

## DISPOSAL OF LIQUID PROPELLANT ROCKET MOTORS

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ABSTRACT THE ISRAEL MINISTRY OF DEFENSE CONTRACTED I.E.O.D. ENGINEERING LTD. FOR THE TASK OF THE DISPOSAL OF TENS OF BULLPUP AGM TYPE ROCKET MOTORS. THESE MOTORS CONTAIN FUEL AND OXIDIZER - A HYPERGOLIC LIQUID PROPELLANT SYSTEM. THE PROPOSED AND EXECUTED DISPOSAL METHOD WAS IGNITION OF THE MOTORS. A REMOTE DESERT SITE WAS SELECTED FOR THE DISPOSAL WORK. A BURNING PIT WAS EXCAVATED FOR EACH ROCKET MOTOR. A FIRING CABLE WAS LAID FROM EACH MOTOR TO A REMOTE CENTRAL LOCATION. THE MOTORS WERE EMPLACED AND IMPROVISED ELECTRICAL IGNITERS WERE INSERTED IN THE MOTOR'S IGNITION DEVICE WELL. DURING DISPOSAL, THE MOTORS WERE IGNITED INDIVIDUALLY WITH DELAYS BETWEEN THEM DEPENDING ON THE WIND SPEED AND DIRECTION. DETAILS ARE GIVEN FOR A CASE OF ONE MOTOR WHICH WAS DESTROYED IN PLACE DUE TO ITS HAZARDOUS CONDITION. THE DISPOSAL EFFORT EXTENDED OVER TWO WEEK PERIOD. DETAILS ARE GIVEN FOR THE CASE OF ONE MOTOR WHICH WAS DESTROYED IN PLACE DUE TO HAZARDOUS CONDITION.

### BACKGROUND

THE USER OF THE BULLPUP AGM-12E SYSTEM DECIDED, THAT IT WAS NO LONGER AN IN-SERVICE ITEM. IT WAS THEREFORE DECIDED TO DISPOSE OF THE INVENTORY OF THESE ROCKET MOTORS.

I.E.O.D. ENGINEERING LIMITED WAS CONTRACTED TO PROVIDE THE DISPOSAL SERVICES FOR THE DESTRUCTION OF ABOUT 180 OF THESE UNITS.

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# Report Documentation Page

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### MOTOR CHARACTERISTICS

THE AGM-12E ROCKET MOTOR HAS THE FOLLOWING BASIC CHARACTERISTICS:

1. LENGHT	-	156.2	CM
2. DIAMETER	-	44.0	CM
3. TOTAL WEIGHT	-	254.0	KG
4. OXIDIZER	-	I.R.F.N.A	
5. OXIDIZER WEIGHT	-	115.0	KG
6. FUEL	-	U.D.M.H	
7. FUEL WEIGHT	-	41.0	KG
8. SOLID PROPELLANT	-	DOUBLE BASE	
9. SOLID PROPELLANT WEIGHT	-	7.0	KG
10. BURNING TIME	-	2.25	SEC.

### DISPOSAL METHODS

THREE METHODS OF DISPOSAL OF SUCH ROCKET MOTORS AS THE ONE USED IN THE BULLPUP SYSTEM WERE CONSIDERED.

- A. DRAINING AND NEUTRALIZING THE OXIDIZER BY CAUSTIC SODA AND THEN SIMPLE BURNING OF THE LIQUID FUEL AT A RATE OF 40 LITERS AT A TIME.
- B. DESTRUCTION BY EXPLOSIVES. DETONATING A T.N.T. CHARGE PLACED IN CONTACT WITH THE ROCKET MOTOR.
- C. IGNITION OF THE ROCKET MOTOR IN A MANNER SIMILAR TO THE CONVENTIONAL FUNCTIONING OF THE PROPELLANT.

THE FIRST METHOD THAT OF DISPOSAL BY NEUTRALIZATION IS THE MOST COSTLY AND TIME CONSUMING. IN ADDITION, IT IS THE MOST HAZARDOUS OF THE THREE METHODS PROPOSED.

WHEN DISPOSING OF ROCKET MOTORS BY EXPLOSIVE DESTRUCTION THE RESULTING DEBRIS IS SPREAD OVER A WIDE AREA. THIS METHOD IS NOT THE MOST DESIRABLE AND SHOULD BE USED ON SPECIAL OCCASIONS WHERE OTHER METHODS ARE NOT PRACTICAL.

IN THE EFFORT DESCRIBED IN THIS PRESENTATION THE THIRD METHOD WAS SELECTED FOR ALL EXCEPT ONE CASE. ONE OF THE ROCKET MOTORS HAD TO BE DISPOSED OF BY EXPLOSION FOR SAFETY REASONS. THIS SPECIAL CASE WILL BE DESCRIBED LATER.

#### THE DISPOSAL EFFORT

A REMOTE DESERT SITE IN THE SOUTH OF ISRAEL WAS SELECTED FOR THIS WORK SO AS TO BE FAR, ABOUT 30 KILOMETERS FROM POPULATED AREAS. THE DISPOSAL SITE ITSELF WAS PLANNED SO THAT THE PREVAILING WINDS WOULD DRIVE THE PRODUCTS OF THE BURNING AWAY FROM THE DISPOSAL TEAM IN THE CONTROL BUNKER.

THE ROCKET MOTORS WERE DELIVERED TO THE AREA AND WERE TEMPORARILY STORED IN AN ORDERLY MANNER IN THE OPEN AT ABOUT 2 KILOMETERS FROM THE DISPOSAL SITE. THE STORAGE AREA WAS ALSO ISOLATED BY A HILL FROM THE BURNING SITE.

EXCAVATIONS WERE MADE AT THE DISPOSAL SITE TO ACCOMMODATE EACH ROCKET MOTOR. TWO SETS OF TWENTY (20) INDIVIDUAL EXCAVATIONS WERE PREPARED , ONE SET FOR EACH DAY OF WORK. EACH EXCAVATION WAS 0.8 METERS WIDE AND SLOPED DOWNWARD AT AN ANGLE OF ABOUT 15 DEGREES FROM THE SURFACE TO A DEPTH OF 1.2 METERS. ADJACENT EXCAVATIONS WERE SEPARATED BY ABOUT TWO METERS.

PRIOR TO THEIR REMOVAL FROM THE STORAGE AREA THE ROCKET MOTORS WERE CHECKED FOR ANY LEAKING OF OXIDIZER OR OF FUEL BY THE USE OF HAND HELD GAS DETECTOR. NO LEAKING PROPELLANT COMPONENTS WERE DETECTED THROUGHOUT THIS DISPOSAL EFFORT.

TWENTY ROCKET MOTORS WERE THEN TRANSPORTED BY A CRANE EQUIPPED TRUCK TO THE DISPOSAL SITE. THIS WAS THE DAILY AMOUNT OF ROCKET MOTORS DISPOSED OF DURING THIS EFFORT. THE MOTORS WERE PLACED WITH ROCKET NOZZLE TOWARDS THE SURFACE SO THAT THE EARTH BURDEN WOULD TAKE THE THRUST OF THE MOTOR.

PRIOR TO THE EMPLACEMENT AND ARMING OF THE MOTORS TO BE DISPOSED OF ON EACH DAY, THE "EMPTY" MOTORS FROM THE PREVIOUS DAY'S WORK WERE CHECKED BY THE GAS DETECTOR FOR REMNANTS OF FUEL OR OXIDIZER. NO HYDRAZINE WAS DETECTED IN ANY OF THE "BURNED-OUT" ROCKET MOTORS. INHIBITED RED FUMING NITRIC ACID WAS DETECTED IN SMALL AMOUNTS.

CONSEQUENTLY, THE "EMPTY" CASES WERE PLACED INTO A TANK CONTAINING WATER AND CAUSTIC SODA WHICH NEUTRALIZED THE OXIDIZER WHICH WAS NOT CONSUMED IN THE BURNING PROCESS.

THE ARMING PROCEDURE WAS AS FOLLOWS:

AS THE IGNITION METHOD WAS ELECTRICAL, TWISTED FIRING WIRES WERE LAID FROM EACH EXCAVATION TO THE CONTROL BUNKER LOCATED THREE HUNDRED AND FIFTY (350) METERS FROM THE EXCAVATIONS. IMPROVISED ELECTRICAL IGNITERS CONSISTING OF AN ELECTRICAL MATCH HEAD AND BLACK POWDER IN A WOODEN DOWEL WERE CONNECTED TO THE SHORTED FIRING LINES. THE FINAL STEP WAS THE INSERTION OF THE IGNITER INTO THE MOTOR'S IGNITION DEVICE WELL. THE SITE WAS THEN EVACUATED BY THE TWO MAN ARMING TEAM WHO RETURNED TO THE CONTROL BUNKER. THE DISPOSAL SITE WAS UNDER SURVEILLANCE BY A CLOSED CIRCUIT TELEVISION SYSTEM WITH A MONITOR LOCATED IN THE CONTROL BUNKER.

AN AMBULANCE AND MEDICALLY TRAINED PERSONNEL WERE ON LOCATION DURING ALL OPERATIONS. THE AMBULANCE WAS LOCATED ON NEARBY HILL WITH EXCELLENT OBSERVATION CAPABILITY OF THE ENTIRE OPERATION.

WIND CONDITIONS WERE CHECKED BY AN ANEMOMETER, PRIOR TO EACH IGNITION TO BE SURE THAT THE DIRECTION AND SPEED WERE SUITABLE FOR CONDUCTING THE OPERATION. WIND SPEEDS OF BETWEEN 4 AND 8 METERS PER SECOND WERE CONSIDERED SATISFACTORY FOR THIS WORK.

AN M-34 BLASTING MACHINE WAS USED TO FIRE THE INDIVIDUAL ROCKET MOTORS VIA THE IMPROVISED IGNITERS. A DELAY OF AT LEAST FOUR (4) MINUTES WAS USED BETWEEN FIRINGS, THERE WERE NO CASES OF PROPAGATION BETWEEN THE ROCKET MOTORS.

#### A SPECIAL CASE

ONE OF THE AGM-12 ROCKET MOTORS HAD SIGNS OF SEVERE CORROSION IT WAS DECIDED TO DISPOSE OF THIS MOTOR BY PLACING A 30 KG CHARGE OF T.N.T PELLETS ON THE CASING OF THIS UNIT. THE MOTOR WAS THUS DESTROYED BY A DETONATION NO PROPELLANT REMAINS WERE FOUND AFTER THE EXPLOSION.

## SUMMARY

A TOTAL OF ONE HUNDRED AND EIGHTY (180) BULLPUP AGM-12 ROCKET MOTORS WERE DISPOSED OF IN A SAFE AND EXPEDIENT FASHION.

THE DISPOSAL METHOD SELECTED, IGNITION OF THE PROPELLANT, WAS THE MOST SUITABLE IN TERMS OF COST AND TIME EFFICIENCY. THE GASES GENERATED ARE BASICALLY THE SAME AS THOSE DURING THE ACTUAL USE OF THE ROCKET MOTOR.

THE METHOD USED OF EMLACING THE MOTOR "HEAD-FIRST" INTO A SLOPING EXCAVATION AND SUBSEQUENTLY IGNITING THE ROCKET MOTOR USING AN IMPROVISED IGNITER WAS FOUND TO BE SATISFACTORY.

IN THE SPECIAL CASE WHERE IT WAS NECESSARY TO DISPOSE OF A CORRODED ROCKET MOTOR BY THE DETONATION METHOD, NO REMAINS WERE DETECTED OF UNREACTED PROPELLANT COMPONENTS.

