OUTPUT INVESTIGATION XM100 ELECTRIC DETONATOR

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ICI United States, Incorporated

Prepared for:

Picatinny Arsenal

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ATLAS AEROSPACE DIVISION
ICI United States Inc.

OUTPUT INVESTIGATION
XM100 ELECTRIC DETONATOR

FINAL REPORT

PREPARED BY

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FOR

PICATINNY ARSENAL
DOVER, NEW JERSEY
07801

ICI UNITED STATES INC.
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VALLEY FORGE, PA 19481

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SUMMARY

The purpose of this investigation was to determine the effect upon output of the XM-100 electric detonator (Dwg. P-9245691) when the cup bottom profile, material and explosives density are altered. The effects of detonator confinement and explosive lead density were also investigated. This program was accomplished in three phases.

Phase I evaluated the cup bottom thickness and profile as well as material. The explosives density was also investigated.

Phase II determined what effect detonator confinement and confinement material has on the ability to initiate an explosive lead.

Phase III evaluated the effect of varying the explosive lead material density.

At the completion of this study, the detonator described by Picatinny dwg. P-9245691 was selected as being one of the most efficient. The detonator cup has a .005" bottom thickness with a .150" radius. Equal in efficiency was a design which has a flat bottom and is also .005" thick. Evaluation of the test data shows that all other cup designs could not exceed the efficiency of these two designs.

The most surprising result of the entire program was the ability of both of these design configurations to initiate a PBXN-5 explosive lead across extremely large air gaps. Steel dent witness block measurements indicate that the explosive lead achieved high order detonation over air gaps up to .7". There is every reason to believe this distance is not the design limit but no further work was performed along these lines. The ability of the detonator to initiate the lead over this large air gap may be dependent on configuration of the test structure. It was not established that the detonator inherently has the capability of initiating a lead over such large air

gaps in any arbitrary configuration. This ability was demonstrated when the detonator was functioned essentially unrestricted in the plastic test clip SKA-102. Any side or bottom confinement may affect this capability drastically either enhancing or limiting its ability. All detonators were functioned with a 100 microfarad capacitor charged to 1.6 volts.

FORWARD

ICI received this contract from Picatinny Arsenal to investigate the output of the XM-100 detonator. The object of the contract was to determine which detonator configuration is the most efficient for initiation of leads across various air gaps.

The investigation was prompted by the fact that testing at Picatinny suggested a marginal area exists in the present ADAM detonator/lead train. The XM-100 had been selected for use in the ADAM fuze train where its required to initiate a PBXN-5 lead over an air gap of .2". The lead is .095" long by .114" in diameter and has an aluminum cup.

The parameters affecting initiation efficiency were previously investigated to some degree by two sources. They are ICI (formerly Atlas Chemical Industries, Inc.) and the Link Ordnance Division of General Precision (now Space Ordnance Systems). Link's report was presented in March of 1966 as an unnumbered final report to Honeywell under Honeywell Purchase Order number 161776. Our development test data is on file. Both developments were for the WAAFM weapons system, an Air Force design. In this weapon, the XM-100 detonator initiated an aluminum cup lead containing HMX which was .305" long and .313" in diameter over an air gap of .150". Reliable initiation was achieved with a detonator having a .005" thick bottom aluminum cup having a bottom radius of .150". This is the XM-100 cup design.

Since that time it has been noted by ICI that other profiles of the cup bottom work equally well under certain conditions and we began to realize that bottom thickness and mass are more pertinent controlling features of the design.

The question of reliability of the ADAM fuze train therefore prompted the investigation to determine the most optimum detonator design so that the train could possibly be improved accordingly. The lead in the ADAM fuze is shown in the appendix. It should be noted that the length of the lead normally is only .095" long. Most of the testing in the early stages of this investigation was done using leads that were .150" long. This was done to eliminate any concern over the fact that the minimum length of this lead may be in itself a problem area. In the later stages of the testing the actual ADAM lead was tested in exactly similar circumstances and for the most part the lead initiation was no different. The output of the smaller lead is less than that of the larger lead when measured by the steel dent block output technique.

INTRODUCTION

The XM-100 detonator and its related piece parts and explosive components are detailed by Picatinny Arsenal drawings. The top assembly drawing P-9245691 lists the related subassembly drawings and describes the explosive materials.

The unique feature of this detonator is its miniature size. Its diameter is .100" and its length is .250" with an extended terminal length of .220". Its extremely low initiation sensitivity and high output efficiency make it a good candidate for consideration in explosive trains.

The present drawings require a glass to metal seal plug assembly with a single terminal. The cup material is aluminum with a .150" bottom radius, .005" thick. Charges of HBX and RD1333 lead azide are consolidated at 12,000 psi. The plug assembly has a resistance welded wire from the terminal to the header. The bridgewire is then covered with a lead styphnate/lacquer mixture. The plug assembly is inserted into the cup assembly and crimped. The crimp joint is sealed with a sealant.

Variables of this design were investigated to determine effect on output efficiency. The cup bottom shape and material was varied and the charges were also altered in density.

Assembly drawings along with test and piece part drawings are included in this report.

DESIGN INVESTIGATION

Phase I

Twelve different cup configurations were investigated. Four cups were investigated varying only the bottom radius for P-9245697. Four other groups were studied with the bottom radius and bottom thickness varied. The remaining four cup configuration was made from steel instead of aluminum which is required by drawing P-9245697, and varying the bottom radius and inside diameter.

Group	Bottom Radius	Bottom Thickness	Material
1	.150 ± .007	$.005^{+.003}_{-.000}$	Aluminum
2	.090 ± .007	"	"
3	.060 ± .007	"	"
4	Flat	"	"
5	.150 ± .007	$.009^{+.002}_{-.000}$	"
6	.090 ± .007	"	"
7	.060 ± .007	"	"
8	Flat	"	"
9	.150 ± .007	$.005^{+.001}_{-.000}$	Steel
10	.090 ± .007	"	"
11	.060 ± .007	"	"
12	Flat	"	"

Group 1 is the cup per dwg. P-9245697
Groups 1 thru 8 use ignition plug ass'y. P-9245692
Groups 9 thru 12 use ignition plug ass'y. SKA-106
Groups 1 thru 8 cup drawing is SKA-105
Groups 9 thru 12 cup drawing is SKA-104

The second part of this phase investigated the effect of density of the explosive materials in the cup. The cup used in Group 1 was selected for this investigation. The present design requires that quantities of HMX and RD1333 lead azide be compressed at 12,000 psi to achieve the proper powder height. This phase investigated explosive densities at 5,000, 15,000 and 30,000 psi. The quantity of explosives was varied to comply with the present drawing height while the column lengths remained constant.

Phase II

This phase investigated confinement and confinement material. This limited investigation compared steel to aluminum with a fixed air gap with two different air gap diameters. A drawing of this holder is in the appendix identified as SKA-103 .

Phase III

This involved the study to determine what effect on steel dent output the acceptor lead density has. Six PBXN-5 lead groups were compared by testing leads having explosive densities of 5,000 to 30,000 psi in increments of 5,000 psi. These leads were .150" long. Detonators of Group 1 design were used to initiate the leads across an air gap.

This phase also included an investigation of a train similar to the ADAM fuze detonator/lead train. One exception is that no confinement existed. In this phase, ICI manufactured 1200 detonators. 1000 were shipped to Picatinny and 200 were tested at ICI. The 200 leads were made to drawing 9275339. These items were tested across an air gap of .250" which is greater than the maximum gap of .200" in the ADAM fuze.

Since two designs performed equally well throughout this study, (Groups 1 and 4), it was decided to test 100 of each group for reliability. Picatinny requested that the 1000 shippable detonators be manufactured with a flat bottom. Their reasoning for this selection was a practical one in that the standard detonator with a .150" radiused bottom were already available. They wished to run more tests at Picatinny with this flat bottom version.

DISCUSSION OF RESULTS

Phase I - Varying Cup Configuration

All 12 different groups as previously listed were tested by initiating the larger ADAM lead (.150"). The lead was positioned against a steel witness block. Each group was tested until a "no-dent" was reported at increasing air gaps. It became evident quickly that the cups incorporating a thicker bottom and smaller radius were markedly less efficient than the flat bottomed and 0.150" radiused cups. This initial screening thus eliminated all of the groups but 1, 2, 4 and 5, and the steel detonators in totality. Further testing over increasingly large air gaps of 0.7 and 0.8 narrowed down the design selections to [illegible] 1 and 4. These final selections were also guided by testing of the smaller lead - with only 1 and 4 displaying the ability to reliably initiate this lead over the larger gaps.

The radiused designs leave a failure trademark in that [illegible] is destroyed by the jetting action of the shaped charge effect with [illegible] initiation. Some of these smaller radii in fact will jet through up to .0 thick steel and could be used as penetrators very reliably. They will initiate the lead even over very small air gaps. It is for this reason t one instinctively would feel the flat bottomed cup will ultimately prove to be superior to the .150" radius even though both performed as well in this study.

Density of Explosives (HMX and RD1333 Lead Azide)

The Group 1 design was used for this test. It consisted of testing detonators that had the explosives consolidated at 5000, 15000 and 30000 psi. Each density group was functioned directly against a steel dent block. The output increased with increased density. It should be noted that this may be partially due to the fact that the higher density items had more explosives in the cup per unit column length.

Another test was to function each group of detonators into a .150" long PBXN-5 lead across air gaps of .250" and .500". The results of these tests had a range of .007" and .011". It can be noted that the density ranges tested resulted in acceptable lead initiation results throughout the range. This indicates that a rather wide tolerance on weight and density can be tolerated provided column lengths of explosives are uniform.

Phase I testing was designed to be a screening phase for the detonator only. Of all the profiles and materials tested, two designs showed a marked superiority over all the others. The designs were basically similar, having a $.005^{+.003}_{-.000}$ inch bottom thickness of aluminum. Design I has a .150" radius which is the present Picatinny design. Design 4 has a flat bottom cup. Test results indicate that neither design displayed a noticeable superiority over the other. More discretionary testing will be necessary to evaluate these two further. It is the authors' opinion that further evaluation would indicate that the flat bottom design would be more efficient. This is based on the overall trend of these tests which demonstrated that initiation ability increases with an increase in radius. In radii less than .150", the ability to initiate leads over an air gap diminishes quickly.

The steel cup detonator output was much less than that of a comparable aluminum design. This indicates that the mass of the detonator bottom is the controlling feature for initiation of leads. The aluminum bottom fragment apparently achieves a higher velocity when it impinges the lead surface. This is the explanation for the ability of the aluminum cup design to initiate over such large air gaps. Bottom particle velocity effects are also apparent because even though the dent output of the steel design is higher per se, than the aluminum, its lead initiation ability is for less.

The explosives consolidation density phase produced somewhat baffling results. It was expected that the 5000 and 30000 psi groups would be less efficient than the 15000 psi group. All worked equally well with the output of the detonator increasing with increased density. All devices initiated the leads high order. From related testing on another program, it is known that at consolidation of approximately 70000 psi the ability to initiate is lost. These findings come from a study on a delay version of the XM-100 for the RAAM program. There is obviously some point above 30000 psi where failures will occur but this program did not find this point.

Phase II - Confinement Comparison

Detonators from Group 1 were used for this series of tests. The PBXN-5 leads used were .150" long. The confinement materials investigated were 2024 aluminum and B1113 steel. The air gap in the holder was .250". The diameters of the air gap were .063" and .093". A drawing of this holder SKA-103 is in the appendix. This assembly was then functioned against a steel dent block. The limited amount of testing showed a deeper dent using steel confinement. From the small amount tested, it is not possible to dis-

tinguish the effect of the gap diameter. More testing is required along these lines.

Phase III - Varying PBXN-5 Density of Lead

This test was run with 6 groups of .150" long leads in which the PBXN-5 density ranged from 5000 thru 30000 psi in 5000 psi increments. Detonators from Group 1 were used to initiate these leads. The air gaps tested were .250" and .500". The 5000 psi group was somewhat less efficient than the remainder. However, it appears that explosive consolidation from 10,000 psi thru 30,000 psi makes the lead increasingly more efficient.

This conclusion must be tempered by the knowledge that previous testing of a similar nature at Picatinny showed that in the ADAM train, failures can be expected at 30,000 psi. Here again we should caution that the tests performed by ICI in this phase were with an unrestricted detonator while those at Picatinny introduced some confinement and bottom restriction.

Reliability with ADAM Lead

100 detonators each from Groups 1 and 4 were tested across a .250" air gap into a .100" PBXN-5 lead (dwg. 9275339). This test was to determine the reliability in a configuration similar to ADAM detonator/lead configuration. The 100 detonators of Group 4 were from a production lot of 1100 of which 1000 were shipped to Picatinny. The steel dents were comparable for each Group.

TEST RESULTS

TEST RESULTS

(Arranged by Group)

Group 1

Qty.	Air Gap (inches)	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	*Ave. Dent (inches)
25	.000	.150	.009	.012	.0107
25	.250	.150	.007	.012	.0104
25	.300	.150	.007	.011	.0098
25	.400	.150	.007	.011	.0098
10	.500	.150	.008	.011	.0096
10	.600	.150	.007	.011	.0095
5	.700	.150	.007	.010	.0092
5	.500	.100	.006	.010	.0086
5	.600	.100	.007	.008	.0078
5	.700	.100	.006	.010	.0086

Group 2

25	.000	.150	.010	.012	.0103
25	.250	.150	.008	.011	.0108
25	.300	.150	.007	.011	.0095
25	.400	.150	.008	.011	.0103
10	.700	.150	.007	.010	.0091
5	.500	.100	No Dent	.009	.0060
5	.700	.100	.008	.009	.0086

Group 3

25	.000	.150	.010	.013	.0111
25	.100	.150	.006	.011	.0091
25	.250	.150	No Dent	.009	.0026
25	.300	.150	No Dent	.009	.0022

Group 4

25	.000	.150	.010	.012	.0100
25	.250	.150	.007	.012	.0102
25	.300	.150	.007	.011	.0094
25	.400	.150	.007	.011	.0098
10	.500	.150	.007	.011	.0089
10	.600	.150	.007	.010	.0089
5	.700	.150	.009	.011	.0100
5	.500	.100	.007	.009	.0082
5	.600	.100	.007	.009	.0080
5	.700	.100	.007	.009	.0080
5	.800	.100	.005	.009	.0082

* Calculated and carried to 4th decimal.

TEST RESULTS

(Arranged by Group)

Group 5

Qty.	Air Gap (inches)	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
25	.000	.150	.008	.013	.0107
25	.250	.150	.007	.011	.0101
25	.300	.150	.007	.011	.0097
25	.400	.150	.007	.011	.0100
10	.500	.150	.007	.010	.0092
10	.600	.150	.007	.011	.0095
5	.700	.150	.007	.010	.0088
5	.800	.150	No Dent	.009	.0066
5	.500	.100	.009	.010	.0092
5	.600	.100	.007	.010	.0084
5	.700	.100	No Dent	.009	.0062

Group 6

25	.000	.150	.010	.012	.0110
25	.250	.150	No Dent	.011	.0062
25	.300	.150	No Dent	.010	.0030

Group 7

25	.000	.150	.008	.012	.0108
25	.100	.150	No Dent	.009	.0046
25	.250	.150	.001	.006	.0016
25	.300	.150	.001	.008	.0039

Group 8

25	.000	.150	.010	.012	.0108
25	.250	.150	.007	.011	.0104
25	.300	.150	.007	.011	.0094
25	.400	.150	.007	.013	.0099
10	.500	.150	No Dent	.011	.0089
5	.500	.100	.004	.008	.0070
5	.600	.100	.006	.009	.0078
5	.700	.100	.005	.010	.0082

TEST RESULTS

(Arranged by Group)

Group 9

Qty.	Air Gap (inches)	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
25	.000	.150	.009	.012	.0110
25	.050	.150	.008	.011	.0100
25	.250	.150	No Dent	.011	.0070
25	.300	.150	No Dent	.010	.0036

Group 10

Qty.	Air Gap (inches)	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
25	.000	.150	.010	.013	.0117
25	.050	.150	.007	.016	.0101
25	.250	.150	No Dent	.012	.0064

Group 11

Qty.	Air Gap (inches)	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
25	.000	.150	.010	.012	.0111
25	.050	.150	.008 (1)	.018 (1)	.0134
25	.250	.150	.005 (1)	.021 (1)	.0134

Group 12

Qty.	Air Gap (inches)	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
25	.000	.150	.010	.013	.0112
25	.050	.150	.007	.012	.0100
25	.250	.150	.007	.011	.0094
25	.300	.150	No Dent	.011	.0086

(1) The bulk of these are not dents produced by the initiation of the booster, but result from the jetting effect of the detonator alone. The majority of the boosters did not initiate.

TEST RESULTS

(Arranged by Air Gap)

No Gap

Group	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
1	.150	.009	.012	.0107
2	.150	.010	.012	.0103
3	.150	.010	.013	.0111
4	.150	.010	.012	.0109
5	.150	.008	.013	.0107
6	.150	.010	.012	.0110
7	.150	.008	.012	.0108
8	.150	.010	.012	.0108
9	.150	.009	.012	.0110
10	.150	.010	.013	.0117
11	.150	.010	.012	.0111
12	.150	.010	.013	.0112

.050" Air Gap

1				
2				
3				
4				
5				
6				
7				
8				
9	.150	.008	.011	.0100
10	.150	.007	.016	.0101
11	.150	.008	.018 (1)*	.0134
12	.150	.007	.012	.0100

.100" Air Gap

1				
2				
3	.150	.006	.011	.0091
4				
5				
6				
7	.150	No Dent	.009	.0046
8				
9				
10				
11				
12				

*See previous comment.

TEST RESULTS

(Arranged by Air Gap)

.250" Air Gap

Group	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
1	.150	.007	.012	.0104
2	.150	.008	.011	.0108
3	.150	No Dent	.009	.0026
4	.150	.007	.012	.0102
5	.150	.007	.011	.0101
6	.150	No Dent	.011	.0062
7	.150	.001	.006	.0016
8	.150	.007	.011	.0104
9	.150	No Dent	.011	.0070
10	.150	No Dent	.012	.0064
11	.150	.005	.021 (1)*	.0134
12	.150	.007	.011	.0094

.300" Air Gap

1	.150	.007	.011	.0098
2	.150	.007	.011	.0095
3	.150	No Dent	.009	.0022
4	.150	.007	.011	.0094
5	.150	.007	.011	.0097
6	.150	No Dent	.010	.0030
7	.150	.001	.008	.0039
8	.150	.007	.011	.0094
9	.150	No Dent	.010	.0036
10				
11				
12	.150	No Dent	.011	.0086

.400" Air Gap

1	.150	.007	.011	.0098
2	.150	.008	.011	.0103
3				
4	.150	.007	.012	.0098
5	.150	.007	.011	.0100
6				
7				
8	.150	.007	.013	.0099
9				
10				
11				
12				

*See previous comment.

TEST RESULTS

(Arranged by Air Gap)

.500" Air Gap

Group	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
1	.100	.006	.010	.0086
	.150	.008	.011	.0096
2	.100	No Dent	.009	.0060
3				
4	.100	.007	.009	.0082
	.150	.007	.011	.0089
5	.100	.009	.010	.0092
	.150	.007	.010	.0092
6				
7				
8	.100	.004	.008	.0070
	.150	No Dent	.011	.0089
9				
10				
11				
12				

.600" Air Gap

1	.100	.007	.008	.0078
	.150	.007	.011	.0095
2				
3				
4	.100	.007	.009	.0080
	.150	.007	.010	.0089
5	.100	.007	.010	.0084
	.150	.007	.011	.0095
6				
7				
8	.100	.006	.009	.0078
9				
10				
11				
12				

TEST RESULTS

(Arranged by Air Gap)

.700" Air Gap

Group	Lead Length (inches)	Min. Dent (inches)	Max. Dent (inches)	Ave. Dent (inches)
1	.100	.006	.010	.0086
	.150	.007	.010	.0092
2	.100	.008	.009	.0086
	.150	.007	.010	.0091
3				
4	.100	.007	.009	.0080
	.150	.009	.011	.0100
5	.100	No Dent	.009	.0062
	.150	.007	.010	.0088
6				
7				
8	.150	.005	.010	.0082
9				
10				
11				
12				

.800" Air Gap

1				
2				
3				
4	.100	.005	.009	.0082
5	.100	No Dent	.009	.0066
6				
7				
8				
9				
10				
11				
12				

TEST SHEETS

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 140

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 1 Detonators (.005" Thick and .150" Radius and Aluminum)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000													
.001													
.002													
.003													
.004													
.005													
.006												1	
.007				1	2	1		1	1	1	1		
.008				3	2	3	2	1			4		
.009	1					1	1	1	1			3	
.010	7			2	17	14	6	6	3			1	
.011	14			18	4	6	1	1					
.012	3			1									
.013													
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO. _____

SPEC. _____

SAMPLE SIZE: 120

LOT SIZE: _____

DATE TESTED 5/7-

ATLAS ORDER NO. 3639

WORK ORDER NO. _____

LOT NO. _____

SWITCH TYPE _____

TESTER: _____

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 2 Detonators (.005" Thick and .090" Radius and Aluminum)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000										1			
.001													
.002													
.003													
.004													
.005										1			
.006													
.007					3				2	1			
.008				1	3	1						2	
.009					6	1			3	2		3	
.010	10			1	11	13			5				
.011	11			23	2	10							
.012	4												
.013													
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO. ____

SPEC.

SAMPLE SIZE: 100

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

STITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 3 Detonators (.005" Thick and .060" Radius and Aluminum)

Test Results

Steel Test Path (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.200	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000				14	3								
.001				2	9								
.002					2								
.003				1									
.004													
.005					1								
.006			1	1	1								
.007			2	3	2								
.008			3	3	1								
.009			9	1	1								
.010	3		8										
.011	18		2										
.012	3												
.013	1												
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 145

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 4 Detonators (.005 Thick and Flat Bottom and Aluminum)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000													
.001													
.002													
.003													
.004													
.005													1
.006													
.007				2	2	1	3	1		1	1	2	
.008				1	7	2		2		2	3	1	1
.009				2	3	5	4	4	1	2	1	2	3
.010	6			6	5	10	1	3	3				
.011	15			13	8	7	2		1				
.012	4			1									
.013													
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 145

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 5 Detonators (.009" Thick and .150" Radius & Aluminum).

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000												1	1
.001													
.002													
.003													
.004													
.005													
.006													
.007				1	3	2	1	1	2		1	2	1
.008	1			2		1	1				2	1	1
.009	1			2	3	2	3	3		4	1	1	2
.010	7			9	15	11	5	5	3	1	1		
.011	12			11	4	9		1					
.012	3												
.013	1												
.014													
.015													
.016													
.017													
.018													

(Long Lead)

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 75

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 6 Detonators (.009" Thick and .090" Radius and Aluminum)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000				9	17								
.001													
.002													
.003													
.004													
.005													
.006				1	1								
.007													
.008					1								
.009				3	1								
.010	3			10	5								
.011	18			2									
.012	4												
.013													
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 100

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 7 Detonators (.009" Thick and .060" Radius and Aluminum)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000			10										
.001				17	2								
.002				5	7								
.003				1	3								
.004					3								
.005			2	1	3								
.006			2	1	5								
.007			3		1								
.008	1		6		1								
.009	2		2										
.010	3												
.011	13												
.012	6												
.013													
.014													
.015													
.016													
.017													
.018													

ITEM: XM100 Detonator

DATE TESTED: 5/74

PURCHASE ORDER NO.:

ATLAS ORDER NO.: 3639

SPEC.:

WORK ORDER NO.:

SAMPLE SIZE: 125

LOT NO.:

LOT SIZE:

SWITCH TYPE:

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 8 Detonators (.009" Thick and Flat Bottom and Aluminum)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000							1						
.001													
.002													
.003													
.004										1			
.005												1	
.006											1		
.007				1	7	1	1			1			
.008				1	2	4	1			3	3	1	
.009				1		3					1	2	
.010	7			16	6	7	3					1	
.011	15			6	10	9	4						
.012	3												
.013						1							
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 100

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 9 Detonators (.005" Thick and .150" Radius and Steel)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000				3	11								
.001				4	5								
.002													
.003													
.004													
.005													
.006													
.007				1									
.008		2		3	2								
.009	1	1		3									
.010	4	17		9	7								
.011	14	5		2									
.012	6												
.013													
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO. _____

SPEC. _____

SAMPLE SIZE: 75

LOT SIZE: _____

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO. _____

LOT NO. _____

SWITCH TYPE _____

TESTER: _____

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 10 Detonators (.005" Thick and .090" Radius and Steel)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000				3									
.001				3									
.002				2									
.003													
.004													
.005													
.006		1											
.007		2		1									
.008		2		3									
.009		3		4									
.010	2	4		4									
.011	9	5		3									
.012	8	2		1									
.013	6	1											
.014		2											
.015		2											
.016		1											
.017													
.018													

ITEM XM100 Detonators

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 75

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 11 Detonators (.005" Thick and .060" Radius and Steel)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000													
.001													
.002													
.003													
.004													
.005				1									
.006				1									
.007													
.008		3		1									
.009		1		2									
.010	2	2		1									
.011	18	1		3									
.012	5	2		2									
.013		2		3									
.014		1											
.015		6		2									
.016		3		4									
.017		2											
.018		2		1									
.019				1									
.020				2									
.021				1									

ATL. 3222 A

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 100

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE 1

TYPE OF TEST AND COMMENTS:

Group 12 Detonators (.005" Thick and Flat Bottom and Steel)

Test Results

Steel Dent Depth (inches)	(.150" LONG LEAD) AIR GAP (INCHES)									(.100" LONG LEAD)			
	No Gap	.050	.100	.250	.300	.400	.500	.600	.700	.500	.600	.700	.800
.000					2								
.001													
.002													
.003													
.004													
.005													
.006													
.007		1		2	1								
.008		6		6	6								
.009				4	4								
.010	4	4		7	9								
.011	14	13		6	3								
.012	4	1											
.013	3												
.014													
.015													
.016													
.017													
.018													

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 225

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

TYPE OF TEST AND COMMENTS: PHASE 1, PART 2

Explosives Density Varied in Detonator

Test Results

	Detonator Against Steel No Air Gap - No Lead			.150" Lead Against Steel Det. to Lead Gap .250"			.150" Lead Against Steel Det. to Lead Gap .500"		
Dent Depth (in.)	Powder Consolidation (PSI) 5,000	15,000	30,000	Powder Consolidation (PSI) 5,000	15,000	30,000	Powder Consolidation (PSI) 5,000	15,000	30,000
.000									
.001									
.002									
.003									
.004									
.005									
.006									
.007				1	3		2		
.008									
.009	6				2	3	5	1	3
.010	18	2		17	14	14	18	23	20
.011	1	3		7	6	8		1	2
.012		12	15						
.013		8	10						
.014									
.015									
Average =	.0098	.0120	.0124	.0102	.0098	.0102	.0096	.0100	.0100

ATL. 3200 A

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 37

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE II

TYPE OF TEST AND COMMENTS:

Group 1 Detonators — Confinement

Test Results

	ALUMINUM CONFINEMENT .150" Lead Length Air Gap = .250"		STEEL CONFINEMENT .150" Lead Length Air Gap = .250"		
Dent (in.)	Air Gap .063 Dia. Hole	Air Gap .093 Dia. Hole	Air Gap .063 Dia. Hole	Air Gap .093 Dia. Hole	
.001					
.002					
.003					
.004					
.005					
.006	1				
.007	1				
.008	2	4			
.009	5				
.010	1	3			
.011					
.012				1	
.013				5	
.014			5	3	
.015			5	1	
.016					
.017					
Average	.0084	.0089	.0145	.0134	

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 102

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

TESTER:

PHASE III
PARTS 1 & 2

TYPE OF TEST AND COMMENTS:

.150" LEAD LENGTH

VERY DENSITY OF LEAD
EXPLOSIVE MATERIAL

Test Results

	5,000 PSI		10,000 PSI		15,000 PSI		20,000 PSI		25,000 PSI		30,000 PSI	
Dent	27 MGS. PBXN-5		29 MGS. PBXN-5		30-1/2 MGS. PBXN-5		31-1/2 MGS. PBXN-5		32-1/2 MGS. PBXN-5		33-1/2 MGS. PBXN-5	
(inches)	.250" Gap	.500" Gap	.250" Gap	.500" Gap	.250" Gap	.500" Gap	.250" Gap	.500" Gap	.250" Gap	.500" Gap	.250" Gap	.500" Gap
.001												
.002												
.003												
.004												
.005												
.006	1	2										
.007			1				1					
.008	1											
.009	3	3									1	
.010	2	5	6	10		9	3	9	1	2		1
.011					7	1	3	1	6	8	3	8
.012											3	1
.013												
.014												
.015												
Average	.0087	.0089	.0096	.0100	.0110	.0101	.0100	.0101	.0109	.0108	.0111	.0110

ATL. 3200 A

ITEM XM100 Detonator

PURCHASE ORDER NO.

SPEC.

SAMPLE SIZE: 200

LOT SIZE:

DATE TESTED 5/74

ATLAS ORDER NO. 3639

WORK ORDER NO.

LOT NO.

SWITCH TYPE

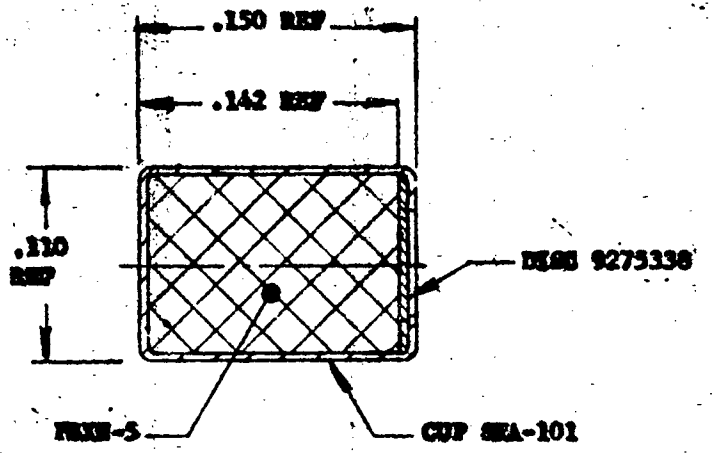
TESTER:

TYPE OF TEST AND COMMENTS: PHASE III, PART 3

AIR GAP - .250"
LEAD CUP ASS'YS PER DWG. 9275339

DENT (inches)	GROUP 1 DET. .150" Rad. Bottom	Test Results	GROUP 4 DET. Flat Bottom	
.001			/	
.002				
.003				
.004				
.005			2	
.006	8		-	
.007	7		12	
.008	47		69	
.009	36		17	
.010	2			
Average	.008		.008	

DRAWINGS



NOTES:

1) CHARGE APPROXIMATELY 31 MGS OF PBXN-5, SPEC. MIL-E-81111
2) POWDER SHALL PASS THROUGH A NO. 20 U.S. STD. SIEVE AND BE RETAINED ON A NO. 40 U.S. STD. SIEVE. (STD. SIEVE PER SPEC RR-S-366.)
3) MOISTURE AND VOLATILES CONTENT OF EXPLOSIVE CHARGE, PBXN-5 AT TIME OF LOADING SHALL BE LESS THAN .1% PER MIL-STD-650 METHOD 101.5.
4) CONSOLIDATE PBXN-5 AT 12,500 ± 500 PSI.
5) DISC MUST BE TIGHT.
6) SEAL JOINT AND COAT EXPOSED SURFACE OF DISC WITH GREEN LACQUER TYPE 1, SPEC MIL-L-10287. COATING OF END OF CUP PERMITTED.

REV.	BCN.	DATE	APPROVED

REVISIONS

MAT'L:

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ±
ANGLES ±
DECIMALS ±
FINISH IS IN ▷ MICROINCHES

NEXT ASSY.

SCALE FULL
DRAWN BY SHUMATE
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE AUG., 1973

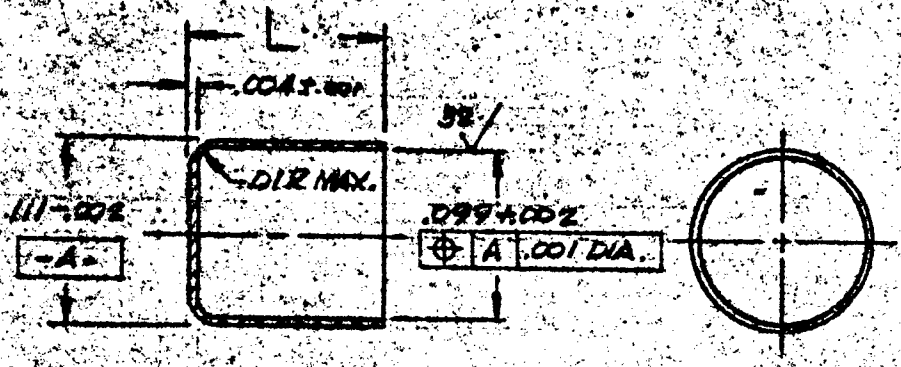
LEAD CUP ASS'Y

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

NO. SEA-100

NOTES:
1. SPEC MIL-A-2550 APPLIES.



PART NUMBER	L
9275337	.115-.005
SKA-101	.175-.005

REV.	DESC.	DATE	APPROVED

REVISIONS

MATL: ALUMINUM ALLOY 5052-O PER ASTM B 209

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± ANGLES ±
DECIMALS ±
FINISH IS IN MICROINCHES

NEXT ASSY.

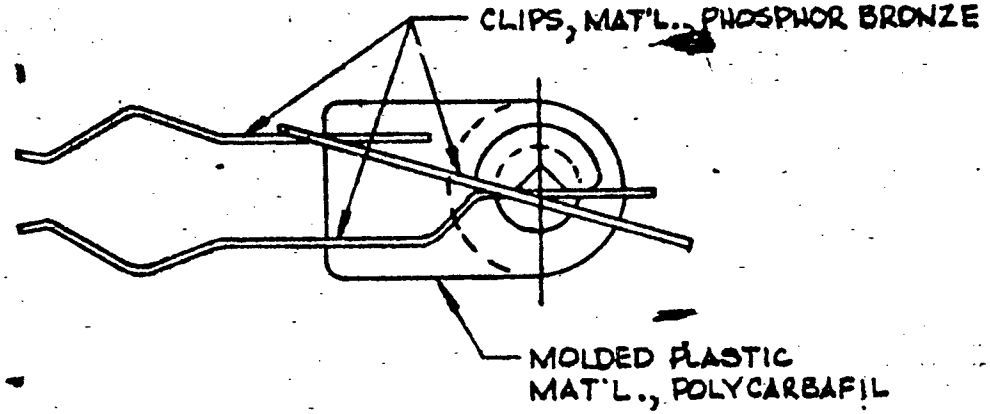
SCALE 10-1
DRAWN BY STUBBS
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE 7-16-73

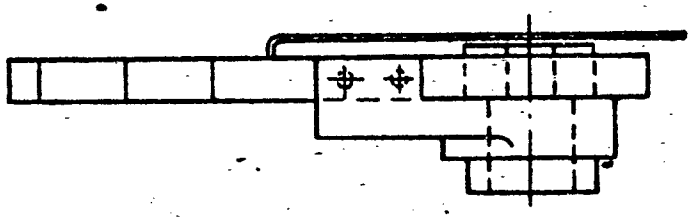
CUP, LEAD

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

SKA-101





REF.: ICI P/N 002-70550

REV.	DCN.	DATE	APPROVED

REVISIONS

MAT'L: SEE ABOVE

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± — ANGLES ± —
DECIMALS ± —
FINISH IS IN MICROINCHES

NEXT ASS'Y.

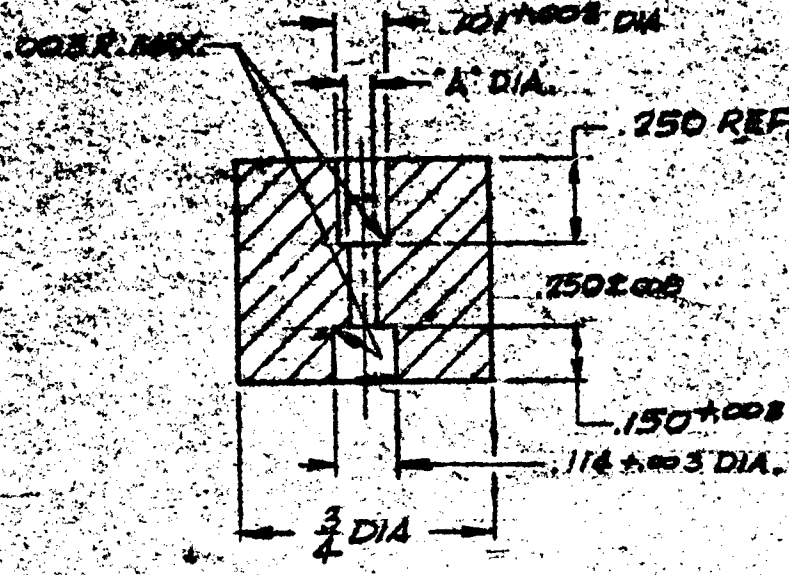
SCALE NONE
DRAWN BY STURGIS
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE SEPT 1973

TEST CLIP

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

NO. SKA-102



P/N	MAT'L	"A"
-1	ALUM.	.063 ±.001
-2	ALUM.	.093 ±.001
-3	STEEL	.063 ±.002
-4	STEEL	.093 ±.002

REVISIONS			
REV.	DESC.	DATE	APPROVED

MAT'L: SEE BOX.

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64 ANGLES ± —
DECIMALS ± .005
FINISH IS IN MICROINCHES

NEXT ASSY.

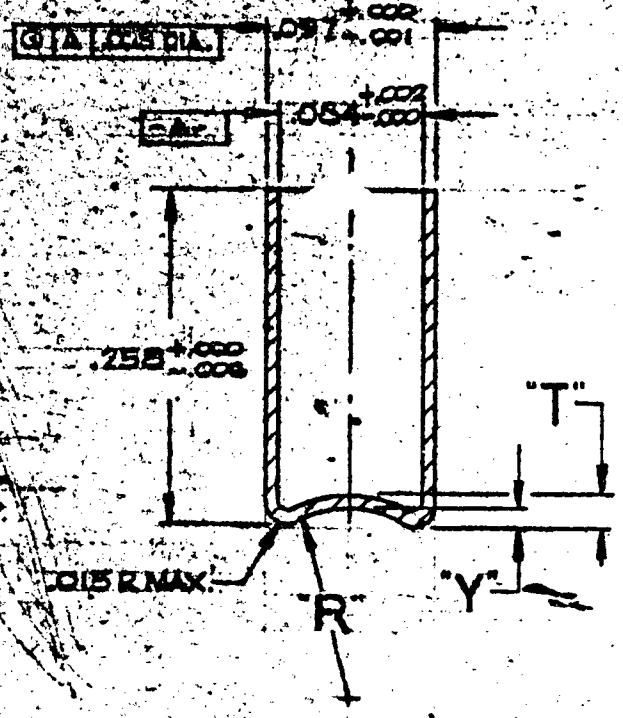
SCALE NONE
DRAWN BY STURGIS
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE 10-11-73

TEST FIXTURE

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

NO. SKA-103



GROUP	"T"	"R" ±.007	"Y" MIN.
9	.005 +.001 -.000	.150	.003
10	"	.090	.006
11	"	.060	.008
12	"	FLAT	"

NOTES:

1. SPEC. MIL-A-2550 APPLIES.
2. MATERIAL: STEEL STRIP, CRES, AISI 302 COND A. SPEC QQ-S-766
3. CUP CONDITION: AS DRAWN.
4. PINCH TRIM ALLOWED.
5. ANNEAL IN INERT ATMOSPHERE PER MIL-A-6875.
6. PASSIVATE PER 5.4.1 OF MIL-STD-171.

REV.	DESC.	DATE	APPROVED
REVISIONS			

MATL: SEE NOTE 2

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN MICHIG
FRACTIONS ± — ANGLES ± —
DECIMALS .x ± —
FINISH IN MICROINCHES

NEXT ASSY.

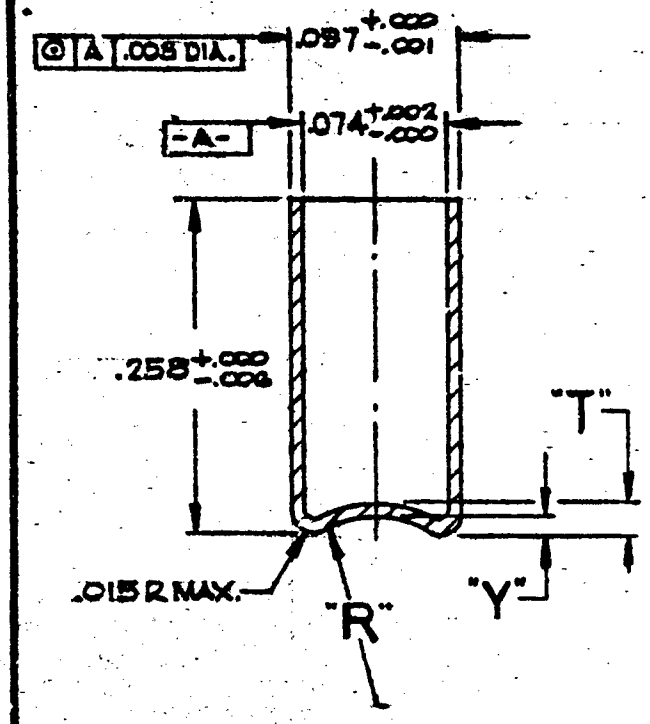
SCALE: NONE
DRAWN BY: STURGIS
CHECKED
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE: AUG. 1973

CUP, DETONATOR STEEL

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

NO. SKA-104



GROUP	"T"	"R" ±.007	"Y" MIN.
1	.005 +.005 -.000	.150	.005
2	"	.090	.006
3	"	.060	.008
4	"	FLAT	-
5	.009 ±.002	.150	.005
6	"	.090	.006
7	"	.060	.008
8	"	FLAT	-

NOTES:

1. SPEC. MIL-A-2550 APPLIES.
2. MATERIAL: ALUMINUM ALLOY, 6061 TEMPER O, SPEC QQ-A-250/11d.
3. THE OPEN END OF THE CUP SHALL BE FREE OF SLIVERS & BURRS.
4. GROUP 1 CUP IS IDENTICAL TO PICATINNY DWG P-9245697.

REV.	DCR.	DATE	APPROVED
REVISIONS			

MAT'L: SEE NOTE 2

UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES
FRACTIONS ± — ANGLES ± —
DECIMALS ± —
FINISH IS IN MICROINCHES

NEXT ASSY.

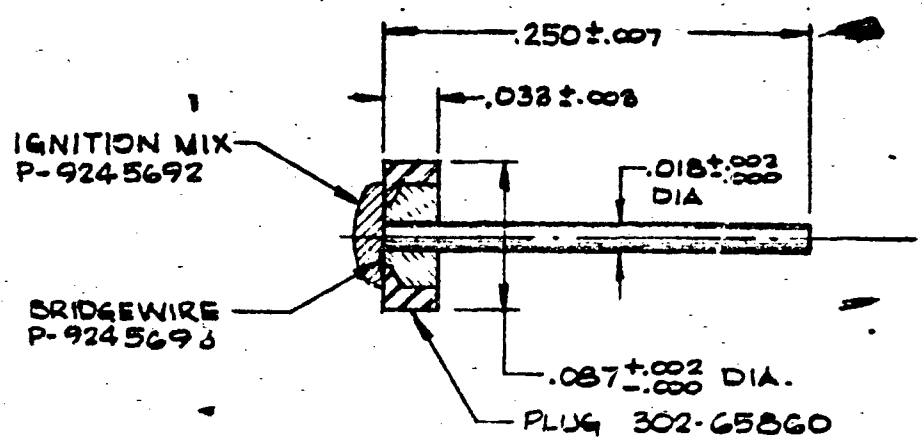
SCALE NONE
DRAWN BY STURGIS
CHECKED
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE AUG. 1973

CUP, DETONATOR ALUMINUM

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

No. SKA-105



REV.	DCN.	DATE	APPROVED

REVISIONS

MAT'L: ——

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± — ANGLES ± —
DECIMALS ± —
FINISH IS IN MICROINCHES

NEXT ASS'Y.

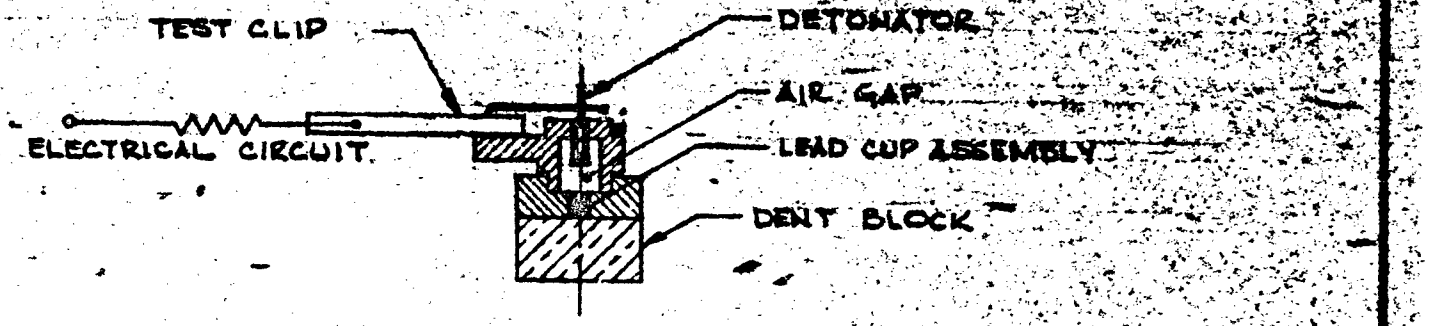
SCALE NONE
DRAWN BY STURGIS
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE AUG 1973

BRIDGED & IGNITION PLUG ASSEMBLY

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

NO. SKA-106



REV.	SCR.	DATE	APPROVED

REVISIONS

MAT'L: —

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± — ANGLES ± —
DECIMALS ± —
FINISH 32 IN MICROINCHES

NEXT ASSY.

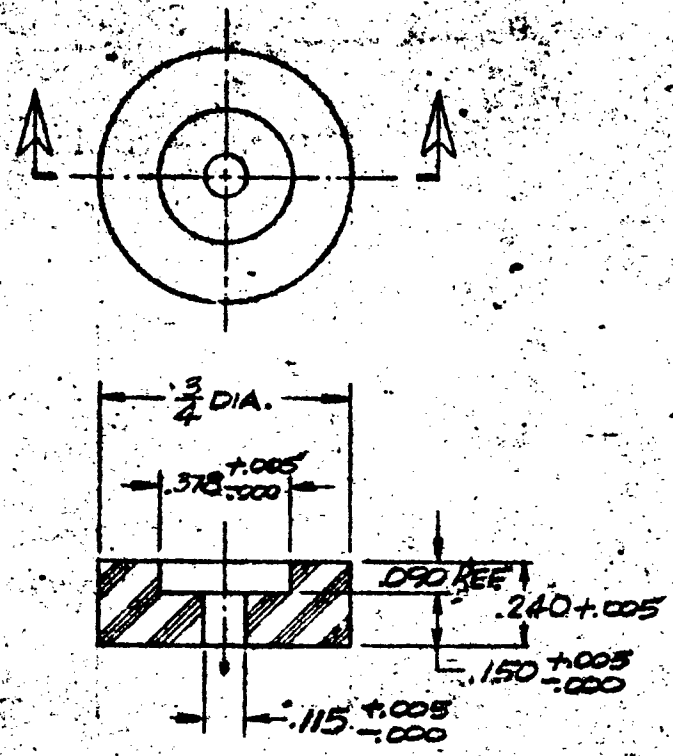
SCALE NONE
DRAWN BY STURGIS
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE AUG 1973

AIR GAP TEST METHOD

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

NO. SKA-107



REV.	DCN	DATE	APPROVED

REVISIONS

MAT'L: NYLON ROD - 101 NATURAL PER MIL-M-20693A, TYPE I

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64 ANGLES ± —
DECIMALS .0 —
FINISH IN IN MICROINCHES

NEXT ASSY.

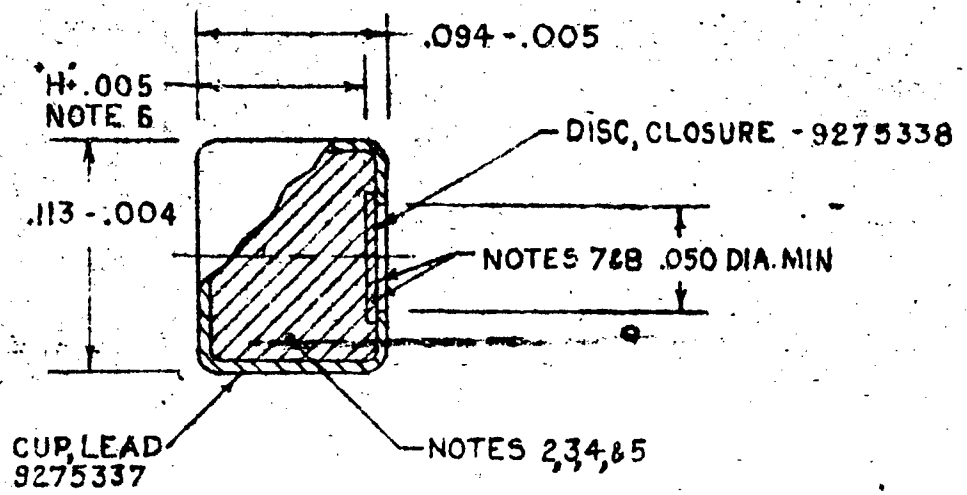
SCALE 2-1
DRAWN BY STEVE K
CHECKED
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE 10-10-73

LEAD HOLDER

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET 1 OF 1

SKA-108



NOTES:

1 - SPEC MIL-A-2550 APPLIES.
2 - CHARGE - APPROXIMATELY 19 MILLIGRAMS (.29 GRAINS) PBXN-5, SPEC MIL-E-3111 PRESSED TO 'H' HEIGHT. (NOTE 6)
3 - CHARGE MAY BE IN PELLET FORM AND RECONSOLIDATED IN CUP.
4 - POWDER SHALL PASS THROUGH A NO. 20 U.S. STANDARD SIEVE AND BE RETAINED ON A NO. 40 U.S. STANDARD SIEVE. (STANDARD SIEVE PER SPEC. RR-S-366).
5 - MOISTURE AND VOLATILES CONTENT OF EXPLOSIVE CHARGE, PBXN-5, AT TIME OF LOADING, SHALL BE LESS THAN .15% PER MIL STD 650 METHOD 101.5.
6 - ESTABLISH "H" AND WEIGHT OF CHARGE REQUIRED TO OBTAIN TIGHT CLOSING DISC AT A DENSITY OF 1.55 TO 1.65 GMS/CC. (NOTE: A VALUE OF .082 HAS BEEN USED SATISFACTORILY FOR "H"). (IT HAS BEEN FOUND THAT A PRESSURE OF 12,500 PSI. RESULTED IN THE REQUIRED DENSITY).
7 - DISC MUST BE TIGHT. SLIGHT BULGE PERMITTED.
8 - SEAL JOINT AND COAT EXPOSED SURFACE OF DISC WITH GREEN NO. 14110 LACQUER TYPE I, SPEC MIL-L-10287. COATING OF END OF CUP PERMITTED.

REF: PICATINNY ARSENAL DWG. 9275339

REV.	DCR.	DATE	APPROVED

REVISIONS

MAT'L:

UNLESS OTHERWISE NOTED
DIMENSIONS ARE IN INCHES
FRACTIONS ± ANGLES ±
DECIMALS ±
FINISH IS 125 MICROINCHES

NEXT ASS'Y.

SCALE NONE
DRAWN BY F.C.H.
CHECKER
PROJECT ENG.
APPROVED BY
APPROVED BY
DATE 9-10-74

LEAD CUP ASSEMBLY

ATLAS CHEMICAL INDUSTRIES, INC.
WILMINGTON 99, DEL.
AEROSPACE COMPONENTS DIVISION

SHEET OF

NO. 9275339