

# Gun Barrels

## Session Outbrief

*“Products That Radically Redefine Warfare, Enabling the American Warfighter to Dominate the Battlefield”*



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# CURRENT USAGE



- **The primary and most widely-used bore protection technology currently used for DoD Large and Medium Caliber GUNS is chromium plating**
  - 20 (+/-) fielded and proposed gun designs, mounted on 40 (+/-) weapons platforms use chrome plating as bore protection
  - On average, between 2,000 and 4,000 Cr-plated gun barrels are produced each year by DoD
- **GUN MOUNTS and CARRIAGES** have a few OEM parts that use Cr-Plating. Many other M/C parts employ Cr-plating in repair/build-up procedures allowed by the DMWRs
- **Chrome replacement in Mount/Carriage production and rebuild is not being addressed.**



# GUN BARREL COATING REQUIREMENTS



## MATERIAL CHARACTERISTIC

## CRITERIA

**Melting Point**

*Cr (1875 C) or better*

**Elastic Modulus**

*Compatible with substrate (facilitates low surface crack densities)*

**YS at Elevated Temps**

*High*

**Fracture Toughness**

*High*

**Hot Hardness**

*High (appropriate)*

**Chemical Resistance**

*High*

**Coefficient of Thermal Exp.**

*Compatible with substrate*

**Thermal Conductivity**

*Low*

**Reaction w/ Rotating Band**

*Inert*

**Phase Transformations**

*None*

## PROCESS CHARACTERISTIC

## CRITERIA

**Deposition Temperature**

*Less than 357C (post autofrettage thermal soak limit – Lg Cal ONLY)*

**Deposit Rate**

*1 mil of coating material per hour*

**Surface Finish**

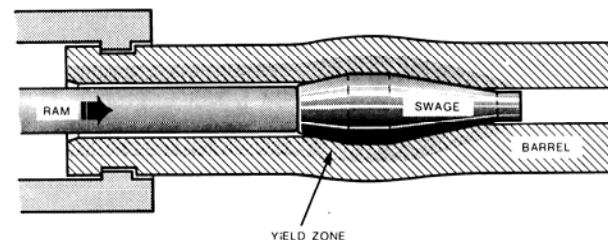
*Equal or better than 32 RMS at deposition*

**Deposition Length**

*58 Calibers or greater (Lg Cal ONLY)*

**Hazardous Impacts**

*None or limited*





# PLATING EXPOSURE IN ARMAMENTS



## AS-PRODUCED

- Watervliet Arsenal –Large Caliber
- GD / ATK – Medium Caliber
- Various OEMs – Mounts (few parts)

## REWORK

- Limited rework with Cr on mount and breech components, none on barrels



# CURRENTLY INVESTIGATED ALTERNATIVES



No Cr-alternatives have been adopted, to date, for use in the manufacture of gun barrels

The Army and the Navy have both gone through extensive down-selection processes and, as a result, have both focused their Chrome Replacement/Life Extension programs for guns on:

Magnetron Sputtering  
Explosive Cladding

- Army Programs
  - ManTech #00-01: Cannon Life Extension via Magnetron Sputtering Technology (120mm)
  - SERDP #1426: Chromium Replacement in Medium Caliber Guns (25mm)
- Navy Programs
  - Future Naval Capabilities Program: Advanced Gun System (AGS) (155mm)



# DRIVERS AND BARRIERS



## DRIVERS

- Environmental Regs
- Weapon Life Requirements (Large Caliber)

## BARRIERS

- Motivation for OEM to adopt Cr-alternative (not an issue for large cal guns)
- Lack of weapon service life reqts (Med Cal)
- Meeting the technical challenges of the process development itself
  - Line-of-Sight issues
  - Process Temps
  - Adhesion
  - Interface quality



# REMAINING NEEDS



## CHALLENGE

**Adhesion of Sputtered Coatings**

**Cladding refractory materials of sufficient hardness**

**Reduction of intermetallics in cladded barrels**

## TECHNICAL APPROACH

Eval of a cold cathode on CMS performance  
Post Processing of CMS coatings  
Reactive chemical cleaning

Upcoming evals in WP1426

Upcoming evals in WP1426