, the Powder-coated sample had 8 leaks out of 50. During the double sample, 13 leaked out of 100 for the Powder-coated sample. With this result, the lot would have failed and would be rejected.

M62 tracer cartridges, because of the incendiary mixture being inserted before the core, do not have a boattail on the end of the projectile. Typically this boattail will allow for a smoother and tighter fit around the cartridge when the projectile is inserted. These rounds are lubed with mineral oil before loading occurs in order to help make the loading procedure more uniform and ease the process.

Mineral oil was applied to both samples prior to any coating being applied. The control sample did not have any other application to the projectiles before loading. The powder-coated projectiles, on the other hand, were shipped to CTC’s facility in Johnstown, PA.

These projectiles were then hand loaded into test jigs, exposed to a temperature of 300ºF for a period on 46 minutes, cooled down, hand packed in containers, and then shipped back to LCAAP where they were unpacked and placed in a container prior to loading.

These results were easily explained by the treatment of the powder-coated sample received. Basically, the various material handling of the powder-coated projectiles throughout the process nullified the effect of the mineral oil application. The mineral oil was not reapplied to the powder-coated sample. This would be addressed in the future by applying the mineral oil directly before loading occurs. This underscores the importance of the mineral oil application for the M62 rounds.

The data obtained from the testing demonstrates the viability of powder coating in this environment. The fact that there were no noticeable differences in results from the control sample and the powder-coated sample (aside from the leak test, which could be explained), demonstrates the effectiveness and feasibility of this technology.

5.3 Technology Comparison

The traditional dipping method and powder coating methods were the two comparisons made during this project. Due to the unique characteristics of the required painting application for small caliber ammunition tip identification, there does not appear to be any additional method of applying paint to the end of the projectiles that would both coat the required area evenly and allow for the elimination of VOCs. This was a consideration in selecting the powder coating method of paint application.

6. Cost Assessment

6.1 Cost Performance

Cost is an important consideration in any project. For this project, cost breakouts have been done for several lines of ammunition produced at LCAAP. A cost analysis using the Environmental Cost Analysis Methodology (ECAM) (3) was performed on several production lines of ammunition at LCAAP. The following tables are taken from the ECAM analysis that was performed by CTC as a part of the economic analysis (4). The complete report is provided in Appendix B.

Table 4. Input Parameters for 7.62mm (M62) Cost Analysis

Category	Input Parameter	Current Tip ID Process at 133 PPM	Powder Coating Process At 200 PPM	Powder Coating Process At 400 PPM
CAPITAL COSTS (One-time fees)	Equipment and Installation Cost	$0	$	$
	Facility Modification Cost	$0	$	$
	Total Capital Investment	**$0**	**$**	**$**
LABOR	Number of Operators	1 per shift	1 per shift	1 per shift
	Pay Rate	$21.85	$21.85	$21.85
	Shift Length (hours)	10 per shift	10 per shift	10 per shift
	Number of Shifts	1 per day	1 per day	1 per day
	Production time per shift (hours)	10 hours	9 hours	9 hours
	Operating Days per Year[1]	75 days	56 days	28 days
	Downtime (for maintenance) [2]	0 hours per year	55 hours (1 hr per day)	28 hours (1 hr per day)
	Total Annual Labor Cost	**$16,388**	**$12,236**	**$6,118**
EHS	Reporting, Training, PPE, etc.	Will not Change	Will not Change	Will not Change
MATERIALS	Paint or Powder Usage per Year[3]	160 gallons	62 pounds	62 pounds
	Paint or Powder Cost[4]	$21.72 per gallon	$19.85 per pound	$19.85 per pound
	Paint or Powder Annual Cost	$3475	$1230	$1230
	Solvent Usage per Year (ethyl acetate)[3]	5,000 pounds	N/A	N/A
	Solvent Cost[5]	$0.75/lb	$0	$0
	Solvent Annual Cost	$3750	$0	$0
	Total Annual Material Cost	**$7225**	**$1230**	**$1230**
WASTE	Category of Waste	Some Hazardous and some Non-hazardous	Non-hazardous	Non-hazardous
	Transportation Fees	None	None	None
	Disposal Method	Non-Haz to Industrial Waste	Industrial Waste	Industrial Waste
	Total Amount of Waste Generated	1 drum of solvent waste	100 pounds per year	100 pounds per year
	Disposal Rate[6]	$100 per drum	$3.00 per pound	$3.00 per pound
	Total Waste Disposal Fees	**$100**	**$300**	**$300**

Notes:

1. ATK stated that they currently produce approximately 6 Million 7.62-mm tracer rounds per year.
2. The hours for maintenance are accounted for due to the current throughput rate only producing 80,000 rounds per day (stated by ATK). Therefore no additional hours are added into the cost for maintenance for the current process. Similarly, for the powder coating system alternatives, it was assumed that 1 hour out of a 10-hour shift will be for start-up, shutdown, and maintenance combined. It was assumed that the powder coating system would be producing the indicated parts per minute (ppm) for 9 hours out of a ten-hour shift.
3. Data provided by ATK.
4. The calculation for the amount of powder needed to coat 6 Million bullets was determined assuming an overall transfer efficiency of 90.25%. The coverage rate supplied by the Sherwin-Williams manufacturer was 128ft^2/mil and the thickness assumed for the bullet tips was 1 mil.
5. Cost is based on an informal quotation of $0.75/lb for a quantity of 10,000 lbs. from a representative at Mid-State Chemical Company.
6. ATK stated that they produce approximately 2 drums of hazardous waste per year combining the operations for both 5.56-mm and 7.62-mm painting lines. *CTC* assumed that ½ of the total waste was from the 7.62-mm solvent cleaning process.

Table 5. Allowable Capital Expenditure at Various Payback Periods for Two Different Powder Coating Systems for 7.62 mm tracer rounds

Payback Period	Total Capital Expenditure (includes equipment and installation costs)	
	200 PPM System	**400 PPM System**
2 years	$18,750	$29,750
5 years	$44,400	$70,000
7 years	$58,250	$93,750

Table 6. Allowable Capital Expenditure for 5.56-mm Cartridge Painting at Various Payback Periods

Payback Period	Total Capital Expenditure (includes equipment and installation costs)
1.75 years	$200,000.00
2.5 years	$297,000.00
3.0 years	$360,000.00

Table 7 is shown to illustrate the effect of including other calibers (5.56mm) into the scope of implementing this powder coating technology. This analysis was done previously before the project focused exclusively on the 7.62mm tracer rounds. Other rounds such as .50 caliber rounds would also add another dimension to the cost benefit analysis.

7. Regulatory Issues

7.1 Approach to Regulatory Compliance

Regulatory issues were not the mandated driver for this program, although decreasing waste associated with the current process is highly desirable. This project focused on removing the VOCs used in the current process while at the same time increasing process efficiency and paint adhesion.

8. Technology Implementation

8.1 DoD Need

The tip identification process employs ethyl acetate, which is a VOC. This solvent could pose health and safety risks to the process operators over an extended period of time. From the information obtained from LCAAP, five thousand (5,000) pounds of ethyl acetate are used per year for this painting identification process for 7.62mm tracer rounds. Ethyl Acetate adheres to the bullet tip surface when applied and presumably evaporates during the process and/or is bound up in the final product. Also, evaporation of the ethyl acetate occurs at all times the compound is exposed to the atmosphere. The amount of product disposed of per year is approximately 1 drum (55gallons). This translates to approximately 663 gallons of ethyl acetate use per year. This means that roughly 600 gallons of ethyl acetate is either evaporated into the atmosphere or adhered to the surface of the round on an annual basis at only base production levels for 7.62mm tracer rounds.

8.2 Transition

Powder coating technology has been successfully demonstrated to be an efficient and acceptable alternative to the traditional dip and spray methods of paint application for bullet tip identification at LCAAP. Powder coating has historically been utilized in many industries, especially in the automobile industry, with impressive results. The painting of bullet tips was a development of this technology because only part of a surface was coated. Also, this application was unique because of the very small size of the area to be coated. CTC's expertise in the coating arena was greatly needed as the method of applying the coating for this application required considerable thought. Modifications to

the way coatings are applied will continue to expand the applicability of powder coating technology to other, more intricate operations.

8.3 Design Requirements

The following factors are taken from process and equipment specifications designed specifically for this process at LCAAP by CTC.

8.3.1 Functional Requirements

The objective of the powder coating system is to apply a tip color identification band and to cure bulk-supplied 7.62-mm small-caliber projectiles at 1500 parts per minute. Application of the powder will require part to be dynamically masked to prevent migration of coating beyond 7/16″ from projectile tip and minimize introduction of potential contaminant materials into coating system or adherents to projectile surface. Part core temperatures should not exceed 310 degrees Fahrenheit at any time during the coating or curing processes.

8.3.1.1 Size and Utility Requirements Required by Alliant Techsystems (ATK)

Table 1 lists the equipment and utility requirements for the powder coating system. Two important requirements to note are:

- Process air for powder applicators and clean-up needs to be oil and silicone-free.
- Humphrey Products automatic solenoids are recommended for coating system's process air control.

Table 7. General System and Utility Specifications

Machinery Footprint	Length	24 feet max
	Width	5 feet max
	Height	40 inches to main table
	Ceiling height	12 feet
Floor Loading	Maximum Load	Less than 250 lb/ft^2 static
Environment	Temperature	60–90 °F
	Humidity	25–55% relative humidity
Utilities supplied	Electricity	480 V/3 phase
	Low-pressure air	105 psig minimum
Grounding Supplied	Electrostatic applicator grounding to true earth ground	Less than 20 ohms

8.3.2 Projectile Feed System

Projectiles will be manually presented to the powder coating system after final projectile assembly (tracer, incendiary, etc.) and a corncob tumble procedure. Projectiles will have a very light coating of mineral oil and residual lard oil from prior machinery operations. The projectiles will most likely be in carts capable of holding 30,000 projectiles (250 lbs.) and will require a tipping or part removal operation to fill initial unscrambling hopper.

8.3.2.1 Design Requirements

- Conveying system should be designed to eliminate any possibility of projectiles getting under track work or into motors or gearing.
- System will be integrated into control system for automatic operation.
- Motors will be sized 150% of max load to prevent stalling.
- Safety covers with electrical interlock will be provided for each piece of moving machinery per OSHA guidelines.
- All oil and lubrication supply systems refill points will be located below the part flow line and accessible from outside machinery.
- Access doors will be provided to all maintenance areas.
- Maintenance hours exceeding 0.5 should not be required.

8.3.3 Unscrambler

The unscrambling operation should be capable of orienting projectiles with minimal abrasion and force. The projectile stream exiting this operation should supply no less than 1500 parts per minute (ppm) to subsequent operations without gapping, tipping over, or jamming. Multiple feeders may be considered as long as total machine footprint size does not exceed the maximum space specified in Table 1.

8.3.3.1 Design Requirements:

- Uniformly provide 1,500 parts per minute (ppm) to next process step in coating system.
- Ensure minimal damage to part (scrapes, scars, nicks) during feeding operations.
- Operate at variable speed to feed parts immediately upon start-up.
- Provide safety covers with electrical interlock for each piece of moving machinery per OSHA guidelines.
- Locate all oil and lubrication supply systems refill points below the part flow line and access from outside machinery.
- Access doors will be provided to all maintenance areas.
- Require no more than 2 hours of maintenance per month.

8.3.4 Preheating System

Preheating the parts can reduce final cure time significantly. If a preheating process station is required either due to the size of post-application heating systems and/or formulation of the powder coating itself, then it should be capable of heating 1,500 parts from 60 degrees Fahrenheit to final process temperature within its area.

8.3.5 Powder Coating Application

The parts shall be presented to coating system at a rate of 1,500 ppm (99% fill capacity of part holder cavities). The system should be easy to maintain and all part-contacting rotary components need to be designed with over torque protection from jamming. Electrostatic grounding resistance of each projectile should be not more than 20 ohms.

8.3.5.1 Masking System Description

Masking of projectiles is an integral part of the application process. The powder coating high-speed/volume masking system, whether coated in bulk or individually, needs to minimize excess powder build-up at coating mask edge of the projectile. The specification for placement of the identification coating on a 7.62 mm projectile is 5/16″(0.313″), +/-1/16″(0.062″) from the blunted projectile tip. The mechanically positioned masking will need to be form-fit to the ogive (the portion of the bullet where the bearing surface ends and the point starts) of the projectile surface nearest to the tip. The form-fitting aspect is necessary to limit powder coating particulate injection into the mask-projectile gap as well as allow for adequate electrical grounding for the electrostatically applied powder.

The mechanical mask system should be self-cleaning, either by use of a self-release, high-dielectric-strength material or a blow-off and/or wiping system. Coating placement on projectile should be of a very uniform consistency and distinct edge transition from coated to uncoated areas. Target-cured film thickness for uniform color = 1.5 mils.

The in-process cleaning method for the masking system should also be capable of dislodging any powder that is applied to mask area where a projectile(s) is missing due to feeding and positioning irregularities.

8.3.5.2 Applicator System

Applicator should provide enough powder to coat all parts uniformly (+/- 10% of target DFT as determined by coating weight and more than 90% of surface covered with continuous coating film) at full production rating (1,500 ppm). Applicator should be of a corona design capable of continuously charging powder particulate to 80 KV. Applicator should be able to be quickly changed out of system (<5 minutes) and monitored by control system for pressure loss or electrostatic charging faults. A second applicator should be included in the system package as part of the quick-change maintenance feature.

8.3.5.3 Over-Spray Collection System

Efficient reclamation of powder coating is desired to reduce maintenance and significantly improve material costs. Over-spray filtration system should have the ability to be cleaned well enough to permit a color change if necessary. Also, the filter system should be self-discharging to allow continuous operation. Airflow should be sufficient to draw powder uniformly during full operation and compensated for when filter is 50% blinded.

Collected powder should be routed automatically to in-feed hopper to minimize in-process powder use and possible exterior contamination.

8.3.5.4 Powder Coating Cleaning System

An integral, manually activated, vacuum system will be supplied to pick up loose powder. The vacuum should be capable of reaching all areas of the system. This powder will not be reclaimed.

A manual blow-off low-pressure air wand will be provided with dedicated supply tap to clean out application area, surrounding tabletop, and system filters. The airline will require a ground wire insert to minimize any arcing.

8.3.6 Curing Oven

The powder coating curing process should be capable of curing 1,500 ppm. This process area will be followed by a forced cooling area so that all curing should be complete in the actual oven area. The curing process should be capable of curing all specified colors of the approved coating formulation.

8.3.6.1 Design Requirements

- Convection curing system will require digital-gauge thermocouple monitoring at part-level horizontal plane. Temperature control set-point inputs will be at a main control panel. An over-temperature sensor will also be installed to shut down system in the event of a system process loss or fire.
- Radiant heating systems will conduct current monitoring via true Root Mean Square (RMS) Silicon Controlled Rectifiers (SCR) of supplied amperage. Visible light or UV light sources may be monitored by intensity measurement at projectile exposure distance provided that machinery commissioning (at supplier's cost) includes check of entire curing area for uniformity of cure.
- Optical safety shielding will be designed to limit operator's exposure.
- Exterior safety covers and framework shall be insulated to limit exterior machinery temperature to no more than 100 °F.
- All powder curing systems will be rated for continuous duty.

- All interior oven materials (guides, track, wiring, etc.) will be rated for a minimum of 150% of maximum service creep temperature.
- Motors will be sized 150% of maximum load to prevent stalling.
- All oil and lubrication supply systems refill points will be located below the part flow line and accessible from outside machinery.
- Access doors will be provided to all maintenance areas.
- Dust shielding, where possible, will be provided to capture/contain loose powder from getting into machinery. All air flows, recirculating or not, will be filtered before entry into curing area
- Traps or guides will be provided to capture/contain loose projectiles.
- Maintenance hours per month beyond regular cleaning should not exceed 2.

8.3.7 Cooling Station

The projectiles should be no warmer than 100 °F leaving the powder coating system. Due to the composite structure of the projectiles, no water or moisture-type cooling can be introduced into the cooling section. Excess air usage costs from Low Pressure air sources prohibits its use as a cooling process tool.

8.3.7.1 Design Requirements

- Cooling air will be filtered to prevent airborne particulate from sticking to hot parts.
- Spent cooling air will be vented from building to minimize room heating and process volatiles such as water and vaporized powder.
- Exiting temperature should be less than 100 °F.
- Cooling capacity should be 1,500 ppm in 90°F/ 25% RH factory environment.
- Conveying motors will be sized 150% of maximum load to prevent stalling and supplied with starters.
- Fan motors will be sized to 125% of maximum load.
- All oil and lubrication supply systems refill points will be located below the part flow line and accessible from outside machinery.
- Access doors will be provided to all maintenance areas.
- Traps will be provided to capture/contain loose projectiles.
- Maintenance hours of maintenance per month beyond regular cleaning should not exceed 0.5.

8.3.8 Discharge System

The discharge of coated and cured projectiles shall be in a positive drive manner (no bridging plate or other passive conveyance except to guide parts falling due to gravity). Discharge should end in soft cloth chute to minimize falling projectile kinetic energy. Multiple discharge points are preferred to equally distribute loading into carts that will be pushed manually to the next processing step.

8.3.8.1 Design Requirements

- Positive conveyance of all projectiles to cart is required.
- System should allow for manual clean-out of conveyor track way for maintenance and cleaning operations.
- Discharge conveying should be rated for 10% higher capacity than coating system and curing system to minimize jamming and backing up into curing and cooling sections.
- Reject and "first article" automated discharge gating system is required to capture all nonconforming parts to separate containment.

9. Lessons Learned

This powder-coating project successfully demonstrated that the process of applying paint to the tips of ammunition for identification purpose could be modified from the current spray and dip methods. Besides the elimination of VOCs in the process, the quality and the adhesion demonstrated by powder coating was clearly superior. One lesson learned was with regard to the treatment of both sample projectiles.

At the time, it was not realized how important the application of mineral oil was to the process. The effect of transporting the powder coated projectiles, and the extra material handling they were exposed to, in essence nullified the effect that the mineral oil was supposed to have. This was evidenced by the seal between the projectile and case not being effective and failure of the casemouth waterproof test for the powder-coated sample was the result. This was a very minor failure that was easily explained, but coating both samples just prior to loading would have alleviated this issue.

The lesson here for future projects is to treat both control and experimental samples as close to the real environment as possible, even when it appears inconsequential. This can be hard to realize at the time because variables, especially how environmental factors affect the process, are often not that well known. Looking back, for this project, once the powder coated projectiles were received back to LCAAP, only then should the mineral oil have been applied. This would have made the results of the waterproof test more accurate.

10.References

1. Powder Coating of Small Caliber Bullet Tips At Lake City Army Ammunition Plant Task 4 Procurement Document June 26, 2002 CDRL No. A001-Task 4 GSA Contract Number DAAE30-01-F-0098

2. ESTCP Technology Demonstration Plan "Powder Coating for Small-Arms Bullet Tip Identification" TACOM-ARDEC, Picatinny Arsenal January 17, 2002

3. Environmental Cost Analysis Methodology (ECAM) Handbook, National Defense Center for Environmental Excellence, Johnstown, PA for the Environmental Security Technology Certification Program. Contract No. DAA21-93-C-0046 Task No. N.098, March 29, 1999

4. "Interim and Cost Analysis Report" dated, December 29, 2000 and submitted by Concurrent Technologies Corporation, Johnstown, PA under GSA contract No. GS-23F-0061L, US ARMY TACOM Order No. DAAA 21-93-C-0046, task No. N.212, CDRL No. A005.

11.Points of Contact

Point of Contact	Organization Name	Phone/Fax/Email	Role in Project
John Heinsohn	Picatinny Arsenal/ARDEC AMSTA-AR-CCL-B	973-724-6492 DSN 880-6492 FAX 973-724-7095 heinsohn@pica.army.mil	ARDEC/ CCAC contact
Michael Docherty	Concurrent Technologies Corp.	Phone (814) 269-6462 FAX (814) 269-2798 docherty@ctc.com	CTC Project Management
Cristina Bressler	Concurrent Technologies Corp.	Phone (814) 269-2863 FAX (814) 269-6847 bressler@ctc.com	Economic Analysis/Process design
Doug Atterbury	Concurrent Technologies Corp.	Phone (814) 269-2869 FAX (814) 269-6847 atterbud@ctc.com	System Design/Project Engineer
Charlie Moran	LCAAP	(816) 796-5154 (816) 796-7302 Charlie.moran@atk.com	Material Handling

APPENDIX A

Test Results from the Lot Acceptance Testing Performed at LCAAP.

ATK 5552A (2/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT - BLDG. 45

Nomenclature 7.62 mm TRACER M62

Lot No. LC-

Date 27 FEBRUARY 2002

Type of Weapon	M134		M134		M134			
Number of Weapon	3265A		3265A		3265A			
Gun Rounds	4550		4750		4950			
Number of Barrel	GP-1		GP-1		GP-1			
Barrel Rounds	4550		4750		4950			
Head Space								
Pin Protrusion								
Pin Indent								
*Cyclic Rate	6470		6372		6386			
Bay	6B		6B		6B			
TEMPERATURE OF TEST	+70		+125		-65			
Rounds in Belt or Magazine	200		200		200			
Rounds Fired	200		200		200			
Misfired	NONE		NONE		NONE			
Bullet Remaining in Bore								
Hangfire								
Primer Leak Small								
Primer Leak Large								
(A) Perforation								
(B) Dropped Primer								
(C) Loose Primer								
(D) Blown Primer								
CASE: LONGITUDINAL SPLIT								
(A) Neck & Shouldr (I & S)								
(B) Body (J)								
(C) Body (K)								
(D) To Head (L)								
(E) Thru Head (M)								
CASE: CIRCUM. RUPTURE								
(A) Partial (J & S)								
(B) Partial (K)								
(C) Partial (L)								
(D) Complete								
Failure to Extract								
Weapon Stoppage								
Bullet Disintegration								
Detached Metal								
Expansion of Mouth/Neck								
FUNCTION	OK		OK		OK			
Bullet Stripping								

*CYCLIC RATE: M80 BALL, M62 TRACER
M134 Automatic Gun - 6,000 rpm min.
200 rd. burst - cool to ambient between burst.

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)

POWDER CONTROL BULLET SAMPLE (1)

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner OHREM - GARY Recorder HATCHEL Foreman [signature]

ATK 5552A (2/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT - BLDG. 45

Nomenclature 7.62 mm TRACER M62

Lot No. LC-

Date 27 FEBRUARY 2002

Type of Weapon	M134		M134		M134			
Number of Weapon	3265A		3265A		3265A			
Gun Rounds	5150		5350		5550			
Number of Barrel	6P-1		6P-1		6P-1			
Barrel Rounds	5150		5350		5550			
Head Space								
Pin Protrusion								
Pin Indent								
*Cyclic Rate	6481		6365		6480			
Bay	6B		6B		6B			
TEMPERATURE OF TEST	+70		+125		-65			
Rounds in Belt or Magazine	200		200		200			
Rounds Fired	200		200		200			
Misfired	NONE		NONE		NONE			
Bullet Remaining in Bore								
Hangfire								
Primer Leak Small								
Primer Leak Large								
(A) Perforation								
(B) Dropped Primer								
(C) Loose Primer								
(D) Blown Primer								
CASE: LONGITUDINAL SPLIT								
(A) Neck & Shouldr (I & S)								
(B) Body (J)								
(C) Body (K)								
(D) To Head (L)								
(E) Thru Head (M)								
CASE: CIRCUM. RUPTURE								
(A) Partial (J & S)								
(B) Partial (K)								
(C) Partial (L)								
(D) Complete								
Failure to Extract								
Weapon Stoppage								
Bullet Disintegration								
Detached Metal								
Expansion of Mouth/Neck								
FUNCTION	OK		OK		OK			
Bullet Stripping								

*CYCLIC RATE: M80 BALL, M62 TRACER
M134 Automatic Gun - 6,000 rpm min.
200 rd. burst - cool to ambient between burst.

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)

POWDER CONTROL PAINT CONTROL SAMPLE (2)

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner OFFEN GARY Recorder HATCHER Foreman

ACCURACY TEST

Test #: PROCESS Cartridge Type: M-62

Date Produced: // Shift Produced:

Primer Lot: Gunner: ATKINSON Plotter: WAHN

Powder Type: Powder Lot: Powder Charge:

Range #: 6A Range Length: 600 Wind Vel: 4-6 Wind Direction: 290

General Condition: CLEAR TEMP.31 Barometric Pressure: 30.38

Remarks:

MR=10.0 1ST TARGET 1 DROP OUT

POWDER COAT BULLET SAMPLE

Unit No	Arm No	RFTD	No Rds Fired	Mean Radius	Horz Stand Dev	Vert Stand Dev	Ext Vert	Ext Horz	Ext Sprd
HS1.628	3792254	6250	9	4.65	3.52	5.21	17.85	11.55	18.30
BBL.#2			10	7.86	9.39	3.50	9.65	32.00	32.85
			10	5.10	4.91	4.01	11.60	19.90	20.30
HS1.630	4004587	3555	10	3.52	3.92	1.97	6.50	14.70	14.90
BBL.#2			10	5.07	4.48	3.99	13.85	15.25	15.30
			10	3.47	1.76	3.51	10.60	5.75	10.65
HS1.629	3477891	3830	10	5.43	4.74	4.47	13.45	15.10	16.05
BBL.#2			10	4.70	3.67	3.97	12.05	10.40	14.75
			10	6.53	3.27	7.10	23.05	9.65	23.20
AVERAGE				5.15	4.41	4.19			

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ACCURACY TEST

Test #: PROCESS Cartridge Type: M-62

Date Produced: // Shift Produced:

Primer Lot: **Gunner: ATKINSON** **Plotter: WAHN**

Powder Type: **Powder Lot:** **Powder Charge:**

Range #: 6A Range Length: 600 Wind Vel: 4-6 Wind Direction: 290

General Condition: CLEAR TEMP.31 Barometric Pressure: 30.38

Remarks:

POWDER COAT PAINT CONTROL SAMPLE

Unit No	Arm No	RFTD	No Rds Fired	Mean Radius	Horz Stand Dev	Vert Stand Dev	Ext Vert	Ext Horz	Ext Sprd
HS1.628	3742254	6280	10	8.07	5.86	6.82	18.05	17.25	23.30
BBL.#2			10	6.55	5.32	4.89	14.60	15.85	17.60
			10	7.10	3.29	7.47	24.15	9.20	24.20
HS1.630	4004587	3585	10	4.28	3.55	3.67	13.75	10.60	14.25
BBL.#2			10	3.44	3.50	1.81	5.20	9.35	10.50
			10	4.14	3.80	3.12	9.75	12.40	12.65
HS1.629	3477891	3860	10	4.88	2.82	4.77	15.35	7.20	15.50
BBL.#2			10	7.09	6.89	3.95	11.45	22.65	22.70
			10	5.83	4.11	4.90	13.60	11.65	15.45
AVERAGE				5.71	4.35	4.60			

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OL C 5539

OLIN CORPORATION-Lake City Army Ammunition Plant

5.56MM & 7.62MM BULLET INTEGRITY ACCEPTANCE REPORT

(Performed in conjunction with trace test) (Screen at 50 feet from muzzle)

Nomenclature: M62 Powder Coat Paint Control Sample

Lot. No. LC-

Date 27 February 2002

RECEIVER NUMBER	BARREL NUMBER	TIMES FIRED	HEADSPACE	WEAPON TYPE
139497	23H 25H	5578 4829	1.633 1.633	M60
333013	3 4	4704 3891	1.637 1.633	T65

139497 WEAPON NO. 139497

BARREL 23H

Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

BARREL 25H

Screen OK

333013 WEAPON NO. 333013

BARREL 3

Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

BARREL 4

Screen OK

WARMERS BBL #23H

1	
2	
3	

WARMERS BBL #25H

1	
2	
3	

WARMERS BBL #3

1	
2	
3	

WARMERS BBL #4

1	
2	
3	

ACCEPTANCE REQUIREMENTS

SHALL NOT BURST IN ITS PASSAGE THROUGH THE BARREL NOR SHALL THE JACKET OR ANY PART STRIP FROM THE SLUG WHEN FIRED.

☐ 7.62MM M62 & M62 CHF

Each weapon 100 rds. Failure of any cartridge shall reject the lot. No second sample permitted.

☐ 5.56MM M196

1st Sample-100 rds.
2nd Sample-200 rds.

Cum. Acc.	Retest	Cum. Rej.
0	1-3	4
3	-	4

TARGET SCREEN OBSERVATIONS

No. of Holes 200

Location of Holes Center

Type of Holes normal

TEST RESULTS

No. Fired 100

No. & Type of Defects 0

Case Casualties 0

Observer at 15 Yards Vicke Gunner Ross

Observer at 100 Yards Angie Gunner Jerry

Observer at 850 Yards Dan Foreman

IS TEST ACCEPTABLE?

1st Sample Yes ☐ No ☐

2nd Sample Yes ☐ No ☐

OL C 5539

OLIN CORPORATION-Lake City Army Ammunition Plant

5.56MM & 7.62MM BULLET INTEGRITY ACCEPTANCE REPORT

(Performed in conjunction with trace test) (Screen at 50 feet from muzzle)

Nomenclature: M62 Powder Coat Bullet Sample

Lot. No. IC-

Date 27-February 2002

RECEIVER NUMBER	BARREL NUMBER	TIMES FIRED	HEADSPACE	WEAPON TYPE
139457	23H 25H	5525 4776	1.635 1.633	M60
333013	3 4	4651 3838	1.637 1.633	T65

139457 WEAPON NO. 139457

BARREL 23H					BARREL 25H				
Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

Screen OK

Screen OK

333013 WEAPON NO. 333013

BARREL 3					BARREL 4				
Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

Screen OK

Screen OK

WARMERS BBL #23H
1
2
3

WARMERS BBL #25H
1
2
3

WARMERS BBL # 3
1
2
3

WARMERS BBL # 4
1
2
3

ACCEPTANCE REQUIREMENTS

SHALL NOT BURST IN ITS PASSAGE THROUGH THE BARREL NOR SHALL THE JACKET OR ANY PART STRIP FROM THE SLUG WHEN FIRED.

☒ 7.62MM M62 & M62 CHF

Each weapon 100 rds. Failure of any cartridge shall reject the lot. No second sample permitted.

☐ 5.56MM M196

1st Sample-100 rds.
2nd Sample-200 rds.

Cum. Acc.	Retest	Cum. Rej.
0	1-3	4
3	-	4

TARGET SCREEN OBSERVATIONS

No. of Holes 200

Location of Holes Center

Type of Holes Normal

TEST RESULTS

No. Fired 200

No. & Type of Defects 0

Case Casualties 0

Observer at 15 Yards Vicke Gunner Russ

Observer at 100 Yards Gagil Gunner Jerry

Observer at 850 Yards Don Foreman

IS TEST ACCEPTABLE?

1st Sample Yes ☐ No ☐

2nd Sample Yes ☐ No ☐

OLC 5556
(8-25-86)

OLIN CORPORATION-Lake City Army Ammunition Plant
7.62MM TRACE TEST ACCEPTANCE REPORT

M62 Powder Coat bullet Sample

Nomenclature
7.62MM TRACER, M62

~~Lot No. LC~~
Date 27 February 2002

WEAPON TYPE	RECEIVER NUMBER	BARREL NUMBER	HEADSPACE	TIMES FIRED
M60	139457	23H 25H	1.633 1.633	5525 4776
T65	333013	3 4	1.631 1.633	4631 3438

WARMERS-BARREL # 23H					WARMERS-BARREL # 25H					WARMERS-BARREL # 3					WARMERS-BARREL # 4				
1					1					1					1				
2					2					2					2				
3					3					3					3				

M60

TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51				
2					52				
3					53				
4					54				
5	F				55				
6					56				
7					57				
8					58	F			
9	F				59				
10				D	60				
11					61				
12					62				
13	F				63				
14					64				
15		E		B	65	F			
16					66				
17					67				
18					68				
19	F				69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32	F			D	82				
33					83	F			
34					84				
35					85				
36	F	D			86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93		E		D
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

T65

TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

OBSERVATIONS AT GUN
INFORMATIONAL ONLY

CHARGEABLE DEFECTS
E - EARLY (BRIGHT) @ 15 YDS.
B - BLIND @ 100 OR 850 YDS.
D - DIM @ 100 OR 850 YDS.

INFORMATIONAL ONLY
F - MUZZLE FLASH
ERF - ERRATIC FLIGHT
BB - BULLET BURST

NO NOTATION MEANS NO DEFECT

OLC 5556 (BACK)
(8-25-86)

OLIN CORPORATION-Lake City Army Ammunition Plant

7.62MM TRACE TEST ACCEPTANCE REPORT

ROUNDS FIRED		TRACE OBSERVED 15 YARDS			TRACE OBSERVED 100 YARDS			TRACE OBSERVED 850 YARDS			TOTAL DEFECTS	SATISFCTRY TRACE		INFORMATIONAL ONLY		
TOTAL	EA.GUN	BRIGHT	DIM	BLIND	BRIGHT	DIM	BLIND	BRIGHT	DIM	BLIND		NO.	%	MUZZLE FLASH	ERRATIC FLIGHT	BULLET BURST
200	100															
M60 GUN		2*	1	97	100	0*	0*	96	3*	1*	4**	96	%	9	0	0
T65 GUN		0*	0	100	100	0*	0*	100	0*	0*	0**	100	%	0	0	0

*DEFECTS. **DEFECTS REPORTED AT MORE THAN ONE POINT FOR THE SAME SHOT SHALL BE RECORDED AS ONE FAILURE.

ACCEPTANCE REQUIREMENTS

SHALL EXHIBIT A VISIBLE TRACE OF FULL LUMINOSITY FROM A POINT 100 YARDS TO A POINT 850 YARDS. THE TRACE SHALL BE OF A LEVEL BELOW FULL LUMINOSITY AND PREFERABLY INVISIBLE AT 15 YARDS.

AQL APPROXIMATELY 6.5%

[X] M62 TRACER — No second sample permitted

	Sample Size	Accept	Reject
M60	100	20	21
T65	100	20	21

Two independent samples; one sample in each weapon (M60 and T65).

AQL APPROXIMATELY 13.0%

[ ] M62 OHF TRACER — No second sample permitted (Fired in M60 Gun Only)

Sample Size	Accept	Reject
100	20	21

IS THE TEST ACCEPTABLE?

Yes [X] No [ ]

Observer At Gun: Ross

Observer At 15 Yards: Vicke

Observer At 100 Yards: Angie

Observer At 850 Yards: Dan

Recorder: Bear

Gunner: Jerry

The material herein was manufactured, inspected and tested in accordance with the provisions of the Government approved Quality Assurance System.

Foreman: _____

REMARKS (NOTE ANY FUNCTION AND CASUALTY DEFECTS)

OLC 5556
(8-25-86)

OLIN CORPORATION-Lake City Army Ammunition Plant
7.62MM TRACE TEST ACCEPTANCE REPORT
M62 Powder Coat Paint Control Sample

Nomenclature
7.62MM TRACER, M62

~~Lot No. LG~~
Date 27 February 2002

WEAPON TYPE	RECEIVER NUMBER	BARREL NUMBER		HEADSPACE		TIMES FIRED	
M60	139497	23H	25H	1.635	1.633	5578	4829
T65	333013	3	4	1.637	1.633	4204	3591

WARMERS-BARREL # 23H					WARMERS-BARREL # 25H					WARMERS-BARREL # 3					WARMERS-BARREL # 4				
1					1					1					1				
2					2					2					2				
3					3					3					3				

M60										T65									
TEST ROUNDS					TEST ROUNDS					TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850	RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51					1					51				
2					52					2					52				
3					53					3					53				
4					54					4					54				
5					55					5					55				
6					56					6					56				
7					57					7					57				
8					58					8					58				
9					59					9					59				
10					60					10					60				
11					61					11					61				
12					62					12					62				
13					63					13					63				
14					64					14					64				
15					65					15					65				
16					66					16					66				
17					67					17					67				
18					68					18					68				
19					69					19					69				
20					70					20					70				
21					71					21					71				
22					72					22					72				
23					73					23					73				
24					74					24					74				
25					75					25					75				
26					76					26					76				
27					77					27					77				
28					78					28					78				
29					79					29					79				
30					80					30					80				
31					81					31					81				
32					82					32					82				
33					83					33					83				
34					84					34					84				
35					85					35					85				
36					86					36					86				
37					87					37					87				
38					88					38					88				
39					89					39					89				
40					90					40					90				
41					91					41					91				
42					92					42					92				
43					93					43					93				
44					94					44					94				
45					95					45					95				
46					96					46					96				
47					97					47					97				
48					98					48					98				
49					99					49					99				
50					100					50					100				

OBSERVATIONS AT GUN
INFORMATIONAL ONLY

CHARGEABLE DEFECTS
E - EARLY (BRIGHT) @ 15 YDS.
B - BLIND @ 100 OR 850 YDS.
D - DIM @ 100 OR 850 YDS.

INFORMATIONAL ONLY
F - MUZZLE FLASH
ERF - ERRATIC FLIGHT
BB - BULLET BURST

NO NOTATION MEANS NO DEFECT

OLC 5556 (BACK)
(8-25-86)

OLIN CORPORATION-Lake City Army Ammunition Plant

7.62MM TRACE TEST ACCEPTANCE REPORT

ROUNDS FIRED		TRACE OBSERVED 15 YARDS			TRACE OBSERVED 100 YARDS			TRACE OBSERVED 850 YARDS			TOTAL	SATISFCTRY TRACE		INFORMATIONAL ONLY		
TOTAL	EA.GUN	BRIGHT	DIM	BLIND	BRIGHT	DIM	BLIND	BRIGHT	DIM	BLIND	DEFECTS	NO.	%	MUZZLE FLASH	ERRATIC FLIGHT	BULLET BURST
200	100															
M60 GUN		* 0	0	100	100	* 0	* 0	100	* 0	* 0	** 0	100	%	0	0	0
T65 GUN		* 0	0	100	100	* 0	* 0	100	* 0	* 0	** 0	100	%	0	0	0

*DEFECTS. **DEFECTS REPORTED AT MORE THAN ONE POINT FOR THE SAME SHOT SHALL BE RECORDED AS ONE FAILURE.

ACCEPTANCE REQUIREMENTS

SHALL EXHIBIT A VISIBLE TRACE OF FULL LUMINOSITY FROM A POINT 100 YARDS TO A POINT 850 YARDS. THE TRACE SHALL BE OF A LEVEL BELOW FULL LUMINOSITY AND PREFERABLY INVISIBLE AT 15 YARDS.

AQL APPROXIMATELY 6.5%

			Sample Size	Accept	Reject
[X]	M62 TRACER	No second sample permitted	M60 100	20	21
			T65 100	20	21

Two independent samples; one sample in each weapon (M60 and T65).

AQL APPROXIMATELY 13.0%

			Sample Size	Accept	Reject
[ ]	M62 OHF TRACER	No second sample permitted (Fired in M60 Gun Only)	100	20	21

IS THE TEST ACCEPTABLE?

Yes [X] No [ ]

Observer At Gun: Vicke

Observer At 15 Yards: Ross

Observer At 100 Yards: Angie

Observer At 850 Yards: Don

Recorder: Beer

Gunner: Jerry

The material herein was manufactured, inspected and tested in accordance with the provisions of the Government approved Quality Assurance System.

Foreman: _____

REMARKS (NOTE ANY FUNCTION AND CASUALTY DEFECTS)

BALLISTIC TESTING
REDUCED TEST

ITEM: 7.62mm CTG. NATO Tracer, M62

LOT NO: POWDER COAT CONTROL

Accepted ☐ Rejected ☐

1st Sample ☐ 2nd Sample ☐

DATE: _____

CHARLIE MORAN + ADAM S.

Date Presented: ☐

Quantity Packed:

Propellant:

Primer Lot Nos.

A.L. Numbers	Charge (Grs.)

FIRING TESTS	Rds Fired	Record	Spec. Limits
+26			
Velocity @ 78° (F.S.)			
Corrected Avg. (70°)	30	2680	2,665 ± 30
Standard Deviation	XX	12	32 Max.
125°	30	+49	+150 from Avg.
-65°	30	-97	-250 from Avg.
Chamber Pressure (PSI) +261			
Corrected Avg. (70°)	XX	52786	Max 52,940
Max Reading (70°)	XX	54450	58,016
Avg. +36 (70°)	XX	55451	58,016
125°	XX	+4256	+7,252
-65°	XX	-6883	-14,054
Port Pressure -1519			7,977 Min
Corrected Avg. (70°)	XX	8846	10,588 Max
Action Time			
Max Individual	XX	1.4	4.0
Trace Performance @ 850 yds			
M60	100	100%	80
T65E	100	100%	80
*Bullet Integrity	XX	0	
Accuracy (Inch) @ 600 yds.			Max. Avg.
Avg. Mean Raddi	90	5.71	15.0

FIRING TESTS

Function	70°	125°	-65°	Record
Machine Gun				
M60	150	150	150	0
M240	150	150	150	0
M134	200	200	200	0
Rifle				
M14	120	80	80	0

Casualties:

NON-FIRING TESTS

		Number Tested	Record	Spec. Limits
Cartridge	1st Sample	50	3	3
Waterproof (Vac)	Cumulative	150		9
Case - Residual Stress			0	
(Mercurous Nitrate)	1st Sample	50		0
	Cumulative	150		1

Bullet Extraction (Min 60 lbs.)	Tested	Min.	Max.	Avg.	Spec. Limits
1St Sample	25	98	185	131	0
Cumulative	75				1

Correction Applied
Velocity
Chamber Pressure
Port Pressure

*Bullet Integrity fired simultaneously with Trace Performance.

Retest Required _____ Allowed _____ Released _____

TUKON: _____ TIME: _____ RELEASED BY: _____

DEHLER System 82 02/02/26-10:44p SlowFire Mode

10:44p Comment: C:\Data\TUE-65.DAT
Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 3:48 PM
ROB: 1510

WARNERS / REF

Round	1-P-Max- (6836 0)	1-Vel/TA (100.000 0)	2-P-Max- (6820 0)	2-T-Pk--
1	48906	2694	10835	1431
2	48621	2690	10724	1453
3	51029	2721	10585	1371
4	51253	2718	10805	1375
5	51424	2729	10695	15103
5 Valid Rounds				
Mean	50247	2711	10729	1428
Std Dev	1365	17	99	58
Max	51424	2729	10835	1510
Min	48621	2690	10585	1371
Range	2803	39	251	139
Mean+3S	54341	2762	11025	1602
Mean-3S	46153	2659	10433	1254

THE MATERIAL HEREIN WAS TESTED, IN ACCORDANCE WITH THE PROVISIONS OF THE GOVERNMENT APPROVED QUALITY ASSURANCE SYSTEM.

Kevin D. Vest

10:48p Comment: C:\Data\TUE-65.DAT

DEHLER System 82 02/02/26-10:48a SlowFire Mode

10:43p Comment: C:\Data\TUE-66.DAT

Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 9:53 PM
ROB: 1515

REFERENCE LOT LC-86J000R009

Round	1-P-Max- (0 6836)	1-Vel/TA (0 100.000)	2-P-Max- (0 6820)	2-T-Pk--
1	48201	2718	11427	1194
2	46986	2692	11451	1205
3	46225	2678	11468	1240
4	45964	2677	11556	1257
5	48732	2710	11452	1200
6	45972	2663	11413	1232
7	45926	2690	11512	1276
8	46519	2682	11420	1222
9	45078	2656	11427	1270
10	48054	2712	11260	1182
11	46271	2688	11342	1247
12	46442	2690	11357	1235
13	46228	2687	11265	1230
14	45603	2659	11292	1275
15	45989	2669	11169	1222
16	46042	2672	11187	1238
17	49446	2712	11103	1181
18	47596	2691	11227	1220
19	45690	2673	11267	1265
20	47322	2692	11289	1200S
20 Valid Rounds				
Mean	46714	2686	11344	1230
Std Dev	1152	18	123	30
Max	49446	2718	11556	1276
Min	45078	2656	11103	1181
Range	4368	62	454	95
Mean+3S	50171	2739	11714	1319
Mean-3S	43258	2632	10975	1140

11:06a Comment: C:\Data\TUE-66.DAT

DEHLER System 82 02/02/26-11:09p SlowFire Mode

11:09p Comment: C:\Data\TUE-67.DAT

Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 10:12 PM
ROB: 1525

AMB - WARNERS

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261 6836	28 100.000	-1519 6820	
1	52293	2670	8616	1293
2	52280	2680	8527	1295
3	51563	2675	8653	1349
4	50530	2660	8805	1379
5	53302	2690	8702	13028
5 Valid Rounds				
Mean	51993	2675	8661	1324
Std Dev	1026	11	103	39
Max	53302	2690	8805	1379
Min	50530	2660	8527	1293
Range	2772	30	278	86
Mean+3S	55071	2708	8970	1439
Mean-3S	48915	2641	8351	1208

11:13p Comment: C:\Data\TUE-67.DAT

DEHLIR System 82 02/02/26-11:13p SlowFire Mode

11:1lp Comment: C:\Data\TUE-68.DAT

Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 10:16 PM
ROB: 1530

AMB TEST

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261 6836	28 100,000	-1519 6820	
1	51849	2677	8818	1344
2	53942	2691	8731	1323
3	52674	2685	8720	1353
4	53672	2684	8776	1294
5	53501	2694	8650	1338
6	53035	2691	8679	1322
7	53454	2699	8668	1306
8	53496	2695	8701	1304
9	52944	2676	8721	1326
10	52587	2670	8725	1315
11	51910	2668	8878	1325
12	52457	2673	8808	1341
13	53127	2686	8767	1314
14	52250	2682	8740	1334
15	50957	2655	8955	1410
16	53908	2694	8777	1312
17	51546	2662	9006	1344
18	52223	2673	8962	1370
19	52924	2686	8939	1287
20	52184	2675	8987	1333
20 Valid Rounds				
Mean	52752	2681	8800	1330
Std Dev	841	12	114	27
Max	53942	2699	9006	1410
Min	50957	2655	8650	1287
Range	2986	45	356	122
Mean+3S	55274	2717	9142	1412
Mean-3S	50230	2645	8458	1247

11:35p Comment: C:\Data\TUE-68.DAT

OEHLE: System 82 02/02/26-11:35p SlowFire Mode

11:35: Comment: C:\Data\TUE-68.DAT AMB TEST - PG 2

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261 6836	28 100.000	-1519 6820	
21	53481	2686	8900	1329
22	52958	2681	8859	1280
23	51883	2661	8919	1357
24	54165	2695	9042	1314
25	52907	2671	8931	1290
26	51145	2667	9069	1342
27	52676	2670	8880	1328
28	54450	2694	8822	1268
29	51951	2686	9004	1342
30	52920	2676	8955	13455
30 Valid Rounds				
Mean	52786	2680	8846	1326
Std Dev	888	12	122	28
Max	54450	2699	9069	1410
Min	50957	2655	8650	1268
Range	3493	45	419	142
Mean+3S	55451	2715	9212	1412
Mean-3S	50121	2645	8481	1241

11:40p Comment: C:\Data\TUE-68.DAT

OEHLE: System 82 02/02/26-11:44p SlowFire Mode

11:44: Comment: C:\Data\TUE-69.DAT
Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 10:47 PM
ROB: 1570

+125 WARMERS

Round	1-P-Max-	1-Vel/TR	2-P-Max-	2-T-Pk--
	261 6836	28 100,000	-1519 6820	
1	55380	2730	8890	1292
2	57360	2729	8677	1297
3	57634	2734	8762	1262
4	56913	2727	8864	1327
5	57945	2730	8800	12879
5 Valid Rounds				
Mean	57046	2730	8799	1293
Std Dev	1006	2	85	23
Max	57945	2734	8890	1327
Min	55380	2727	8677	1262
Range	2565	6	213	66
Mean+3S	60064	2737	9053	1363
Mean-3S	54029	2723	8544	1223

11:49p Comment: C:\Data\TUE-69.DAT

OEHLIR System 82 02/02/26-11:49p SlowFire Mode

11:4'p Comment: C:\Data\TUE-70.DAT

Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 10:52 PM
ROB: 1575

+125 TEST

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261 / 6836	28 / 100.000	-1519 / 6820	
1	57815	2732	8777	1331
2	58617	2739	8772	1301
3	56757	2730	8910	1296
4	55780	2732	9009	1288
5	57700	2724	8839	1301
6	57473	2731	8868	1284
7	57576	2734	8704	1262
8	56094	2719	8893	1294
9	57415	2732	8887	1321
10	57456	2738	8743	1301
11	56892	2725	8818	1286
12	56831	2721	8820	1305
13	57010	2725	8866	1291
14	56585	2736	8835	1290
15	57489	2733	8854	1318
16	57201	2717	8779	1287
17	56542	2717	8870	1296
18	56617	2718	8904	1353
19	56566	2736	8808	1285
20	56673	2725	8885	1289
20 Valid Rounds				
Mean	57054	2728	8842	1299
Std Dev	655	7	68	20
Max	58617	2739	9009	1353
Min	55780	2717	8704	1262
Range	2837	22	305	90
Mean+3S	59020	2750	9048	1358
Mean-3S	55089	2707	8637	1240

10:00a Comment: C:\Data\TUE-70.DAT

OEHLER System 82 02/02/27-00:00a SlowFire Mode

00:00a Comment: C:\Data\TUE-70.DAT +125 TEST - PG 2

Round	261 6836 1-P-Max-	28 100.000 1-Vel/TA	-1519 6820 2-P-Max-	2-T-Pk--
21	55436	2718	8912	1288
22	57362	2731	8796	1277
23	56993	2738	8915	1328
24	56113	2726	8924	1326
25	56858	2726	8774	1342
26	57178	2727	8791	1287
27	58634	2728	8733	1346
28	57034	2727	8672	1306
29	56431	2726	8844	1316
30	58128	2755	8764	1286S
30 Valid Rounds				
Mean	57042	2729	8832	1303
Std Dev	739	8	74	22
Max	58634	2755	9009	1353
Min	55436	2717	8672	1262
Range	3198	38	338	90
Mean+3S	59259	2753	9055	1368
Mean-3S	54824	2704	8610	1237

00:05a Comment: C:\Data\TUE-70.DAT

OEHLER System 82 02/02/27-00:05a SlowFire Mode

00:05a Comment: C:\Data\TUE-71.DAT

Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 11:10 PM
ROB: 1605

-65 WARMERS

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261	28	-1519	
	6836	100.000	6820	
1	46816	2603	8847	1385
2	45873	2576	8878	1402
3	44736	2538	9032	1417
4	47344	2589	8917	1390
5	45908	2571	9091	1469S
5 Valid Rounds				
Mean	46135	2575	8953	1413
Std Dev	1000	24	104	34
Max	47344	2603	9091	1469
Min	44736	2538	8847	1385
Range	2609	65	244	84
Mean+3S	49136	2648	9265	1514
Mean-3S	43134	2503	8641	1312

00:11a Comment: C:\Data\TUE-71.DAT

OEHL:R System 82 02/02/27-00:11a SlowFire Mode

00:11a Comment: C:\Data\TUE-72.DAT

Lot Number: LC-CONTROL TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103145
P.P. Gauge#: 1110209
Time In: 02-26-02 3:10 PM
Time Fired: 02-26-02 11:15 PM
ROB: 1610

-65 TEST

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261 6836	28 100.000	-1519 6820	
1	46390	2586	8980	1402
2	44671	2568	9049	1383
3	47144	2593	8892	1360
4	45206	2571	9059	1369
5	44006	2552	9134	1446
6	45409	2571	9090	1415
7	46001	2592	9091	1381
8	44604	2550	9141	1495
9	45423	2581	9049	1373
10	44198	2549	9175	1435
11	46389	2601	8979	1371
12	47826	2602	8883	1350
13	44753	2561	9069	1442
14	45083	2584	9072	1406
15	43570	2560	9113	1443
16	46423	2597	8967	1376
17	45579	2573	9057	1409
18	48925	2617	8759	1260
19	45538	2576	9009	1431
20	48082	2608	8817	1362
20 Valid Rounds				
Mean	45761	2580	9019	1395
Std Dev	1411	20	110	49
Max	48925	2617	9175	1495
Min	43570	2549	8759	1260
Range	5354	68	416	235
Mean+3S	49993	2639	9350	1543
Mean-3S	41529	2520	8689	1248

00:25a Comment: C:\Data\TUE-72.DAT

OEHLER System 82 02/02/27-00:25a SlowFire Mode

00:25a Comment: C:\Data\TUE-72.DAT -65 TEST - PG 2

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	261 6836	28 100.000	-1519 6820	
21	46060	2592	9033	1408
22	46043	2580	9032	1390
23	47120	2607	8909	1374
24	48333	2611	8813	1314
25	44434	2561	9090	1415
26	44958	2573	9175	1432
27	49752	2650	9043	12751371F
28	45331	2588	9105	1399
29	46906	2602	9045	1371
30	47558	2610	8958	1326
31	45133	2561	9211	14716
30 Valid Rounds				
Mean	45903	2583	9025	1394
Std Dev	1357	20	112	48
Max	48925	2617	9211	1495
Min	43570	2549	8759	1260
Range	5354	68	452	235
Mean+3S	49973	2642	9360	1537
Mean-3S	41834	2524	8690	1250

00:34a Comment: C:\Data\TUE-72.DAT

ATK-5552 (3/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT

Nomenclature
CTG 7.62mm M62 NATO TRACER

Lot No. POWDER COAT ~~PAINT~~ CONTROL
DATE: 02-27-02

Type of Weapon	M60	M240	M14			M60	M240	M14
Number of Weapon	182143	U75349	470113			182143	U75349	470113
Gun Rounds	6700	21000	24820			6850	21150	24740
Number of Barrel	1	3	3			1	3	3
Barrel Rounds	6700	300	4480			6850	450	4600
Head Space	1.637	1.629	1.636			1.637	1.629	1.636
Pin Protrusion	0.038	0.031	0.050			0.038	0.031	0.050
Pin Indent	0.033	0.036	0.021			0.033	0.036	0.021
	—	—	—			—	—	—
*Cyclic Rate	591	724	766			583	702	754
Bay	10	4	8			10	4	8
TEMPERATURE OF TEST	AMB	AMB	AMB			+125	+125	+125
Rounds in Belt or Magazine	50/100	50/100	20			50/100	50/100	20
Rounds Fired	150	150	120			150	150	80
CASUALTIES								
Misfired								
Bullet Remaining in Bore								
Hangfire								
Primer Leak Small								
Primer Leak Large								
(A) Perforation								
(B) Dropped Primer								
(C) Loose Primer								
(D) Blown Primer								
CASE: LONGITUDINAL SPLIT								
(A) Neck & Shoulder (I & S)								
(B) Body (J)								
(C) Body (K)								
(D) To Head (L)								
(E) Thru Head (M)								
CASE: CIRCUM. RUPTURE								
(A) Partial (J & S)								
(B) Partial (K)								
(C) Partial (L)								
(D) Complete								
Failure to Extract								
Weapon Stoppage								
Bullet Disintegration								
Detached Metal								
Expansion of Mouth/Neck								
FUNCTION	OK	OK	OK			OK	OK	OK
Bullet Stripping								
**Screen Perforations								

***CYCLIC RATE M62 BLANK**
M60 - 450 min. M14 - 600 min. M240 - 650 min. Failure of any burst (of 1,040 rd. test), to meet specification shall be cause for 2nd sample (2,080 rounds). Any defect 2nd sample shall reject lot.

****SCREEN PERFORATION-At 15' shall not cause perforations of 0.1" or larger.**

	SS	Cum. SS	Cum. Accp.	Retest	Cum. Rej.
1st Sample	200	—	3	8	9
2nd Sample	400	600	6	—	9

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)
The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner Brushen - Jenkins - McKinley Recorder Hegemulle Foreman [illegible]

ATK-5552 (3/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT

Nomenclature
CTG 7.62mm M62 NATO TRACER

Lot No. POWDER COAT ~~PAINT~~ CONTROL
DATE: 02-27-02

Type of Weapon	M60	M240	M14					
Number of Weapon	182143	U75349	470113					
Gun Rounds	7000	21300	24820					
Number of Barrel	1	3	3					
Barrel Rounds	7000	600	4680					
Head Space	1.637	1.629	1.636					
Pin Protrusion	0.038	0.031	0.050					
Pin Indent	0.033	0.036	0.021					
	—	—	—					
*Cyclic Rate	609	735	764					
Bay	10	4	8					
TEMPERATURE OF TEST	-65	-65	-65					
Rounds in Belt or Magazine	50/100	50/100	20					
Rounds Fired	150	150	80					
CASUALTIES								
Misfired								
Bullet Remaining in Bore								
Hangfire								
Primer Leak Small								
Primer Leak Large								
(A) Perforation								
(B) Dropped Primer								
(C) Loose Primer								
(D) Blown Primer								
CASE: LONGITUDINAL SPLIT								
(A) Neck & Shoulder (I & S)								
(B) Body (J)								
(C) Body (K)								
(D) To Head (L)								
(E) Thru Head (M)								
CASE: CIRCUM. RUPTURE								
(A) Partial (J & S)								
(B) Partial (K)								
(C) Partial (L)								
(D) Complete								
Failure to Extract								
Weapon Stoppage								
Bullet Disintegration								
Detached Metal								
Expansion of Mouth/Neck								
FUNCTION	OK	OK	OK					
Bullet Stripping								
**Screen Perforations								

*CYCLIC RATE M82 BLANK

M60 - 450 min. M14 - 600 min. M240 - 650 min. Failure of any burst (of 1,040 rd. test), to meet specification shall be cause for 2nd sample (2,080 rounds). Any defect 2nd sample shall reject lot.

**SCREEN PERFORATION-At 15' shall not cause perforations of 0.1" or larger.

	SS	Cum. SS	Cum. Accp.	Retest	Cum. Rej.
1st Sample	200	—	3	8	9
2nd Sample	400	600	6	—	9

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [X] No [ ] 2ND SAMPLE Yes [ ] No [ ]

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner Brashear - Jenkins - McKeb Recorder Hergenrulle Foreman Delbie Wilson

ATK 5552A (2/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT - BLDG. 45

Nomenclature 7.62 mm TRACER M62

Lot No. LC-

Date 27 FEBRUARY 2002

Type of Weapon	M134		M134		M134				
Number of Weapon	3265A		3265A		3265A				
Gun Rounds	5150		5350		5550				
Number of Barrel	GP-1		GP-1		GP-1				
Barrel Rounds	5150		5350		5550				
Head Space									
Pin Protrusion									
Pin Indent									
*Cyclic Rate	6481		6365		6480				
Bay	6B		6B		6B				
TEMPERATURE OF TEST	+70		+125		-65				
Rounds in Belt or Magazine	200		200		200				
Rounds Fired	200		200		200				
Misfired	NONE		NONE		NONE				
Bullet Remaining in Bore									
Hangfire									
Primer Leak Small									
Primer Leak Large									
(A) Perforation									
(B) Dropped Primer									
(C) Loose Primer									
(D) Blown Primer									
CASE: LONGITUDINAL SPLIT									
(A) Neck & Shouldr (I & S)									
(B) Body (J)									
(C) Body (K)									
(D) To Head (L)									
(E) Thru Head (M)									
CASE: CIRCUM. RUPTURE									
(A) Partial (J & S)									
(B) Partial (K)									
(C) Partial (L)									
(D) Complete									
Failure to Extract									
Weapon Stoppage									
Bullet Disintegration									
Detached Metal									
Expansion of Mouth/Neck									
FUNCTION	OK		OK		OK				
Bullet Stripping									

*CYCLIC RATE: M80 BALL, M62 TRACER
M134 Automatic Gun - 6,000 rpm min.
200 rd. burst - cool to ambient between burst.

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)
CONT
Powder Control Paint Control Sample (2)

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner OHREM & GARY Recorder HATCHER Foreman [signature]

ATK 5533 5/00

ATK LCAAP

WATERPROOFNESS ACCEPTANCE REPORT

(Shall Not Release More Than One Bubble)

NOMENCLATURE: 7.62 m/m TRACER M-62

Lot No. ~~LOT~~ Powder Coat Control Sample

Date 2-26-02

1	OK	51	
2		52	
3		53	
4		54	
5	OK	55	
6	MF	56	
7	OK	57	
8		58	
9		59	
10		60	
11		61	
12		62	
13		63	
14		64	
15		65	
16		66	
17		67	
18		68	
19		69	
20		70	
21		71	
22		72	
23	OK	73	
24	MS	74	
25	OK	75	
26		76	
27	OK	77	
28	MF	78	
29	OK	79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50	OK	100	

ACCEPTANCE REQUIREMENT (AQL = 10)

	SS	Cum. SS	Cum. Accept	Retest	Cum. Reject
1ST SAMPLE	20	20	4	5-8	9
2ND SAMPLE	40	60	8	--	9

☐ 7-1/2 PSI for 30 Seconds
CAL. .50 M8 API, M20 API-T M33 BALL.

☐ 2 PSI for 15 Seconds -
5.56MM M200 BLANK,
7.62 MM M62 BLANK,
CAL. .50 M1A1 BLANK

☐ 5 PSI for 15 Seconds -
7.62MM Frangible M160

NUMBER OF DEFECTS

1st Sample _____

2nd Sample _____

Cumulative _____

(1st & 2nd)

ACCEPTANCE REQUIREMENT (AQL = 4.0)

	SS	Cum. SS	Cum. Accept	Retest	Cum. Reject
1st Sample	50	50	3	4-9	10
2nd Sample	100	150	9	--	10

☑ 7-1/2 psi for 30 seconds

5.56mm: M193, M196, M855, M856,
Heavy Bullet Reference, Reference

7.62mm : M62, M62-OHF, M80, M80-OHF, XM276
NATO Reference

Cal. .50: Reference.

NUMBER OF DEFECTS

1st Sample 3

2nd Sample _____

Cumulative 3

(1st & 2nd)

1ST ARTICLE ACCEPTANCE REQUIREMENTS

	SS	Accept	Reject
1st Sample			

NUMBER OF DEFECTS _____

RECORD TEST RESULTS:

MF - Fast Mouth Leaker
MS - Slow Mouth Leaker
HF - Fast Head Leaker
HS - Slow Head Leaker

REMARKS

IS THE TEST ACCEPTABLE?

1st Sample: Yes ☒ No ☐

2nd Sample: Yes ☐ No ☐

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

Gunner: Reynolds

Foreman: Debbie Wilson

ATK-5530 (10/01) ATK

BULLET EXTRACTION ACCEPTANCE REPORT

NOMENCLATURE 7.62mm TRACER M62

LOT NO. LC-POWDER CONT CONTROL

DATE 2-26-02

	CIRCLE ANY DEFECT		
1	22	51	
2	158	52	
3	12	53	
4	121	54	
5	10	55	
6	120	56	
7	16	57	
8	128	58	
9	04	59	
10	121	60	
11	18	61	
12	160	62	
13	28	63	
14	137	64	
15	52	65	
16	129	66	
17	20	67	
18	185	68	
19	65	69	
20	98	70	
21	36	71	
22	135	72	
23	32	73	
24	130	74	
25	18	75	
26		76	
27		77	
28		78	
29		79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	

ACCEPTANCE REQUIREMENT

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	25	25	0	1	2
2nd Sample	50	75	1	---	2

- [ ] 35 lbs. minimum - 5.56mm Ball M193, Tracer M196
- [✓] 60 lbs. minimum - 7.62mm ~~Tracer M62~~ Ball M80, Dim Tracer M276
- [ ] 200 lbs. minimum - Cal. .50 API M8, Tracer M17, APIT M20, Ball M33, MARK 257 API Dim Tracer

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	25	25	0	1 - 2	3
2nd Sample	50	75	2	---	3

- [ ] 20 lbs. minimum - 7.62mm M118 Special Ball Long Range M118
- [ ] 45 lbs. minimum - 5.56mm Ball M855, Tracer M856

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	20	20	0	1	2
2nd Sample	40	60	1	—	2

- [ ] 20 lbs. minimum - 7.62mm Special Ball M118 (not L.R.), Match M852
- [ ] 200 lbs. minimum - Cal. .50 MARK 211 API

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	50	50	0	1	2
2nd Sample	100	150	1	---	2

- [ ] 60 lbs. minimum - 7.62mm Trace OHF M62, Ball OHF M80
- [ ] 175 lbs. minimum - 7.62mm Inert M172
- [ ] 200 lbs. minimum - Cal. .50 Dummy M2

SPECIAL SAMPLE SIZE FOR FIRST ARTICLES

	Cartridge Type	Minimum Pull	Sample Size	Accept	Reject
[ ]	5.56mm Ball M855	45 lbs.	75	2	3
[ ]	5.56mm Tracer M856	45 lbs.	75	2	3
[ ]	7.62mm M852	20 lbs.	20	0	1
[ ]	Cal. .50 Tracer M17	200 lbs.	50	1	2
[ ]	Cal. .50 Ball M33	200 lbs.	50	1	2

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

Average Pull 131

Maximum Pull 185

Minimum Pull 98

NUMBER OF DEFECTS

1st Sample 0

2nd Sample

Cumulative (1st/2nd)

IS THE TEST ACCEPTABLE?

1st Sample Yes [✓] No [ ]

2nd Sample Yes [ ] No [ ]

CALIBER .50 SPOTTER TRACER M48A2:

Are the Flash Tube and Lacquer Acceptable? Yes [ ] No [ ]

Gunner S. Gibson/Wood

Foreman [signature]

...K 5534 5/00

ATK LCAAP

RESIDUAL STRESS ACCEPTANCE REPORT

(SUBJECT TO 1.0% MERCUROUS NITRATE 15 MIN. RECORD LOCATION OF CRACK/SPLIT & ATTACH OLC 5344.)

NOMENCLATURE: 7.62 M/M TRACER M-62

LOT NO. ~~to~~ Powder Coat Control Sample

DATE 2-27-02

1	OK	26	OK	51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25	OK	50	OK	75		100	

ACCEPTANCE REQUIREMENTS

M193, M195, M196, M197, M200, M855, M856
M62, M62 OHF, M80, M80 OHF, M82, M276,
M1, M6, M17, M20, M33, M1A1,
5.56MM REF., 5.56MM HEAVY BULLET REF.:

	SS	CUM SS	CUM ACCEPT	RETEST	CUM REJECT
1st Sample	50	50	0	1	2
2nd Sample	100	150	1	--	2

M160, M172, M852, M118, 7.62MM NATO REF.,
CAL. .50 REF., CAL. .50 DUMMY M2:

	SS	CUM SS	CUM ACCEPT	RETEST	CUM REJECT
1st Sample	20	20	0	1	2
2nd Sample	40	60	1	--	2

	# TESTED	# SPLITS	LOCATION
COMPLETE CTG.	25	0	
PULLDOWN CASE	25	0	
NO. OF SPLITS 1st SAMPLE		0	
NO. OF SPLITS AND SAMPLE			

1ST ARTICLE ACCEPTANCE REQUIREMENTS

* CALIBER _____

	SS	ACCEPT	REJECT
1st SAMPLE			
NUMBER OF SPLITS			
LOCATION			

* SEE CURRENT SPECIFICATION FOR FIRST ARTICLE REQUIREMENTS

IS TEST ACCEPTABLE?

1st SAMPLE: YES [X] NO [ ]

2nd SAMPLE: YES [ ] NO [ ]

REMARKS

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

GUNNER Reynolds GUNNER _____ FOREMAN [signature]

OLC 5556
(8-25-86)

OLIN CORPORATION-Lake City Army Ammunition Plant
7.62MM TRACE TEST ACCEPTANCE REPORT
M62 Powder Coat Paint Control Sample

Nomenclature: 7.62MM TRACER, M62

~~Lot No: LCA:~~

Date: 27 February 2002

WEAPON TYPE	RECEIVER NUMBER	BARREL NUMBER		HEADSPACE		TIMES FIRED	
M60	139497	23H	25H	1.635	1.633	5578	4829
T65	333013	3	4	1.637	1.633	4704	3891

WARMERS-BARREL # 23H					WARMERS-BARREL # 25H					WARMERS-BARREL # 3					WARMERS-BARREL # 4				
1					1					1					1				
2					2					2					2				
3					3					3					3				

M60

TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

T65

TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

OBSERVATIONS AT GUN
INFORMATIONAL ONLY

CHARGEABLE DEFECTS
E - EARLY (BRIGHT) @ 15 YDS.
B - BLIND @ 100 OR 850 YDS.
D - DIM @ 100 OR 850 YDS.

INFORMATIONAL ONLY
F - MUZZLE FLASH
ERF - ERRATIC FLIGHT
BB - BULLET BURST

NO NOTATION MEANS NO DEFECT

OLC 55.9

OLIN CORPORATION-Lake City Army Ammunition Plant

5.56MM & 7.62MM BULLET INTEGRITY ACCEPTANCE REPORT

(Performed in conjunction with trace test) (Screen at 50 feet from muzzle)

Nomenclature: M62 Powder Coat Paint Control Sample

Lot No. ~~10~~

Date: 27 February 2002

RECEIVER NUMBER	BARREL NUMBER	TIMES FIRED	HEADSPACE	WEAPON TYPE
139497	23H 25H	5578 7829	1.635 1.633	M60
333013	3 4	4704 3891	1.637 1.633	T63

139497 WEAPON NO. 139497

BARREL 23H

Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

Screen OK

Screen OK

333013 WEAPON NO. 333013

BARREL 3

Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

Screen OK

Screen OK

WARMERS BBL #23H
1
2
3

WARMERS BBL #25H
1
2
3

WARMERS BBL #3
1
2
3

WARMERS BBL #4
1
2
3

ACCEPTANCE REQUIREMENTS

SHALL NOT BURST IN ITS PASSAGE THROUGH THE BARREL NOR SHALL THE JACKET OR ANY PART STRIP FROM THE SLUG WHEN FIRED.

☒ 7.62MM M62 & M62 CHF

Each weapon 100 rds. Failure of any cartridge shall reject the lot. No second sample permitted.

☐ 5.56MM M196

1st Sample-100 rds.
2nd Sample-200 rds.

Cum. Acc.	Retest	Cum. Rej.
0	1-3	4
3	-	4

TARGET SCREEN OBSERVATIONS

No. of Holes 200

Location of Holes Centr

Type of Holes normal

TEST RESULTS

No. Fired 200

No. & Type of Defects 0

Case Casualties 0

Observer at 15 Yards Vicke — Gunner ROSS

Observer at 100 Yards Angie — Gunner Jerry

Observer at 850 Yards Don — Foreman [signature]

IS TEST ACCEPTABLE?

1st Sample: Yes ☒ No ☐

2nd Sample: Yes ☐ No ☐

ACCURACY TEST

Test #: PROCESS Cartridge Type: M-62

Date Produced: // Shift Produced:

Primer Lot: Gunner: ATKINSON Plotter: WAHN

Powder Type: Powder Lot: Powder Charge:

Range #: 6A Range Length: 600 Wind Vel: 4-6 Wind Direction: 290

General Condition: CLEAR TEMP.31 Barometric Pressure: 30.38

Remarks:
MR=15.0 CONTROL
POWDER COAT PAINT ~~CONTROL~~ SAMPLE

Unit No	Arm No	RFTD	No Rds Fired	Mean Radius	Horz Stand Dev	Vert Stand Dev	Ext Vert	Ext Horz	Ext Sprd
HS1.628	3742254	6280	10	8.07	5.86	6.82	18.05	17.25	23.30
BBL.#2			10	6.55	5.32	4.89	14.60	15.85	17.60
			10	7.10	3.29	7.47	24.15	9.20	24.20
HS1.630	4004587	3585	10	4.28	3.55	3.67	13.75	10.60	14.25
BBL.#2			10	3.44	3.50	1.81	5.20	9.35	10.50
			10	4.14	3.80	3.12	9.75	12.40	12.65
HS1.629	3477891	3860	10	4.88	2.82	4.77	15.35	7.20	15.50
BBL.#2			10	7.09	6.89	3.95	11.45	22.65	22.70
			10	5.83	4.11	4.90	13.60	11.65	15.45
AVERAGE				5.71	4.35	4.60			

FOREMAN Gary Cuellar Wed Feb 27 2002 05:19 PM

BALLISTIC TESTING
REDUCED TEST

ITEM: 7.62mm CTG. NATO Tracer, M62

LOT NO: 7.62mm M62 POWDER COAT

Accepted ☐ Rejected ☐

1st Sample ☐ 2nd Sample ☐

DATE: _____

CHARLIE MORAN + ADAM SWERINGEN

Date Presented: ☐

Quantity Packed:

Propellant:

Primer Lot Nos.

A.L. Numbers	Charge (Grs.)

FIRING TESTS	Rds Fired	Record	Spec. Limits
Velocity @ 78' (F.S.)			
Corrected Avg. (70°)	30	2670	2,665 ± 30
Standard Deviation	XX	11	32 Max.
125°	30	54	+150 from Avg.
-65°	30	-89	-250 from Avg.
Chamber Pressure (PSI)			
Corrected Avg. (70°)	XX	52488	Max 52,940
Max Reading (70°)	XX	54249	58,016
Avg. +3σ (70°)	XX	54757	58,016
125°	XX	3873	+7,252
-65°	XX	-6207	-14,054
Port Pressure			7,977 Min 10,588 Max
Corrected Avg. (70°)	XX	8869	
Action Time			
Max Individual	XX	1.408	4.0
Trace Performance @ 850 yds			
M60	100	96%	80
T65E1	100	100%	80
*Bullet Integrity	XX	0	
Accuracy (Inch) @ 600 yds.			Max. Avg.
Avg. Mean Radii	90	5.15	15.0

FIRING TESTS

Function	70°	125°	-65°	Record
Machine Gun				
M60	150	150	150	0
M240	150	150	150	1
M134	200	200	200	0
Rifle				
M14	120	80	80	0

Casualties: 1 large primer leaker on M240 @ +125

NON-FIRING TESTS

		Number Tested	Record	Spec. Limits
Cartridge	1st Sample	50	8	3
Waterproof (Vac)	Cumulative	150	21	9
Case - Residual Stress				
(Mercurous Nitrate)	1st Sample	50	0	0
	Cumulative	150		1

Bullet Extraction (Min 60 lbs.)	Tested	Min.	Max.	Avg.	Spec. Limits
1St Sample	25	99	194	137	0
Cumulative	75				1

Correction Applied
Velocity 28
Chamber Pressure -121
Port Pressure -988

*Bullet Integrity fired simultaneously with Trace Performance.

Retest Required _____ Allowed _____ Released _____

TUKON: _____ TIME: _____ RELEASED BY: _____

DEHLER System 82 02/02/26-04:47p SlowFire Mode

04:47p Comment: C:\Data\TUE-51.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Day#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 3:55 PM
ROB: 1370

WARMERS / REF

Round	1-P-Max- (0 / 6923)	1-Vel/TA (0 / 100,000)	2-P-Max- (0 / 6277)	2-T-Pk--
1	49970	2702	10319	1458
2	50278	2729	10335	1395
3	51211	2716	10341	1361
4	51182	2718	10216	1439
5	52542	2714	10092	14156
5 Valid Rounds				
Mean	51037	2716	10261	1414
Std Dev	1004	10	107	38
Max	52542	2729	10341	1458
Min	49970	2702	10092	1361
Range	2572	27	250	98
Mean+3S	54048	2745	10582	1528
Mean-3S	48025	2687	9939	1300

04:57p Comment: C:\Data\TUE-51.DAT

THE MATERIAL HEREIN WAS TESTED, IN ACCORDANCE WITH THE PROVISIONS OF THE GOVERNMENT APPROVED QUALITY ASSURANCE SYSTEM.

Debbie Wilson

OEHLER System 82 02/02/26-05:13p SlowFire Mode

05:13p Comment: C:\Data\TUE-53.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 4:16 PM
ROB: 1385

REFERENCE LOT LC-86J000R009

Found	1-P-Max- (0 / 6923)	1-Vel/TA (0 / 100.000)	2-P-Max- (0 / 6277)	2-T-Pk--
1	46995	2687	10822	1202
2	47604	2690	11015	1223
3	47435	2691	10930	1242
4	47713	2692	10891	1206
5	45645	2662	10986	1252
6	46941	2686	10861	1241
7	46420	2674	10715	1259
8	47589	2703	10862	1254
9	47611	2699	10757	1214
10	47949	2699	10767	1204
11	46851	2685	10776	1236
12	46313	2675	10986	1235
13	47727	2694	10746	1195
14	46382	2675	10687	1276
15	46685	2684	10801	1253
16	47770	2689	10731	1218
17	47999	2698	10809	1229
18	45647	2668	10748	1266
19	47630	2696	10742	1250
20	47012	2679	10624	1232S
20 Valid Rounds				
Mean	47096	2686	10813	1234
Std Dev	725	11	106	23
Max	47999	2703	11015	1276
Min	45645	2662	10624	1195
Range	2354	41	391	81
Mean+3S	49272	2720	11131	1303
Mean-3S	44920	2653	10494	1166

05:2 p Comment: C:\Data\TUE-53.DAT

OEHLER System 82 02/02/26-05:34p SlowFire Mode

05:54p Comment: C:\Data\TUE-56.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 4:55 PM
ROB: 1410

AMB - WARMERS

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121 6923	28 100.000	-988 6277	
1	53136	2671	8900	1305
2	51412	2660	8966	1377
3	53631	2676	8892	1300
4	51582	2654	8947	1334
5	51305	2645	8916	13255
5 Valid Rounds				
Mean	52213	2661	8924	1328
St. Dev	1087	13	31	31
Max	53631	2676	8966	1377
Min	51305	2645	8892	1300
Range	2326	31	74	77
Mean+3S	55474	2699	9018	1420
Mean-3S	48952	2623	8830	1236

05:56p Comment: C:\Data\TUE-56.DAT

OEHLE? System 82 02/02/26-05:56p SlowFire Mode

05:56 Comment: C:\Data\TUE-57.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 5:00 PM
ROB: 1415

AMB - TEST

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121	28	-988	
	6923	100.000	6277	
1	52487	2669	8953	1328
2	52871	2659	8831	1347
3	53229	2681	8848	1339
4	51814	2650	9013	1327
5	52769	2674	8931	1307
6	52516	2681	8898	1342
7	52210	2658	8955	1362
8	53110	2684	8923	1302
9	51900	2661	8859	1378
10	52322	2665	8914	1319
11	51744	2672	8809	1378
12	51831	2649	8903	1333
13	52331	2662	8878	1357
14	53006	2676	8743	1301
15	50768	2657	8908	1350
16	53061	2684	8809	1276
17	54249	2686	8671	1322
18	51639	2671	8857	1338
19	51590	2656	8814	1351
20	53326	2691	8927	1353
20 Valid Rounds				
Mean	52439	2669	8872	1336
Std Dev	792	13	79	26
Max	54249	2691	9013	1378
Min	50768	2649	8671	1276
Range	3481	42	342	102
Mean+3S	54814	2707	9109	1414
Mean-3S	50063	2632	8635	1257

06:1 p Comment: C:\Data\TUE-57.DAT

DEHLE! System 82 02/02/26-06:11p SlowFire Mode

06:11p Comment: C:\Data\TUE-57.DAT AMB TEST - PG 2

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121 6923	28 100,000	-988 6277	
21	52601	2677	8798	1354
22	53345	2683	8771	1295
23	52149	2667	9008	1348
24	52501	2665	8851	1368
25	52525	2661	8776	1310
26	52452	2676	8986	1366
27	50960	2655	9054	1408
28	53401	2679	8909	1315
29	52701	2664	8710	1330
30	53231	2674	8762	1330S
30 Valid Rounds				
Mean	52488	2670	8869	1338
Std Dev	756	11	92	28
Max	54249	2691	9054	1408
Min	50768	2649	8671	1276
Range	3481	42	383	132
Mean+3S	54757	2703	9146	1423
Mean-3S	50219	2636	8592	1253

06:1!p Comment: C:\Data\TUE-57.DAT

OEHLE System 82 02/02/26-06:42a SlowFire Mode

06:43 Comment: C:\Data\TUE-5B.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Day#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 5:45 PM
ROB: 1440

+125 WARMERS

	-121	28	-988	
	6923	100,000	6277	
Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
1	54754	2724	8853	1299
2	58001	2746	8642	1327
3	58281	2742	8683	1230
4	57319	2733	8690	1323
5	58330	2736	8621	1310S
5 Valid Rounds				
Mean	57337	2736	8698	1298
Std Dev	1499	9	91	40
Max	58330	2746	8853	1327
Min	54754	2724	8621	1230
Range	3576	23	232	98
Mean+3S	61835	2762	8972	1417
Mean-3S	52840	2710	8424	1179

06:48 Comment: C:\Data\TUE-5B.DAT

DEHLER System 82 02/02/26-06:48p SlowFire Mode

06:48p Comment: C:\Data\TUE-59.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 5:52 PM
ROB: 1445

+125 TEST

Found	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121	28	-988	
	6923	100,000	6277	
1	55893	2713	8727	1290
2	56158	2708	8672	1326
3	56341	2718	8694	1322
4	58603	2739	8679	1322
5	55491	2700	8906	1354
6	57269	2725	8685	1341
7	57208	2742	8699	1288
8	56620	2736	8781	1293
9	56918	2722	8664	1329
10	57314	2717	8785	1360
11	55235	2719	8856	1351
12	56423	2727	8836	1278
13	56014	2731	8768	1336
14	56095	2717	8890	1308
15	55690	2733	8865	1318
16	55185	2721	8857	1340
17	57136	2736	8734	1316
18	58221	2754	8693	1309
19	56348	2739	8865	1298
20	55708	2716	8991	1294
20 Valid Rounds				
Mean	56494	2726	8782	1319
Std Dev	926	13	95	24
Max	58603	2754	8991	1360
Min	55185	2700	8664	1278
Range	3418	54	326	82
Mean+3S	59272	2765	9068	1390
Mean-3S	53715	2686	8496	1247

07:02p Comment: C:\Data\TUE-59.DAT

OEHLER System 82 02/02/26-07:02p SlowFire Mode

07:02p Comment: C:\Data\TUE-59.DAT +125 TEST - PG 2

Found	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121	28	-988	
	6923	100,000	6277	
21	57378	2728	8818	1305
22	56532	2714	8948	1306
23	56959	2733	8886	1305
24	57241	2733	8853	1263
25	54967	2705	8894	1326
26	54190	2715	8952	1383
27	56083	2726	8970	1333
28	54567	2702	9008	1362
29	56180	2725	8900	1298
30	56857	2722	8922	13255
30 Valid Rounds				
Mean	56361	2724	8827	1319
Std Dev	1001	13	105	27
Max	58603	2754	9008	1383
Min	54190	2700	8664	1263
Range	4413	54	344	120
Mean+3S	59365	2761	9141	1400
Mean-3S	53357	2686	8512	1238

07:08p Comment: C:\Data\TUE-59.DAT

DEHLER System 82 02/02/26-08:51p SlowFire Mode

08:51p Comment: C:\Data\TUE-60.DAT

Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 7:54 PM
ROB: 1475

-65 WARMERS

	-121	28	-988	
	6923	100.000	6277	
Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
1	51940	2677	8861	1317
2	51061	2665	8892	1378
3	50249	2657	9054	1349
4	49294	2641	9052	1348
5	49552	2642	9055	13565
5 Valid Rounds				
Mean	50419	2656	8983	1349
Std Dev	1092	15	98	22
Max	51940	2677	9055	1378
Min	49294	2641	8861	1317
Range	2646	36	195	61
Mean+3S	53696	2702	9276	1415
Mean-3S	47142	2610	8689	1284

09:01p Comment: C:\Data\TUE-60.DAT

OEHLER System 82 02/02/26-09:01p SlowFire Mode

09:01p Comment: C:\Data\TUE-61.DAT
Lot Number: LC-POWDER TEST
Cal: 7.62 M62 TRACER
BBL#: VP762-40
Rec#: 83466
H.S.: 1.628
Bay#: 4

Gunner: DEAL
C.P. Gauge#: 1103140
P.P. Gauge#: 1112786
Time In: 02-26-02 1:45 PM
Time Fired: 02-26-02 8:03 PM
ROB: 1480

-65 TEST

Round	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121 6923	28 100.000	-988 6277	
1	47411	2587	8923	1383
2	46604	2597	8966	1332
3	46092	2584	9040	1402
4	45813	2574	9082	1381
5	46912	2572	9041	1422
6	46286	2580	9014	1363
7	45450	2574	9104	1399
8	46230	2575	9027	1429
9	43923	2552	9143	1448
10	45893	2586	9044	1367
11	47546	2591	8890	1374
12	45242	2574	9152	1440
13	47116	2588	9041	1377
14	46419	2579	9126	1422
15	47066	2588	9010	1319
16	45830	2581	9022	1342
17	45505	2583	9027	1350
18	45328	2568	9058	1461
19	49479	2614	8740	1358
20	44027	2554	9065	1427
20 Valid Rounds				
Mean	46209	2580	9026	1390
Std Dev	1243	14	94	41
Max	49479	2614	9152	1461
Min	43923	2552	8740	1319
Range	5556	62	413	142
Mean+3S	49938	2621	9307	1511
Mean-3S	42479	2539	8744	1268

09:16p Comment: C:\Data\TUE-61.DAT

OEHLER System 82 02/02/26-09:16p SlowFire Mode

09:16p Comment: C:\Data\TUE-61.DAT -65 TEST - PG 2

Found	1-P-Max-	1-Vel/TA	2-P-Max-	2-T-Pk--
	-121 6923	28 100.000	-988 6277	
21	46029	2583	9038	1386
22	46909	2592	9021	1401
23	47116	2581	8981	1429
24	46556	2595	9022	1430
25	47464	2597	8944	1344
26	44316	2546	9091	1410
27	45893	2570	9069	1432
28	47066	2584	9049	1375
29	46964	2590	8950	1356
30	45941	2580	9018	1428S
30 Valid Rounds				
Mean	46281	2581	9023	1393
Std Dev	1134	14	81	38
Max	49479	2614	9152	1461
Min	43923	2546	8740	1319
Range	5556	69	413	142
Mean+3S	49684	2622	9265	1506
Mean-3S	42878	2539	8781	1280

09:23p Comment: C:\Data\TUE-61.DAT

ATK-5552 (3/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT

Nomenclature CTG 7.62mm M62 NATO TRACER

Lot No. POWDER COAT BULLET

DATE: 02-27-02

Type of Weapon	M60	M240	M14			M60	M240	M14
Number of Weapon	182143	U75349	470113			182143	U75349	470113
Gun Rounds	7150	21450	24900			7300	21800	25020
Number of Barrel	1	3	3			1	3	3
Barrel Rounds	7150	750	4780			7300	900	4880
Head Space	1.637	1.629	1.636			1.637	1.629	1.636
Pin Protrusion	0.038	0.031	0.050			0.038	0.031	0.050
Pin Indent	0.033	0.036	0.021			0.033	0.036	0.021
*Cyclic Rate	589	654	760			588	642	691
Bay	10	4	8			10	4	8
TEMPERATURE OF TEST	AMB	AMB	AMB			+125	+125	+125
Rounds in Belt or Magazine	50/100	50/100	20			50/100	50/100	20
Rounds Fired	150	150	120			150	150	80
CASUALTIES								
Misfired								
Bullet Remaining in Bore								
Hangfire								
Primer Leak Small								
Primer Leak Large							0	
(A) Perforation								
(B) Dropped Primer								
(C) Loose Primer								
(D) Blown Primer								
CASE: LONGITUDINAL SPLIT								
(A) Neck & Shoulder (I & S)								
(B) Body (J)								
(C) Body (K)								
(D) To Head (L)								
(E) Thru Head (M)								
CASE: CIRCUM. RUPTURE								
(A) Partial (J & S)								
(B) Partial (K)								
(C) Partial (L)								
(D) Complete								
Failure to Extract								
Weapon Stoppage								
Bullet Disintegration								
Detached Metal								
Expansion of Mouth/Neck								
FUNCTION	ok	ok	ok			ok	ok	ok
Bullet Stripping								
**Screen Perforations								

***CYCLIC RATE M62 BLANK**

M60 - 450 min. M14 - 600 min. M240 - 650 min. Failure of any burst (of 1,040 rd. test), to meet specification shall be cause for 2nd sample (2,080 rounds). Any defect 2nd sample shall reject lot.

****SCREEN PERFORATION-At 15' shall not cause perforations of 0.1" or larger.**

	ss	Cum. ss	Cum. Accp.	Retest	Cum. Rej.
1st Sample	200	—	3	8	9
2nd Sample	400	600	8	—	9

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner [illegible] Recorder [illegible] Foreman [illegible]

ATK-5552 (3/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT

Nomenclature				Lot No. POWDER COAT BULLET				
CTG 7.62m/m M62 NATO TRACER				DATE: 02-27-02				
Type of Weapon	M60	M240	M14					
Number of Weapon	182143	U75349	470113					
Gun Rounds	7450	21750	25100					
Number of Barrel	1	3	3					
Barrel Rounds	7450	1050	4960					
Head Space	1.637	1.629	1.636					
Pin Protrusion	0.038	0.031	0.050					
Pin Indent	0.033	0.036	0.021					
*Cyclic Rate	606	764	780					
Bay	10	4	8					
TEMPERATURE OF TEST	-65	-65	-65					
Rounds in Belt or Magazine	50/100	50/100	20					
Rounds Fired	150	150	80					
CASUALTIES								
Misfired								
Bullet Remaining in Bore								
Hangfire								
Primer Leak Small								
Primer Leak Large								
(A) Perforation								
(B) Dropped Primer								
(C) Loose Primer								
(D) Blown Primer								
CASE: LONGITUDINAL SPLIT								
(A) Neck & Shoulder (I & S)								
(B) Body (J)								
(C) Body (K)								
(D) To Head (L)								
(E) Thru Head (M)								
CASE: CIRCUM. RUPTURE								
(A) Partial (I & S)								
(B) Partial (J)								
(C) Partial (K)								
(D) Complete								
Failure to Extract								
Weapon Stoppage								
Bullet Disintegration								
Detached Metal								
Expansion of Mouth/Neck								
FUNCTION	ok	ok	ok					
Bullet Stripping								
**Screen Perforations								

*CYCLIC RATE M62 BLANK

M60 - 450 min. M14 - 600 min. M240 - 650 min. Failure of any burst (of 1,040 rd. test) to meet specification shall be cause for 2nd sample (2,080 rounds). Any defect 2nd sample shall reject lot.

**SCREEN PERFORATION-At 15' shall not cause perforations of 0.1" or larger.

	pc	Cum. ss	Cum. Accp.	Retest	Cum. Rej.
1st Sample	200	—	3	6	9
2nd Sample	400	600	6	—	9

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner [signature] Recorder [signature] Foreman [signature]

ATK 5882A (2/01) ATK

7.62MM FUNCTION & CASUALTY ACCEPTANCE REPORT - BLDG. 45

Lot No. LC-

Date 27 FEBRUARY 2002

Nomenclature 7.62 mm TRACER M62

Type of Weapon	M134		M134		M134				
Number of Weapon	3265A		3265A		3265A				
Gun Rounds	4550		4750		4950				
Number of Barrel	GP-1		GP-1		GP-1				
Barrel Rounds	4550		4750		4950				
Head Space									
Pin Protrusion									
Pin Indent									
*Cyclic Rate	6470		6372		6386				
Bay	6B		6B		6B				
TEMPERATURE OF TEST	+70		+125		-65				
Rounds in Belt or Magazine	200		200		200				
Rounds Fired	200		200		200				
Misfired	NONE		NONE		NONE				
Bullet Remaining in Bore									
Hangfire									
Primer Leak Small									
Primer Leak Large									
(A) Perforation									
(B) Dropped Primer									
(C) Loose Primer									
(D) Blown Primer									
CASE: LONGITUDINAL SPLIT									
(A) Neck & Shouldr (I & S)									
(B) Body (J)									
(C) Body (K)									
(D) To Head (L)									
(E) Thru Head (M)									
CASE: CIRCUM. RUPTURE									
(A) Partial (J & S)									
(B) Partial (K)									
(C) Partial (L)									
(D) Complete									
Failure to Extract									
Weapon Stoppage									
Bullet Disintegration									
Detached Metal									
Expansion of Mouth/Neck									
FUNCTION	OK		OK		OK				
Bullet Stripping									

*CYCLIC RATE: M80 BALL, M62 TRACER
M134 Automatic Gun - 6,000 rpm min.
200 rd. burst - cool to ambient between burst.

REMARKS (LIST ANY FUNCTION & CASUALTY DEFECTS FROM OTHER FIRING TESTS)
POWDER COAT BULLET SAMPLE (1)

IS THE FUNCTION & CASUALTY TEST ACCEPTABLE?

1ST SAMPLE Yes [✓] No [ ] 2ND SAMPLE Yes [ ] No [ ]

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance system.

Gunner EHREM L GRAY Recorder Hatches Foreman

ATK 5533 5/00

ATK ALLIANT TECHSYSTEMS LCAAP

WATERPROOFNESS ACCEPTANCE REPORT

(Shall Not Release More Than One Bubble)

NOMENCLATURE 7.62 m/m TRACER M-62

Lot No. Powder Coat Bullet Sample

Date 2-26-02

1	OK	51	
2	"	52	
3	"	53	
4	OK	54	
5	MS	55	
6	OK	56	
7	"	57	
8	"	58	
9	OK	59	
10	MS	60	
11	MF	61	
12	OK	62	
13	"	63	
14		64	
15		65	
16		66	
17		67	
18		68	
19		69	
20		70	
21		71	
22		72	
23		73	
24		74	
25		75	
26		76	
27		77	
28		78	
29		79	
30		80	
31	OK	81	
32	MS	82	
33	OK	83	
34	"	84	
35	"	85	
36	OK	86	
37	MS	87	
38	MF	88	
39	OK	89	
40	MS	90	
41	OK	91	
42	"	92	
43	"	93	
44	"	94	
45	OK	95	
46	MF	96	
47	OK	97	
48	"	98	
49	"	99	
50	OK	100	

ACCEPTANCE REQUIREMENT (AQL = 10)

	ss	Cum. ss	Cum. Accept	Retest	Cum. Reject
1ST SAMPLE	20	20	4	5-8	9
2ND SAMPLE	40	60	8	--	9

☐ 7-1/2 PSI for 30 Seconds
CAL. .50 M8 API, M20 API-T M33 BALL.

☐ 2 PSI for 15 Seconds -
5.56MM M200 BLANK,
7.62 MM M82 BLANK,
CAL. .50 M1A1 BLANK

☐ 5 PSI for 15 Seconds -
7.62MM Frangible M160

NUMBER OF DEFECTS

1st Sample _____

2nd Sample _____

Cumulative _____

(1st & 2nd)

ACCEPTANCE REQUIREMENT (AQL = 4.0)

	ss	Cum. ss	Cum. Accept	Retest	Cum. Reject
1st Sample	50	50	3	4-9	10
2nd Sample	100	150	9	--	10

☑ 7-1/2 psi for 30 seconds

5.56mm: M193, M196, M855, M856,
Heavy Bullet Reference, Reference

7.62mm: M62, M62-OHF, M80, M80-OHF, XM276
NATO Reference

Cal. .50: Reference.

NUMBER OF DEFECTS

1st Sample 8

2nd Sample _____

Cumulative _____

(1st & 2nd) _____

1ST ARTICLE ACCEPTANCE REQUIREMENTS

	ss	Accept	Reject
1st Sample			

NUMBER OF DEFECTS _____

RECORD TEST RESULTS:

MF - Fast Mouth Leaker
MS - Slow Mouth Leaker
HF - Fast Head Leaker
HS - Slow Head Leaker

REMARKS

IS THE TEST ACCEPTABLE?

1st Sample: Yes ☐ No ☒

2nd Sample: Yes ☐ No ☐

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

Reynolds
Gunner

Delbie Wilson
Foreman

ATK 553.3 5/00

ATK LCAAP

WATERPROOFNESS ACCEPTANCE REPORT

(Shall Not Release More Than One Bubble)

NOMENCLATURE: 7.62 m/m TRACER M-62 (RETEST)

Lot No. Powder Coat Bullet Sample

Date 2-26-02

1	OK	51	OK
2		52	
3		53	
4		54	
5		55	OK
6		56	MS
7		57	OK
8		58	MF
9		59	OK
10	OK	60	MF
11	MS	61	MS
12	OK	62	MF
13		63	OK
14		64	OK
15		65	MS
16	OK	66	MF
17	MS	67	OK
18	OK	68	MF
19		69	OK
20		70	
21		71	
22		72	
23		73	
24		74	
25		75	
26		76	
27		77	
28		78	
29		79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	OK
43		93	MF
44		94	OK
45		95	
46		96	
47	OK	97	
48	MF	98	
49	OK	99	OK
50	OK	100	MS

ACCEPTANCE REQUIREMENT (AQL = 10)

	ss	Cum. ss	Cum. Accept	Retest	Cum. Reject
1ST SAMPLE	20	20	4	5-8	9
2ND SAMPLE	40	60	8	--	9

☐ 7-1/2 PSI for 30 Seconds
CAL .50 M8 API, M20 API-T M33 BALL.

☐ 2 PSI for 15 Seconds -
5.56MM M200 BLANK,
7.62 MM M82 BLANK,
CAL. .50 M1A1 BLANK

☐ 5 PSI for 15 Seconds -
7.62MM Frangible M160

NUMBER OF DEFECTS

1st Sample _____

2nd Sample _____

Cumulative _____

(1st & 2nd)

ACCEPTANCE REQUIREMENT (AQL = 4.0)

	ss	Cum. ss	Cum. Accept	Retest	Cum. Reject
1st Sample	50	50	3	4-9	10
2nd Sample	100	150	9	--	10

☑ 7-1/2 psi for 30 seconds

5.56mm: M193, M196, M855, M856, Heavy Bullet Reference, Reference

7.62mm (M62) M62-OHF, M80, M80-OHF, XM276 NATO Reference

Cal. .50: Reference.

NUMBER OF DEFECTS

1st Sample 8

2nd Sample 13

Cumulative 21

(1st & 2nd)

1ST ARTICLE ACCEPTANCE REQUIREMENTS

	ss	Accept	Reject
1st Sample			

NUMBER OF DEFECTS _____

RECORD TEST RESULTS:

MF - Fast Mouth Leaker
MS - Slow Mouth Leaker
HF - Fast Head Leaker
HS - Slow Head Leaker

REMARKS

IS THE TEST ACCEPTABLE?

1st Sample Yes ☐ No ☒

2nd Sample Yes ☐ No ☐

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

Reynolds
Gunner

Debbie Wilson
Foreman

ATK-5530 (10/01) ATK

BULLET EXTRACTION ACCEPTANCE REPORT

NOMENCLATURE 7.62mm TRACER M 62

LOT NO. LC-POWDER COAT BULLET SAMPLE

DATE 2-26-02

CIRCLE ANY DEFECT			
1	162	51	
2	162	52	
3	12	53	
4	170	54	
5	119	55	
6	165	56	
7	90	57	
8	111	58	
9	12	59	
10	155	60	
11	13	61	
12	116	62	
13	15	63	
14	182	64	
15	19	65	
16	118	66	
17	13	67	
18	103	68	
19	14	69	
20	112	70	
21	14	71	
22	152	72	
23	11	73	
24	138	74	
25	110	75	
26		76	
27		77	
28		78	
29		79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	

ACCEPTANCE REQUIREMENT

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	25	25	0	1	2
2nd Sample	50	75	1	---	2

- [ ] 35 lbs. minimum - 5.56mm Ball M193, Tracer M196
- [✓] 60 lbs. minimum - 7.62mm Tracer M62, Ball M80, Dim Tracer M276
- [ ] 200 lbs. minimum - Cal. .50 API M8, Tracer M17, APIT M20, Ball M33, MARK 257 API Dim Tracer

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	25	25	0	1 - 2	3
2nd Sample	50	75	2	---	3

- [ ] 20 lbs. minimum - 7.62mm M118 Special Ball Long Range M118
- [ ] 45 lbs. minimum - 5.56mm Ball M855, Tracer M856

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	20	20	0	1	2
2nd Sample	40	60	1	---	2

- [ ] 20 lbs. minimum - 7.62mm Special Ball M118 (not L.R.), Match M852
- [ ] 200 lbs. minimum - Cal. .50 MARK 211 API

	Sample Size	Cumulative ss	Cumulative Accept	Retest	Cumulative Reject
1st Sample	50	50	0	1	2
2nd Sample	100	150	1	---	2

- [ ] 60 lbs. minimum - 7.62mm Trace OHF M62, Ball OHF M80
- [ ] 175 lbs. minimum - 7.62mm Inert M172
- [ ] 200 lbs. minimum - Cal. .50 Dummy M2

SPECIAL SAMPLE SIZE FOR FIRST ARTICLES

	Cartridge Type	Minimum Pull	Sample Size	Accept	Reject
[ ]	5.56mm Ball M855	45 lbs.	75	2	3
[ ]	5.56mm Tracer M856	45 lbs.	75	2	3
[ ]	7.62mm M852	20 lbs.	20	0	1
[ ]	Cal. .50 Tracer M17	200 lbs.	50	1	2
[ ]	Cal. .50 Ball M33	200 lbs.	50	1	2

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

Average Pull 137

Maximum Pull 194

Minimum Pull 99

NUMBER OF DEFECTS

1st Sample 0

2nd Sample

Cumulative (1st/2nd)

IS THE TEST ACCEPTABLE?

1st Sample Yes [✓] No [ ]

2nd Sample Yes [ ] No [ ]

CALIBER .50 SPOTTER TRACER M48A2:

Are the Flash Tube and Lacquer Acceptable? Yes [ ] No [ ]

Gunner S. I. Gibson / Wood

Foreman Dublin Wilson

ATK 5534 5/00

ATK AMMUNITION SYSTEMS LCAAP

RESIDUAL STRESS ACCEPTANCE REPORT

(SUBJECT TO 1.0% MERCUROUS NITRATE 15 MIN. RECORD LOC/ OF CRAC /SPLIT & ATTACH OLC 5344.)

NOMENCLATURE: 7.62 M/M TRACER M-62

LOT NO. LC- POWDER COAT BULLET SAMPLE

DATE 2-26-02

1	OK	26	OK	51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25	OK	50	OK	75		100	

ACCEPTANCE REQUIREMENTS

M193, M195, M196, M197, M200, M855, M856
M62, M62 OHF, M80, M80 OHF, M82, M276,
M1, M9, M17, M20, M33, M1A1,
5.56MM REF., 5.56MM HEAVY BULLET REF.:

	SS	CUM SS	CUM ACCEPT	RETEST	CUM REJECT
1st Sample	50	50	0	1	2
2nd Sample	100	150	1	--	2

M160, M172, M852, M118, 7.62MM NATO REF.,
CAL. .50 REF., CAL. .50 DUMMY M2:

	SS	CUM SS	CUM ACCEPT	RETEST	CUM REJECT
1st Sample	20	20	0	1	2
2nd Sample	40	60	1	--	2

	# TESTED	# SPLITS	LOCATION
COMPLETE CTG.	25	0	
PULLDOWN CASE	25	0	
NO. OF SPLITS 1st SAMPLE		0	
NO. OF SPLITS AND SAMPLE			

1ST ARTICLE ACCEPTANCE REQUIREMENTS

* CALIBER _____

	SS	ACCEPT	REJECT
1st SAMPLE			
NUMBER OF SPLITS			
LOCATION			

* SEE CURRENT SPECIFICATION FOR FIRST ARTICLE REQUIREMENTS

IS TEST ACCEPTABLE?

	1st SAMPLE	2nd SAMPLE
YES	X	
NO		

REMARKS

The material herein was tested in accordance with the provisions of the Government approved Quality Assurance System.

GUNNER T. Madole GUNNER _____ FOREMAN Delilie Wilson

OLC 5556
(8-25-86)

OLIN CORPORATION-Lake City Army Ammunition Plant
7.62MM TRACE TEST ACCEPTANCE REPORT

M62 Powder Coat bullet Sample

Nomenclature: 7.62MM TRACER, M62

~~Lot No. 16~~

Date: 27 February 2002

WEAPON TYPE	RECEIVER NUMBER	BARREL NUMBER		HEADSPACE		TIMES FIRED	
M60	139497	23H	25H	1.635	1.633	5525	4776
T65	333013	3	4	1.637	1.633	4651	3838

WARMERS-BARREL # 23H					WARMERS-BARREL # 25H					WARMERS-BARREL # 3					WARMERS-BARREL # 4				
1					1					1					1				
2					2					2					2				
3					3					3					3				

M60

TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51				
2					52				
3					53				
4					54				
5	F				55				
6					56				
7					57				
8					58	F			
9	F				59				
10				D	60				
11					61				
12					62				
13	F				63				
14					64				
15		E		B	65	F			
16					66				
17					67				
18					68				
19	F				69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32	F			D	82				
33					83	F			
34					84				
35					85				
36	F	D			86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93		E		D
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

T65

TEST ROUNDS					TEST ROUNDS				
RDS.	GUN	15	100	850	RDS.	GUN	15	100	850
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
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43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

OBSERVATIONS AT GUN
INFORMATIONAL ONLY

CHARGEABLE DEFECTS
E - EARLY (BRIGHT) @ 15 YDS.
B - BLIND @ 100 OR 850 YDS.
D - DIM @ 100 OR 850 YDS.

INFORMATIONAL ONLY
F - MUZZLE FLASH
ERF - ERRATIC FLIGHT
BB - BULLET BURST

NO NOTATION MEANS NO DEFECT

OL C 5539

OLIN CORPORATION-Lake City Army Ammunition Plant
5.56MM & 7.62MM BULLET INTEGRITY ACCEPTANCE REPORT
(Performed in conjunction with trace test) (Screen at 50 feet from muzzle)

Nomenclature: M62 Powder Coat bullet Sample
~~Lot No. 46~~
Date: 27-February 2002

RECEIVER NUMBER	BARREL NUMBER	TIMES FIRED	HEADSPACE	WEAPON TYPE
139497	23H 25H	5525 4976	1.633 1.633	M60
333013	3 4	4651 3838	1.637 1.633	T65

139497 WEAPON NO. 139497

BARREL 23H					BARREL 25H				
Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
20					70				
21					71				
22					72				
23					73				
24					74				
25					75				
26					76				
27					77				
28					78				
29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

333013 WEAPON NO. 333013

BARREL 3					BARREL 4				
Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt	Shot	Loud Rpt.	Lrg. Flsh	Blnd	Errt. Flgt
1					51				
2					52				
3					53				
4					54				
5					55				
6					56				
7					57				
8					58				
9					59				
10					60				
11					61				
12					62				
13					63				
14					64				
15					65				
16					66				
17					67				
18					68				
19					69				
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22					72				
23					73				
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25					75				
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29					79				
30					80				
31					81				
32					82				
33					83				
34					84				
35					85				
36					86				
37					87				
38					88				
39					89				
40					90				
41					91				
42					92				
43					93				
44					94				
45					95				
46					96				
47					97				
48					98				
49					99				
50					100				

WARMERS BBL #23H
1
2
3

WARMERS BBL #25H
1
2
3

WARMERS BBL # 3
1
2
3

WARMERS BBL # 4
1
2
3

ACCEPTANCE REQUIREMENTS
SHALL NOT BURST IN ITS PASSAGE THROUGH THE BARREL NOR SHALL THE JACKET OR ANY PART STRIP FROM THE SLUG WHEN FIRED.

☒ 7.62MM M62 & M62 CHF
Each weapon 100 rds Failure of any cartridge shall reject the lot. No second sample permitted.

☐ 5.56MM M196
1st Sample-100 rds.
2nd Sample-200 rds.

Cum. Acc.	Retest	Cum. Rej.
0	1-3	4
3	-	4

TARGET SCREEN OBSERVATIONS
No. of Holes 200
Location of Holes Center
Type of Holes Normal

TEST RESULTS
No. Fired 200
No. & Type of Defects 0
Case Casualties 0

Observer at 15 Yards Vicke Gunner Russ
Observer at 100 Yards Gnsil Gunner Jerry
Observer at 850 Yards Don Foreman [signature]

IS TEST ACCEPTABLE?
1st Sample Yes ☒ No ☐
2nd Sample Yes ☐ No ☐

ACCURACY TEST

Test #: PROCESS Cartridge Type: M-62

Date Produced: // Shift Produced:

Primer Lot: Gunner: ATKINSON Plotter: WAHN

Powder Type: Powder Lot: Powder Charge:

Range #: 6A Range Length: 600 Wind Vel: 4-6 Wind Direction: 290

General Condition: CLEAR TEMP.31 Barometric Pressure: 30.38

Remarks:
MR=15.0 1ST TARGET 1 DROP OUT
POWDER COAT BULLET SAMPLE

Unit No	Arm No	RFTD	No Rds Fired	Mean Radius	Horz Stand Dev	Vert Stand Dev	Ext Vert	Ext Horz	Ext Sprd
HS1.528	3792254	6250	9	4.65	3.52	5.21	17.85	11.55	18.30
BBL.#2			10	7.86	9.39	3.50	9.65	32.00	32.85
			10	5.10	4.91	4.01	11.60	19.90	20.30
HS1.530	4004587	3555	10	3.52	3.92	1.97	6.50	14.70	14.90
BBL.#2			10	5.07	4.48	3.99	13.85	15.25	15.30
			10	3.47	1.76	3.51	10.60	5.75	10.65
HS1.529	3477891	3830	10	5.43	4.74	4.47	13.45	15.10	16.05
BBL.#2			10	4.70	3.67	3.97	12.05	10.40	14.75
			10	6.53	3.27	7.10	23.05	9.65	23.20
AVERAGE				5.15	4.41	4.19			

FOREMAN _____ Wed Feb 27 2002 05:14 PM

APPENDIX B

ECAM Analysis Performed on Painting Operation at LCAAP

Powder Coating of Small Caliber Bullet Tips
At
Lake City Army Ammunition Plant

Task 3 Report
Cost Analysis

September 6, 2001

Distribution Statement "C" applies
Distribution Authorized to U.S. Government Agencies and their Contractors.

CDRL No. A001-Task 3
GSA Contract No. GS-23F-0061L
US Army TACOM-ARDEC Order No. DAAE30-01-R-0412

Submitted by

Concurrent Technologies Corporation
100 *CTC* Drive
Johnstown, PA 15904

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Appendix A. P2 Finance Software Output Sheets for the 5-Year Payback Period

EXECUTIVE SUMMARY

Concurrent Technologies Corporation (*CTC*) was tasked through the General Services Administration (GSA contract number DAAE30-01-Q-0412) to support the U.S. Army Tank-Automotive and Armaments Command-Armament Research, Development and Engineering Center's (TACOM-ARDEC) efforts to evaluate the feasibility of using powder coating for the tip identification of small-arms ammunition. This ammunition is currently manufactured at the Lake City Army Ammunition Plant (LCAAP), located in Independence, Missouri.

Alliant Techsystems (ATK) operates the ammunition plant in Lake City, and produces several types of small arms ammunition including 5.56-mm, 7.62-mm and 0.50 caliber rounds. The top 0.25-inch of 7.62-mm projectiles is coated with a waterborne orange paint so that the projectiles are easily identified as tracer rounds. The tip identification process employs ethyl acetate, which is a Volatile Organic Compound (VOC). This solvent could pose health and safety risks to the process operators over an extended period of time. Previous projects conducted through TACOM-ARDEC and performed by *CTC* have shown that powder coating is a potential alternative to the current dip process and other wet spray processes at LCAAP. Also, powder coating is a technology that can be used to paint all three types of cartridges produced by ATK. So, if it is found to be technically feasible, the technology can be used to replace all of the wet spray, and dip processes at LCAAP. That would greatly favor the justification for powder coating at LCAAP.

This report provides the results of a cost analysis that was performed to determine the maximum capital expenditure that would be allowable for ATK at different payback periods for the 7.62-mm tracer projectiles. Since powder coating technology (when optimized), can be used with any color and any caliber of cartridge, the summary of a cost analysis that was performed previously for the 5.56-mm cartridges is also included in this report.

The results of the cost analysis show that the payback period for implementing powder to replace the current 7.62-mm tracer painting process is rather long and not justifiable based on economics alone. The payback period for implementing powder to replace the 5.56-mm painting process is much better, but there are material handling issues that need to be resolved. Since there are many benefits to implementing powder coating at LCAAP, the justification should not be based solely on economics for the single type of projectile examined.

Powder coating would be very favorable economically if all types of 7.62-mm. Ammunition is included. Powder coating is a very reliable technology and it relatively maintenance free. The technology is very consistent and could provide a high quality coating at a high throughput rate when optimized. The current coating process is not reliable and is often plagued by operational and maintenance problems. Also, multiple colors could be used in a single powder coating system. Therefore, it is recommended that LCAAP continue to evaluate the powder coating technology based on the long-term benefits of eliminating all of their current wet spray and dip processes.

1.0 INTRODUCTION

Concurrent Technologies Corporation (*CTC*) was tasked through the General Services Administration (GSA contract number GS-23F-0061L, US ARMY TACOM Order No. DAAE30-01-Q-0412) to support the U.S. Army Tank-Automotive and Armaments Command-Armament Research, Development and Engineering Center's (TACOM-ARDEC) efforts to evaluate the feasibility of using powder coating for the tip identification of small-arms ammunition. This ammunition is currently manufactured at the Lake City Army Ammunition Plant (LCAAP), located in Independence, Missouri. This report is the first project deliverable, and provides a cost benefit analysis for the implementation of powder coating for selected 7.62-mm projectiles manufactured at LCAAP. The cost benefit analysis is based on, and uses similar methodology, as a previous cost benefit analysis performed for 5.56-mm projectiles manufactured at LCAAP.

Alliant Techsystems (ATK) operates the ammunition plant in Lake City, and produces several types of small arms ammunition including 5.56-mm, 7.62-mm and 0.50 caliber rounds. The tips of small-arms ammunition are painted for identification purposes. This paint allows tracer and armor-piercing incendiary (API) rounds to be visually identified and distinguished from regular (ball) ammunition. During a previous project, a cost analysis was performed to determine the economic feasibility of using powder coating technology as a replacement for the current tip identification process for the 5.56-mm green tipped cartridges. The focus of this project is the orange tip identification process for the 7.62-mm tracer cartridges.

The top 0.25-inch of 7.62-mm projectiles is coated with a waterborne orange paint so that the projectiles are easily identified as tracer rounds. ATK produces approximately 6 million 7.62-mm tracer rounds per year. The current process involves using a Manurhin™ loading system to load the cartridges, and then manually transporting the loaded rounds in bulk to a paint application area. The paint application area involves using a hopper that shakes the cartridges into plates that are then conveyed through the cleaning step (ethyl acetate) and then the orange paint. This process only involves one operator but is somewhat labor intensive.

The tip identification process employs ethyl acetate, which is a Volatile Organic Compound (VOC). This solvent could pose health and safety risks to the process operators over an extended period of time.

Previous projects conducted through TACOM-ARDEC and performed by *CTC* have shown that powder coating is a potential alternative to the current dip process and other wet spray processes at LCAAP. However, since powder coating is not currently being used at LCAAP, there would be some facility modifications involved with the implementation of a powder coating system that may detract from the desired payback period for the equipment.

This report provides the results of a cost analysis that was performed to determine the maximum capital expenditure that would be allowable for ATK at different payback periods. Since powder coating technology (when optimized), can be used with any color and any caliber of cartridge, the summary table for the 5.56-mm cost analysis is also included in this report.

1.1 Project Background

Previous projects have shown that powder coating is a technically feasible alternative to wet spray application of paint for bullet tip identification at LCAAP. It was also shown that the process of curing the powder at an elevated temperature did not compromise the energetic mixtures inside the cartridges. Finally, laboratory test results indicated that the powder coating was able to meet the durability criteria and passed test firing.

In a previous project, *CTC* determined that with all of the potential safety risks, the cost of the powder coating system for full 7.62-mm cartridges was escalated to the point where it was not economical. Therefore, to avoid the elevated cost due to unknown safety hazards, the 7.62-mm tracer projectiles (prior to loading) were targeted for implementing powder coating.

The intent of this project is to focus on the 7.62-mm projectiles before they are assembled into fully loaded cartridges. This results in less risk of a cartridge being ignited during the elevated cure stage that would required by a powder coating system.

Another benefit to focusing on the 7.62-mm projectiles is that they are more heavily weighted at the tip due to the tracer material being present at the opposite end of the projectile. The 5.56-mm cartridges used in a previous project had an even weight distribution and so were more difficult to orient for coating application. The benefit of the 7.62-mm projectiles is easier material handling. If the tips are weighted, it is believed that they will be easier to orient for painting.

One of the primary reasons that ATK is interested in evaluating powder coating technology is that the new loading/painting system for the 7.62-mm cartridges has been found to be inconsistent and does not produce an acceptable coating on the cartridge tips. Also, powder coating is a technology that can be used to paint all three types of cartridges produced by ATK. So, if it is found to be technically feasible, the technology can be used to replace all of the wet spray, and dip processes at LCAAP. That would greatly favor the economic justification for powder coating at LCAAP.

2.0 COST ANALYSIS FOR 7.62-mm TRACER CARTRIDGES

The primary objective of the cost analysis is to determine whether a powder coating process could be implemented with an acceptable payback period. The cost analysis was performed using the US EPA's pollution prevention software called P2 Finance.

The cost analysis software uses three performance measures for determining investment opportunities, namely, payback period, net present value (NPV), and internal rate of return (IRR). The payback period is the time required to recover 100% of the capital investment with future cost benefits. The NPV is the difference between the sum of the future annual cost benefits and the capital investment of the alternative. The IRR is the true interest yield promised by an investment project over its useful life. NPV and IRR account for the time value of money, and discount the future capital investments or annual cost benefits to the current year.

A standard questionnaire was used to obtain information regarding the costs associated with the current 7.62-mm painting line at LCAAP. The same questionnaire was used to obtain information about the 5.56-mm painting area in the previous project. The 7.62-mm questionnaire was completed by *CTC* during a site visit to LCAAP, and the information was entered into the US EPA's cost accounting software, P2 Finance. The software performs the calculations for payback period, NPV, and IRR.

The current throughput rate is approximately 133 parts per minute and requires one person to operate. However, a powder coating system would be able to process projectiles at a higher. For the analysis, *CTC* determined the maximum capital expenditure for a powder coating system that was capable of coating 200ppm and 400ppm.

The input that was used for the cost analysis is outlined in Table 1. Table 2 summarizes the total capital expenditure allowable for three different payback periods.

Table 1. Input Parameters for 7.62-mm Cost Analysis

Category	Input Parameter	Current Tip ID Process at 133 PPM	Powder Coating Process At 200 PPM	Powder Coating Process At 400 PPM
CAPITAL COSTS (one-time fees)	Equipment and Installation Cost	$0	$	$
	Facility Modification Cost	$0	$	$
	Total Capital Investment	**$0**	**$**	**$**
LABOR	Number of Operators	1 per shift	1 per shift	1 per shift
	Pay Rate	$21.85	$21.85	$21.85
	Shift Length (hours)	10 per shift	10 per shift	10 per shift
	Number of Shifts	1 per day	1 per day	1 per day
	Production time per shift (hours)	10 hours	9 hours	9 hours
	Operating Days per Year[1]	75 days	56 days	28 days
	Downtime (for maintenance) [2]	0 hours per year	55 hours (1 hr per day)	28 hours (1 hr per day)
	Total Annual Labor Cost	**$16,388**	**$12,236**	**$6,118**
EHS	Reporting, Training, PPE, etc.	Will not Change	Will not Change	Will not Change
MATERIALS	Paint or Powder Usage per Year[3]	160 gallons	62 pounds	62 pounds
	Paint or Powder Cost[4]	$21.72 per gallon	$19.85 per pound	$19.85 per pound
	Paint or Powder Annual Cost	$3475	$1230	$1230
	Solvent Usage per Year (ethyl acetate)[3]	5,000 pounds	N/A	N/A
	Solvent Cost[5]	$0.75/lb	$0	$0
	Solvent Annual Cost	$3750	$0	$0
	Total Annual Material Cost	**$7225**	**$1230**	**$1230**
WASTE	Category of Waste	Some Hazardous and some Non-hazardous	Non-hazardous	Non-hazardous
	Transportation Fees	None	None	None
	Disposal Method	Non-Haz to Industrial Waste	Industrial Waste	Industrial Waste
	Total Amount of Waste Generated	1 drum of solvent waste	100 pounds per year	100 pounds per year
	Disposal Rate[6]	$100 per drum	$3.00 per pound	$3.00 per pound
	Total Waste Disposal Fees	**$100**	**$300**	**$300**

Notes:

1. ATK stated that they currently produce approximately 6 Million 7.62-mm tracer rounds per year.
2. The hours for maintenance are accounted for due to the current throughput rate only producing 80,000 rounds per day (stated by ATK). Therefore no additional hours are added into the cost for maintenance for the current process. Similarly, for the powder coating system alternatives, it was assumed that 1 hour out of a 10 hour shift will be for start-up, shut-down, and maintenance combined. It was assumed that the powder coating system would be producing the indicated ppm for 9 hours out of a ten hour shift.
3. Data provided by ATK.
4. The calculation for the amount of powder needed to coat 6 Million bullets was determined assuming an overall transfer efficiency of 90.25%. The coverage rate supplied by the Sherwin-Williams manufacturer was $128ft^2$/mil and the thickness assumed for the bullet tips was 1 mil.
5. Cost is based on an informal quotation of $0.75/lb for a quantity of 10,000 lbs. from a representative at Mid-State Chemical Company.
6. ATK stated that they produce approximately 2 drums of hazardous waste per year combining the operations for both 5.56-mm and 7.62-mm painting lines. *CTC* assumed that ½ of the total waste was from the 7.62-mm solvent cleaning process.

Table 2. Capital Expenditure and Payback Periods for Two Different Powder Coating Systems

Payback Period	Total Capital Expenditure (includes equipment and installation costs)	
	200 PPM System	**400 PPM System**
2 years	$18,750	$29,750
5 years	$44,400	$70,000
7 years	$58,250	$93,750

It should be noted that ATK will need to perform facility modifications to incorporate the powder coating system into the current material handling (conveyor) system at LCAAP. The figures shown in Table 2 are the maximum allowable expenditure to stay within the specified payback period. The dollar amounts in table 2 represent the total cost including equipment and facility modifications. For reference, the software output sheets for the data used to calculate the 5 year payback period are located in Appendix A.

The assumptions that were made to complete the cost analysis are as follows:

- The powder coating system would require one operator.
- EHS costs (permitting and reporting) for powder coating would be the same as the current process. Therefore, EHS issues were not factored into the cost analysis.
- The powder coating system will include a reclamation system so that the unused powder would be reclaimed and reused.
- Powder coating could increase the parts per minute and therefore reduce the overall annual labor cost by reducing the number of days needed to produce the 6 million tracer rounds.
- The 7.62-mm painting line is currently responsible for ½ of the overall hazardous waste production for Building 3. ATK stated that they product 2 drums of hazardous waste per year from Building 3.
- The cost of the orange paint used for tip ID is $21.72. Data taken from previous cost analysis performed at LCAAP.

3.0 RESULTS OF PREVIOUS COST ANALYSIS FOR 5.56-mm M855 CARTRIDGES

A similar questionnaire to the one used for collection information about the 7.62-mm tip identification process was used to obtain information regarding the costs associated with the 5.56-mm painting line at LCAAP. The full cost analysis was submitted to the government in a report entitled "Interim and Cost Analysis Report" dated, December 29, 2000 and submitted under GSA contract No. GS-23F-0061L, US ARMY TACOM Order No. DAAA 21-93-C-0046, task No. N.212, CDRL No. A005.

The focus of the 5.56-mm cost analysis was on the M855 cartridges. The green tipped M855's represented approximately 65 to 70% of the production of all 5.56-mm cartridges painted at LCAAP at that time. Therefore, if powder coating could be demonstrated for

the green tipped M855's it would replace 70% of the workload for the 5.56-mm painting operation.

Since the desired payback period was between two and three years, the cost accounting software was used to calculate the maximum capital expenditure allowable to achieve a payback of 1.75, 2.5, and 3 years (assuming a 5.0% interest rate). Table 3 summarizes the total capital expenditure allowable for three different payback periods.

Table 3. Capital Expenditure for 5.56-mm Cartridge Painting at Different Payback Periods

Payback Period	Total Capital Expenditure (includes equipment and installation costs)
1.75 years	$200,000.00
2.5 years	$297,000.00
3.0 years	$360,000.00

It is assumed in each case that there will be a $40,000 cost for facility modifications to incorporate the powder coating system into the current material handling (conveyor) system at LCAAP. The $40,000 is already factored into each of the payback periods shown in Table 3. The only number changed in the P2 Finance software to obtain the other payback periods was the capital investment cost.

The assumptions that were made to complete the cost analysis were as follows:

- The powder coating system would require one operator.
- EHS costs (permitting and reporting) for powder coating would be the same as the current process. Therefore, EHS issues were not factored into the cost analysis.
- The powder coating system will include a reclamation system so that the unused powder would be reclaimed and reused.
- The transfer efficiency for powder coating is 98% and the transfer efficiency of the current process is 5%.
- To calculate the cost for filter waste, it was assumed that the roll-type filters provided at least 22 squares out of one roll, and that the squares weigh 5 pounds each (when contaminated). It was assumed the square filters weighed 10 pounds each when loaded with paint.

The results of the coat analysis showed that a maximum capital expenditure of $360,000 was allowed in order for LCAAP to meet their cost payback objectives. This number presents a unique challenge to the implementation of powder coating for two reasons.

First, since COTS equipment is not available to meet the material handling needs, the cost of that subsystem alone may drive the overall cost to an unacceptable level.

Second, the $360,000 value is much smaller than typical powder coat line installations. In commercial industry, automated powder coating lines of $1 million and over are

common. Many commercial system integrators and installers will be hesitant to confront such a small installation with a high level of risk associated with coating of ammunition.

4.0 CONCLUSIONS AND RECOMMENDATIONS

From the data presented in Table 2, a minimum payback period is greater than 7 years for powder coating to be economical for painting 7.62-mm tracer projectiles at LCAAP. This long payback period can be attributed to the relatively low production rate for the 7.62-mm projectiles, and the infrequent basis on which these projectiles are manufactured. In addition, although the current process is not efficient, the low production rate results in a low annual cost for painting the projectiles. As a result, the timeframe required to pay back the cost of an initial powder coating investment is longer than normal.

This analysis was performed on only one type of 7.62-mm ammunition however. If expanded to all 7.62-mm ammunition, powder coating could provide a faster payback period based on an increased volume of production. For powder coating to provide a positive, long-term cost impact, *CTC* recommends that it be used on all types of 7.62-mm ammunition.

One factor that is not easily quantified is that the current dip process at LCAAP uses a hazardous chemical (ethyl acetate). By implementing powder coating, ATK can eventually eliminate the use of this material in all of the wet spray and dip coating processes used for tip identification at LCAAP.

Appendix A

P2 Finance Software Output Sheets for the 5 Year Payback Period

P2/FINANCE Title-pg1
Version 3.0

August 2001

PROJECT TITLE: ATK Powder Coating for 7.62 mm Tracer Tip ID ECAM

PREPARED BY: CTC Personnel

ORGANIZATION: Concurrent Technologies Corporation (CTC)

COMMENTS: This ECAM was prepared using assumptions and estimated values. Therefore, the following results and data should only be used as guidance tools.

Please refer any questions to Ms. Cristina Bressler, Process Engineer, at 814-269-2863 or via email at bressler@ctc.com.

P2/FINANCE

Pollution Prevention Financial Analysis
and Cost Evaluation System

Version 3.0
Copyright 1996
Tellus Institute
Boston, MA

DEFAULT PARAMETERS

Analysis Name: ATK Powder Coating for 7.62 mm Tracer Tip ID ECAM August 2001 Default-pg1

Global Parameters

P2/FINANCE uses the Inflation Rate, Discount Rate, and Income Tax Rate entered here for calculations on the Tax Deduction Schedule, Incremental Cash Flow Analysis, and Incremental Profitability Analysis sheets.

Inflation reflects the overall rate at which you expect prices to increase. For cases in which this Inflation Rate does not fully capture expected price changes, P2/FINANCE allows you to define an additional Escalation Rate for each Annual Operating Cost category.

Inflation Rate	0.0%

The Discount Rate accounts for the fact that there is an opportunity cost to using money -- if you choose to invest in one project, you lose the opportunity to gain a return on another investment. Many companies use their weighted average cost of capital as a Discount Rate. For more information on Discount Rate and its relationship to inflation, see the on-line help.

Discount Rate	5.0%

State and local income taxes are deductible from the taxable income used to calculate federal taxes. Enter your Local, State, and Federal Income Tax Rates below, and P2/FINANCE will calculate an Aggregate Income Tax Rate.

Local Income Tax Rate	0.0%
State Income Tax Rate	0.0%
Federal Income Tax Rate	0.0%
Aggregate Income Tax Rate	0.0%

The Default Parameters entered by the user in this section can be applied to the entire project file by pressing the button below. Do not press this button unless you are sure that you want these values to apply to the entire project file!

P2/FINANCE uses the Depreciation Method and Period entered here as defaults for all Initial Investment Costs. You can change the Depreciation Method and Period for individual categories on the Initial Investment Costs sheet.

Depreciation Method	exp
Depreciation Period	10.0

To specify Depreciation Method, use these abbreviations:

Straight Line	SL
150% Declining Balance switching to Straight Line	1.5DB
200% Declining Balance switching to Straight Line	DDB or 2DB
Expensed (tax deductible in the first year)	EXP
Working Capital (not tax deductible)	WC

The Default Parameters entered by the user in this section can be applied to the entire project file by pressing the button below. Do not press this button unless you are sure that you want these values to apply to the entire project file!

Scenario Parameters

P2/FINANCE allows you to create two alternative financial analysis scenarios, which represent different investment options you are considering. You can also create a baseline scenario, which contains data on your current "business-as-usual" operations. On the Incremental Cash Flow Analysis and the Incremental Profitability Analysis sheets, the Alternative Scenarios are compared to the Base Scenario, i.e., P2/FINANCE calculates incremental cash flows and profitability.

The Investment Year and Lifetime entered here are used as defaults for both Initial Investment Costs and Annual Operating Costs. P2/FINANCE assumes that investments occur AT THE END OF THE INVESTMENT YEAR, so the default Start Year for Annual Operating Costs is Investment Year + 1. The most common Investment Year will be Year 0, i.e., most Initial Investment Costs are incurred at the very beginning of the project lifetime.

Alternative Scenario 1

Name: 200 ppm Powder Coating

Inv. Year	0	Lifetime	15
Start Year	1	End Year	15

Alternative Scenario 2

Name: 400 ppm Powder Coating

Inv. Year	0	Lifetime	15
Start Year	1	End Year	15

Base Scenario

Name: Water-based Dip Coating

Inv. Year	0	Lifetime	15
Start Year	1	End Year	15

INITIAL INVESTMENT COSTS - Base Scenario

Base Scenario: Water-based Dip Coating | August 2001 | Inv-Base-pg1

Initial Investment Costs			$ Amount
Capital Investment			
Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Salvage Value	$0	**TOTAL**	$0
Training			
Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Salvage Value		**TOTAL**	$0
Permitting			
Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Salvage Value		**TOTAL**	$0
N/A			
Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15
Salvage Value		**TOTAL**	$0
N/A			
Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15
Salvage Value		**TOTAL**	$0

Initial Investment Costs			$ Amount
Planning Costs			
Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Salvage Value		**TOTAL**	$0
Environmental, Health, and Safety Issues			
Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Salvage Value		**TOTAL**	$0
Other/Miscellaneous			
Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Salvage Value		**TOTAL**	$0
N/A			
Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15
Salvage Value		**TOTAL**	$0
N/A			
Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15
Salvage Value		**TOTAL**	$0

Inv-Base-pg2

N/A			
Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15
N/A			
Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15

ANNUAL OPERATING COSTS - Base Scenario

Base Scenario: Water-based Dip Coating | August 2001 | Op-Base-pg1

Annual Operating Costs	$ Amount

Direct Materials

Escalation Rate 0.0% | Start Year 1 | End Year 15

Water-based paint	$3,475
Ethyl Acetate	$3,750
TOTAL	$7,225

Utilities

Escalation Rate 0.0% | Start Year 1 | End Year 15

Neg	
TOTAL	$0

Labor

Escalation Rate 0.0% | Start Year 1 | End Year 15

Labor	$16,388
TOTAL	$16,388

Disposal Activities

Escalation Rate 0.0% | Start Year 1 | End Year 15

Solid, hazardous	$100
Solid, non-hazardous	$100
TOTAL	$200

Regulatory Compliance

Escalation Rate 0.0% | Start Year 1 | End Year 15

Reporting activities (no change to alt)	
Permitting requirements (no change to alt)	
TOTAL	$0

Health and Safety

Escalation Rate 0.0% | Start Year 1 | End Year 15

PPE (no change to alt)	
Annual training activities (no change to alt)	
Maintenance/Up-keep (no change to alt)	
TOTAL	$0

SCENARIO SUMMARY - Base Scenario

Base Scenario: Water-based Dip Coating | August 2001 | Summ-Base-pg1

INITIAL INVESTMENT COSTS	Cost	Salvage Value	Inv. Year	Lifetime	Depreciation Period	Depreciation Method
Capital Investment	$0	$0	0	15	10	EXP
Planning Costs	0	0	0	15	10	EXP
Training	0	0	0	15	10	EXP
Environmental, Health, and Safety Issues	0	0	0	15	10	EXP
Permitting	0	0	0	15	10	EXP
Other/Miscellaneous	0	0	0	15	10	EXP
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL

ANNUAL OPERATING COSTS	Cost	Start Year	End Year	Escalation
Direct Materials	$7,225	1	15	0.0%
Utilities	0	1	15	0.0%
Labor	16,388	1	15	0.0%
Disposal Activities	200	1	15	0.0%
Regulatory Compliance	0	1	15	0.0%
Health and Safety	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%

GLOBAL PARAMETERS		SCENARIO PARAMETERS	
Project Title: ATK Powder Coating for 7.62 mm Tracer Tip ID ECAM			
Inflation Rate	0.0%	Default Investment Year	0
Discount Rate	5.0%	Default Lifetime	15
Aggregate Income Tax Rate	0.0%	Default Start Year	1
Default Depreciation Method	exp	Default End Year	15
Default Depreciation Period	10		

INITIAL INVESTMENT COSTS - Alternative Scenario 1

Alternative Scenario 1: 200 ppm Powder Coating | August 2001 | Inv-Alt1-pg1

Initial Investment Costs	$ Amount

Capital Investment

Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15

Equipment/Installation and Site Prep	$44,400
Salvage Value	**TOTAL** $44,400

Training

Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

Permitting

Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

N/A

Initial Investment Costs	$ Amount

Planning Costs

Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

Environmental, Health, and Safety Issues

Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

Other/Miscellaneous

Dep. Method	exp	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

N/A

ANNUAL OPERATING COSTS - Alternative Scenario 1

Alternative Scenario 1: 200 ppm Powder Coating | August 2001 | Op-Alt1-pg1

Annual Operating Costs	$ Amount

Direct Materials

Escalation Rate	0.0%	Start Year	1
		End Year	15

Powder paint	$1,230
TOTAL	$1,230

Utilities

Escalation Rate	0.0%	Start Year	1
		End Year	15

Neg.	
TOTAL	$0

Labor

Escalation Rate	0.0%	Start Year	1
		End Year	15

Labor	$12,236
TOTAL	$12,236

Disposal Activities

Escalation Rate	0.0%	Start Year	1
		End Year	15

Solid, non-hazardous	$100
TOTAL	$100

Regulatory Compliance

Escalation Rate	0.0%	Start Year	1
		End Year	15

Reporting activities (remain same as current)	
Permitting requirements (remain same as current)	
TOTAL	$0

Health and Safety

Escalation Rate	0.0%	Start Year	1
		End Year	15

PPE (remain same as current)	
Annual training activities (remain same as current)	
Maintenance/Up-keep (remain same as current)	
TOTAL	$0

SCENARIO SUMMARY - Alternative Scenario 1

Alternative Scenario 1: 200 ppm Powder Coating August 2001 Summ-Alt1-pg1

INITIAL INVESTMENT COSTS	Cost	Salvage Value	Inv. Year	Lifetime	Depreciation Period	Depreciation Method
Capital Investment	$44,400	$0	0	15	10	EXP
Planning Costs	0	0	0	15	10	EXP
Training	0	0	0	15	10	EXP
Environmental, Health, and Safety Issues	0	0	0	15	10	EXP
Permitting	0	0	0	15	10	EXP
Other/Miscellaneous	0	0	0	15	10	EXP
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL

ANNUAL OPERATING COSTS	Cost	Start Year	End Year	Escalation
Direct Materials	$1,230	1	15	0.0%
Utilities	0	1	15	0.0%
Labor	12,236	1	15	0.0%
Disposal Activities	100	1	15	0.0%
Regulatory Compliance	0	1	15	0.0%
Health and Safety	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%

GLOBAL PARAMETERS		SCENARIO PARAMETERS	
Project Title: ATK Powder Coating for 7.62 mm Tracer Tip ID ECAM			
Inflation Rate	0.0%	Default Investment Year	0
Discount Rate	5.0%	Default Lifetime	15
Aggregate Income Tax Rate	0.0%	Default Start Year	1
Default Depreciation Method	exp	Default End Year	15
Default Depreciation Period	10		

INITIAL INVESTMENT COSTS - Alternative Scenario 2

Alternative Scenario 2: 400 ppm Powder Coating | August 2001 | Inv-Alt2-pg1

Initial Investment Costs	$ Amount

Capital Investment

Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15

Equipment/Installation and Site Prep	$70,000
Salvage Value	**TOTAL** $70,000

Training

Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

Permitting

Dep. Method	sl	Investment Year	5
Dep. Period	10.0	Lifetime	10

N/A	
Salvage Value	**TOTAL** $0

Initial Investment Costs	$ Amount

Planning Costs

Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	5

N/A	
Salvage Value	**TOTAL** $0

Environmental, Health, and Safety Issues

Dep. Method	sl	Investment Year	0
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

Other/Miscellaneous

Dep. Method	sl	Investment Year	10
Dep. Period	10.0	Lifetime	15

N/A	
Salvage Value	**TOTAL** $0

ANNUAL OPERATING COSTS - Alternative Scenario 2

Alternative Scenario 2: 400 ppm Powder Coating | August 2001 | Op-Alt2-pg1

Annual Operating Costs	$ Amount

Direct Materials

Escalation Rate	0.0%	Start Year	1
		End Year	15

Powder paint	$1,230
TOTAL	$1,230

Utilities

Escalation Rate	0.0%	Start Year	1
		End Year	15

Neg.	
TOTAL	$0

Labor

Escalation Rate	0.0%	Start Year	1
		End Year	15

Labor	$6,118
TOTAL	$6,118

Disposal Activities

Escalation Rate	0.0%	Start Year	1
		End Year	15

Solid, non-hazardous	$300
TOTAL	$300

Regulatory Compliance

Escalation Rate	0.0%	Start Year	1
		End Year	15

Reporting activities (remain same as current)	
Permitting requirements (remain same as current)	
TOTAL	$0

Health and Safety

Escalation Rate	0.0%	Start Year	1
		End Year	15

PPE (remain same as current)	
Annual training activities (remain same as current)	
Maintenance/Up-keep (remain same as current)	
TOTAL	$0

SCENARIO SUMMARY - Alternative Scenario 2

Alternative Scenario 2: 400 ppm Powder Coating August 2001 Summ-Alt2-pg1

INITIAL INVESTMENT COSTS	Cost	Salvage Value	Inv. Year	Lifetime	Depreciation Period	Depreciation Method
Capital Investment	$70,000	$0	0	15	10	SL
Planning Costs	0	0	0	5	10	SL
Training	0	0	0	15	10	SL
Environmental, Health, and Safety Issues	0	0	0	15	10	SL
Permitting	0	0	5	10	10	SL
Other/Miscellaneous	0	0	10	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL
N/A	0	0	0	15	10	SL

ANNUAL OPERATING COSTS	Cost	Start Year	End Year	Escalation
Direct Materials	$1,230	1	15	0.0%
Utilities	0	1	15	0.0%
Labor	6,118	1	15	0.0%
Disposal Activities	300	1	15	0.0%
Regulatory Compliance	0	1	15	0.0%
Health and Safety	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%
N/A	0	1	15	0.0%

GLOBAL PARAMETERS		SCENARIO PARAMETERS	
Project Title: ATK Powder Coating for 7.62 mm Tracer Tip ID ECAM			
Inflation Rate	0.0%	Default Investment Year	0
Discount Rate	5.0%	Default Lifetime	15
Aggregate Income Tax Rate	0.0%	Default Start Year	1
Default Depreciation Method	exp	Default End Year	15
Default Depreciation Period	10		

INCREMENTAL PROFITABILITY ANALYSIS

Analysis Name: ATK Powder Coating for 7.62 mm 1 August 2001 Profit-pg1

P2/FINANCE calculates three indicators of profitability. (See on-line help for more detailed descriptions.)

Net Present Value (NPV), the most reliable indicator, is the value in today's dollars of the discounted future savings of a project. A positive NPV indicates a profitable project. When considering multiple projects, the most profitable project has the highest NPV.

Internal Rate of Return (IRR) is the Discount Rate for which the NPV of a project would equal zero. An IRR greater than the Discount Rate indicates a profitable project. When considering multiple projects, the most profitable project usually, but not always, has the highest IRR. IRR cannot be calculated for some projects with irregular cash flows.

Discounted Payback is the time period within which the discounted future savings of a project repay the Initial Investment Costs. A shorter payback period often, but not always, indicates a more profitable project because Discounted Payback does not account for cash flows that occur after the payback period. Discounted Payback cannot be calculated for some projects.

P2/FINANCE provides four time horizons for calculating Net Present Value and Internal Rate of Return. P2/FINANCE automatically calculates the profitability over 5, 10, and 15 years. You may choose an optional fourth time horizon between 1 and 15 years.

Optional Time Horizon 2

This analysis calculates the incremental profitability of each Alternative Scenario relative to the Base Scenario.
Base Scenario: Water-based Dip Coating

Net Present Value ($)

Scenario	Name	Years 0-5	Years 0-10	Years 0-15	Years 0- 2
Alternative Scenario 1	200 ppm Powder Coating	(36)	34,725	61,960	(25,347)
Alternative Scenario 2	400 ppm Powder Coating	(14)	54,822	97,787	(39,943)

Internal Rate of Return (%)

Scenario	Name	Years 0-5	Years 0-10	Years 0-15	Years 0- 2
Alternative Scenario 1	200 ppm Powder Coating	5.0%	19.0%	21.9%	#N/A
Alternative Scenario 2	400 ppm Powder Coating	5.0%	19.1%	21.9%	#N/A

Discounted Payback (years)

Scenario	Name	Payback
Alternative Scenario 1	200 ppm Powder Coating	5.00
Alternative Scenario 2	400 ppm Powder Coating	5.00