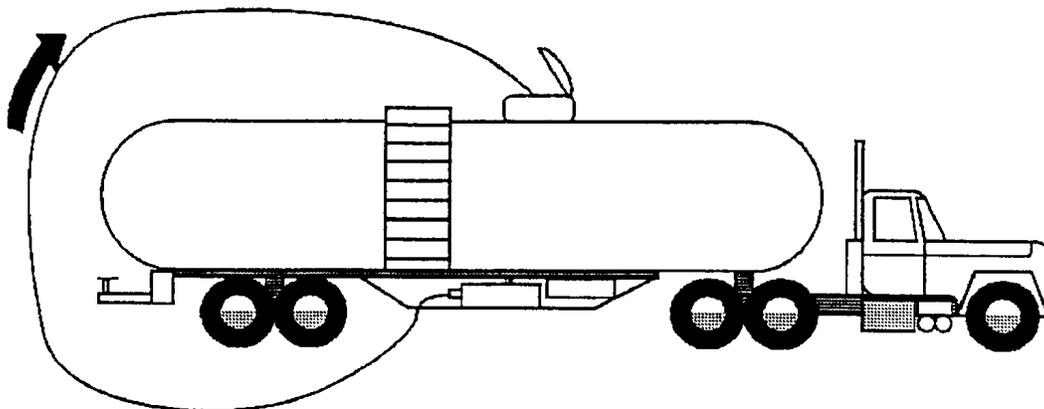


GUIDE FOR FIELD BLENDING OF ADDITIVES INTO GROUND FUELS



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1. Introduction. The purpose of this procedure is to provide guidance for the field additization of all ground military fuels by means of batch blending. Such blending of fuels is considered a field expedient method and only will be used only when additive injection equipment is not available. Additive injection equipment includes the Hammonds Portable Multi-additive Injector and the Army Fuel Filtration Additive Unit (FAU). The decision to additize fuel in the field should be based on feedback from the field and/or the results of laboratory tests. Fuels treated by batch blending should be used in *ground vehicles and equipment* only. Only distillate fuels (diesel fuel) and kerosene base fuels (JP-5, JP-8, Jet A, Jet A-1) should be field blended. Gasoline (Mogas and Avgas) and naphtha base fuels (JP-4 and Jet B) should never be field blended. Examples of possible field fuel treatments include:

- Upgrading Jet A-1 to JP-8 by blending in the three military additives.
- Addition of the stability additive to diesel fuel to enhance storage capabilities.
- Adding corrosion inhibitor/lubricity improver to diesel fuel or ground turbine fuel to enhance lubricity.

Batch blending of fuels is best accomplished in tank vehicles, tank-semi trailers, or in above ground tanks equipped with a bottom discharge. Blending is possible in underground tanks using special equipment and procedures. Blending is not possible in collapsible (pillow) tanks and is generally impractical in 500 gallon collapsible drums, in vehicle/equipment fuel tanks, or in fuel cells. Blending is best performed by preparing a premix of the additive and fuel, then adding the premix *ahead* of the bulk fuel during loading operations. The premix will dilute the additive and facilitate mixing. In general, additives should not be combined together in a premix. Mixing can be accomplished in the most effective manner by recirculation within the tank using the on-board or auxiliary pump. Less effective mixing would be by movement of the tank vehicle over a rough terrain. Addition of the premix on top of the bulk fuel is least effective and mixing times should generally be doubled.

Appropriate procedures are as follows:

2. Addition of Fuel System Icing Inhibitor (FSII) to ground turbine or diesel fuels.

FSII is added to fuel to prevent freezing of separated water. This additive is soluble in both fuel and water and, in the presence of separated water, will migrate from the fuel to the water. In general, it is used in cold climates where subfreezing ambient temperature are expected.

Obtain sufficient FSII meeting MIL-I-85470 (di-ethylene glycol monomethyl ether) using the National Stock Numbers (NSNs) as shown in Table I.

Table I.

Nomenclature	Container	NSN
Fuel System Icing Inhibitor, MIL-I-85470	Five gallon can	6850-01-057-6427
	Fifty-five gallon drum	6850-01-089-5541

Fuel should be checked for existing FSII by use of the B-2 Test Kit or other suitable laboratory method before addition. If present, do not add additional FSII.

Recommended concentration of FSII is 0.10 to 0.15 volume percent for JP-5, JP-8, Jet A, and Jet A. Diesel fuel can tolerate up to 0.25 volume percent if needed.

Premix preparation: Combine fifty percent FSII, as received, with fuel in a suitable container such as a Jerri can, or gallon jug. Mix by shaking the container for one or two minutes.

3. Addition of prescribed levels of Corrosion Inhibitor/Lubricity Improver to ground turbine or diesel fuel.

Corrosion Inhibitor/Lubricity Improver can be added at prescribed levels to Jet A, Jet A-1 or diesel fuel to improve the corrosion resistance of the fuel.

Obtain sufficient Corrosion Inhibitor/Lubricity Improver, MIL-I-25017, using the National Stock Numbers shown in Table II or directly from a vendor listed in a current edition of the Air Force Qualified Products List, QPL-25017 (Appendix A)

Table II.

Nomenclature	Container	NSN
Corrosion Inhibitor/ Lubricity Improver	One gallon can	6850-01-180-1074
	Fifty five gallon drum	6850-00-292-9780

Recommended concentration of the corrosion inhibitor/lubricity improver for conventional use varies by manufacturer/vendor as shown in QPL -25017. Use the minimum effective concentration and assume g/m^3 is equivalent to parts per million (ppm) by volume.

Premix Preparation: Combine fifty percent Corrosion Inhibitor/Lubricity Improver, as received, with fuel in a suitable container such as a liter bottle or can. Shake container for one or two minutes.

4. Addition of Corrosion Inhibitor/Lubricity Improver to enhance lubricity of ground fuels.

Higher levels of Corrosion Inhibitor/Lubricity Improver may be used to enhance the lubricity of ground fuels that have been found to be deficient in lubricity.

Obtain sufficient corrosion inhibitor/lubricity improver from the National Stock Numbers shown in Table II or from a vendor listed in the Air Force QPL-25017 (Appendix A). Recommended concentration for this application is 250 parts per million (ppm) by volume.

Premix Preparation: Combine fifty percent Corrosion Inhibitor/Lubricity Improver, as received,

with fuel in a suitable container such as a liter bottle or can. Shake container for one or two minutes.

5. Addition of Paradyne 655 Additive to optimize lubricity of ground fuels

The Paradyne 655 additive manufactured by Exxon has been found to be an excellent lubricity improver; it can provide the highest degree of wear protection. It should be utilized when severe wear problems persist, or when the fuel has been tested and found to have very low lubricity. .

WARNING: The Paradyne 655 additive should not be blended in fuel where the ambient temperature is expected to be below minus 20 °C (minus 4 °F).

Paradyne 655 can be procured as follows:

<p>Exxon Chemical Co. Paramins Division P.O. Box 719 Linden, NJ 07036 Attn: Customer Service Center (800) 654-1233</p>	<p>Exxon Chemical Ltd Paramins Business Center P.O. Box 255 Abingdon Oxfordshire OX13 6TT United Kingdom (44) 1235 545700</p>
<p>Exxon Chemical Japan Ltd. TBS Kaikan Bldg 3-3 Akasaka 5-Chome Minato-ku Tokyo 107, Japan Attn: A. Kato-Paramins (03) 3585 9320</p>	<p>Exxon Chemical Singapore Pte Ltd 14 Science Park Drive Unit 02-01 Singapore 118226 Attn: S. Sim-Paramins (65) 779 1116</p>

Recommended concentration is 80 parts per million (ppm) by volume but concentration can be increased to 200 ppm by volume if necessary.

Premix Preparation: Combine fifty percent Paradyne 655, as received, with fuel in a suitable container such as a liter bottle or can. Shake container for one or two minutes.

6. Addition of Stabilizer Additive, Diesel Fuel, MIL-S-53021, to ground turbine or diesel fuels.

The Diesel Fuel Stabilizer Additive is intended to retard or prevent the formation of fuel deterioration products in ground fuels due to auto-oxidation processes, and to eliminate the presence of any microbiological growth. It contains a multi functional additive mixture that serves as an antioxidant, metal deactivator, corrosion inhibitor, and detergent/dispersant as well as including a biocide. It is available in either a one-package or two-package system. The two package system has the fuel biocide as a separate package. The two packages may be used

separately, but it is recommended that they be added together.

Table III.

Nomenclature	Container	NSN
Biocide Package (Part of Two-package)	Five gallon can	6840-01-167-6940
	Fifty-five gallon drum	6840-01-041-0098
Stabilizer Package (Part of Two-Package)	Five gallon can	6850-01-167-4789
	Fifty-five gallon drum	6850-01-167-4788

Table IV.

Nomenclature	Container	NSN
Diesel Fuel Stabilizer Additive (One-Package)	Five gallon can	6850-01-246-6544
	Fifty-five gallon drum	6850-01-246-6545

Recommended concentration for the Diesel Fuel stabilizer Additive packages varies by manufacturer/vendor as shown in QPL 53021 (Appendix B).

Premix Preparation: A premix of fifty percent Diesel Fuel Stabilizer Additive (one-package or two package), as received, with fuel is recommended. The two packages may be combined into one premix. Prepare in a suitable container such as a liter bottle or can. However, if premixing is not possible or practical, the additive may be used directly. The Diesel Fuel Stabilizer Additive packages, whether in a premix or not, should never be added to a tank that contains no fuel.

7. Mixing:

Mixing in Tank Vehicles:

Prepare the properly proportioned premix for the additive or additive combination. Pour the agitated premix into an empty or near empty tank (Note: Do not pour the diesel fuel stabilizer additive into an empty tank). Fill the tank with fuel by means of top or bottom loading. Thorough mixing can be achieved by mixing within the tank using either the on-board fuel transfer pump or an auxiliary pump. If an auxiliary pump is used it should be grounded to the vehicle chassis. Recirculation is accomplished by placing the discharge nozzle in the top manhole or access port (See Fig 1.). Nozzle should be secured against slippage and grounded to the chassis. Filter/separators should be by-passed to avoid static electricity build up. Personnel should stay off the top of the tank vehicle during recirculation. Minimum mixing times should be governed by the formula:

$$\text{Mixing time} = \frac{\text{Total Fuel Quantity (gallons)} \times 1/2}{\text{Pump Output (gallons / min)}}$$

If the fuel premix is added to the top of the fuel (i.e., to a tank practically full), mixing times should be doubled. Recommended mixing times for selected tank vehicles are given in Table V.

If mixing by recirculation within the tank or tank vehicle is not possible (e.g., no pump or bottom discharge), sufficient agitation may be possible by movement of the tank vehicle. The tank must be filled sufficiently for the fuel to clear the tank baffles but not so high as to eliminate “sloshing” of the fuel. Vehicle should be driven at a moderate speed over rough terrain for a minimum of fifteen minutes or on a paved roadway for a minimum of one-half hour. If the fuel premix was added on top of the fuel, driving times should be doubled.

Mixing in Underground Tanks.

Mixing in underground tanks is best accomplished by the adding the premix to an empty or partially filled tank the loading the remaining fuel on top. Adding the premix on to the top of the fuel will require double the mixing time. Mixing within the fuel tank will require an auxiliary pump. A service station type pump cannot effectively circulate the fuel as its flow is too low (usually no more than 12 gallons/min) to be effective and the pump meter is used as a basis of inventory control. An auxiliary pump will require access to two tank access ports (see Figure 2.). Metallic housing of the pump should be grounded to the access port.

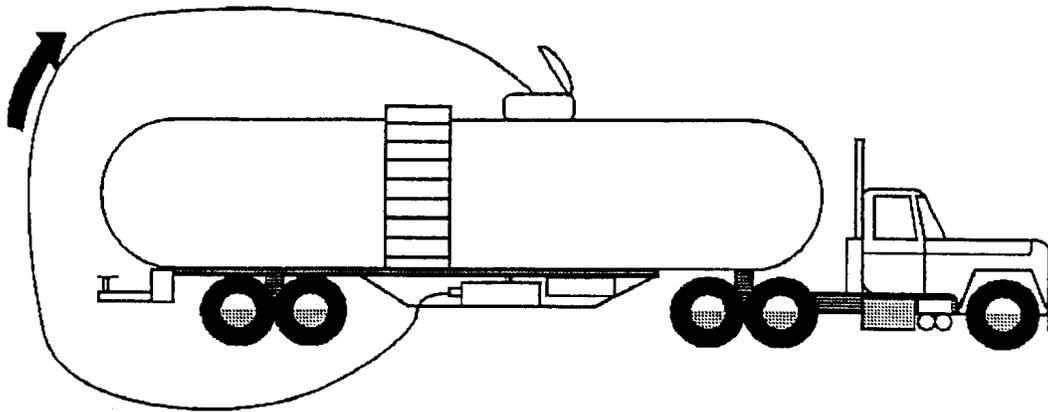


Figure 1.
Mixing in Tank Vehicle

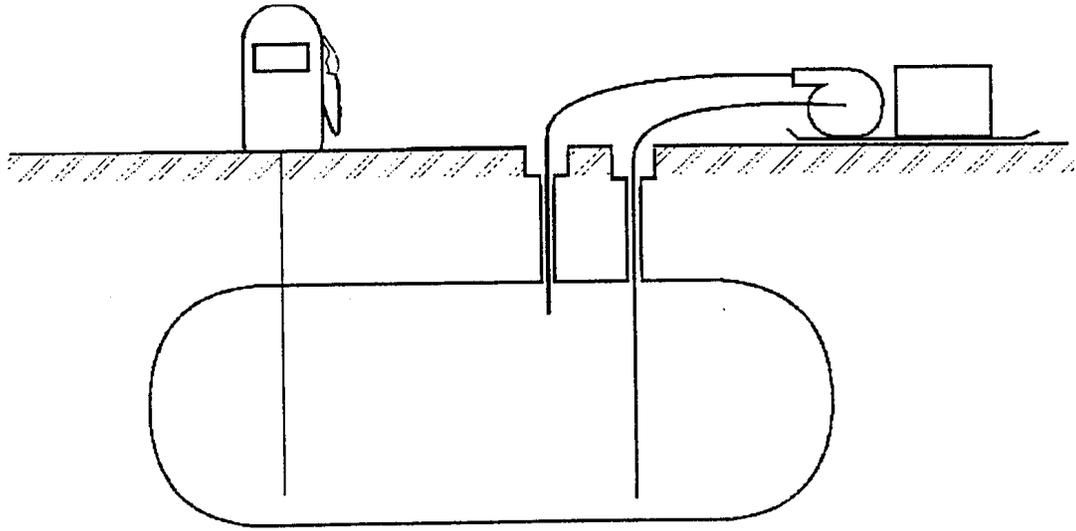


Figure 2.
Mixing in Underground Tank

Table V. Mixing times for selected tank vehicles.

VEHICLE	CAPACITY, gals	PUMP RATE, gals/min. MIN.	MIN. MIX TIME, min.*
Tank and Pump Unit	1200	50	15
M559 GOER	2500	300	4
M978 HEMTT	2500	300	4
M131 Trailer	5000	225	11
M970 Trailer	5000	60	41

* Assume tank is filled to capacity and pump is running at maximum rate.

PRECAUTIONS

While most fuel additives are not generally highly toxic, protective gloves and goggles should be worn. Although a respirator is not required, its use is recommended. Skin contact with any of the additives should be avoided. In the event of an unprotected contact, the exposed area should be thoroughly washed with soap and water. In the event of eye contact, immediately wash the eye with large quantities of water; continue the wash for at least 15 minutes and obtain medical help as soon as possible. When the additive is diluted with fuel, the health hazards are significantly reduced. Additional information on health, fire and toxicological hazards will be found in the appropriate Material Safety Data Sheet (MSDS) found with the additive container.

Nozzles and hoses placed on top of fuel tank vehicles should be firmly secured. Metal components should be grounded to the tank chassis. Filter/separators should not be used during any fuel recirculation process as their use can significantly increase the build-up of static electricity. Personnel should stay off the top of tank vehicles during pumping, recirculating or refueling