

INTRODUCTION TO MARINE ELECTRICITY

CONTENTS

	Page
PREFACE	iii
CHAPTER 1. SAFETY	1-1
CHAPTER 2. FUNDAMENTALS OF ELECTRICITY	2-1
CHAPTER 3. DIRECT CURRENT	3-1
CHAPTER 4. BATTERIES	4-1
CHAPTER 5. CONCEPTS OF ALTERNATING CURRENT	5-1
CHAPTER 6. INDUCTANCE	6-1
CHAPTER 7. CAPACITANCE	7-1
CHAPTER 8. TRANSFORMERS	8-1
CHAPTER 9. CIRCUIT MEASUREMENT	9-1
CHAPTER 10. CIRCUIT PROTECTION DEVICES	10-1
CHAPTER 11. CIRCUIT CONTROL DEVICES	11-1
CHAPTER 12. ELECTRICAL CONDUCTORS	12-1
CHAPTER 13. BELT-DRIVEN ALTERNATORS	13-1
CHAPTER 14. SHIP SERVICE GENERATORS (AC)	14-1

DISTRIBUTION RESTRICTION: Approved for public release; distribution is unlimited.

	Page
CHAPTER 15. WIRING AND ELECTRICAL DISTRIBUTION	15-1
CHAPTER 16. THREE-PHASE ALTERNATING CURRENT MOTORS	16-1
CHAPTER 17. SINGLE-PHASE MOTORS	17-1
CHAPTER 18. DIRECT CURRENT GENERATORS	18-1
CHAPTER 19. DIRECT CURRENT MOTORS	19-1
CHAPTER 20. THE ELECTRICAL CIRCUIT	20-1
APPENDIX ELECTRICAL SYMBOLS	A-1
GLOSSARY	GLOSSARY-1
REFERENCES	REFERENCES-1

PREFACE

This manual is an electrical reference text for the marine engineering field. It provides information for the 88L10, 88L20, 88L30, 88L40, 881A1, and 881A2 military occupational specialties (MOSSs).

This text reinforces good marine electrical practices. A good knowledge of marine electricity helps maintain the health and welfare of the crew by promoting the safe operation of the many electrical systems on board a vessel.

This manual covers marine electrical safety and alternating current (AC) and direct current (DC) fundamentals. It details the vessel distribution system as well as circuit protection and the electrical motor load. This information corresponds with the program of instruction presented to the marine engineering students at Fort Eustis.

The marine engineer must understand the entire production, distribution, and user end of the electrical process. He will be required to maintain and overhaul all the electrical apparatus for safely operating the vessel.

The proponent of this publication is the US Army Transportation School. Submit changes for improving this publication on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commandant, US Army Transportation School, ATSP-TDL, Fort Eustis, VA 23604-5001.

This publication contains copyrighted material.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

CHAPTER 1

SAFETY

INTRODUCTION

Successfully completing everyday activities depends on safe execution. Preparation and conduct during these activities reflects on performance. In no other field is this more significant than in the marine field.

Safety is an encompassing subject. This text does not repeat existing electrical safety practices outlined in other references. Instead it emphasizes those standards necessary to successfully complete Army watercraft missions.

Current is the measure of shock intensity. The passage of even a very small current through a vital part of the human body can kill. At about 100 milliamperes (0.1 ampere), the shock is fatal if it lasts for one second or more. Fatalities have resulted from voltages as low as 30 volts.

Conditions on board a vessel add to the chance of receiving an electrical shock. The body is likely to be in contact with the metal structure of the vessel. The body's resistance may be low because of perspiration or damp clothing. Personnel must be aware that electrical shock hazards exist.

Accidentally placing or dropping a metal tool, ruler, flashlight case, or other conducting article across an energized terminal can cause short circuits. The resulting arc and fire, even on relatively low-voltage circuits, may extensively damage equipment and seriously injure personnel.

Touching one conductor of an ungrounded electrical system while the body is in contact with the hull of the ship or other metal equipment enclosures could be fatal.

WARNING

Treat all energized electric circuits as potential hazards at all times.

DANGER SIGNALS

Be constantly alert for any signs that might indicate a malfunction of electrical equipment. When any danger signals are noted, report them immediately to the chief engineer or electrical officer. The following are examples of danger signals:

- Fire, smoke, sparks, arcing, or an unusual sound from an electric motor or contactor.
- Frayed and damaged cords or plugs.
- Receptacles, plugs, and cords that feel warm to the touch.
- Slight shocks felt when handling electrical equipment.
- Unusually hot running electric motors and other electrical equipment.
- An odor of burning or overheated insulation.
- Electrical equipment that either fails to operate or operates irregularly.
- Electrical equipment that produces excessive vibrations.

CAUTION

Do not operate faulty equipment. Stand clear of any suspected hazard, and instruct others to do likewise.

ELECTRIC SHOCK

Electric shock is a jarring, shaking sensation. Usually it feels like receiving a sudden blow. If the voltage and current are sufficiently high, unconsciousness occurs. Electric shock may severely burn the skin. Muscular spasms may cause the hands to