

UNCLASSIFIED

DECLASSIFIED

NRL REPORT NO. R-3132

INVESTIGATION OF THE RADIO FREQUENCY HAZARD
TO CASE IGNITION PRIMERS
OF 5"/38, 6"/47 AND 8"/55 FIXED AMMUNITION

DECLASSIFIED: By authority of
DDI DIR 5200.10
Date
1570
Entered by
NRL Code



DECLASSIFIED by NRL Control
Declassification Term
Date: 15 DEC 2016
Reviewer's name: A. THOMPSON
A. HARRIS
Declassification authority: NAVY DECLASS
GUIDE/NAVY DECLASS MANUAL, 11 DEC 2012,
83 SERIES

FR-3132



DISTRIBUTION STATEMENT A APPLICABLE
Further distribution authorized by
UNLIMITED only.

NAVAL RESEARCH LABORATORY

Washington, D.C.

DECLASSIFIED

DECLASSIFIED

NRL REPORT NO. R-31

~~CONFIDENTIAL~~

**INVESTIGATION OF THE RADIO FREQUENCY HAZARD
TO CASE IGNITION PRIMERS
OF 5"/38, 6"/47 AND 8"/55 FIXED AMMUNITION**

by

E. R. Longman

June 1947

Problem No. 39R07-10

Approved by:

L. A. Gebhard
Superintendent
Radio Division II

Commodore H. A. Schade, US
Director
Naval Research Laboratory



DECLASSIFIED

NAVAL RESEARCH LABORATORY

Washington, D.C.

DECLASSIFIED

CONFIDENTIAL

DISTRIBUTION

BuOrd Attn: Code Re2a and Re4f	(10)
BuShips Attn: Code 911-C	(2)
BuAer Attn: TD-4	(1)
ONR Attn: Code N482	(4)
USNEL	(2)
Chief of Ordnance, War Dept. Attn: Ammunition Development Division	(1)
Attn: Rocket Development Division	(1)
OcSigO Attn: Res. & Dev., SIGET	(2)
JRDB Attn: Library	(2)
Attn: Navy Secretary	(1)

DECLASSIFIED

~~CONFIDENTIAL~~

DECLASSIFIED

CONTENTS

	Page
Abstract	iv
Problem Status	iv
Authorization	iv
INTRODUCTION	1
SURVEY OF LOW, MEDIUM, AND HIGH COMMUNICATION FREQUENCIES (0.175 to 20 Mc.)	1
Search for Possible Resonant Conditions	1
Exposure of Cartridge Cases in Strong R-F Fields	2
Use of More Sensitive Primers	3
Hazard Due to Grounding Primer Pin with Case Isolated From Ground	4
Effect of Cartridge Case Contact With an Energized Antenna	4
SURVEY OF HIGH, VERY-HIGH, AND ULTRA-HIGH COMMUNICATION FREQUENCIES (20 to 550 Mc.)	6
Search for Possible Resonant Conditions	6
Exposure of Cartridge Cases in Strong R-F Fields	7
SURVEY OF RADAR FREQUENCIES	8
CHARACTERISTICS OF TYPE XCM2 PRIMER	9
USE OF THE INFORMATION PRESENTED	9
LIMITATIONS OF THE INVESTIGATION	10
CONCLUSIONS	10

DECLASSIFIED

DECLASSIFIED

ABSTRACT

The possibility of accidental firing of 5"/38, 6"/47 and 8"/55 fixed naval ammunition due to very strong radio fields on shipboard has been investigated over the frequency range from 175 kilocycles to 550 megacycles, and at certain higher radar frequencies. No serious hazard was found to exist. Only by setting up artificial conditions which are not believed likely to occur during ordinary shipboard handling or storage of ammunition, was it possible to ignite the primers.

PROBLEM STATUS

This report concludes the work on this problem in accordance with BuOrd ltr. NP14 (Re4f) of 27 February 1947 to NRL.

AUTHORIZATION

This investigation was initiated by BuOrd ltr NP14 (Re2a) of 4 August 1944 to NRL.

DECLASSIFIED

DECLASSIFIED

CONFIDENTIAL

INVESTIGATION OF THE RADIO FREQUENCY HAZARD TO CASEIGNITION PRIMERS OF 5"/38, 6"/47, and 8"/55 FIXED AMMUNITION

INTRODUCTION

The increased use of fixed ammunition of larger calibers necessitated an investigation to determine whether radio-frequency fields would cause accidental firing of ammunition in turrets, splinter shields or ready-service bulwark stowage. It was decided to divide the problem into two parts. The first part called for a thorough study of primers and related material, beginning with 5"/38, 6"/47 and 8"/55 fixed ammunition, to determine any radio-field-strength conditions which could be considered hazardous. The second part required an investigation to determine the field strengths existing aboard various types of naval vessels. This report is concerned with the first phase of the problem.

During the investigation, the Mark 13-1 and the Type XC2B and XC4B Primers were used in an inert condition with the 5"/38, 6"/47 and 8"/55 brass cartridge cases respectively. Type XCM2 Primers having a light booster charge were also used with the 6"/47 case. The cartridge cases, with the primer and the extension tube in place, but without the main powder charge, were considered to represent live ammunition adequately for the purpose of this investigation. Unless it is indicated otherwise, the 2-mil platinum-alloy bridge wire normally used in ammunition of this type was employed in the primers.

A 24-inch extension tube was used in the 6"/47 cartridge case during the investigation of frequencies below 20 megacycles. It was then learned that all new 6"/47 cases would have a 20-inch extension tube. In order to represent the production model of the 6"/47 case as nearly as possible, the extension tube furnished with the 6"/47 case was cut down to 20 inches. The 20-inch tube was used during the investigation of communication frequencies above 20 megacycles, and the radar frequencies. The small change in extension tube length would not affect the data obtained at frequencies below 20 megacycles.

SURVEY OF LOW, MEDIUM AND HIGH COMMUNICATION FREQUENCIES (0.175 to 20 Mc)

SEARCH FOR POSSIBLE RESONANCE CONDITIONS

The investigation for possible hazardous conditions existing in this frequency range included an initial search for possible resonance conditions affecting the primer bridge-wire circuit. This search was carried out by means of a very small pick-up loop which was cemented adjacent to the primer bridge wire, and connected through carefully shielded leads to a sensitive receiver. A signal generator with a large loop antenna was used to cover the frequency range up to 20 megacycles. The receiver response from the pick-up loop in each of the cartridge case primers was compared with the signal received from a small probe antenna, in order to determine whether a resonant condition existed in any of the primer circuits within the cartridge cases. A more complete

DECLASSIFIED

DECLASSIFIED

2

NAVAL RESEARCH LABORATORY

description of the method used is included in a previous report to the Bureau of Ordnance.* This procedure indicated that no resonant condition existed in the 5"/38, 6"/47 or 8"/55 primer circuits over the frequency range from 175 kilocycles to 20 megacycles.

The procedure used to search for resonant conditions was originally considered as a possible means of determining actual dangerous values of field strength. Under this plan the receiver output (determined by the signal obtained from the primer pick-up loop) could be related to known values of primer bridge-wire current by a calibration process, and the relationship between field strength and receiver output could then be established for any frequency by exposing the cartridge cases to a radio-frequency field of known value. This information would provide a relationship between field strength and primer bridge-wire current. The ratio of known bridge-wire current to primer ignition current would be the same as the ratio of known field strength, to dangerous field strength for a particular frequency. Then, if the primer ignition current were determined by experiment, the dangerous field strength for any given frequency could be calculated. Although every effort was made to perfect this method, it was found that satisfactory results could not be obtained in practice due to pick-up in the loop circuit from sources other than the primer bridge wire. At the higher frequencies, errors were introduced by the presence of standing waves on the leads from the pick-up loop to the receiver.

EXPOSURE OF CARTRIDGE CASES IN STRONG R-F FIELDS

Since no resonant condition was found in this frequency range, and therefore no single frequency could be considered to be particularly hazardous, it was decided to expose the cartridge cases to very strong radio-frequency fields at intervals over the frequency range being investigated. A wisp of gun cotton was placed around the bridge wire in each of the primers, in order to indicate, by ignition, any dangerous value of bridge-wire current. Several models of Navy transmitters were used to establish the required fields. The cartridge cases were placed approximately two feet from an energized vertical antenna and were oriented in various positions with respect to it. Data indicating the transmitters used, the d-c power input to the transmitter final stage, the resulting field-strength values and the effect on the primers are presented in Table I.

No ignition of the gun-cotton around the primers of any of the cartridge cases occurred. It should be noted that the Model TAQ, TBU, and TBA Transmitters are standard types, of the highest power rating normally used on shipboard in the frequency range indicated. The Model TDH Transmitter is designed for shore installation and is more powerful than shipboard transmitters commonly employed over the same frequency range. The radio-frequency power output obtained from the various transmitters can be roughly approximated as one half of the transmitter power input to the final stage. The field-strength values were measured by first reducing the transmitter antenna current to a very low value, and measuring the field strength under this condition with a Model OF-2 Field Strength Meter. The transmitter was then fully loaded into the antenna, and the ratio of the observed antenna current to the above-mentioned low value was used to determine the field strength under the conditions established. Care was taken not to use an antenna very nearly one-half wave length long, to avoid the possible errors occurring under this condition in which small changes in antenna current values represent comparatively large changes in field strength. No data are presented in Table I regarding antenna currents, since the values have significance only for the particular antenna used.

* NRL ltr. C-S71-8 (1210-ERL), C-1210-205/46 of 16 August 1946 to BuOrd.

DECLASSIFIED

TABLE I
EXPOSURE OF CARTRIDGE CASES TO R-F FIELDS
(0.175 to 20 Mc.)

Frequency (Mc.)	Model of Transmitter	Input to Final Stage (kw)	Field Strength (v/m)	Effect on Primers
0.175	TAQ	3.05	99	No ignition of the primers occurred with the 5"/38, 6"/47 or 8"/55 cartridge cases.
0.30	TAQ	4.55	108	
0.55	TAQ	4.70	98	
1.0	TBU	2.63	126.5	
2.5	TDH	6.00	115	
5.0	TDH	6.25	188	
7.5	TDH	6.00	108	
10.0	TDH	6.30	96	
15.0	TDH	6.15	22	
20.0	TBA	1.68	12.5	

USE OF MORE SENSITIVE PRIMERS

As a means of extending this investigation in order to determine the effect of still higher field-strength values, the standard 2-mil platinum-alloy primer bridge wire was replaced by a 1-mil nickel wire which would ignite the gun-cotton primer charge at a much lower current value. A comparison of the bridge wires using radio-frequency currents at 5 megacycles indicated that with the 1-mil nickel wire, ignition would occur at approximately one-fourth the current value required to produce ignition in the standard 2-mil platinum-alloy bridge circuit. To assure a factor of safety, the 1-mil nickel bridge wire was considered as requiring one-third the necessary ignition current for the standard 2-mil primer wire. A further increase in sensitivity of the XC2B and XC4B Primers was provided by opening one side of the parallel bridge-wire circuit. Thus the sensitivity of the Mark 13-1 Primer for the 5"/38 case was increased at least by a factor of three, and the sensitivity of the XC2B and XC4B Primers for the 6"/47 and 8"/55 cases was increased at least by a factor of six, since one arm of the parallel bridge-wire circuit was open. All of the cartridge cases with the sensitive primers were exposed to very strong radio-frequency fields, following the procedure previously indicated. From the standpoint of possible ignition, this was considered as being the equivalent of exposing the standard primer and case assembly to three times the actual field-strength values as regards the 5"/38 cartridge case, or six times the actual field strength values as regards the 6"/47 and 8"/55 cartridge cases. The actual field-strength values, and the equivalent field-strength values for the standard 2-mil platinum-alloy primer circuit are indicated in Table II.

CONFIDENTIAL

TABLE II

EXPOSURE OF CARTRIDGE CASES WITH SUBSTITUTE BRIDGE WIRE TO R-F FIELDS
(0.175 to 20 Mc.)

Frequency (Mc)	Model of Transmitter	Input to Final Stage (kw)	Actual Field Strength (v/m)	5"/38 Equivalent Field Strength(v/m)	6"/47 & 8"/55 Equivalent Field Strength (v/m)	Effect on Primers
0.175	TAQ	4.03	135	405	810	No ignition of the primers occurred with the 5"/38, 6"/47 or 8"/55 cartridge cases.
0.30	TAQ	4.50	104	312	624	
0.55	TAQ	4.48	99	297	594	
1.0	TBU	3.06	128	384	768	
2.5	TDH	6.20	115	345	690	
5.0	TDH	6.35	199	597	1194	
7.5	TDH	5.96	111	333	666	
10.0	TDH	5.81	94.5	284	568	
15.0	TDH	6.02	26	78	156	
20.0	TBA	2.48	13.4	40	80	

No ignition of the gun cotton occurred in any of the primers. Although these equivalent values are believed to be without hazard in so far as primer bridge-wire current values are concerned, it should be pointed out that at field strengths above several hundred volts per meter, corona effects may introduce new hazards. However, such extreme values of field strength are not likely to be encountered near locations where ammunition is handled or stored on shipboard.

HAZARD DUE TO GROUNDING PRIMER PIN WITH CASE ISOLATED FROM GROUND

To determine whether primer ignition would occur under the most extreme condition which could be devised, one 8"/55 cartridge case with the central pin of the XC4B Primer grounded, and the cartridge-case proper isolated from ground, was placed approximately two feet from an energized antenna. One arm of the parallel bridge-wire circuit, using the standard 2-mil platinum-alloy wire, was opened so that ignition would occur at approximately one half the normal ignition-current value. This arrangement was considered the most likely to produce ignition, since all of the radio-frequency current induced into the cartridge case would flow to ground through the single bridge wire in the primer. However, ignition occurred only at 15 megacycles, with the Model TDH Transmitter nearly fully loaded into the antenna. This indicates that ignition is possible only under an extreme condition. It is difficult to imagine that any condition analogous to the one described would occur on shipboard.

EFFECT OF CARTRIDGE CASE CONTACT WITH AN ENERGIZED ANTENNA

In addition to the study of possible hazards existing when the cartridge cases were in the proximity of transmitting antennas, theoretical consideration was given to the hazard existing if a cartridge case were permitted to touch an energized antenna. It is apparent that if the case were grounded at the time, the possibility of accidental ignition would be lessened, since current would flow through the case to ground rather than through the primer circuit. On the other hand, any condition which would cause the

central pin of the primer to become grounded while the cartridge case proper was isolated from ground would be very hazardous, since the current from the antenna would flow directly through the primer bridge wire. When the case touches an antenna but is isolated from ground, the conditions existing may be represented as shown in Figure 1.

In the diagram, C_1 represents the capacity from the primer pin to the cartridge case proper, and R is the resistance of the primer bridge wire. The capacitance from

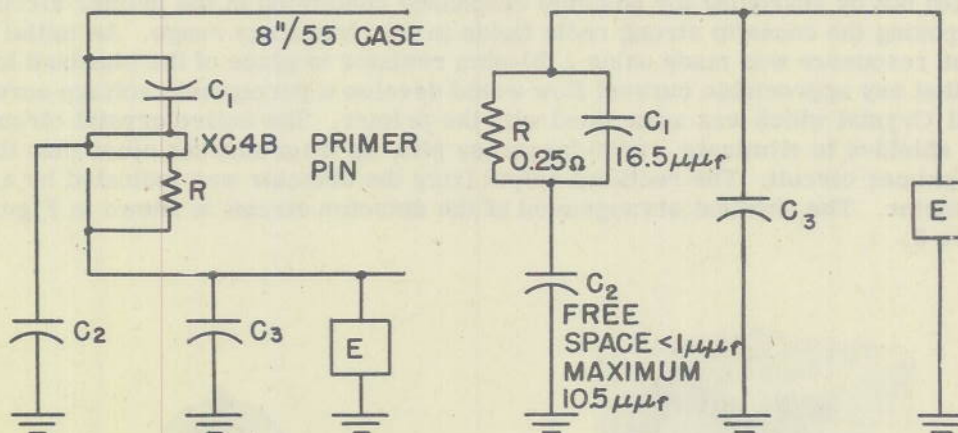


Figure 1 - Schematic Diagram and Equivalent Circuit for a Cartridge Case in Contact with an Antenna

the primer pin to ground is represented by C_2 , and C_3 is the capacitance from the cartridge case to ground. If the case is brought to a potential above ground by the radio-frequency power source, E , the capacitance C_1 must be charged through the bridge wire, R , and high values of charging current through R could possibly cause primer ignition. The current through R is dependent upon the potential of the case with respect to ground, and upon the impedance of C_2 . Measurements of capacity with any appreciable spacing of the primer from ground indicated that the impedance of C_2 became so high that the current driven through the series circuit C_1 and R by the highest voltages anticipated on a shipboard antenna installation (25 kilovolts at 175 kilocycles to 3 kilovolts at 20 megacycles) would not be sufficient to cause primer ignition. If C_2 were made a maximum value, by placing the case base downward with a dielectric coating between the base and ground -- for example, with the paint film on a metal deck serving as the dielectric -- the capacity of C_2 becomes as high as $10.5 \mu\text{f}$, which could permit an appreciable flow of current through the primer bridge wire. In order to study this condition further, the 8"/55 cartridge case was placed base downward, separated from ground by a 1/16-inch-thick polystyrene sheet. The case was made a part of the antenna system of the Model TDH Transmitter, and the system was tuned to provide maximum voltage from the cartridge case to ground. At 15 megacycles this voltage was 880 volts. One side of the parallel bridge-wire circuit (standard platinum-alloy wire) in the Type XC4B Primer was opened, so that only one-half of the normal firing current would be required to fire the primer; however, ignition did not occur.

Although this part of the investigation does not conclusively prove that ignition can not occur under a more severe condition, it appears that ignition is not likely. It should be noted that some measure of protection may be provided in the event that a cartridge case is brought into contact with an energized antenna by the relatively large capacity (C_3) of the case to ground. This capacity may so detune the antenna as to reduce the very high radio-frequency voltages on it.

DECLASSIFIED

6

NAVAL RESEARCH LABORATORY

CONFIDENTIAL

SURVEY OF HIGH, VERY-HIGH, AND ULTRA-HIGH COMMUNICATION FREQUENCIES (20 to 550 Mc)

SEARCH FOR POSSIBLE RESONANCE CONDITIONS

The investigation to determine the extent of hazard existing at the higher frequencies was carried out by searching for possible resonance conditions in the primer circuit, and by exposing the cases to strong radio fields in this frequency range. An initial search for primer resonance was made using a 20-ohm resistor in place of the standard bridge wire, so that any appreciable current flow would develop a perceptible voltage across a Type 1N21 Crystal which was associated with the primer. The entire crystal circuit was carefully shielded to eliminate radio-frequency pick-up from sources other than the modified primer circuit. The rectified output from the detector was indicated by a d-c microammeter. The physical arrangement of the detector circuit is shown in Figure 2 and Figure 3.



Figure 2 - Crystal Detector
Circuit on 5"/38 Case



Figure 3 - Crystal Detector Circuit
With Shield Removed

Variable-frequency oscillators were used to excite the cartridge cases over the frequency range from 20 to 550 megacycles. No resonant condition affecting the primer circuit could be found. Since no single frequency could be considered particularly hazardous, the cartridge cases were exposed to radio-frequency fields at random frequencies between 20 and 550 megacycles. The cartridge cases with the sensitive 1-mil nickel bridge wire in the primer circuit were exposed to radio-frequency fields from a General Radio UHF Oscillator, Model 757A, having an output of approximately 3 watts. This sensitive primer permits ignition at less than one-third the current value required for the standard Mark 13-1 Primer for the 5"/38 cartridge case, or less than one-sixth the current value required for ignition of the XC2B and XC4B Primers for the 6"/47 and 8"/55 cartridge cases. During the investigation a short antenna from the oscillator was extended within the open end of each of the cartridge cases, and the oscillator was varied from 140 to 550 megacycles. Later, each cartridge case was connected directly to the antenna making the cartridge case a part of the oscillator antenna system, and the oscillator frequency was varied from 140 to 550 Megacycles. No ignition of the primers occurred.

DECLASSIFIED

Since at these high frequencies, a physical separation of only a few feet becomes large in terms of wavelength, the use of the oscillator with comparatively low power output, but in very close proximity to the cartridge cases, was considered to be representative of the conditions which would obtain with a more powerful transmitter with the antenna located a few feet from the ammunition.

EXPOSURE OF CARTRIDGE CASES IN STRONG R-F FIELDS

In addition, the cartridge cases having the sensitive 1-mil nickel bridge wire in the primers were exposed very near the antenna systems of the Model TBA, TBS, TDQ and TDZ Transmitters. The cartridge cases were placed approximately one foot distant from the TBA and TBS antennas. With the Model TDQ and TDZ Transmitters, the appropriate dipole antenna was placed in several positions about the cartridge cases, and the ungrounded section of the dipole was inserted into the open end of each of the cases. The frequencies used and the approximate input power to the final stage of the transmitters are indicated in Table III.

TABLE III
EXPOSURE OF CARTRIDGE CASES WITH SUBSTITUTE
BRIDGE WIRE TO R-F FIELDS
(20 to 390 Mc.)

Frequency (Mc)	Model of Transmitter	Input to Final Stage (Watts)	Effect on Primers
25.0	TBA	2340	No ignition of the primers occurred with the 5"/38, 6"/47 or 8"/55 cartridge cases.
60.04	TBS	63	
65.34	TBS	83	
67.20	TBS	85	
74.70	TBS	96	
78.00	TBS	66	
117.18	TDQ	57	
123.09	TDQ	64	
135.09	TDQ	66	
142.56	TDQ	62	
147.92	TDQ	66	
151.20	TDQ	69	
236.2	TDZ	90	
262.6	TDZ	90	
273.0	TDZ	90	
285.8	TDZ	90	
309.0	TDZ	90	
325.0	TDZ	90	
341.0	TDZ	90	
354.6	TDZ	90	
363.4	TDZ	90	
384.4	TDZ	90	

No ignition of the primers occurred. The cartridge cases having the crystal detector unit in the primer circuit, originally used to search for possible primer resonance conditions, were also exposed to the TBA, TBS, TDQ, and TDZ antennas, and no discernable primer-circuit current was indicated. By the use of the sensitive 1-mil nickel bridge wire in the primer circuit, and by exposure very close to energized antennas of standard naval and other electronic equipment, it has been shown that accidental ignition is very unlikely in any radio-frequency field which may be encountered in this frequency range during normal handling of ammunition.

SURVEY OF RADAR FREQUENCIES

Radar equipment was not considered to present as great a hazard to ammunition as communication equipment in the low-, medium-, and high-frequency ranges, since the radar antennas are usually mounted considerably above deck with the radio field concentrated outward or upward, away from locations where ammunition would be handled or stored. Additionally, at all but the lowest radar frequencies, separations of only a few feet become large in terms of wavelength, so that the field strength is considerably reduced within a short distance from the antenna. However, in order to determine whether accidental ignition of the primers of the 5"/38, 6"/47 and 8"/55 cartridge cases could occur, the cases with the primers having the sensitive 1-mil nickel bridge wire were exposed in the immediate field of antennas of several types of radar transmitters. In this phase of the investigation, the radar antennas used were nearly all located on the roofs of two adjacent buildings, and the equipments were operated simultaneously. Although the cartridge cases were brought into the direct field of only one antenna at a time, the conditions of exposure were made more severe due to the presence of weaker radio fields set up by many of the nearby radars. The equipments used, with data indicating frequency and approximate peak power are indicated in Table IV.

TABLE IV
EXPOSURE OF CARTRIDGE CASES WITH SUBSTITUTE BRIDGE WIRE TO
R-F FIELDS (RADAR FREQUENCIES)

Frequency	Model of Radar	Approximate Peak Power (kw)	Effect on Primers
200 Mc	SK	200	No ignition of the primers occurred with the 5"/38, 6"/47 or 8"/55 cartridge cases.
400 Mc	SRa	200	
S-Band	SG-1B	40	
S-Band	SG3	300	
S-Band	SL	150	
S-Band	SX	1 Megawatt	
X-Band	Mark 13	50	
L-Band	Mark 12	100	
X-Band	Mark 22	40	

No ignition of the primers occurred. Additionally, the 5"/38 case equipped with the crystal detector circuit was exposed at each of the antennas, and no discernable bridge-wire current was indicated. A 6"/47 case using the standard Type XCM2 Primer was also exposed without ignition.

CHARACTERISTICS OF TYPE XCM2 PRIMER

To supplement the data obtained for the Mark 13-1, and the Type XC2B and XC4B Primers, the characteristics of the Type XCM2 Primer for use with the 6"/47 cartridge case were investigated. The construction of the Type XCM2 Primer differs considerably from the Type XC2B Primer. Type XC-9 primer material is used in the XCM2 Primer in place of the gun cotton found in the other types of primers investigated. To permit comparison of the original XC2B Primer, having the gun-cotton primer charge, with the XCM2 Primer having the XC-9 composition primer charge, firing-current data were taken with both primers. The average firing current required for the XCM2 Primer was 1.5 amperes at 5.0 Megacycles, as compared with the 1.25-ampere value for the XC2B Primer. The capacity from the center pin to case of the XCM2 assembly is $75\mu\mu\text{f}$ as compared with the $16.5\text{-}\mu\mu\text{f}$ capacity observed with the XC2B Primer. Additionally, the shielding of the XCM2 Primer is far more complete than that of the XC2B assembly. All of these factors assure an added degree of safety for the XCM2 Primer over the XC2B Primer. The XCM2 Primer was received after the investigation of the low-, medium-, and high-communication frequencies had been completed. This primer, with the 6"/47 cartridge case, was exposed to very strong radio-frequency fields at the very-high and ultra-high communication frequencies, and at radar frequencies. Primer ignition did not occur.

USE OF THE INFORMATION PRESENTED

In order that the fullest use may be obtained from the results of this investigation, it is believed that the facts concerning any reported hazardous conditions on shipboard should be considered in the light of the findings reported herein. Over the frequency range from 175 kilocycles to 20 megacycles, field-strength measurements may be taken on shipboard, using instruments and techniques similar to those described in this report. The data obtained may then be compared with the safe values reported herein. As an example, personnel aboard the USS Iowa have reported* the possibility of the existence of a hazardous condition at a location near the 5" gun stations where a field strength of 50 microvolts per meter was recorded. This low field strength value is questionable considering an accompanying statement that, "A small gauge, three-foot piece of copper wire, suspended in one hand in this area, will pick up enough current to burn the skin." However, if the measurement is correct, the data presented in Table I and Table II of this report indicate that there is no radio-frequency hazard to 5"/38, 6"/47 or 8"/55 ammunition under the condition reported.

The extreme conditions under which the cartridge cases were exposed without the occurrence of primer ignition indicate that a very thorough survey of field-strength values occurring on various types of naval vessels will not be required, and that only those instances involving exposure to exceptionally high field strengths will call for consideration. The hazard involved in the normal shipboard handling and storage of ammunition of the calibers investigated is very slight.

* CO USS Iowa ltr. BB61/S67 (1), Serial 1195 of 1 October 1945 with enclosure.

DECLASSIFIED

10

NAVAL RESEARCH LABORATORY

CONFIDENTIAL

LIMITATIONS OF THE INVESTIGATION

Briefly, this investigation shows that for the types of ammunition considered, no individual frequencies could be regarded as being particularly hazardous; and that only under the most severe and artificial conditions which could be established in the laboratory could primer ignition be made to occur due to radio-frequency fields. However, it was impossible to study or even to foresee all of the many and varied conditions in which external objects which could possibly be resonant and in close proximity to an energized antenna might contact the ammunition and introduce new hazards. It should also be noted that this investigation is concerned only with 5"/38, 6"/47 and 8"/55 fixed ammunition, and that possible hazard could exist from ammunition to other types or calibers. Accordingly, it must be realized that the possibility of accidental explosion of ammunition due to very strong radio-frequency fields can never be entirely discounted.

CONCLUSIONS

The possibility of accidental ignition of 5"/38, 6"/47 and 8"/55 fixed ammunition due to the presence of strong radio-frequency fields on shipboard is very slight. During the investigation it was possible to ignite a primer in a radio-frequency field only under the most extreme conditions.

* * *

PRNC-2765-8-18-47-100

DECLASSIFIED