LEIDIAN KEXUE YU JISHU ZHUANYE YINGYU DUWU

雷电科学与技术专业英语读物

王振会　许先文　李　霞　施广全　编

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雷电科学与技术专业英语读物

101 TOPICS ON
LIGHTNING AND LIGHTNING PROTECTION
WITH 2 APPENDICES ON SPECIALIZED TERMS

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内容简介

本书摘录了101篇雷电科学与技术专业英文文章，分九个单元介绍了雷电基本特征、雷电危害与风险评估、雷电防护规范、雷电防护技术、雷电探测等相关内容。每篇文章后面都有本课生单词的介绍和练习，以便于读者阅读学习。书中附录还介绍了常用雷电防护专业词汇英文释义、常用雷电防护专业术语汉英对照，方便读者查询，具有很强的实用性。

本书可作为高等院校雷电防护相关专业本科生的教材，也可作为雷电防护工作者的参考用书。

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Foreword

Lightning is one of the most spectacular meteorological phenomena and considered as one of the most common severe weather affecting human being directly in many aspects. This book, with 101 topics edited within 9 units and 2 appendices attached, is intended to provide the readers professional and unprofessional with sort of basic knowledge and also some answers to frequently asked questions concerning lightning and lightning protection.

But the main purpose of this book is to provide the college students majoring in Lightning Protection Science and Technology with a part of reading materials in English. Practice on reading and comprehension based on this material is helpful to improve the ability to use English in their future activities associated with lightning and lightning protection.

Though some topics have been new-modeled for certain purpose, all the passages in this book are selected from various publications, websites, product specifications and so on. References can only list out part of the sources. Nevertheless we here give all our thanks to those who have made contributions directly and indirectly.

Thanks are given to Prof. XIAO Wen-an, Mr. YANG Zhongjiang and all the teachers in the Department of Lightning Science & Technology, School of Remote Sensing for their close cooperation during the past few years.

We have done our best in all the way but mistakes are unavoidable because of the limited time and lack of experience. We are responsible for any mistakes existing in the book. We hope that our purposes to compile this book can be realized under the help of all the readers who are going to send us comments and suggestions in order to renew the book in the future. Thanks in advance.

This work has been supported by Nanjing University of Information Science and Technology Foundation for Textbook Publication. We would also like to give our thanks to Nanjing Phoenix Contact Co. Ltd. for their financial support to compilation and publication of this book.

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2 June 2007

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Unit 1 General Introduction

总论

Topic 1: A Brief Description of Lightning and Lightning Protection

Lightning has long fascinated the technical community. Ben Franklin studied lightning's electrical nature over two centuries ago and Charles R Steinmetz generated artificial lightning in his General Electric laboratory in the 1920's.

Lightning is the visible discharge of static electricity within a cloud, between clouds, or between the earth and a cloud. Scientists still do not fully understand what causes lightning but most experts believe that different kinds of ice interact in a cloud. Updrafts in the cloud separate charges so that positive charges move and end up at the top of the cloud while negative flow to the bottom.

When the negative charges move down, a pilot leader forms. This leader rushes toward the earth in 150 discrete steps, ionizing a path in the air. The final breakdown generally occurs to a high object and the major part of the lightning discharge is then carried in the return stroke which flows along the ionized path.

Lightning can strike anywhere on earth - even the North and South Poles! In any U. S. geographical location, lightning storms occur as few as five times or as many as 100 times per year. The Northeast United States has the most violent thunderstorms in the country because of the area's extremely high earth resistivity. High earth resistivity (the earth's resistance to conduct current) increases the potential of a lightning strike. If struck, structures in these areas will generally sustain more damage when there is no lightning protection system present.

Each year, thousands of homes and other properties are damaged or destroyed by lightning. It accounts for more than a quarter billion dollars in property damage annually in the United States. Lightning is responsible for more deaths and property loss than tornadoes, hurricanes and floods combined, but of these violent forces of nature, lightning is the only one we can economically afford to protect ourselves against.

Some properties have a higher risk of lightning damage. When considering installation of a lightning protection system, you may want to assess this risk. A risk assessment guide for determining lightning loss for all types of structures can be found in the National Fire Protection Association's Lightning Protection Code, NFPA 780. This guide takes into consideration the type of structure, type of construction (wood, brick, concrete, reinforced concrete, and steel frame construction), structure location, topography, occupancy (persons, animals), contents and lightning frequency.

Vocabulary

1. Discharge 放电
2. Updrafts 上升气流
3. positive charge 正电荷
4. negative charge 负电荷
5. discrete steps 逐步
6. pilot leader 先导
7. return stroke 回击
8. ionized path 电离通道
9. strike v. & n. 击，击中
10. resistivity n. 电阻率 resistance n. 电阻值
11. conduct current 传导电流
12. the potential of a lightning strike 雷击可能性
13. sustain v. 承受
14. property n. 财产
15. lightning frequency 闪电频率
16. earth resistivity 土壤电阻率
17. high risk 高风险
18. risk assessment 风险评估
19. Lightning Protection Code 防雷法规/规范

Exercises

1. Write out the English equivalents to the following terms.

(1) 正电荷
(2) 负电荷
(3) 先导
(4) 回击
(5) 电离通道
(6) 土壤电阻率
(7) 传导电流
(8) 闪电频率
(9) 风险评估
(10) 防雷法规/规范

2. Answer the following questions according to the passage.

(1) What causes lightning in the eyes of most experts?

(2) Why does the potential of a lightning strike increase in high earth resistivity?

(3) What factors should be considered when we carry out a lightning risk assessment?

3. Choose the best answer.

(1) Ben Franklin studied lightning's electrical nature ________.

A. in the sixteenth century　B. in the seventeenth century

C. in the eighteenth century　D. in the nineteenth century

(2) Which one of the following causes the most deaths and the property losses?

A. tornadoes　B. lightning

C. hurricanes　D. floods

4. True or false.

(1) Scientists have already understood what causes lightning. (　　)

(2) North and South Poles may also be struck by lightning. (　　)

(3) Lightning frequency is tantamount in any U.S. geographical location. (　　)

(4) We can economically afford to protect ourselves against lightning. (　　)

5. Translate the following sentences into English.

(1) 云内的上升运动将云内电荷分离,结果正极性电荷向上移动到云的顶部,而负极性电荷则向下运动到云底。

(2) 雷电是可以看见的、发生在云内、云间或者是云地间的静电荷放电。

(3) 在没有雷电防护系统的情况下,该地区的建筑物如果被击中,通常会遭受更大的损坏。

(4) 当负电荷向下移动时,先导形成了。

Topic 2: Lightning and Thunder

Lightning is associated with a thunderstorm. Typically, thunderstorms are characterized as intense individual rain cells or showers embedded in a broad area of light rain. These intense cells are only over a fixed location for a few minutes. They are on average, several miles in each direction. In the continental United States thunderstorm cells move from west to east along a squall line. A squall line is about 12—30 miles in width and up to 1,250 miles long. The speed at which the thunderstorm cell moves is generally 55 km per hour.

Rapidly rising air in a thunderstorm interacts with rapidly falling air within the thunderstorm to create separately positive and negative charged areas within the cloud. Air acts as an insulator, but when the charge builds up to a level that exceeds its ability — typically 3—4 kV/cm at the altitude of the negative charge region of the cloud — to act as an insulator, the result is a spark we see as lightning. The lightning equalizes the positive and negative charged areas.

Four types of lightning are common: in-cloud (or intracloud) lightning extends from one charged region of a cloud to another, cloud-to-cloud lightning extends between two clouds, cloud-to-air lightning extends from a cloud to the air, not touching the ground, and cloud-to-ground lightning stretches from a cloud to the ground.

Lightning can travel between points within a cloud, from a cloud to clear air, from a cloud to an adjacent cloud, and from a cloud to ground. These flashes are referred to as intracloud, cloud-to-air, cloud-to-cloud, and cloud-to-ground, respectively.

Intracloud (IC) flashes, redistributing the charge within the cloud, account for over half the lightning flashes in northern latitudes (Uman and Krider 1989). Cloud-to-cloud and cloud-to-air flashes are less common. Besides aviation, these three types of flashes have little impact on man.

Cloud-to-ground (CG) flashes are very common and have been well documented. They exchange charge between the cloud and ground. These flashes affect man greatly, causing injury and death, disrupting power and communications, and igniting forest fires. Because of these impacts, the cloud-to-ground flash has been the topic of much research.

The cloud-to-ground lightning flash can lower positive (+CG) or negative (−CG) charge, depending on the source of the flash. This can be determined by the polarity of the stroke's current. Characteristics of negative and positive cloud-to-ground flash are summarized as shown in Table 1.

Table 1 Some characteristics of positive and negative cloud-to-ground flashes

Characteristic	Negative	Positive
% occurrence	90	10
Average peak current (kA)	30	35
Average current half life (micro sec)	30	230
Average number of strokes	3—4	1
% containing long continuing current	20	80

Ground-to-cloud flashes (those that originate from the ground) occur as well, as observed from large buildings such as the Empire State Building, but are not normally distinguished from CG flashes in studies.

The air in the lightning strike is heated very rapidly and expands, creating a shock wave we hear as thunder. Thunder lasts a few seconds because we first hear the shock wave from the portion of lightning closest to us and then we continue to hear the shock wave from the lightning bolt farther away from us that is reaching us at later times.

Thunder can be defined as the acoustic emission associated with a lightning discharge. It appears that all impulsive processes in both cloud-to-ground and cloud flashes, including M-component-type processes, produce thunder. The significant part of the thunder spectrum extends from a few hertz or less to a few kilohertz. It is the general view that audible thunder (above 20 Hz or so) is a series of degenerated shock waves produced by the gas dynamic expansion of various portions of the rapidly heated lightning channel, while infrasonic thunder (approximately 20 Hz and below) is associated with the sudden contraction of a relatively large volume of the thundercloud when lightning rapidly removes the charge from that volume.

The electromagnetic (including optical) radiation from the lightning channel propagates at about 300 m μs^{-1}, the speed of light, and hence arrives at an observer, say, 3 to 4 km away in about 10μs. The corresponding thunder, an acoustic or sound wave, travels at about 340 m s^{-1} for an air temperature of ~20℃ and atmospheric