



Marine Corps Systems Command



**2006 Insensitive Munitions & Energetic Materials
Technology Symposium
Mine Clearance System (MCS) *Insensitive
Munition (IM) Weapons System*
(# 3408 Poster Session)**



24-28th April, 2006

Thistle Hotel, Bristol, United Kingdom

Zaemuddin Husain

Code E312E, Bldg 302-113

Robert S Hutcheson Jr.* Eric A Hampton

Code E312F, Bldg 302-114

Code E123E, Bldg 841

NSWCIHMD

101 Strauss Ave

Indian Head, MD 20640

Distribution statement A: Unlimited - Approved for Public Release





ENERGETIC MATERIAL RESPONSE AND EXPLOSIVE INFORMATION



USMC Mine Clearance System IM Improvement Program

Baseline IM test Results

CURRENT SYSTEM

Current Energetic Materials

Mk1 and Mk2, Mine Clearance System (MCS) IM Test Reactions						
System	FCO	SCO	BI	FI	SD	SCJ
M58/M59*	Type V	Type V	Type I	Type I	Fail	N/A
Mk22**	Type V	Type III	Type IV	Type V	(Pass)**	N/A

*The M58 and M59 were evaluated in accordance to MIL-STD-2105C.
 **Testing on the Mk22 Rocket met the requirements of the US Navy Bureau of Weapons WR-50 in 1983.

Explosive Components Main Charge		
Component	Explosive	Weight
Pellet	Composition C-4 Class III	1700 lbs. (nominal)
Detonating Cord	PETN	12.25 lbs.
Relay Cups	PETN	.014 lbs.
Explosive Components Rocket Motor		
Propellant	N-5, Double Based	42 lbs.
Igniter	Igniter Charge (MTV) Initiator (BKNO ₃)	.11 lbs. .00049 lbs.
Explosive Components Fuze		
Bellows	Ignition Charge (ZPPV) Gas Producer (Single-base Smokeless Powder)	.00003 lbs. .00003 lbs.
Detonator	Ignition Charge (ZPPV) Intermediary Charge (Lead Azide, RD) Output Charge (PETN)	.00026 lbs. .00051 lbs. .00062 lbs.

Expected Reaction (S)
Burning Type V
Deflagration Type IV
Explosion Type III
Partial Detonation Type II
Detonation Type I

System Improvements

The Makeover*		
Rocket Motor Improvements*		
Current:	Future (?):	Personnel performing task:
N-5 Double-based Propellant	Dual end venting	Peter Lewis @ NSWC/IHMD
Deflagrates during Slow Cook-Off		E313 @ NSWC/IHMD
Linear Demolition Charge Improvements		
Current:	Future (?):	Personnel performing task:
	Replacement energetic evaluation	E312 @ NSWC/IHMD
PETN Detonating Cord	PBXN-8 Detonating Cord	R331 @ NSWC/IHMD
PETN Transfer Cups	Comp A-5 Transfer Cups	E1 @ NSWC/IHMD
Comp C-4 Main Charge Explosive	PBXN-10 Back-up for Main Charge	T233 @ NSWC/IHMD
	Structural Overbraid to eliminate number of transfer cups	
Container Shielding*		
Current:	Future (?):	Personnel performing task:
MK1 - Aluminum Container	Ceramic Ball Shielding	Tom Swirk @ NSWCDD
		Greg Little @ NSWCDD
MK2 - Steel Container		Dr Ray Gamache @ NSWCDD
		E123 @ NSWC/IHMD
	E312 @ NSWC/IHMD	

* Additional information regarding these issues are being provided in other presentations and poster sessions at this conference



Distribution statement A: Unlimited



BASELINE & CANDIDATES DETONATION CORDS QUALIFICATION INFORMATION



USMC Mine Clearance System IM Improvement Program

Explosive	Qualification Status	IM Compliance	Performance	Relative cost	Comments
PETN	Final (type) Qualified	Baseline Used under Waivers	Baseline	Baseline	PETN (pure) is no longer allowed in weapons systems except in fuze initiation trains.
Comp A-5	Final (type) Qualified Material	Approved	Higher Detonation Pressure, less sensitive	Slightly Higher	Developmental <i>IM</i> testing has been performed on this material as a Detonating Cord. Manufacture was unable to produce usable material for this use
PBXN-8	Final (type) Qualified	Approved	Higher detonation Pressure, less sensitive	Higher Cost	Final Type Qualified in APOBS and System is <i>IM</i> Certified.

Test Type	Test Result	
	PBXN-8 (APOBS 115 gr/ft)	Comp A-5 (50-65 gr/ft)
Slow Cook-Off	Burn	Burn
Fast Cook-Off	Burn	-
Bullet Impact	No Reaction	No Reaction
Crossover Testing	1/4" partial detonation otherwise passed	-
Curvature Testing	Passed to 1/2"	-
Reference	NAVSWC TR 90-170	IHTR 1977





OVERVIEW OF DETONATING CORD TRANSFER TESTING



USMC Mine Clearance System IM Improvement Program

Relay/Transfer Cups Transfer Testing			
Description	Test Set-up	PETN (AO) WITH PETN Transfer Cups	PBXN-8 (ST) with Comp A-5 Transfer Cups
Between fuse and booster cup		Testing to be performed	Testing to be performed
Between cord and booster cup (Initiation from detonation cord side)		Testing to be performed	Testing to be performed
Between booster cup and cord (Initiation from booster cup side)		Testing to be performed	Testing to be performed

American Ordnance (AO)
Shock Tube System (ST)
EBA&D (EB)

CURVATURE TESTING			
Explosives	Radius (in)	TEST RESULTS	
		3/8	1/4
		AMB/ -65 °F	AMB/ -65 °F
PETN (AO)		GO/ GO	No GO/ Not tested
PBXN-8 (ST)			GO/ GO
PBXN-8 (EB)			GO/Not Tested

FLEXURE TESTING					
Detonation Cord description	Test Set-up	Rod Dia (in)	Temp (°F)	Result	
				GO	NO-GO
PETN (AO)		1/2	77	X	-
PETN (AO)		3/4	77	-	-
PBXN-8 (ST)		1/2	77	X	-
PBXN-8 (ST)		3/4	77	-	-
PBXN-8 (EB)		1/2	77	X	-
PBXN-8 (EB)		3/4	77	-	-

Note: -65 °F not performed to date

CROSSOVER TESTING										
Explosives	Test Set-up	Gap (in)	Angle (°)	Temp (°F)	Results					
					LEG # 2		LEG # 3		LEG # 4	
					Go ³	No-go ⁴	Go	No-go	Go	No-go
PETN (AO)		0	30/ 45 /60 /90	AMB/-65	P		P		P (-65)	F (AMB)
		1/8"	30/ 45 /60 /90	AMB/-65	P		P		P	
PBXN-8 (ST)		0	30/ 45 /60 /90	AMB/-65	P		P		P	
		1/8"	30/ 45 /60 /90	AMB/-65	P		P		P	
PBXN-8 (EB)		0	30/ 45 /60 /90	AMB/-65	P		P		P	
		1/8"	30/ 45 /60 /90	AMB/-65	P		P		P	

3 PASSED: Detonation transferred from donor to acceptor.

4 FAILED: detonation did not transfer from donor to acceptor.



Distribution statement A: Unlimited



IM TESTING OF DETONATING CORD



USMC Mine Clearance System IM Improvement Program

SLOW COOK-OFF TEST @ 3.3°C (STANAG 4382)		
Cord Type	Observed Reaction Level	
PETN	Detonation	Test series completed. No further tests required.
PBXN-8 (ST)	Burn	
PBXN-8 (EB)	Burn	
FAST COOK-OFF TEST (STANAG 4240 OPEN FUEL FIRE)		
Cord Type	Observed Reaction Level	
PETN	Burn	Test series completed. No further tests required.
PBXN-8 (ST)	Burn	
PBXN-8 (EB)	Burn	
BULLET IMPACT TEST (MIL-STD-2105C)		
Cord Type	Observed Reaction Level	
PETN	To Be Performed	
PBXN-8 (ST)		
PBXN-8 (EB)		

Applicable STANDARD (s)	MIL-STD 2105-C
	STANAG 4382
	STANAG 4240
PASSING CRITERIA	No reaction severe than TYPE V or un sustained reaction on cords



Distribution statement A: Unlimited



ENVIRONMENTAL TESTING



USMC Mine Clearance System IM Improvement Program

Test Group	Test Types	Definition	Applicable Standard (S)
	Testing Completed 15 Mar 06	Quick Look To Be Performed	
Environmental	28-Day Temperature And Humidity (T&H).	Determine Survivability Of The Detonating Cord(S) When Exposed To This Condition	Mil-Std-331, Test C1
	28-Day Temperature And Humidity (T&H) On A Varied Diameter Dowel.	Determine Transfer Reliability Along The Detonating Cord Length When Exposed To This Condition	MIL-STD-331, Test C1
	28-Day High Temperature Storage.	Determine Transfer Reliability Along The Detonating Cord Length When Exposed To This Condition	MIL-STD-810, Test 501.4
	Thermal Shock Test.	Determine Survivability And Transfer Reliability Along The Detonating Cord Length When Exposed To This Condition	MIL-STD-810, Test 503.3



Distribution statement A: Unlimited



DOWN SELECTED DETONATING CORD



USMC Mine Clearance System IM Improvement Program

Based On Testing To Date PBXN-8 Has
Been Down Selected For The Detonating
Cord With
Composition A-5 Relay Cups



Distribution statement A: Unlimited



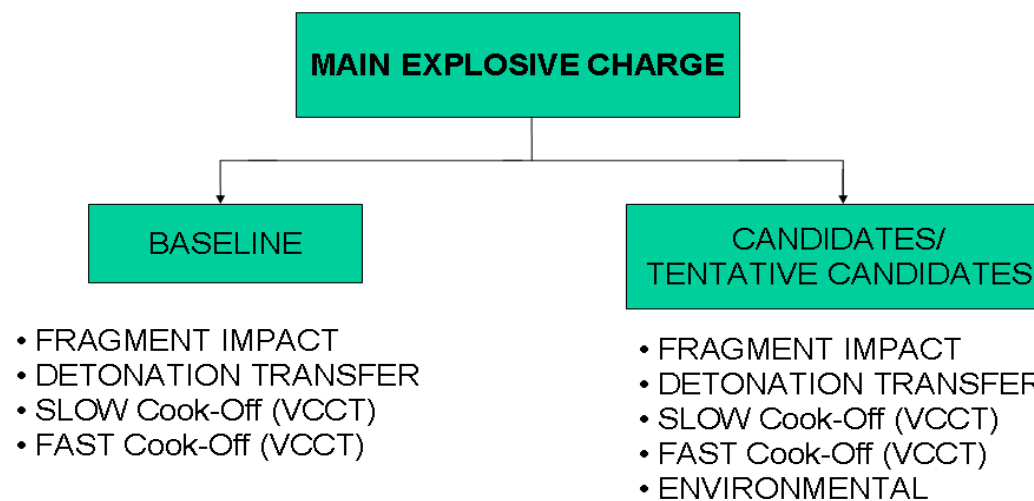
MCS IM IMPROVEMENT PROGRAM

(Main Charge Program)



USMC Mine Clearance System IM Improvement Program

Explosive	Composition	Qualification Status	Relative cost	Options	Comments
C-4	RDX	Final (type) Qualified in current system	\$6/lbs	Keep as Baseline	Advantages:-Low cost Readily Available Performance Marginal Adequate for AT Mine Breaching Disadvantages: Poor Low Temp and aging properties Performance Marginal
PBXN-9	HMX	Final (type) Qualified in APOBS, Hellfire, and JASSM	Much Higher	Replacement material	Qualified in IM Certified APOBS System
PBXN-10	RDX	Final (type) Qualified in APOBS	Higher	Replacement material	Qualified in IM Certified APOBS System
PBXN-109	RDX / AI	Final (type) Qualified in various system	Higher	Replacement material	Good IM response in metal hardware
PBXW-114	HMX / AI	Navy Qualified material	Much Higher	Replacement material	Good IM response in metal hardware
PBXIH-18	HMX/ AI	Navy Qualified material	Much Higher	Replacement material	Good IM response in metal hardware
PBXIH-301	RDX	Experimental Material	Higher	Replacement material	Good IM response in metal hardware
PX-84	RDX	Israeli DOD used material	similar	Replacement material	Testing need to be done
P2000	RDX	Final (type) Qualified EB Material	slightly higher	Replacement material	Testing need to be done
PAX-3	HMX/AI	Army Experimental Material	Much Higher	Replacement material	Testing need to be done



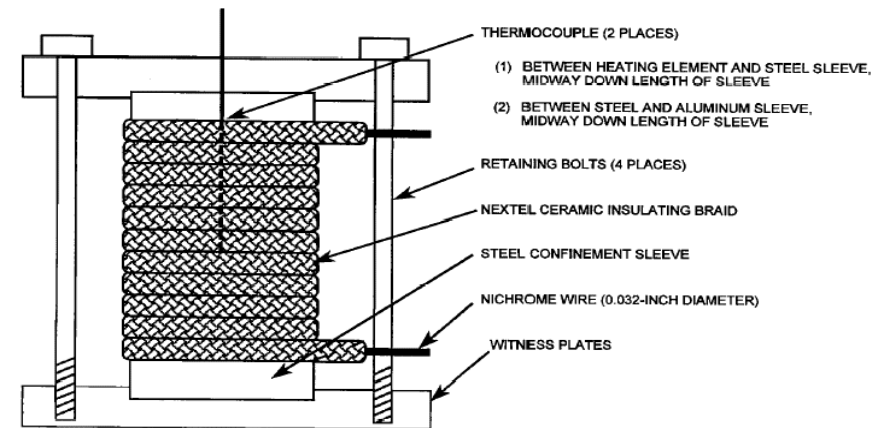
Distribution statement A: Unlimited

VARIABLE CONFINEMENT COOK-OFF TEST

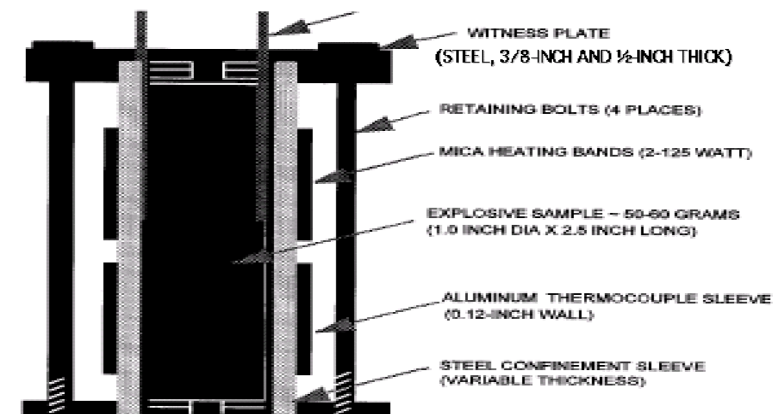
USMC Mine Clearance System IM Improvement Program

The VCCT test sequence starts by evaluating the behavior of an explosive sample at a predetermined level of confinements. Slow and Fast Cook-off tests were performed on baseline MCS main charge (C-4) in accordance with DOD- STD-2105C, using the Variable Confinement Cook-off Test hardware. Historically, C-4 passes the unconfined Slow and Fast Cook-off. By performing the confinement type cook-off tests, we will be able to ball park the cook-off temperature of C-4 based on confinement levels. Results from C-4 (VCCT) will then be use as a threshold for the other replacement candidates we have for MCS. Down selected MCS candidate(s) explosive will have similar or higher (VCCT) cook-off temperature than the C-4 we are trying to replace in current MCS design.

Fast Cook-off Test Setup



Slow Cook-off Test Setup



Expected Reaction (S) From Confinement Type (VCCT)	Passing Criteria	Description Of Passing Criteria	Pictures Of Test Results
Burning Type V	Meet All	Steel Sleeve Recovered In Two (2) Pieces Or Less. None Of The Retaining Bolts Are Broken. No Deformation Of The Witness Plates Occurs.	
Pressure Rupture Type IV	Meet All	Steel Sleeve Is Recovered In No More Than Three (3) Large Fragments. No More Than Two (2) Bolts Are Sheared. No Deformation Of The Witness Plates Occurs.	
Deflagration Type IV	Meet Two Or All	Steel Sleeve Is Recovered In Three (3) Or More Fragments. Two Or More Bolts Are Sheared. Deformation Of One Or Both Witness Plates Is Evidenced.	
Explosion Type III	Meet Two Or All	Steel Sleeve Reduced To Numerous Small Fragments. All Bolts (4) Are Sheared. Deformation Of One Or Both Witness Plates.	
Partial Detonation Type II	Meet All	Steel Sleeve Is Reduced To Numerous Small Fragments. All Bolts (4) Are Sheared. Witness Plates Are Recovered With Shearing Or A Clean Hole Punched Through One Of The Plate And Deformation To Shearing In Other Plate.	
Detonation Type I	Meet All	Steel Sleeve Is Reduced To Numerous Small Fragments. All Bolts (4) Are Sheared. Witness Plates Are Recovered With Shearing Or A Clean Hole Punched Through One Of The Plate And Deformation To Shearing In Other Plate.	



Cook-Off Test Results



USMC Mine Clearance System IM Improvement Program

Slow Cook-off Test Results

Explosive Type	Density (g/cm ³)	Cylinder wall thickness (in)	Reaction Level
C-4	1.6	0.015	Explosion
		0.03	Detonation
		0.045	Deflagration
		0.075	Explosion
PBXN-9 ¹	1.63	0.075	Burn
		0.09	Rupture
PBXN-10 ²	1.69	0.015	Deflagration
		0.015	Deflagration
PBXIH-18 ³	1.97	0.09	Rupture
		0.12	Deflagration
		0.105	Rupture
PBXIH-301	1.58	0.03	Burn
		0.045	Deflagration
		0.045	Burn
		0.075	Deflagration
PBXN-109	1.65	0.075	Deflagration
PBXW-114	1.65 ~ 1.70	0.06	Burn
PX - 84	1.55 ~ 1.63	0.015	Rupture
		0.03	Burn
		0.045	Deflagration
		0.06	Burn
		0.075	Explosion
PAX - 3 ⁴	1.75	0.015	Burn
		0.03	Rupture
		0.045	Rupture
		0.06	Explosion
PAX - 3 ⁴	1.75	0.075	Explosion
		0.075	Explosion
P-2000			Test Not performed

Fast Cook-off Test Results

Explosive Type	Density (g/cm ³)	Cylinder wall thickness (in)	Reaction Level
C-4	1.58 ~ 1.60	0.015	Deflagration
		0.03	Deflagration
		0.045	Detonation
PBXN-9	1.63	0.09	Burn
		0.12	Burn
PBXN-10	1.69	0.015	Rupture
		0.045	Deflagration
PBXIH-18	1.97	0.12	Burn
		0.12	Burn
PBXIH-301	1.58	0.03	Burn
		0.06	Rupture
		0.075	Burn
		0.12	Burn
PBXN-109	1.65	0.075	Deflagration
PBXW-114	1.65		Test Not performed to Date
PX - 84	1.59	0.06	Burn
		0.075	Rupture
		0.09	Detonation
PAX - 3 ⁴	1.75	0.09	Burn
		0.12	Burn
P-2000			Test Not performed

- 1 IHTR 1840
- 2 IHTR 2281
- 3 IHTR 2583 (In publication)
- 4 From AMSRD-AAR-AEE-W

CONFIGURATION	STEEL WALL THICKNESS (IN)	BURST PRESSURE (PSI)
1	0.000*	1200
2	0.015	2350
3	0.030	5230
4	0.045	7725
5	0.060	10000
6	0.075	12700
7	0.090	15305**
8	0.105	17634**
9	0.120	19963**

* Aluminum sleeve without steel confinement sleeve
 ** Burst Pressure Calculation include added confinement presented by aluminum sleeve



Distribution statement A: Unlimited



MCS IM IMPROVEMENT PROGRAM FRAGMENT TESTS RESULTS MAIN EXPLOSIVE CHARGES

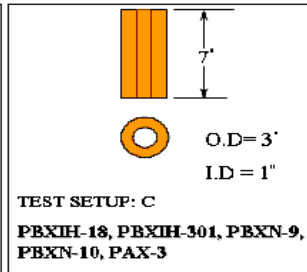
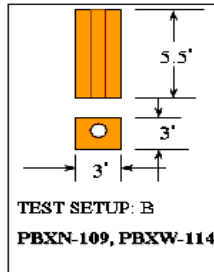
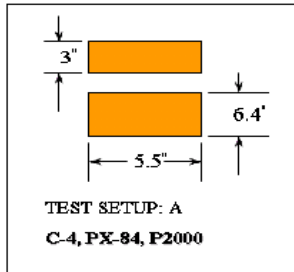


USMC Mine Clearance System IM Improvement Program



Test	Test Setup	Test Item Configuration	Nominal Conditions
Fragment Impact	C	Single annular charge wrapped in polyethylene bag and jacketed with the nylon sock material to simulate similar MICLIC line charge sheathing. (2.7 lbs Max.)*	Impacted by single STANAG 4496 Fragment with velocity listed in table.
	A	Two standard individual charges cut in half and stacked together as a unit of 4 charges, wrapped in polyethylene bag and jacketed with the nylon sock material to simulate similar MICLIC line charge sheathing (2.7 lbs Max.)*	Impacted by single STANAG 4496 Fragment with velocity listed in table.
	B	Two standard individual half blocks stacked together as a unit of 1 block, wrapped in polyethylene bag and jacketed with the nylon sock material to simulate similar MICLIC line charge sheathing (2.7 lbs Max.)*	Impacted by single STANAG 4496 Fragment with velocity listed in table.

*Min. 2.5lbs.



The purpose of the test is to evaluate the response of each test item to the Fragment Impact test specified in MIL-STD-2105C, Paragraph 5.2.4. The tests are being conducted to evaluate the response of the System to impacts from three fragments moving up to 8300±300 ft/sec.

APPLICABLE STANDARD (S): MIL-STD 2105C or STANAG 4496
TEST CONCLUSION;

Determine what level of protection is needed from shielding to prevent or mitigate the chance for detonation of the main charge. Hopefully the shielding can be designed to ensure a burning or no reaction response. Currently PBXW-114 is the best material.

Explosive Type	Achieved Velocity (ft/sec)	Result(s)
C-4	4997	No Detonation
C-4	5420	Detonation
PBXIH-18	5606	No Detonation
PBXIH-18	6621	Detonation
PBXIH-301	5574	No Detonation
PBXIH-301	6534	Detonation
PBXN-10	4413	No Detonation
PBXN-10	5660	Detonation
PBXN-109	6510	No Detonation
PBXN-109	6605	Detonation
PBXN-9	4399	No Detonation
PBXN-9	5659	Detonation
PBXW-114	6583	No Detonation
PAX-3	5389	Detonation
PX-84	5498	Detonation
PX-84	4292	No Detonation
P-2000	5416	Detonation



Distribution statement A: Unlimited

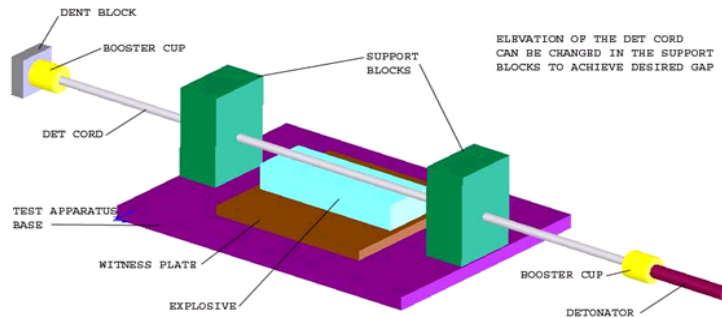


MCS IM IMPROVEMENT PROGRAM TRANSFER TESTS RESULTS MAIN EXPLOSIVE CHARGES



USMC Mine Clearance System IM Improvement Program

Typical Detonation Transfer test setup.



Main charge & Detonation cord combination	Environmental conditions	Main charge configuration	Booster usage & Type	Test results	
				0"	1/8"
C-4 w 90 ¹ gr/ft PETN	77°F	Single MCS style half block (1.25 lbs).	-	GO	GO
	-65°F			GO	FAILED
PBXW-114 with 90 gr/ft PETN	77°F	Single MCS style half block (1.25 lbs).	-	FAILED	-
	-65°F			-	-
PBXIH-301 with 90 gr/ft PETN	77°F	Single MCS style half cylinder	-	FAILED	-
	-65°F			-	-
PBXN-9 with 90 gr/ft PETN	77°F	Single MCS style half cylinder	-	GO	-
	-65°F			-	-
PBXN-10 with 90 gr/ft PETN	77°F	Single annular (1.25lbs).	-	GO	-
	-65°F			-	-
PBXN-109 with 90 gr/ft PETN	77°F	Single MCS style half block (1.25 lbs).	-	FAILED	-
	-65°F			-	-
PBXIH-18 with 90 gr/ft PETN	77°F	Single MCS style half cylinder	-	GO	-
	-65°F			-	-
PX-84 with 90 gr/ft PETN	77°F	Single block (1.25 lbs).	-	GO	GO
	-65°F			GO	FAILED
PAX-3 with 90 gr/ft PETN	77°F	Single annular (2.5 lbs).	-	-	-
	-65°F			FAILED	-
P-2000 with 90 gr/ft PETN	77°F	Single block (1.25 lbs).	-	-	-
	-65°F			-	-
PBXN-109 with 112 ³ gr/ft PBXN-8	77°F	Single block (1.25 lbs).	-	GO	-
	-65°F			-	-
PBXN-10 with 112 gr/ft PBXN-8	77°F	Single annular (1.25lbs).	-	GO	-
	-65°F			GO	-
PX-84 with 100 ² gr/ft PBXN-8	77°F	Single block (1.25 lbs).	-	GO	-
	-65°F			GO	-
PX-84 with 112 gr/ft PBXN-8	77°F	Single block (1.25 lbs).	-	GO	-
	-65°F			GO	-
PBXW-114 with 100 gr/ft PBXN-8	77°F	Single MCS style half block (1.25 lbs).	-	GO	-
	-65°F			-	-
Two Detonating Cords were used for all these					
1 From American Ordnance					
2 From Shock Tube System					
3 From EBA&D					



Distribution statement A: Unlimited



MCS IM IMPROVEMENT PROGRAM

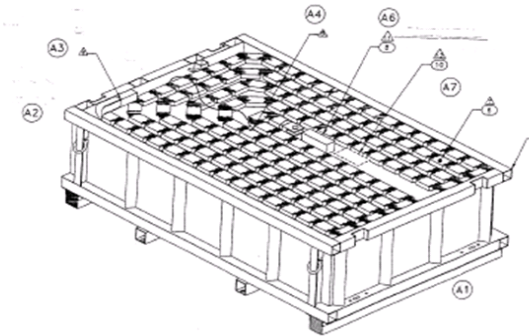
Hybrid M58 Shipping Containers and Selected IM Performance Tests



USMC Mine Clearance System IM Improvement Program

In Order To Perform The Fragment Impact And Bullet Impact Tests On The Shipping Container Which Is Made Of Steel, Two Hybrid Systems Will Have To Be Produce. Both Hybrid Systems Will Have A Combination Of Live (C-4) Explosive And Inert Rubber Blocks Maintaining The Same 5 Lbs/Ft MCS Explosive Charge Requirement. There Will Be No Detonation Cord Or Relay Cups In The Hybrid Systems. The Center Rope Will Be Used To Support And Attached The Live C-4 And Inert Pallets. Fuzing System Will Also Be Not Included In The Hybrid Setup. The Orientation Of The Explosives Will Have To Be Different For Each Test And Special Consideration Will Have To Be Provided To Achieve The Proposed Zones Of Impact During Testing By Relocating And Maximizing The Live C-4 At That Zone.

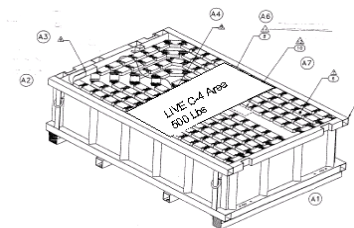
The Two Hybrid Systems Will Be Called As **Hybrid System A** And **Hybrid System B** To Perform Fragment Impact and Bullet Impact per Applicable Spec: MIL-STD 2105C



Typical View of MICLIC HYBRID SYSTEM A & B M58 shipping container.

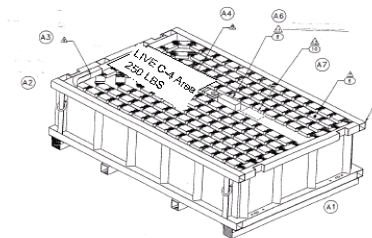
MCS HYBRID SYSTEM A DETAILS

MCS HYBRID SYSTEM A, Uses a maximum of 200 Unit Charge Assemblies (~400 C-4 pellets) with the remainder being Inert Unit Charge Assemblies (500 max) (1000 inert pellets max) for a total of 700 unit charge assemblies per loaded container (kit). The total mass of live C-4 comes out to be ~500 lbs of C-4. Two (2) Hybrid system A will be produce with the mass of live C-4 focused on the side of the box. One (1) fragment impact and one (1) bullet impact test will consume two (2) hybrid systems A.



MCS HYBRID SYSTEM B DETAILS

MCS HYBRID SYSTEM B, Uses a maximum of 100 Unit Charge Assemblies (~200 C-4 pellets) with the remainder being Inert Unit Charge Assemblies (600 max) (1200 inert pellets max) for a total of 700 unit charge assemblies per loaded container (kit). The total mass of live C-4 comes out to be ~250 lbs of C-4. One (1) Hybrid system B will be produce with the mass of live C-4 focused on the Aft end of the box. One (1) bullet impact test will consume one (1) hybrid system B.



Distribution statement A: Unlimited



MCS M58 SHIPPING CONTAINER TESTS WITH HYBRID EXPLOSIVES



USMC Mine Clearance System IM Improvement Program

Bullet Impact Test on Hybrid System B Without Shielding Point of Impact (AFT END OF CONTAINER)

- Procedure
 - Bullet Impact Test will be conducted in accordance with MIL-STD-2105C, paragraph 5.2.3
 - Purpose of the test is to evaluate the response of each test item to the bullet impact test specified in MIL-STD-2105C, Paragraph 5.2.3
- Unit Configuration
 - One containerized MCS system modified to be Hybrid B system will be tested
- Test
 - The System shall be impacted by three .50 caliber type M2 AP projectiles
 - Velocity of 850 ± 60 m/s (2800 ± 200 ft/s)
 - the center of the live pellet area to ensure live pellets are above, below, around and behind the bullet impact points.
 - This allows bullets to strike to the left and right of the aim point
 - The fixture will support the container and restrain it from any undesired motion due to the bullet impacts.
 - Pressure gauges will be used to measure any resulting overpressure
 - Fragmentation distances and weights will be recorded
- Criteria for Assessing Results
 - The criteria for assessing the results of this test are found in paragraph 5.2.3.4 of MIL-STD-2105C
 - The passing criterion of MIL-STD-2105C is no reaction more severe than Type V



**Instantaneous Detonation after 2nd Round
before 3rd Round could be fired**



Distribution statement A: Unlimited



MCS M58 SHIPPING CONTAINER TESTS WITH HYBRID EXPLOSIVES



USMC Mine Clearance System IM Improvement Program

Bullet Impact Test on Hybrid System A With Shielding Point of Impact (**SIDE PORTION OF CONTAINER**)

- Procedure
 - Bullet Impact Test will be conducted in accordance with MIL-STD-2105C, paragraph 5.2.3
 - Purpose of the test is to evaluate the response of each test item to the bullet impact test specified in MIL-STD-2105C, Paragraph 5.2.3
- Unit Configuration
 - One containerized MCS system modified to be Hybrid A system will be tested
- Test
 - The System shall be impacted by three .50 caliber type M2 AP projectiles
 - Velocity of 850 ± 60 m/s (2800 ± 200 ft/s)
 - the center of the live pellet area to ensure live pellets are above, below, around and behind the bullet impact points.
 - This allows bullets to strike to the left and right of the aim point
 - The fixture will support the container and restrain it from any undesired motion due to the bullet impacts.
 - Pressure gauges will be used to measure any resulting overpressure
 - Fragmentation distances and weights will be recorded
- Criteria for Assessing Results
 - The criteria for assessing the results of this test are found in paragraph 5.2.3.4 of MIL-STD-2105C
 - The passing criterion of MIL-STD-2105C is no reaction more severe than Type V



Burning Reaction after 3rd Round was fired



USMC Mine Clearance System IM Improvement Program

Fragment Impact Test on Hybrid System A With Shielding Point of Impact (**SIDE PORTION OF CONTAINER**)

- Procedure
 - The purpose of the test is to evaluate the response of each test item to the Fragment Impact test specified in MIL-STD-2105C, Paragraph 5.2.4.
 - The tests are being conducted to evaluate the response of the System to impacts from three fragments moving at 8300 ± 300 ft/sec.
- Unit Configuration
 - One containerized MCS system modified to be Hybrid A system will be tested
- Test
 - Each test item shall be impacted by 1 fragment size (conical ended cylinder weighing 18.6 grams)
 - Velocity of the fragment 8300 ± 300 ft/s
 - Fragments will be aimed at the center of the live pellet area to ensure live pellets area above, below, around and behind the fragment impact point.
 - Pressure gauges will be used to measure any resulting overpressure
 - Fragmentation distances and weights will also be recorded.
- Criteria for Assessing Results
 - The criteria for assessing the results of this test are found in paragraph 5.2.4.4 of MIL-STD-2105C
 - The passing criterion of MIL-STD-2105C is no reaction more severe than Type V.



Burning Reaction after Fragment Round was fired