

Subject: Solicitation RFI-04-GLD-01
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Here are the terms for this request:

This team is conducting a review of current lubrication requirements, applicable specifications, and test & evaluation (T&E) processes for lubricants. The Government is soliciting industry's input for both an operationally-based performance criteria for small arms weapon lubricants used in a desert environment and for the T&E process for potential candidates. For consideration, please provide your input to both the criteria and T&E process designed to work in sandy/dusty/desert environments

Responses should cite the RFI number in the subject line of the email and should include the name and telephone number of a point of contact having authority and knowledge to discuss responses with government representatives. All correspondence concerning this RFI should refer to RDECOM RFI number RFI-04-GLD-01

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We are pleased to have this opportunity to present technical information on our product, MILITEC-1 Synthetic Metal Conditioner, and propose test and evaluation (T&E) processes that show its value in small arms for use in a desert environment. While MILITEC-1 was not designed solely for sandy/dusty/desert environments, we intend to describe its strength in such environments for the purpose of your evaluation. We are supportive of the effort to generate criteria oriented to operationally-based performance. We believe that our product has technical merits that maximize reliability, safety and convenience; the key elements we propose for evaluating operationally-based performance. For this effort, we will provide more detailed performance criteria and the T&E process to best evaluate against these criteria.

We would like to emphasize that MILITEC-1 has been in the Federal Supply System since 1993 and is the standard weapons lubricant of most federal agencies. Many of these agencies have subjected it to their own extensive testing. Your evaluation team may gain additional understanding of the product through input from these agencies. Also, there has been considerable use of MILITEC-1 in Afghanistan, Kuwait and Iraq by our Armed Forces and after-action

reports have cited the benefits of the product for use in sandy/dusty/desert environments.

This opportunity has been precipitated, in part, by the way MILITEC-1 performed for our U.S. troops during live fire exercises held last summer in Kuwait, during 140 degree temperatures and the recent wave of rush orders by our deployed forces. In spite of the very difficult environmental conditions encountered, weapons conditioned with MILITEC-1 performed reliably.

MILITEC-1 is a synthetic metal conditioner that impregnates a wide range of metals to form a complex molecular size compound within the surface metal. The reaction starts to occur when the friction from firing, or an outside heat source heats the metal surface. When the brief heat reaction is complete, the remaining surface oil can be wiped completely dry. The result is a water-repelling dry compound that is now a physical part of the metal's surface. This dry lubricated surface has more lubricity on the metal surface than does a film of even the most effective oils. This dry metal conditioning effect remains until the metal compound is worn away from extended firing.

A MILITEC-1 conditioned weapon will not allow dust, dirt, and sand, including the residue from firing to combine with the metal or become pasted to the metal surfaces. The MILITEC-1-conditioned firearm (that is bone dry) has the ability to fire thousands of rounds with no decrease in reliability from the environmental effects. The result is a high level of performance and reliability. The dust, sand and other debris, which might impair performance, do not adhere as easily to the metal surfaces as there is no stickiness to attach and hold debris to the gunmetal. The constant lubrication effect of MILITEC-1 can provide for higher muzzle velocity. Bullets will smoothly feed into the firing chamber. The benefit of self-lubrication to gunmetal is that cleaning and constantly lubricating a weapon during firing exercises or in combat is not necessary.

Another convenience of MILITEC-1 is the ease with which a firearm can be cleaned. Since there is very little debris on metal surfaces, and there is greatly reduced compaction of debris against the metal surfaces, what debris there is can be quickly removed, most often with a dry patch, but also with little effort when cleaners or a moistened patch with MILITEC-1 are employed.

This characteristic of MILITEC-1 to bond chemically with metal surfaces provides other benefits as well. Since MILITEC-1 is a physical part of the metal, the new molecular compound is no longer subject to the unstable characteristics of fluids in very hot or very cold environments. It therefore cannot flash off or evaporate in extremely hot conditions or crystallize in extreme cold. Even when the film of MILITEC-1 is left on the metal, (the flash point 410°F and the pour point -45°F) this thin synthetic film can withstand difficult environmental conditions. This can be valuable when there is no time after MILITEC-1 has been applied to wipe the metal surfaces dry.

Another characteristic of MILITEC-1 is its environmental safety record. In closed environments, off-gassing of MILITEC-1 is not a problem as proven in tests undertaken by the U.S. Navy's Medical Command. The Medical Command approved MILITEC-1 for storage and use aboard submarines. We include in this proposal the off-gassing requirements that we think should be a part of the qualification of a metal conditioning firearms lubricant. The subject "Characterization of a Synthetic Metal Conditioner" below will further describe special characteristics of MILITEC-1.

**METAL CONDITIONER
CHARACTERIZATION BRIEF**

IN *A product which conditions and modifies metal surfaces in a weapon so that:
a) friction during operation is virtually eliminated or substantially reduced,
b) the conditioned metal becomes highly corrosion resistant, and
c) the conditioned weapon can be readily cleaned from firing residue and other debris.*

PROCEDURE FOR PERFORMANCE COMPARISON TESTING USING MILITEC-1

- Select at least eight weapons of the same type, age, and model. The weapons must be new, or, if previously operated, thoroughly cleaned with solvent.
- Treat one-half of the weapons with MILITEC-1; treat the other half with the standard gun lubricant, per manufacturer's directions. *To condition a weapon with MILITEC-1, apply a thin film to the bore and to all other metal surfaces (See application directions below).*
- Fire the eight weapons, at least a thousand rounds each, in battlefield conditions, (SW Asia) including dirt, sand, and dust. Note any jamming that occurs for each weapon.
- When firing is completed, clean all the weapons. (1) First use a dry cloth patch to see if that will remove all visible debris. Second, for any remaining debris, use a cloth patch moistened with MILITEC-1. Note the time it takes to clean the weapon and the amount of physical effort required. Check to see if there is any remaining debris after this cleaning. A solvent or cleaner can be used to test for this. Also, we suggest doing the opposite when testing other products. When you have finished a normal cleaning with those products, apply MILITEC-1 as a cleaner to see if it picks up residue that the other cleaner/lubricants did not remove.
- As a separate demonstration of MILITEC-1, conduct a bench test of a weapon before conditioning with MILITEC-1: measure muzzle velocity with a chronograph. Then condition the weapon, including the bore. Fire at least fifty rounds to impregnate the MILITEC-1, and then conduct the same bench test. Typically, MILITEC-1 conditioning will produce higher muzzle velocities compared with boundary film, or solid film lubricants.
- It is critical to note that once a weapon is conditioned with MILITEC-1, it remains conditioned. This means that performance characteristics imparted by MILITEC-1 remain, even if another product is subsequently applied to the weapon - In that event, strong performance characteristics could mistakenly be attributed to the other product.
- It is most important to test MILITEC-1 in the hot desert where lubricants would normally evaporate off metal surfaces over time and not be available if weapons are needed for immediate use and have not been lubricated recently. The weapons can be left in an open, hot environment for 3-6 months without further lubrication and still function as if the lubricant had just been applied. While it may be impractical to do testing over such long periods of time, we recommend that weapons be subjected to both high ambient temperature and radiant heat as would be experienced under the desert sun, to see the effect of these on the lubrication status of the weapon over time to the extent practical.

Characterization of a Synthetic Metal Conditioner

The metal conditioner shall have an Autoignition Temperature ASTM (D2155) greater than 700°F, an ASTM (D97) pour point lower than -40°F, and a Flash Point (D92) no lower than 400°F. It shall include a mild detergent to facilitate cleaning of metal surfaces.

The metal conditioner shall function by reducing the degree of deformation (increasing the stiffness) of metal surfaces by a factor of at least 15, determined through Atomic Force Microscopy. The metal conditioner shall sustain 750 lbs on the Falex Load Carrying Capacity test for more than one minute, and shall exceed 150 ft lbs of torque for 60 seconds with one drop applied on the Falex FLC Extreme Pressure Machine.

The conditioned metal surfaces shall not off-gas harmful components when subjected to standard off-gassing analyses. The analyses shall include heating the test material to 150°F for 24 hours in a sealed container, and conducting the tests with no atmospheric renewal. Metal surfaces conditioned with the metal conditioner must not produce harmful off-gassing at any time, including periods of firing.

Weapons properly conditioned with metal conditioner and heated through firing shall be virtually jam free and corrosion resistant. The conditioned weapons must be able to be wiped dry and continue to function in extremes of heat and cold, as well as in dry, dusty conditions. The conditioned weapons must be capable of being transported, stored, and operated with no surface film of lubricant, without degradation of their performance.

The properly conditioned weapon must be easily cleanable, after firing 1,000 rounds, without solvents, using instead at most only a cloth patch moistened with the metal conditioner.

ENVIRONMENTAL SAFETY OFF-GAS REQUIREMENTS

PROCEDURES FOR DETECTING OFF-GASSING

Determine total hydrocarbons with a total hydrocarbon analyzer. This instrument uses a flame ionization detector system. The sensitivity of this method is 0.45 ppm.

Determine light hydrocarbons (C₁ to C₆) with a gas chromatograph equipped with a Porapak Q stainless steel column, 213 x 0.32 cm, utilizing a flame ionization detector. Flame ionization gas chromatography has a detection limit of 0.1 ppm for many organic compounds.

Determine heavy hydrocarbons (C₆ to C₁₈) with a gas chromatograph using a flame ionization detector and a 183 x 0.32 cm stainless steel column packed with 10 percent OV-101 on Chromosorb W-HF.

Determine total halogenated hydrocarbons with a total halogen analyzer. This instrument uses an ionization type of detector that responds only to halogenated hydrocarbons. The detection limit of this instrument is 0.5 ppm for most halogenated hydrocarbons.

Determine individual halogenated hydrocarbons with a gas chromatograph using an electron capture (Ni₆₃) detector and a 305 x 0.32 cm nickel column packed with Chromosorb 102. Electron capture gas chromatography has a detection limit of 0.01 ppm or better for many halogenated hydrocarbons.

Determine carbon monoxide using a non-dispersive infrared analyzer equipped with a CO detector. The detection limit of this of this instrument is 0.3 ppm.

To identify organic compounds difficult to identify using a gas chromatograph, use a mass spectrometer/gas chromatograph system. The mass spectrometer is a quadrupole instrument with a 55-megabyte computer and an NBS library containing 38,500 compounds. The mass range of the mass spectrometer is 10-800 AMU. The gas chromatograph uses a flame ionization detector and a 45.7 x 0.32 cm stainless steel column packed with Molecular Sieve 13X, and a 12 meter x 0.2 mm capillary column glass packed with cross-linked methyl silicone. This capillary column serves as an interface between the packed columns and the mass spectrometer.

OFF-GASSING EVALUATION PROCEDURES

Place a sample material of known weight or surface area in a Parr Oxygen Bomb of known internal volume. Sample size will determine the final volume of the off-gassing chamber. Pre-clean the off-gassing chamber,

and obtain blank background runs under conditions identical to the final material's off-gassing evaluation to ensure a zero hydrocarbon background.

Charge the chamber containing the sample material with high-purity (zero) air, normally 6800 cc ambient conditions. Charging pressure depends on the internal volume of the oxygen bomb. Allow the hydrocarbon content of the contained sample material to equilibrate with the zero air for four hours at 130°F, or another acceptable temperature, before accomplishing gas analysis (low ppm level) for specific and total hydrocarbons. Perform the gas analysis while the sample is still at the specified temperature.

Obtain gas analysis by using the following equipment: gas chromatographs equipped with flame ionization, thermal conductivity, and electron capture detectors, total hydrocarbon analyzer, total halogenated hydrocarbon analyzer, non-dispersive infrared analyzer, and a mass spectrometer/gas chromatograph. Use other instruments for special requirements.

Out-Gassed Components	Out-Gassed Levels in Air	
	ppm	ppm/g/L*
Total Hydrocarbons (as methane)	0.6	10.6
Total Halogens (as methyl chloride)	<0.5	<9.2
Carbon monoxide	1.1	20.1
Methane	<0.1	<1.9
Acetylene	<0.1	<1.9
Acetone	<0.1	<1.9
Freon 113	<0.1	<1.9
Methyl Ethyl Ketone	<0.1	<1.9
Benzene	<0.1	<1.9
Toluene	<0.1	<1.9
Aldehydes (as formaldehyde)	<0.1	<1.9

* ppm/g/L-Normalized for a one-gram sample in one liter of air.

FIREARMS APPLICATION INSTRUCTIONS: SELF-LUBRICATION

CHARACTERISTICS: MILITEC-1 Synthetic Metal Conditioner has the unique ability to create a complex, molecular compound within the surface of heated gunmetal. This causes MILITEC-1 to become part of the metal, not merely a temporary coating or a boundary film. There are two main characteristics of this safe new compound. First, it seals and conditions the metal by stiffening (not hardening) the metal surface. Second, it makes the gunmetal self-lubricating under all environmental conditions.

SELF-LUBRICATION: After a complete application, a MILITEC-1 conditioned firearm is self-lubricating. Self-lubrication gives the firearm's gunmetal the dry lubricity that is required for sustained fire under all environmental conditions. If exposure to dust, sand, or extreme cold is a concern, all excess MILITEC-1 **must** be wiped away, leaving the firearm's surface metal clean, dry, and constantly lubricated. **Please note:** Enhanced corrosion resistance and self-lubrication are attained **only** after **both** Step One and Step Two

(below) are completed.

PREPARATION: To take full advantage of MILITEC-1's unique properties, start with a clean firearm. Although MILITEC-1 contains a mild detergent that will help with subsequent cleaning, there are no solvents or other hazardous materials in MILITEC-1, so it cannot remove old caked-on fouling and build-up from other lubes. Thus, if a firearm is dirty, you must clean it with a solvent before you proceed. Normal fieldstrip cleaning should be perfectly adequate. If possible, remove the handgrips, clean and prepare.

INITIAL TREATMENT: Applying MILITEC-1 to a firearm for the first time is a two-step process: (1) Application and (2) Firing. Step two does not need to be performed if the firearm will be employed directly after the MILITEC-1 is applied. Subsequent applications of MILITEC-1 require only that a light film be applied as Step One below.

STEP ONE: APPLICATION. Now that the firearm is clean and dry, apply a **light** film of MILITEC-1 to **all** surfaces, including the bore. Burnish/polish MILITEC-1 into exterior surfaces by rubbing rapidly using a cloth lightly dampened with MILITEC-1. **Sparingly** apply drops into the action, concentrating on springs, moving parts and metal-to-metal contact areas. If your firearm has a magazine, be sure to apply MILITEC-1 both inside and out. Leave a very light film of MILITEC-1 on all surfaces during reassembly. Now proceed to Step Two.

STEP TWO: FIRING. Once you fire your weapon enough times to reach operating temperatures, the heat and friction will activate MILITEC-1, strengthening the bonding process that was started in Step One. While firing, MILITEC-1 creates a self-lubricating, water-repelling, dry compound within the gunmetal.

Additional Application Instructions: If Step Two is not immediately possible, and the weapon will not be put into immediate use, consider applying low heat to the firearm to facilitate the bonding process until you can perform Step Two. In field conditions, place your lubed firearm in the sun underneath black plastic or a similar ventilated heat source for at least two hours. Alternatively, you may use a heat gun, hairdryer, burnishing or polishing tool to heat the gunmetal. In heat controlled environments, do not exceed 150° F (65° C). In all applications that require heat to condition the firearm, always insure proper ventilation and wear protective clothing. Please consult our [MSDS](#) for additional information.

ULTIMATE PROTECTION: To maximize the effects of MILITEC-1, repeat Step One and Step Two while the firearm is still hot from the first firing session. MILITEC-1's impregnated molecular bond intensifies during the next 2-3 applications on hot gunmetal. MILITEC-1 has now become a physical part of the gunmetal.

SUBSEQUENT APPLICATIONS: It is important to continue using MILITEC-1 to lubricate your firearm throughout its normal service life. Consistent use of MILITEC-1 will maintain the self-lubricating effect, maximize corrosion resistance, and minimize wear on all friction surfaces. Fouling, deposits and metallic debris do not adhere as easily to gunmetal surfaces conditioned with MILITEC-1. Use a safe, inexpensive cleaner or solvent to detail the firearm, if necessary. For maximum corrosion resistance, and especially if long-term storage is anticipated, leave a very light film of MILITEC-1 on all surfaces, after both steps or field application procedures are completed.

APPLICABILITY: MILITEC-1 is recommended for all pistols, shotguns, rifles, automatic weapons, tank guns and artillery of all calibers and sizes. Note: MILITEC-1 will alleviate jamming due to tight tolerances.

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