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会议议程

Agenda

美国贸易开发署 (USTDA)
中国-美国标准与合格评定合作项目 (SCACP)
2013 静电防护与标准化学术交流会

会议议程

时间/地点:

2013 年 11 月 4 日至 5 日 苏州南园宾馆 (姑苏区带城桥路 99 号)

主办单位:

中国标准化研究院
中国空间技术研究院
电磁环境效应国家级重点实验室
美国贸易开发署 (USTDA)
美国国家标准协会 (ANSI)
美国静电放电协会 (ESDA)

协办单位:

北京东方计量测试研究所
上海防静电工业协会
中国电子仪器行业协会防静电装备分会
苏州市静电防护协会
苏州天华超净科技股份有限公司
北京市劳动保护科学研究所

承办单位:

中国标准化杂志社
江苏东方航天校准检测有限公司

2013 年 11 月 4 日

- | | |
|---------------|---|
| 08:00 - 09:00 | 报到注册 |
| 09:00 - 09:10 | 致欢迎辞 |
| 09:10 - 10:10 | 讲演题目 1 公共安全标准化
演讲人: 王金玉, 研究员, 中国标准化研究院党委副书记, 全国公共安全基础标准化技术委员会秘书长 |
| 10:10 - 10:50 | 讲演题目 2 技术进步及其对标准的影响 |

演讲人: Nathaniel Peachey, 美国静电放电协会标准业务部经理.

10:50 - 11:25 讲演题目 3 粉体静电学国内外研究动态与进展

演讲人: 孙可平, 教授, 上海海事大学静电技术研究所所长, 国务院特殊津贴获得者

11:25 - 12:00 讲演题目 4 防静电工作服的分类及性能要求

演讲人: 黄建华, 高级工程师, 上海防静电工业协会理事长, 中国制冷空调工业协会洁净室技术委员会理事

12:00 - 12:10 专题报告 《中国标准化》杂志社

报告人: 赵宏春, 《中国标准化》杂志社社长

12:10 - 14:00 午餐

14:00 - 14:35 讲演题目 5 防静电产品生产企业标准体系构建

演讲人: 裴振华, 苏州天华超净科技股份有限公司董事长、中国物理学会静电学术委员会委员、中国电子仪器行业协会防静电装备分会副理事长

14:35 - 15:20 讲演题目 6 S20.20 项目进展--接地

演讲人: John Kinnear, 美国静电放电协会设施认证主席;

15:20 - 15:55 讲演题目 7 兵器工业静电危害与控制

演讲人: 曾丹, 兵器工业安全技术研究所, 静电检测中心主任, 研究员

15:55 - 16:15 茶歇

16:15 - 17:00 讲演题目 8 关于工厂和现场中 EOS/ESD 事件中 ESDA 的新任务

演讲人: Terry L. Welsher, JEDEC / ESDA 的 HBM 和 CDM ESD 工作组联合主席, ESDA 副主席

17:00 - 17:35 讲演题目 9 静电防护工程学与标准化

演讲人: 刘民, 研究员, 中国空间技术研究院北京东方计量测试研究所计量总师, 研发中心主任

2013 年 11 月 5 日

09:00 - 09:35 讲演题目 10 科学高效掌握 ESD 控制关键技术，充分合理选择 ESD 控制项目

演讲人: 黄久生, 高级工程师, 北京特种机电技术研究所, 美国密苏里大学电磁兼容实验室客座教授

09:35 - 10:10 讲演题目 11 电子元器件 ESD 损伤分析

演讲人: 来萍, 研究员级高工, 工业和信息化部电子第五研究所, 中国赛宝认证中心 ESD 认证项目技术审核专家

10:10 - 10:45 讲演题目 12 选择包装静电敏感元件器件材料的标准规范--屏蔽袋、屏蔽防潮袋

演讲人: 郭先正, 美商卫利有限公司

10:45- 11:00 论文交流1 多因素影响静电放电参数变化特性实验研究

报告人: 阮方鸣, 贵州师范大学电子信息工程系

11:00- 11:15 论文交流2 自动化设备及带电器件模型的静电防护问题

报告人: 袁亚飞, 北京东方计量测试研究所

11:15 - 11:30 论文交流3 长效型防静电材料的研究与开发应用

报告人: 张明, 上海航天电子有限公司

11:30- 11:45 论文交流4 输油管道静电危害及放电能量检测方法研究

报告人: 蒋漳河, 广州市特种机电设备检测研究院

11:45- 12:00 论文交流5 基于能量法屏蔽包装袋测试技术研究

报告人: 冯文武, 北京东方计量测试研究所

12:00 - 14:00 午餐

会议地点/Venue: 苏州南园宾馆/ Garden Hotel Suzhou

地址/Address: 江苏省苏州市姑苏区带城桥路 99 号/No.99
Daichengqiao Road, Gusu District, Suzhou

电话/TEL: (0512) 67786778



**U.S.-China Standards and Conformity Assessment Cooperation Program (SCACP)
The United States Trade and Development Agency (USTDA)**

2013 Electrostatic Protection and Standardization Seminar

Agenda

Date/Venue:

November 4-5, 2013
Garden Hotel Suzhou
No.99 Daichengqiao Road, Gusu District, Suzhou

Sponsors:

China National Institute of Standardization (CNIS)
China Academy of Space Technology (CAST)
National Key Laboratory for Electromagnetic Environmental Effects
The United States Trade and Development Agency (USTDA)
American National Standards Institute (ANSI)
Electrostatic Discharge Association (ESDA)

Co-organizers:

Beijing Orient Institute of Measurement & Test, CAST
Shanghai Electrostatic Protective Industrial Association (SEPIA)
Anti-Static Equipment Branch, China's Electronic Instrument Industry Association
Suzhou Electrostatic Protection Association
Suzhou TA&A Ultra Clean Technology Co., Ltd.
Beijing Municipal Institute of Labor Protection

Organizers:

China Standardization Press
Oriental Aerospace Calibration and Testing Co. Ltd.

November 4, 2013

08:00 - 09:00 Registration

09:00 - 09:10 Welcome Address

09:10 - 10:10 Topic 1: Standardization of Public Security

Speaker: Wang Jinyu, Researcher, Vice President, China National Institute of Standardization; Secretary General, Technical Committee of Basic Public Security Standardization(SAC/TC351)

10:10 - 10:50 Topic 2: Technology Advances and Their Impact on Standards

Speaker: Nathaniel Peachey, Manager, Standard Business Dept., ESDA/RFMD

10:50 - 11:25 Topic 3: Powder Electrostatics, International & Domestic Research Review and Developing Tendency

Speaker: Sun Keping, Professor, Director, Electrostatic Technology Institute of Shanghai Maritime University; the recipient of special allowance from State Council, China

11:25 - 12:00 Topic 4 Classification and performance requirements of anti-static working clothes

Speaker: Huang Jianhua, Senior Engineer, Director-General, Shanghai Electrostatic Protective Industrial Association (SEPIA); Member, Technical Committee on Cleanroom Technology, China Refrigeration and Air-Conditioning Industry Association (CRAA)

12:00 - 12:10 Special report China Standardization Press

Speaker: Zhao Hongchun, President , China Standardization Press

12:10 - 14:00 Lunch

14:00 - 14:35 Topic 5: Standard System Establishment of Antistatic Production Enterprises

Speaker: Pei Zhenhua, President, Suzhou TA&A Ultra Clean Technology Co., Ltd. ;
Vide Director General, Anti-Static Equipment Branch, China Electronic Instrument Industry Association (CEIA);

14:35 - 15:20 Topic 6: 20.20 Program Development - Grounding

Speaker: John T. Kinnear Jr., Chairman, Facility Certification, ESDA ANSI / ESD;
former president, Electrostatic Discharge Association (ESDA)

15:20 - 15:55 Topic 7 Electrostatic Hazards and Control Status of Ordnance Industry

Speaker: Zeng Dan, Researcher, Director, Electrostatic Test Center of Safety Technique Research Institute of Ordnance Industry

15:55 - 16:15 Coffee Break

16:15– 17:00 Topic 8: New Work in ESDA on EOS/ESD Events in Factory and Field

Speaker: Terry L. Welsher, Co-Chairman, HBM&CDM ESD Group, JEDEC / ESDA;
Vice-President, ESDA

17:00 - 17:35 Topic 9: Electrostatic protection engineering and standardization

Speaker: Liu Min, Researcher, Chief Engineer, Beijing Orient Institute of Measurement & Test, CAST;

November 5, 2013

- 09:00 - 09:35 Topic 10: Scientific and Efficient Mastering of ESD Control Key Technologies, Sufficient and Rational Selection of ESD Control Projects**
Speaker: Huang Jiusheng, Beijing Institute of Special Electromechanical Technologies; Visiting Professor, Electromagnetic Compatibility Laboratory, University of Missouri, USA
- 09:35 - 10:10 Topic 11: Analysis on the ESD Damage of Electronic Parts and Components**
Speaker: Lai Ping, Senior Engineer (Researcher), Fifth Institute of Electrical, MIIT; technical review specialist, ESD Certification Program, CEPREI Certification Body.
- 10:10 - 10:45 Topic 12: Packaging Materials for Static Sensitive Items**
Speaker: Steve Kuo, Vice President, Winifred Int'l Technology Ltd.
- 10:45 - 11:00 Author communication 1 Experiment Investigation of Electrostatic Discharge Parameters under Impact of Multiple Factors**
Speaker: Ruan Fangming, Department of Electronic & Information Engineering, Guizhou Normal University
- 11:00 - 11:15 Author communication 2 The ESD protect for AHE and CDM**
Speaker: Yuan Yafei, Beijing Orient Institute of Measurement and Test
- 11:15 - 11:30 Author communication 3 Research and development of anti electrostatic materialsDepot**
Speaker: Zhang Ming,, Shanghai Aerospace Electronics Co., Ltd.
- 11:30 - 11:45 Author communication 4 Study on Hazards of Electrostatic and Its Discharge Energy Detection Methods in Oil Pipeline s**
Speaker: Jiang Zhanghe, Guangzhou Academy of Special Equipment Inspection and Testing (China National Quality Supervision and Test Centre for Explosion-proof Equipment)
- 11:45 - 12:00 Author communication 5 Research of shield package measurement based on Energy**
Speaker: Feng Wenwu , Beijing Orient Institute for Measurement & Test
- 12:00- 14:00 Lunch**

11:45 - 12:00 Author communication 5 Research of shield package measurement based on Energy

Speaker: Feng Wenwu , Beijing Orient Institute for Measurement & Test

12:00 - 12:15 Special Report :Access to scientific literature resource of electrostatic protection

Speaker: Liu Hua, Institute of Scientific and Technical Information of China

12:15- 14:00 Lunch

主办、协办及承办单位介绍

Sponsor and Organizer Overviews

中国标准化研究院

中国标准化研究院（初名国家科委标准化综合研究所）始建于1963年，是直属国家质量监督检验检疫总局，从事标准化研究的国家级社会公益类科研机构，主要针对我国国民经济和社会发展中全局性、战略性和综合性的标准化问题进行研究。

全院现有职工500余人，包括研究员27名、博士及博士后87名，主要开展标准化发展战略、基础理论、原理方法和标准体系研究。承担节能减排、质量管理、公共安全、视觉健康与安全防护、现代服务、公共管理与政务信息化、信息分类编码、人类工效、食品感官分析等领域标准化研究及相关标准的制修订工作。承担相关领域的全国专业标准化技术委员会、分技术委员会秘书处工作。承担相关标准科学实验、测试等研发及科研成果的推广与应用工作。组织开展能效标识、顾客满意度测评工作，承担地理标志产品保护研究及技术支持工作。负责标准文献资源建设与社会化服务工作，承担国家标准文献共享服务平台运行和标准化基础科学数据资源建设与应用工作。同时，我院的工作直接支撑着国家质量监督检验检疫总局以及国家标准化委员会的相关管理职能，包括我国缺陷产品召回管理、国家标准技术审查、全国工业产品生产许可证审查、全国质检中心审查管理等工作。

作为国家级社会公益类科研机构，中国标准化研究院一直致力于积极参与并主导国际组织活动，维护国家利益，承担了国际地理标志网络组织（ORIGIN）副主席职务，承担了国际标准化组织(ISO)的技术委员会副主席、秘书等13个关键职务，主持制定ISO标准20余项。

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[Http://www.cnis.gov.cn](http://www.cnis.gov.cn)

China National Institute of Standardization

Affiliated with the General Administration of Quality Supervision and Inspection and Quarantine of the People's Republic of China (AQSIQ), China National Institute of Standardization (CNIS) is a non-profit national research body engaging in standardization research. The main responsibilities of CNIS are to conduct all-round, strategic, and comprehensive research of standardization during the development process of economy and society, to research and develop comprehensive fundamental standards, as well as to provide authoritative standards information services. CNIS is poised to provide all-round support in standardization for China's economic development and social progress, to support technical progress, industrial upgrading, and product's quality improvement, and to provide scientific evidence for government policy-making on standardization.

Since its founding in 1963, CNIS has undertaken many national key scientific and research projects. Among them, three important projects of the 10th Five-Year Plan (2000–2005) Key Science and Technology Special Program, namely, Research on Development Strategies for Chinese Technical Standards, Research on Development of China's National Technical Standards System, and Basic Research on and Technological Measures for the Safety Standards of Main Foods, have played important supportive roles for promotion of national standardization. One of our projects, Development of a National Terminology and Graphic Symbol System, has been awarded the State-level Second Prize for Advancement of Science and Technology, the highest prize so far in the field of scientific research on standardization. In addition, many of our projects have been awarded state-level and ministry-level prizes for advancement of science and technology and prizes for key scientific research achievements of the 8th (1990–1995), and 9th (1995–2000) Five-Year Plan periods. Our research has brought about significant influence home and abroad, and has made outstanding contributions to development of China's economic development and the progress of science and technology.

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Post code: 100088

[Http://www.cnis.gov.cn](http://www.cnis.gov.cn)

中国空间技术研究院简介

中国空间技术研究院成立于1968年，隶属中国航天科技集团公司。经过40余年的发展，中国空间技术研究院已成为中国主要的空间技术及其产品研制基地，是中国空间事业最具实力的骨干力量，主要从事空间技术开发、航天器研制，空间领域对外技术交流与合作、航天技术应用等业务。

自1970年，中国空间技术研究院先后成功研制并发射了中国第一颗人造地球卫星——东方红一号、实现环月运行的中国首颗月球探测器、实现中国航天员首次空间出舱活动的神舟七号载人飞船等，为中国航天事业发展做出了突出贡献。中国空间技术研究院在北京航天城建成了集系统设计、集成、总装、测试、试验一体化的新型航天器研制生产基地，现在拥有员工1万余人，其中包括8名两院院士、12名国家级突出贡献专家和1700多名高级专业技术人才。

中国空间技术研究院是我国飞船和卫星的重点研制单位，十分重视电子元器件、单机及整机系统的电磁兼容设计，开展了大量的地面和星上静电防护技术研究工作，并在静电防护管理体系、静电防护技术、防静电系统测试、防静电工作区配置等方面建立了一系列的静电防护院级标准Q/W 1300~1303-2010，组建了院静电防护管理体系认证委员会和认证中心，在认证中心办公室和审核专家组的协助下，明确了静电防护系统建设与认证管理流程，已经完成对多家院内单位及外协单位开展了静电防护管理体系认证工作，推进了航天领域的静电安全防护进程。

China Academy of Space Technology (CAST)

China Academy of Space Technology (CAST), subordinated to China Aerospace Science and Technology Corporation (CASC), was established on February 20, 1968. Through 44-year development, it has become the main development base for space technology and products in China and the most powerful backbone strength for China's space endeavor. It is mainly engaged in such fields as development and manufacturing of spacecraft, external exchange and cooperation in space technology, satellite applications, etc. CAST also participates in formulating the state space technology development plans, studies the technological approaches to exploration, exploitation and utilization of outer space, and develops a variety of spacecraft and ground application equipments.

CAST successfully developed and launched china's first artificial earth satellite. To date, the academy has successfully developed and launched 129 satellites of various kinds and nine Shenzhou spaceships, including scientific and technological test satellites, communications and broadcasting satellites, meteorological satellites, returnable remote sensing satellites and ocean satellites.

CAST has built in Beijing Space City a new spacecraft development and production base which combines system design, assembly, integration, checkout and test in one place. CAST has more than 20,000 staff members, including 8 members of Chinese Academy of Sciences and Chinese Academy of Engineering, 12 national level experts making outstanding contributions, and over 1700 senior specialists. CAST has been making wide contacts with the astronautical companies and space research institutes throughout over a dozen countries and regions.

CAST has engaged in electrostatic field of development of spacecraft and ground application equipments for years, and published series of standards for electrostatic discharge protection management system. It has established certification committee and Electrostatic Discharge Certification of the system, and organized the electrostatic certification of units subordinated to CAST and other co-operation units.



美中标准与合格评定合作项目

由美国贸易发展署 (USTDA) 提供资助、美国国家标准协会 (ANSI) 负责协调的美中标准与合格评定合作项目 (SCCP) 在以下几个方面为美国和中国相关行业和政府代表提供了一个论坛:

- 在标准、合格评定以及技术法规等领域的合作;
- 为促进美中在标准、合格评定以及技术法规等领域的技术交流建立必要的联系;
- 及时交流关于标准、合格评定以及技术法规等领域的最新议题和发展情况的相关信息

根据SCCP项目规定, 从2013年开始的三年内, ANSI 将在中国协调举办20场研讨会。根据美国私营业界相关组织的建议, 研讨会内容将覆盖不同的行业和领域。研讨会的主题将由相关行业组织、ANSI 以及 USTDA 协调选定。

欲了解该项目的更多情况或有意赞助或参与该项目, 请访问下列网站:

www.standardsportal.org/us-chinasccp

了解其他信息, 请联系

Ms. Madeleine McDougall

项目经 理

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美国国家标准学会

American National Standards Institute (ANSI——美国国家标准学会)是由公司、政府和其他成员组成的自愿组织,负责协商与标准有关的活动,审议美国国家标准,并努力提高美国在国际标准化组织中的地位。ANSI是IEC和ISO的5个常任理事成员之一,也是4个理事局成员之一,参加79%的ISO/TC的活动,参加89%的IEC/TC活动。ANSI是泛美技术标准委员会(COPANT)和太平洋地区标准会议(PASC)的成员。

美国国家标准学会(American National Standards Institute: ANSI)成立于1918年。当时,美国的许多企业和专业技术团体,已开始了标准化工作,但因彼此间没有协调,存在不少矛盾和问题。为了进一步提高效率,数百个科技学会、协会组织和团体,均认为有必要成立一个专门的标准化机构,并制订统一的通用标准。1918年,美国材料试验协会(ASTM)、与美国机械工程师协会(ASME)、美国矿业与冶金工程师协会(ASMME)、美国土木工程师协会(ASCE)、美国电气工程师协会(AIEE)等组织,共同成立了美国工程标准委员会(AESC)。美国政府的三个部(商务部、陆军部、海军部)也参与了该委员会的筹备工作。1928年,美国工程标准委员会改组为美国标准学会(ASA)。为致力于国际标准化事业和消费品方面的标准化,1966年8月,又改组为美利坚合众国标准学会(USASI)。1969年10月6日改成现名:美国国家标准学会(ANSI)。

美国国家标准学会是非赢利性质的民间标准化组织,是美国国家标准化活动的中心,许多美国标准化学协会的标准制修订都同它进行联合,ANSI批准标准成为美国国家标准,但它本身不制定标准,标准是由相应的标准化团体和技术团体及行业协会和自愿将标准送交给ANSI批准的组织来制定,同时ANSI起到了联邦政府和民间的标准系统之间的协调作用,指导全国标准化活动,ANSI遵循自愿性、公开性、透明性、协商一致性的原则,采用3种方式制定、审批ANSI标准。

ANSI现有工业学、协会等团体会员约200个,公司(企业)会员约1400个。领导机构是由主席、副主席及50名高级业务代表组成的董事会,行使领导权。董事会闭会期间,由执行委员会行使职权,执行委员会下设标准评审委员会,由15人组成。总部设在纽约,卫星办公室设在华盛顿。

American National Standards Institute (ANSI)

As the voice of the U.S. standards and conformity assessment system, the American National Standards Institute (ANSI) empowers its members and constituents to strengthen the U.S. marketplace position in the global economy while helping to assure the safety and health of consumers and the protection of the environment.

The Institute oversees the creation, promulgation and use of thousands of norms and guidelines that directly impact businesses in nearly every sector: from acoustical devices to construction equipment, from dairy and livestock production to energy distribution, and many more. ANSI is also actively engaged in accrediting programs that assess conformance to standards – including globally-recognized cross-sector programs such as the ISO 9000 (quality) and ISO 14000 (environmental) management systems.

ANSI has served in its capacity as administrator and coordinator of the United States private sector voluntary standardization system for more than 90 years. Founded in 1918 by five engineering societies and three government agencies, the Institute remains a private, nonprofit membership organization supported by a diverse constituency of private and public sector organizations.

Throughout its history, ANSI has maintained as its primary goal the enhancement of global competitiveness of U.S. business and the American quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and promoting their integrity. The Institute represents the interests of its nearly 1,000 companies, organization, government agency, institutional and international members through its office in New York City, and its headquarters in Washington, D.C.

美国静电放电协会

Electrostatic Discharge Association (ESDA——美国静电放电协会) 于1982年在美国成立，总部设在纽约，是一个专业的自愿组织，从事静电放电理论和实践研究。其成员从成立初期不到100名，发展到遍布全球、总数超过2,000名。其领域从仅限于电子元器件的ESD影响，拓宽到纺织品、塑料、居室清洁和形象艺术等领域。该协会授权通过标准开发、教育节目、专业书籍、出版物、指南、认证工作和座谈会宣传ESD知识。

ESDA是一个国际化组织，其成员来自30多个国家。他们服务于协会标准委员会，在EOS/ESD年会上进行技术研讨，并为其它国家的相关组织提供资讯联系。协会已经和不同国家的类似组织建立了正式和非正式联系，正式联系包括日本可靠性中心，新加坡生产力标准部 (PSB)，日本电子工业协会 (EIAJ)，德国ESD论坛，欧洲的ESREF，以及巴西的ABRICEM。

ESDA的职责是在国际电工委员会 (IEC) 静电学领域代表美国利益。随着标准领域全球协调性要求的增加，ESD协会日益受到广泛关注。

Electrostatic Discharge Association (ESDA)

Founded in 1982, the ESD Association (ESDA) is a professional voluntary association dedicated to advancing the theory and practice of electrostatic discharge (ESD) avoidance. From fewer than 100 members, the Association has grown to more than 2,000 members throughout the world. From an initial emphasis on the effects of ESD on electronic components, the Association has broadened its horizons to include areas such as textiles, plastics, web processing, clean-rooms, and graphic arts. To meet the needs of a continually changing environment, the Association is chartered to expand ESD awareness through standards development, educational programs, local chapters, publications, tutorials, certification, and symposia.

Although founded and headquartered in the United States, the ESD Association has a strong international flavor. Its members come from more than 30 countries throughout the world. They serve on Association Standards Committees, present technical papers at the annual EOS/ESD Symposium, and provide the communication links with similar organizations in other countries.

The Association has established informal and formal relationships with similar organizations in various countries. The formal relationships include the Reliability Center of Japan, Productivity Standards Board (PSB) in Singapore, Electronics Industry Association of Japan (EIAJ), ESD Forum of Germany, ESREF in Europe, and ABRICEM in Brazil.

The ESD Association has the responsibility of representing the interest of the United States at the International Electro-technical Commission (IEC) in the area of electrostatics. With the increasing need for global harmonization in the area of standards, the international focus of the ESD Association is vitally important.

北京东方计量测试研究所简介

北京东方计量测试研究所成立于1985年，又称为中国航天科技集团公司第五研究院第五一四研究所，是中国空间技术研究院所属的专业计量测试研究所。

北京东方计量测试研究所是国防科技工业电学一级计量站，是集电磁学、无线电电子学、时间频率、几何量、热学、力学、真空、卫星应用和电磁干扰等专业为一体的综合性计量测试研究所，承担着我国国防科技工业、军队系统特别是航天和空间技术领域量值传递和计量校准测试任务，开展计量标准装置和测试设备研制、测量技术和测试方法研究、能力验证和比对、计量人员培训和计量标准考核等工作，同时面向社会提供公正的校准、检测和检验服务。

北京东方计量测试研究所是博士、硕士研究生培养单位，是国家批准的“仪器科学与技术”硕士学位一级学科点。现有博士生导师、硕士生导师、学科带头人后备人员10多名，与国内外技术、学术团体有着广泛的接触与联系。

近年来，北京东方计量测试研究所积极开展航天型号产品相关的静电防护技术研究，承接了多项静电相关的星船地面试验任务，负责起草了中国空间技术研究院的静电防护管理体系院标Q/W1300~1303，正在进行集团公司静电标准的编制，是院静电防护管理体系的技术支撑单位和认证中心的挂靠单位，已经组织开展了多家院内单位及外协单位的静电防护管理体系建设和认证工作。

Beijing Orient Institute of Measurement & Test (BOIMT)

Founded in 1968, Beijing Orient Institute of Measurement & Test (BOIMT) is a metrological institute, subordinated to China Academy of Space Technology (CAST).

BOIMT is tasked with establishing, maintaining and improving measurement standards and conducting research on relevant technologies to achieve more precise measurement. BOIMT plays an important role in every development process of the spacecraft. Each year, BOIMT calibrates approximately 90 thousands set of equipments for CAST.

The calibration services of the institute mainly relate to electromagnetic calibration, radio calibration, time and frequency calibration, geometrical calibration, mechanics calibration (including vacuum calibration), etc. Up until now, BOIMT has established 43 measurement standards, including 14 national–defense primary electrical standards. BOIMT provides essential guard for the accuracy and reliability of quantity values within national–defense system. Especially, it has advanced electrical calibration standards, such as Quantum Hall resistor primary standard and Josephson Voltage primary standard, which have reached the international advanced level.

So far, BOIMT has engaged in electrostatic field for years, and drafted series of standards for electrostatic discharge protection management system, which include electrostatic discharge protection management system requirements, technical requirements for electrostatic discharge protection, test requirements for electrostatic discharge protection system and configuration requirements for electrostatic discharge protected area. What's more, BOIMT is the technical unit of electrostatic discharge protection, and Electrostatic Discharge Certification of CAST.

上海防静电工业协会

上海防静电工业协会 Shanghai Electrostatic Protective Industrial Association (缩写: SEPIA), 成立于2004年9月。本协会是由从事防静电产业的企业、事业单位自愿发起组成的专业性、跨行业、跨地区的非盈利性组织, 是上海市一级行业协会, 社会团体法人。会员单位主要是覆盖长三角地区的生产防静电服装、地板、包装、耗材、装备设备或有关设计等领域的骨干企业, 现有会员单位105个, 理事单位22个。

随着我国信息化建设发展, 计算机、通讯、集成电路等行业进入了快速发展期, 静电危害问题突出。防静电装备、器材、工具以及防静电环境工程, 生产线防静电系统等防静电产业逐步成为先进制造业配套服务的充满活力的新兴产业。由于防静电装备产品有近100类, 2000多种, 初期生产加工相对容易, 部分企业质量管理水平较低, 产品生产没有标准, 迫切需要加以提高。协会设: 标准化委员会、专家委员会等, 并投资成立具有独立法人资格的“上海工业静电技术研发服务中心”, 负责技术咨询、检测、评估、组织培训、项目开发等。协会有内部季刊《上海防静电工业》。

协会成立以来, 已多次牵头组织会员单位参与制定防静电方面国家、行业、地方标准; 召开国际、国内有关新技术、新产品研讨会; 开展相关知识、技术培训及静电专业职称申报评审等。

会长: 黄建华-上海晨隆国际贸易有限公司董事长、总经理

法定代表人: 黄建华

秘书长: 罗宏昌 (2010年2月开始-病假)

代秘书长: 孙君同-上海君江科技有限公司总经理、协会副会长

专职副秘书长: 熊衍元

协会地址: 上海市虹口区车站北路625弄57号306室

邮编: 200434

电话: 021-65367650

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网址: <http://www.esdchina.org.cn>

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Shanghai Electrostatic Production Industry Center

Founded in Sep.2004, Shanghai Electrostatic Protection Industry Association (abbr. SEPIA) is a non-profit organization voluntarily formed by electrostatic protection enterprises and institutions of professionals, cross-trades and cross-regions. SEPIA is a Class A legal body corporate of the industry associations in Shanghai and social groups. Members are mainly covered the backbone enterprises of manufacturing and producing anti-static clothing, floors, packages, consumable goods, equipments, devices or related designing, etc. in the areas of the Yangtze River Delta. Currently, SEPIA holds 105 member units, among them 22 are council members.

With the development of the building- of our country's information system, the industries of computer, telecommunication, integrate circuit, etc. have been getting into a speedy developing period, but the issue of the electrostatic hazards has also become prominent to them. Thus, the industries of installation, facility, equipment, tool, environmental engineering, production line system, etc. for electrostatic protection have become vibrant new and rising ones of the Hi-Tech manufacturers with assorted supporting services. Because there were nearly 100 classifiable outfits and 2000 varieties of products, the production and processing in part of the industries were relatively easy entry at the early stage, the standards of their products' quality control were weak in some manufactures and no criterions could be followed. So it seemed the improvement was in an urgent need.

The Association has set: the Standardization Committee and the Committee of Experts, etc. and invested in establishing a working unit of independent legal personality "Shanghai Research and Development Service Center for Industrial Electrostatic Technology", responsible for technical consulting, testing, evaluation, organization, training, project development. SEPIA also has its internal magazine <Shanghai Electrostatic Protection Industry> published quarterly.

Since its founding, the Association has taken the leading role in repeatedly organizing its member units involved in formulating the criterions in the fields of electrostatic protection for the country, the industry and the local; also convening domestic and international conferences and seminars for the related new technologies and new products and launching and developing trainings of technical know-how, also doing jobs on applying, assessing, evaluating and filing electrostatic professional titles, etc.

President: Huang-JianHua Chairman & General Manager of Shanghai Chen-Long International Trade Ltd., Com.

Legal Representative: Huang-JianHua

Secretary-general: Luo-HongChang (sick leave since Feb. 2010)

Deputy secretary-general: Sun JunTong General Manager of Shanghai Jun-Jiang science and technology Ltd., Com. Vice-President of the association

Executive Vice- secretary-general: Xiong-YanYuan

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中国电子仪器行业协会防静电装备分会

中国电子仪器行业协会防静电装备分会成立于一九九七年。业务上受国家工业和信息化部相关部门的指导，隶属于中国电子仪器行业协会。是由从事静电与净化控制产业研发、制造、销售、工程施工、检测、培训及应用的相关企事业单位、大专院校、科研院所、业内有关社会团体，以及专家、学者等热心静电与净化控制事业的个人，不受部门和地区限制，自愿组成的全国非盈利性社会团体。本协会经国家民政部批准依法登记，具有社会团体法人资格的社会组织，现有会员单位280余家。

协会的宗旨是：为会员单位服务，维护本行业和会员单位的合法权益，贯彻执行国家的政策法规，推动防静电装备行业的发展。

防静电装备分会的主要任务包括：

- 1、协助政府部门制定本行业的技术与产业发展规划；
- 2、组织行业内外有关单位的联合技术攻关和开发新产品；
- 3、征集会员单位建议，向政府有关部门反映、沟通情况；
- 4、组织行业概况调研，制定行规行约；
- 5、组织并参与制、修定本行业的GB、GJB、SJ/T等标准工作；
- 6、开展技术研究、产品开发、投资项目的论证、评估等咨询服务；
- 7、开展本行业经营管理业务的培训；
- 8、利用协会网站组织防静电技术及应用的推广普及，开展市场调研，协助会员单位开拓市场、沟通生产单位与用户之间的联系；
- 9、开展与国内外有关学术团体、企事业单位、行业协会、信息网及杂志社等联系与合作，组织技术、产品及应用市场等方面的交流，组织国内国际展览会、展示会和技术研讨会等；
- 10、出版行业刊物《中国防静电》杂志，向政府部门、会员单位、相关用户免费赠阅；
- 11、根据政府部门委托和会员单位要求，举办其他有关活动。

联系方式：（010）68647410/51246352（电话）（010）68647410（传真），北京市石景山区万达广场CRD银座B-1128室，100040。网站为66防静电网，邮箱chinaesd@chinaesd.org.cn

协会LOGO：



电子行业职业技能鉴定工作站

电子行业职业技能鉴定工作站是工业和信息化部电子行业职业技能鉴定指导中心批准成立的专业防静电职业技能培训机构，为客户提供防静电培训、静电防护管理咨询、生产线防静电评估优化、ESD质量体系认证等服务。自2004年以来本站已经组织静电防护中、高级培训班60多期，内训企业70多家，培训人数达到五千余人次，旨在帮助电子企业解决生产过程中的静电困扰，建立最具性价比的静电防护体系，提升产品质量与可靠性。

本站受工业和信息化部电子行业职业技能鉴定指导中心委托开展了静电防护专业的职业技能鉴定培训，包括防静电系统中、高级检验员培训，以及防静电系统检验师培训，培训后颁发国家承认的相应等级职业资格证书。

联系方式：010-68865786（电话），010-68865786（传真），北京市石景山路23号中础大院设计院二分院二层208室，100049，任丽丽。网址 www.esdtraining.com.cn，邮箱 esdtraining@chinainfoesd.com

信息产业部防静电产品质量监督检验中心简介

信息产业防静电产品质量监督检验中心于1993年4月成立，原名为信息产业部防静电产品质量监督检测中心。中心已通过国家认证认可监督管理委员会认证。该中心作为电子行业唯一一家经国家认监委及工业和信息化部认可的防静电产品质量检测机构，授权对信息产业及有关行业中的防静电产品装备和工程进行质量监督检验。中心同时对提高产品质量和发展新产品提供技术咨询、服务和ESD知识培训，受理质量争议仲裁检验，承担防静电产品和有关产品的进出口商检任务，以及行业防静电标准制订和修订的组织工作。中心拥有专业的阻燃性能实验室，可完成建筑材料的阻燃性能测试。中心成立至今，已对国内外近千家生产厂商及经销单位送检的防静电产品、工程和ESD环境，进行了委托、仲裁检测和评估，年均接待近400个厂家送检产品近1000个批次。

中心作为中国电子行业防静电标准制修订组织单位，组织有关单位对现行的国家、行业标准进行修改或重新制订。近年来，牵头组织并完成了SJ/T10796-2001《防静电活动地板通用规范》、SJ/11236-2001《防静电帖面板通用规范》、SJ/T11277-2002《防静电周转容器通用规范》、SJ/T11294-2003《防静电地坪涂料通用规范》、SJ/T10694-2006《电子产品制造防静电系统测试方法》和GJB3007-2009《防静电工作区技术要求》标准的制订工作。中心协助相关单位企业制定的标准有：《防静电洁净工作服及织物通用规范》、《离子风静电消除器通用规范》和国家标准《防静电工程施工和验收规范》。另外，《防静电系统技术和质量通用规范》和《活动地板通用技术规范》两项国家标准的立项和申报工作也已经列入了2010年的工作计划。

联系方式：010-68865301/68869773（电话），010-68865301（传真），北京石景山区石景山路23号，100049，网址 www.chinainfoesd.com，邮箱 esds001@163.com。

China's Electronic Instrument Industry Association Anti-static Equipment Branch

Anti-static equipment branch is the anti-static equipment industry engaged in scientific research, production and management of enterprises and institutions, not affected by departments and regions limit is composed of voluntary social organizations. Belongs to the Chinese electronic instrument industry association, the association the approval of the ministry of civil affairs shall be registered according to law, have the corporative qualifications of social group, more than 280 members of the existing units.

Association's objective is: for the member unit service and maintain the industry member unit and the lawful rights and interests of the implement state policy laws and regulations, and promote the development of anti-static equipment industry.

Anti-static equipment branch is the government department of anti-static equipment industry to industry management assistant and staff. In the government department and the enterprises and institutions between the bridge and button take effect, to reflect the government enterprises and wishes and requirements, maintain the lawful rights and interests of the industry, assisting the government do a good job in industry management, in business by state ministry of industry and information related departments guidance.

Association tasks include:

Assisting the government department to make the industry technology and industry development planning;

Inside and outside the industry organization of the units concerned joint technology research and development of new products;

Suggestions for the member unit, convey to the government departments, communication circumstance;

An overview of the industry organization investigation, formulate guild regulations HangYao;

Carry out technology research, product development, investment project argumentation, evaluate consulting services;

Participate in making relevant industry standards work;

To carry out the industry management business training;

Use association website organization antistatic technology and application of the popularization and carry out market research, assist member unit to expand the market, communication production unit and the connection between the users;

Development and domestic and foreign related research institutions, enterprises and institutions, industry association, the information network and magazines, etc contact and cooperation, organization technology, product and application market exchanges, organize the domestic and international exhibitions, exhibitions and technical seminars, etc.;

Publishing industry publication national defence in electrostatic magazine, to government departments, the member unit, the related users provide free;

According to the government commission and member unit requirements, hold other relevant activities;

China's electronic instrument industry association anti-static equipment branch address:

Address: Beijing city wanda plaza CRD ginza B – 1128 room

Zip code: 100040

Telephone: (010) 68647410 51246352 fax: (010) 68647410

Web site: 66 antistatic grid

E-mail: chinaesd@chinaesd.org.cn

苏州天华超净科技股份有限公司企业简介

苏州天华超净科技股份有限公司是一家以向客户提供静电与微污染防控解决方案为核心，专业从事防静电超净技术产品研发、生产和销售的国家高新技术企业，产品涵盖了工业生产过程中静电与微污染防控的三大主要系统，即：人体防护系统、制程防护系统和环境防护系统，是国内防静电超净技术产品行业中的领先企业。公司依靠十多年积累的专业基础和技术实力以及丰富的下游行业应用经验，基于“系统平衡、成本节约化”设计原则，按照客户的需求为其量身定制静电与微污染防控解决方案，并凭借强大的研发实力和技术创新能力以及先进的生产工艺，根据设计方案或客户的特定要求，生产并提供涵盖三大防护系统的优质防静电超净技术产品。

公司产品性能已达到国际同类产品的先进水平，已广泛用于电子、医药、石化行业，并出口日本、韩国、新加坡、菲律宾及欧洲和北美等地。本公司努力拓展创新技术和综合服务能力，以canmax为品牌核心的天华产品，以高度的责任感，真诚与客户建立密切的合作伙伴关系，为客户提供最大价值的服务。目前企业正在向中国证监会申请创业板上市，已处于预披露阶段。Canmax立志成为防静电、无尘控制行业的领导品牌。

Suzhou TA&A Ultra Clean Technology Co., Ltd.

Since its inception in November 1997, the focus of Suzhou TA&A Ultra Clean Technology Co., Ltd. has been to provide trusted solutions to the ESD control and critical environment requirements of industry leaders in the high technology manufacturing sector.

Located in the China–Singapore Suzhou Industrial Park, TA&A is a high technology manufacturing enterprise with a strong foundation in research and development. TA&A has continuously been awarded the Exemplary Enterprise in the High Technology Manufacturing Industry on a National level.

In order to meet and surpass customers' requirements, TA&A has set up a world class manufacturing facility, equipped with advanced production equipment, as well as imported ESD performance testing and contamination analysis systems from the USA, EU and Japan.

TA&A is proud to hold the following key products in its stable of customer focused offerings:

- ESD control/ cleanroom garments and footwearCleanroom wipes
- Gloves
- ESD control trays
- Shielding bags
- Protective films
- Sticky mats/rollers
- Ionizing blowers and workstation monitor

Canmax, a brand registered by TA&A, is the most recognized name in the ESD and contamination control industry in China. Canmax products are widely accepted in the HDD, semiconductor, FPD, telecommunication, pharmaceuticals, aerospace, automobile and petrochemical industries in China and have found acceptance in many export markets.

北京市劳动保护研究所简介

北京市劳动保护科学研究所（BEIJING MUNICIPAL INSTITUTE OF LABOUR PROTECTION INTRODUCTION）成立于1956年，是我国第一家综合性安全科学研究所，是我国最早从事安全和环境科学领域研究的科研机构之一。半个多世纪来，我所在城市公共安全、安全生产与劳动保护、人居环境三个重点领域建立了多个专业技术研究机构和检测中心，为基础性、应用性、前瞻性的研发工作奠定了坚实的基础。取得科研成果500多项，获得国家、省(市)、部级科技成果和科技进步奖200多项，为国家制定了100余项有关劳保和环保方面的标准。挂靠我所的十多个国家级科研中心与北京市重点实验室，获得CMA计量资质认定，CNAS认可，职业卫生技术机构资质，北京市司法局批准的司法鉴定中心。我所是恢复高考后国务院学位委员会颁布的我国第一批硕士学位授予单位之一，具有《安全技术及工程》和《劳动卫生与环境卫生学》两项硕士学位授予权，并设有博士后工作站。

我所上世纪60年代成立了静电安全和静电除尘的研究室，引进了日本和美国先进仪器，拥有10000平方米的科研大楼，700多台仪器设备，80%以上为进口。70年代对工业企业特别是石化工业中静电进行了大量测试研究，对国内百余家中大型石化企业进行防静电治理，80年代，培养了从事防火防爆防静电和静电除尘研究方向的硕士研究生数十多名。通过大量实验研究，自主制定我国的一系列防静电国家标准:GB4386-84《防静电胶底鞋、导电胶底鞋电阻值测量方法》、GB4385-84《防静电胶底鞋、导电胶底鞋安全技术条件》、GB6950-86《轻质油品安全静止电导率》、GB6539-86《轻质石油产品电导率测定法》、GB6951-86《轻质油品装油安全油面电位值》、GB12014-89《防静电工作服》和GB12158-90《防止静电事故通用导则》等，由我所起草编制的大部分国家标准成为90年代以后的其它各行业各静电标准、参考、裁剪、引用，极大地促进了我国静电标准的发展与完善。为实施相关国家标准，我所研制了大量与国家标准配套的测量仪器。研制出高精度数字超高阻计(获国家专利)，数字电荷仪，防爆型数字多用表等。近10多年来我所科技人员多次参加美国EOS/ESD静电协会年会，IEEE EMC电磁兼容年会，IEEE-EAS(美国静电学会)年会并发表学术论文。2007年美国iNARTE批准我所为ESD工程师考试中心并与北京华晶汇组织各种培训。我所坚持以自主创新、重点研究、合作发展、协调推进的发展方针。为把我所建设成为国内一流的安全和环境科学研究机构而努力奋斗。

北京市劳动保护科学研究所地址：北京市西城区陶然亭路55号（100054）

电话：010-63580337, esd@esd-china.com

中国标准化杂志社

中国标准化杂志社是由中国标准化协会和中国标准化研究院的全资公司——中国标准科技集团有限公司共同出资的股份制企业。由国家质检总局主管，中国标准化研究院和中国标准化协会共同主办。本着顺应国家新闻出版总署关于中央新闻出版业文化体制改革精神的要求，依据国家新闻出版总署及有关部门规定，经国家质检总局同意，2010年9月，由中国标准化研究院主办的标准科学杂志社(出版刊物为：《标准科学》、《标准生活》、《术语标准化与信息技术》)与中国标准化协会主办的中国标准化杂志社（出版刊物为：《中国标准化》、《China Standardization》）正式合并，2011年12月《术语标准化与信息技术》更名为《产品安全与召回》。现五本杂志涵盖了中国标准化领用领域的政策形势时事政策、发展动态、研究成果、国行标权威发布、标准科技前沿和热点探讨、标准化理论与实践、中国标准化文化历史，以及与百姓生活息息相关的标准知识普及等内容，是目前中国标准化领域最全面、最权威和最具实力的传媒机构。



中国标准化杂志社
China Standardization Press

China Standardization Press

China Standardization Press is a professional media institution in the field of standardization jointly established by China National Institute of Standardization (CNIS) and China Standardization Association (CAS). It is dedicated to be an authoritative media group in China standardization and make great contributions to its development.

China Standardization Press has five journals:

China Standardization (Chinese)

Started in 1958, it is the most influential professional media in China's standardization field.



China Standardization (Overseas)

Started in 2004, it reports the China standardization development in an all-round to the international community, expressing the viewpoints of experts from home and abroad and displaying the standardization culture with Chinese characteristics. It is the only English journal for exchange with overseas standardization organizations.



Standard Science

Started in 1964, it is a core journal in science and technology in China focusing on probing and research of theories of standardization science. It is also a platform for communication of standardization theory and academic exchanges.



Standard Living

Started in 1964, it is a fashionable magazine for science popularization, using popular and easy ways to explain standards, plain and simple language to report news of standardization, and adopting shocking cases to strengthen standards, so as to serve as a standardization guide for common people.



Product Safety and Recall

Started in 1996, it was originally named as Terminology of Standardization and Information Technology. It is professional periodical for introduction of policies, laws, regulations and standards of product safety, analysis of current status and development trend of product safety management at home and abroad, summing up and exchange of experiences in enterprises' product safety management, promotion of product safety technologies, and popularization of product safety knowledge.



苏州市静电防护协会（筹）简介

苏州市静电防护协会（以下简称“协会”），英文：Electrostatic Protection Association of Suzhou，是从事静电防护行业相关的企事业单位自愿发起组成的专业性、跨行业的非盈利性组织，是苏州市一级行业协会，社会团体法人。会员单位主要是覆盖苏州大市范围地区内的通讯电子、半导体、包装耗材、仪器设备、技术研究服务等领域的骨干企业。

>> 协会的宗旨

贯彻执行国家政策法规，振兴静电防护产业，全心全意为社会服务；维护行业利益和会员单位的合法权益，保障企事业单位产品质量和技术安全，促进静电防护管理和技术的普及和推广，参与国家静电防护标准的制订，实现静电防护行业与地方经济的融合；加强自律，不断创新，推动静电防护行业的繁荣发展。

>> 协会的主要任务

一、贯彻宣传静电防护行业相关的政策法规、技术标准、规范和规程；向会员提供各类服务：包括市场资讯、管理体系咨询、技术支持；开展行业培训、交流、展览活动；

二、在政府和企业之间发挥桥梁和纽带作用，协助企业和政府有关部门沟通协调，向政府有关部门反映行业和会员企业的利益诉求，维护会员的合法权益；收集静电防护行业政策信息，开展行业调查、统计及有关行业资料整理工作；经政府主管部门授权或委托，参与对本行业企业诚信评价、资质评审、企业生产备案等工作；

三、引导和推动会员单位在静电防护的产品推广、人才培养、科研、技术交流等领域，提供更多的便利资源；帮助企业建立和完善静电防护管理体系，提高企业的产品质量，提高安全防护能力，降低企业生产成本，实现经济效益和社会效益双赢；

四、组织会员单位参与制定静电防护领域的国家、行业或地方标准；召开国际、国内有关新技术、新方法、新产品交流会；发展与国内外各地区、同行业之间的联系，代表会员单位联络静电防护及相关领域的其他协会和学会；

江苏东方航天校准检测有限公司公司简介

江苏东方航天校准检测有限公司是中国航天科技集团公司北京东方计量测试研究所在苏州工业园区投资控股设立的从事校准检测技术服务及相关产品研发的专业化公司，是集电磁学、无线电电子学、时间频率、几何量、热学、力学（真空）、理化等计量专业为一体的综合性校准测试技术服务机构，通过了中国合格评定国家认可委员会（CNAS）和国防科技工业实验室认可委员会（DILAC）的校准与检测实验室认可。可开展校准检测技术服务以及测试技术研究、产品开发、系统集成、实验室认可咨询、专业计量培训、仪器设备销售、租赁、维修等业务。

江苏东方航天校准检测有限公司依据ISO/IEC17025国际标准建设标准化实验室，拥有过百项无线电和电磁学自动化校准测试程序，2011年公司成为苏州市社会化计量服务平台，2012年获得国家级高新技术企业称号、国家级火炬计划项目承担单位。

江苏东方航天校准检测有限公司将以北京东方计量测试研究所为强大后盾，秉承“严谨、专业、精确、先进”的计量理念，信守“质量为本、客户至上、科学公正、止于至善”的质量承诺，利用先进的计量标准仪器设备和精湛的测试技术，竭诚为每一位客户提供高水平的校准检测服务和整体解决方案。

目前江苏东方航天校准检测有限公司已为环旭电子、伟创力、威宏电子、松下电工、富士康等公司提供优质的计量服务，受到广大客户的认同与推广，竭诚欢迎社会其他企业单位的莅临指导，合作与交流。

Presentations

演讲文稿

公共安全标准化

中国标准化研究院 王金玉研究员
2013年11月4日

Standardization of Public Security

China National Institute of Standardization
Researcher: Wang Jinyu
November, 4th, 2013

讲演题目1/Topic1

提纲

- 一 主要国家标准化战略与公共安全标准化
- 二 国际国外公共安全标准化现状
- 三 中国公共安全基础标准化
- 四 公共安全业务连续性管理体系标准

Outline

- I Standardization strategy and public security standardization in major countries
- II Current status of international public security standardization
- III The standardization of public security infrastructure in China
- IV Business continuity management system standardization of public security

一、主要国家标准化战略与公共安全标准化

① 战略背景：态势、特征与动因

② 中国战略重点：全面推进公共安全标准化

I. Standardization strategy and public security standardization in major countries

① Strategic background: situation, characteristics and motivation

② Strategic focus in China: overall promotion of the public security standardization

一、主要国家标准化战略与公共安全标准化

1. 战略背景：态势、特征与动因

- 2000年前后，国际上出现了标准化战略热，主要发达国家和一些发展中国家相继发布了标准化战略。
- 2005年前后，各国又对战略进行了修订或提出了新的目标。
- 2010年前后主要发达国家发表的研究报告和制定的标准化战略更具时代特点。

I. Standardization strategy and public security standardization in major countries

i. Strategic background: situation, characteristics and motivation

- Standardization strategy became an international trend around the year of 2000, and major developed countries & some developing countries have published the standardization strategies consecutively.
- Those countries made amendment or published new targets towards the strategies around the year of 2005.
- Research reports and standardization strategies published by major developed countries have shown more characteristics of the times around the year of 2010.

一、主要国家标准化战略与公共安全标准化

■ 主要发达国家

- 欧 盟（1999制定 2007修订 2010修订）
- 美 国（2000制定 2005修订 2010修订）
- 日 本（2001制定 2006发布国际战略—安倍 2010新目标和重点）
- 法国、英国、德国

■ 主要发展中国家

- 新加坡、马来西亚、泰国等
- 中国2002年三大战略：人才、专利、技术标准

I. Standardization strategy and public security standardization in major countries

■ Major developed countries

- E.U.（Published in 1999, amended in 2007 and 2010）
- U.S.（Published in 2000, amended in 2005 and 2010）
- Japan（Published in 2001. Published international strategy by Abe in 2006 and published new targets and focus in 2010）
- France, England and Germany

■ Major developing countries

- Singapore, Malaysia, Thailand, etc.
- Three Strategies published by China in 2002: talents, patents and technical standard

一、主要国家标准化战略与公共安全标准化

为什么制定修订战略？

标准化的环境在不断发生重大变化，新科技革命、全球产业变革和社会管理创新向标准化提出了更高的要求，不把标准化提到国家战略的高度就难以解决经济社会发展中的战略难题。

I. Standardization strategy and public security standardization in major countries

Why publish and amend the strategies?

The environment of standardization is having constant and significant changes, and higher requirements have been presented to standardization by new scientific revolution, global industrial reform and social management innovation. Promoting standardization to national strategy level is the foundation of solving strategic issues in economic and social development.

一、主要国家标准化战略与公共安全标准化

2. 中国战略重点：全面推进公共安全标准化

国 家	重 点 领 域
美 国	健康、安全、环境、高技术
日 本	健康、安全、环境、消费者和弱势群体、先进制造业、信息技术
加拿大	健康、安全、环境、城市可持续
欧 盟	健康、安全、环境、新技术、城市可持续
中 国	公共安全……

I. Standardization strategy and public security standardization in major countries

ii. Strategic focuses: overall promotion of the public security standardization

Country	Keynote
U.S.	Health, security, environment and high-tech
Japan	Health, security, environment, customer & vulnerable groups, advanced manufacturing industry and information technology
Canada	Health, security, environment and city sustainability
E.U.	Health, security, environment, new technology and city sustainability
China	Public security……

一、主要国家标准化战略与公共安全标准化

2.战略重点:全面推进公共安全标准化

■ 为什么？

公共安全标准化是经济社会可持续发展的基础

I. Standardization strategy and public security standardization in major countries

ii. Strategic focuses: overall promotion of the public security standardization

■ Why？

Public security standardization is the foundation of having sustainable economic and social development.

I. Standardization strategy and public security standardization in major countries

The relevance between emergency incidents is becoming stronger

Relevance between emergency incidents, e.g. natural disasters, accidents, public health events, social security events, etc. is becoming stronger. They are mutually influencing each other and mutually transforming to secondary, derivative events or new events.

- Urbanization issues
- ISO/TC268 Standardization issue in city sustainable development
- ISO/TC268 and ISO/TC223 coordinate with each other

2013-10-29

一、主要国家标准化战略与公共安全标准化

各类突发事件的关联性越来越强

自然灾害、事故灾难、公共卫生事件和社会安全事件等突发事件的关联性越来越强，相互影响、相互转化导致次生、衍生事件或成为各种事件的耦合。

- 城市化问题
- ISO/TC268城市可持续发展标准化问题
- ISO/TC268与ISO/TC223协同

2013-10-29

I. Standardization strategy and public security standardization in major countries

Summary :

- Serious emergency incidents are frequently happening in China recently, which have severely threatened people 's life and property safety. Economic loss occurred by emergency incidents takes 5% - 6% of the GDP.
- We must overall promote the public security standardization as a strategic focus.

2013-10-29

一、主要国家标准化战略与公共安全标准化

小结：

- 近年我国重大突发事件频发，严重威胁人民的生命财产安全。突发事件造成的经济损失占GDP的5% ~ 6%
- 必须把公共安全标准化作为战略重点全面推进

2013-10-29

二、国际国外公共安全标准化现状

1

国际标准化组织现状

2

主要发达国家现状

3

经验启示和趋势研判

11

II. Current status of international public security standardization

1

Current status of ISO

2

Current status of major developed countries

3

Experience, inspiration and trend predicting

11

二、国际国外公共安全标准化现状-国际

1.国际标准化组织现状

基于世界各国对公共安全标准的迫切需求，ISO、IEC和ITU三大国际标准化组织大力加强公共安全标准化。

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II. Current status of international public security standardization-international

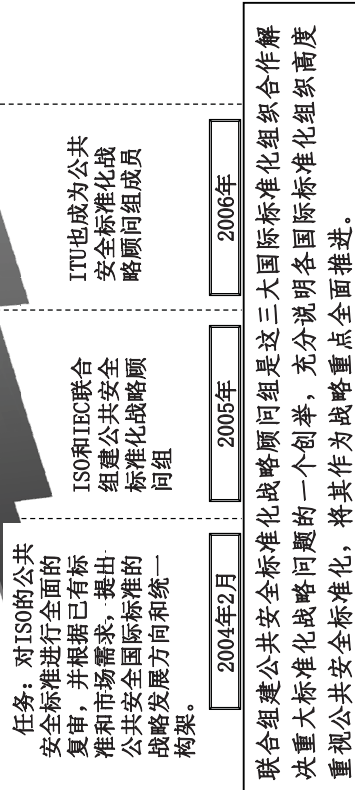
i. Current status of ISO

Due to the desperate need of worldwide countries to public security standards, ISO, IEC and ITU are dedicated in promoting the public security standardization.

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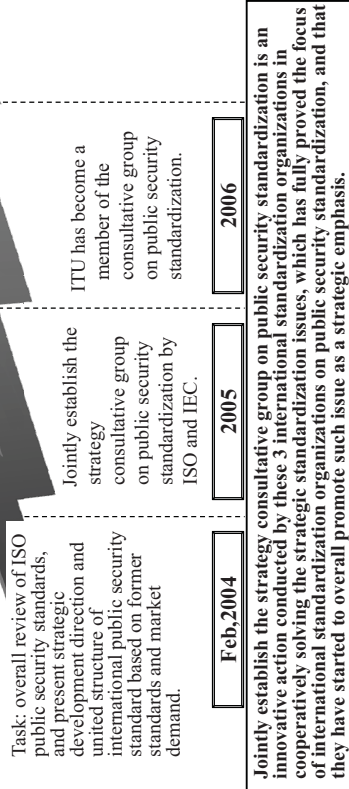
二、国际国外公共安全标准化现状-ISO

■ 从战略高度加强公共安全标准化活动的组织管理



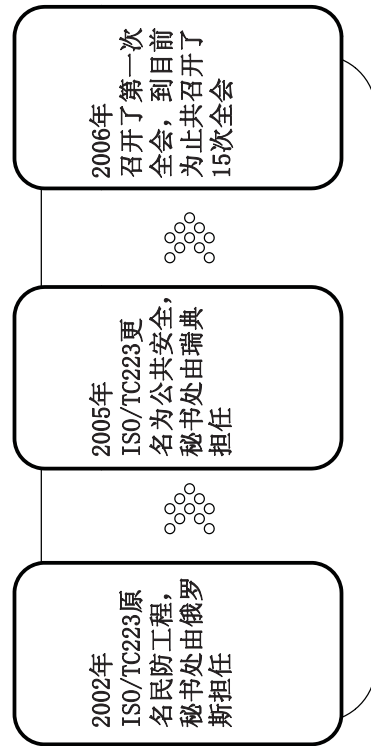
II. Current status of international public security standardization-ISO

■ Improve the organization and management of public security standardization activities at strategic level



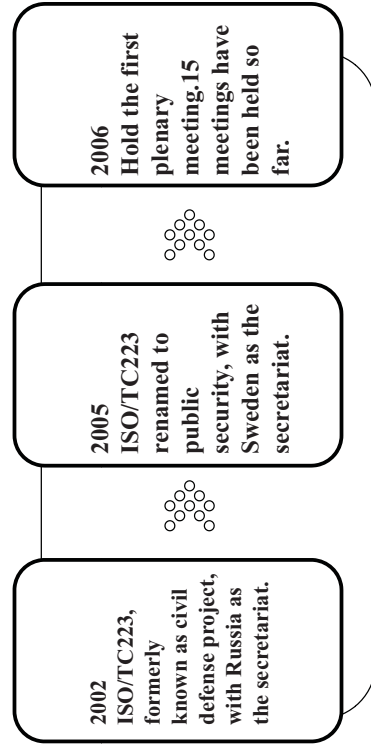
二、国际国外公共安全标准化现状-ISO

■ 加强ISO/TC 223建设



II. Current status of international public security standardization-ISO

■ Strengthen the construction of ISO/TC 223



二、国际国外公共安全标准化现状-ISO

■ 技术委员会工作组情况

编号	名称	成立时间
WG1	框架与路线图	2005
WG2	公共安全术语	2005
WG3	(指令与控制)应急管理	(2005)2009
WG4	组织弹性与业务连续性	2009
WG5	视频监控	2009
WG6	大规模疏散	2012

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二、国际国外公共安全标准化现状-ISO

■ 加强标准制定（13项）

序号	编号及进展情况	标准名称	工作组
1	ISO/CD 22397	公共安全-组织间建立合作关系协议的指南	WG1
2	ISO/FDIS 22398	公共安全-演练指南	WG1
3	ISO 22300:2012	公共安全-术语	WG2
4	ISO 22320:2011	公共安全-应急管理-突发事件应急响应要求	WG3
5	ISO/DIS 22322	公共安全-应急管理-公共预警	WG3
6	ISO/DIS 22324	公共安全-应急管理-预警颜色编码	WG3
7	ISO/CD 22325	公共安全-应急管理-组织机构应急能力评估	WG3
8	ISO/DTR 22351	公共安全-应急管理-信息共享	WG3

II. Current status of international public security standardization-ISO

■ Brief introduction of the technical committee working team

No.	Name	Time of establishment
WG1	Frame and route map	2005
WG2	Public security terms	2005
WG3	(Instruction and controlling) Emergency management	(2005)2009
WG4	Organization elasticity and business continuity	2009
WG5	Video monitoring	2009
WG6	Large-scale evacuation	2012

5

II. Current status of international public security standardization-ISO

■ Promoting the standards formulation (13 items)

No.	No. and progress	Name of standards	Working team
1	ISO/CD 22397	Public security - Agreement manual on establishing cooperative relationship between organizations	WG1
2	ISO/FDIS 22398	Public security - Drill manual	WG1
3	ISO 22300:2012	Public security - Terms	WG2
4	ISO 22320:2011	Public security - Emergency management - Emergency response requirement for emergency incidents	WG3
5	ISO/DIS 22322	Public security - Emergency management - Publish pre-warning	WG3
6	ISO/DIS 22324	Public security - Emergency management - Pre-warning color code	WG3
7	ISO/CD 22325	Public security - Emergency management - Emergency response ability evaluation of organizations and institutions	WG3
8	ISO/DTR 22351	Public security - Emergency management - Information sharing	WG3

二、国际国外公共安全标准化现状-ISO

■ 加强标准制定（13项）

序号	编号及进展情况	标准名称	工作组
9	ISO 22301:2012	公共安全-业务连续性管理体系要求	WG4
10	ISO 22313:2012	公共安全-业务连续性管理体系指南	WG4
11	ISO/NP 22316	公共安全-组织弹性-原则和指南	WG4
12	ISO 22311:2012	公共安全-视频监控	WG5
13	ISO/CD 22315	公共安全-大规模疏散-计划指南	WG6

II. Current status of international public security standardization-ISO

■ Promoting the standards formulation (13 items)

No.	No. and progress	Name of standards	Working team
9	ISO 22301:2012	Public security - Requirement for business continuity management system	WG4
10	ISO 22313:2012	Public security - Manual on business continuity management system	WG4
11	ISO/NP 22316	Public security - Organization elasticity - Principles and guidelines	WG4
12	ISO 22311:2012	Public security - Video monitoring	WG5
13	ISO/CD 22315	Public security - Large-scale evacuation - Plan guideline	WG6

二、国际国外公共安全标准化现状-IEC

IEC的公共安全标准化工作更多的在于和ISO的合作，通过联合技术委员会和联合战略安全顾问组的工作，对公共安全标准化工作进行协调和指导。

ISO已经制定和发布了5483项与安全有关的标准和出版物，这些标准和出版物很多都冠以ISO/IEC双标识。

II. Current status of international public security standardization-IEC

The public security standardization related works of IEC are mainly done by cooperating with ISO, and providing coordination & guidance for public security standardization issues with the assistance of Technical Committee and Strategic Security Consultative Team.

ISO has formulated and published 5483 standards and publications related to safety, which are mostly imprinted with dual sign of ISO and IEC.

二、国际国外公共安全标准化现状-ITU

ITU的标准工作领域更多涉及到信息和数据等非实物实体，同时也注重安全管理网络的建立。ITU制定了与信息通讯有关的信息安全标准共102项。

信息技术的快速发展对ITU的公共安全标准提出更高的要求，建立了专门的研究组（SG 17）来开展制定公共安全标准化工作。

II. Current status of international public security standardization-ITU

The standardization related works done by ITU are mostly involved with non-physical entities, e.g. information and data, and also the establishment of safety management network.

ITU formulated 102 information safety standards related to information communication.

The rapid development of information technology presented a higher requirement to public security standards. Therefore ITU established a specific research team (SG 17) to formulate the public security standards.

二、国际国外公共安全标准化现状-美国

2.主要发达国家现状

美国：加强应急管理法律法规体系建设

年份	名称	主要内容
1950	联邦民防法	授权联邦民防管理局负责起草预案，为州和地方政府提供协调、指导、培训和帮助，并对地方民防的装备和供给的采购提供资助。
1950	灾害救济法	首次授权总统可以宣布灾难状态。
1968	全国洪水保险法	创立了全国洪水保险计划，将保险引入救灾领域。
1970	灾害救济法	要求政府开始对受灾的人民提供直接的帮助。建立了关于临时住房、失业保险、法律服务和其他个人帮助计划等。
1974	灾害救济法	设立了对受灾家庭和个人的资助项目，将政府的应急管理从应对和恢复的反应性政策，拓展成减灾和准备的预防性政策。
1976	紧急状态管理法	规定了全国紧急状态的过程、期限以及紧急状态下总统的权力，并对政府的职责做了具体的规范。
2002	国土安全法案	为成立国土安全部奠定法律基础，在国家层面对应急体系中的组织管理体系、机构设置、指挥协调体系、法律和规范标准体系、应急预案体系、应急平台体系、应急救援队伍体系等进行了统一规划和规范。

II. Current status of international public security standardization-U.S.

ii. Current status of major developed countries

U.S.: strengthening the establishment of emergency management law and regulation system

Year	Name	Main content
1950	Federal Civil Defense Act	Authorize the Federal Civil Defense Administration to draft the plan, to provide coordination service, guidance, training and assistance to states and local government, and subsidize the equipment and supply purchase of local civil defense.
1950	Disaster Relief Act	Authorize the president to declare a disaster condition for the first time.
1968	National Flood Insurance Act	Launched the national flood insurance plan and introduced insurance to disaster relief field.
1970	Disaster Relief Act	Demand the government to provide direct help for stricken people. Established individual assistance plans, e.g. temporary housing, unemployment insurance, legal service, etc.
1974	Disaster Relief Act	Established funding projects for stricken family and individuals, and expanded the government's emergency management from responsiveness policies (response & recovery) to preventability policies (disaster reduction & preparation)
1976	Emergency Management Act	Regulated the process, term and power of president in an emergency condition, and specifically regulated the responsibilities of government.
2002	Homeland Security Act	Set foundation for the establishment of DHS (Department of Homeland Security), uniformly regulated the organization management system, institution establishment, coordination system, legal & regulation standard system, contingency plan system, contingency platform system and emergency rescue team system at national level.

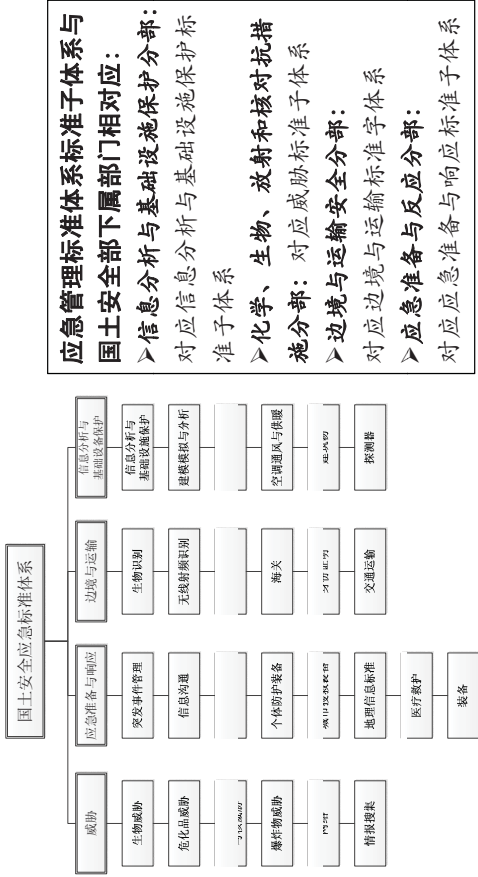
二、国际国外公共安全标准化现状-美国

美国：加强应急管理机构建设

年份	机构名称	主要职责
1949	联邦民防管理局	隶属国防部。民防的功能在于保护平民对付敌对行动或灾害影响；援助平民从敌对行动和灾害影响中恢复；为平民提供必要的生存条件。
1958	民防与国防动员办公室	将民防与国防任务合并。
1961	紧急事态准备办公室	负责全国的自然灾害应对，民防的职能依然留给国防部的国防动员办公室。美国的公共安全和应急管理机构开始从民防体系中萌芽。
1979	联邦应急管理局（FEMA）	美国的应急管理机制正式建立。主要任务是防灾减灾、应急准备、应急响应和灾后恢复重建。
2003	国土安全部（DHS）	把FEMA并入其中。在原有的联邦政府应急救灾指挥中心等基础上设立了国土安全运行中心（HSOC），作为其应急机构的日常值班中心。

二、国际国外公共安全标准化现状-美国

建立了美国公共安全与应急管理标准体系



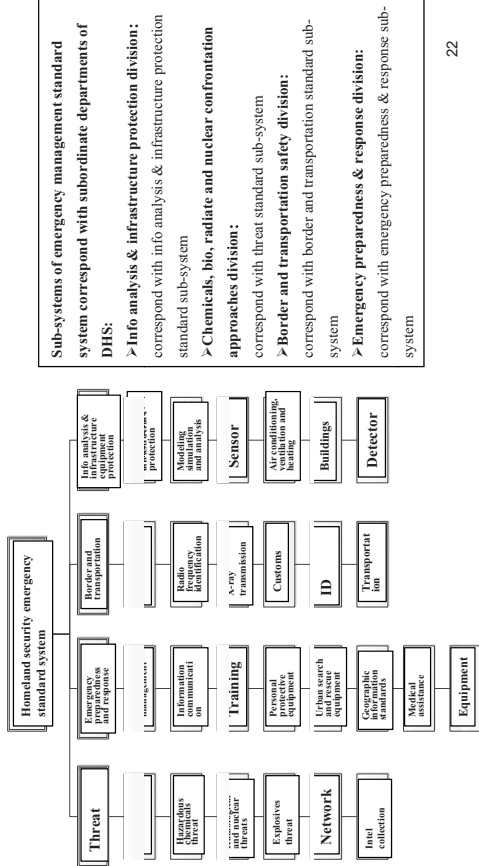
II. Current status of international public security standardization-U.S.

U.S.: strengthening the establishment of emergency management institution

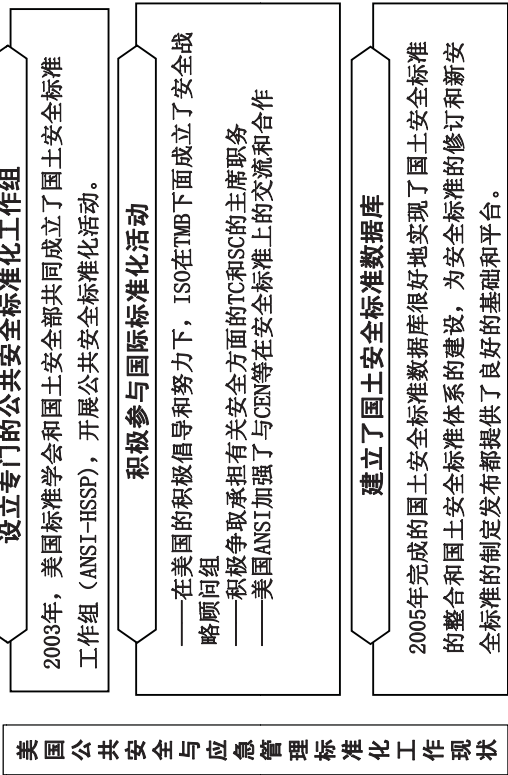
Year	Name of institution	Major responsibilities
1949	Federal Civil Defense Administration	Under the Ministry of National Defense with the functions of protecting civilians from warpath or disasters; assisting civilians to recover from the warpath or disasters and providing civilians with necessary survival conditions.
1958	Civil and Defense Mobilization Office	Combining the civil defense and national defense tasks.
1961	Emergency Readiness Office	In charge of responding to national natural disasters while the civil defense function remaining to be the responsibility of Office of Defense Mobilization. The public security and emergency management institution of U.S. became to sprout from the civil defense system.
1979	Federal Emergency Management Agency (FEMA)	Officially establishment of U.S. emergency management mechanism. Major tasks: disaster prevention, damage reduction, emergency preparedness, emergency response and post restoration and reconstruction.
2003	Department of Homeland Security (DHS)	Merge the FEMA into DHS. Established HSOC (Homeland Security Operation Center) on the basis of former Federal Emergency Relief Command Center, etc. as the daily duty center of the emergency institution.

II. Current status of international public security standardization-U.S.

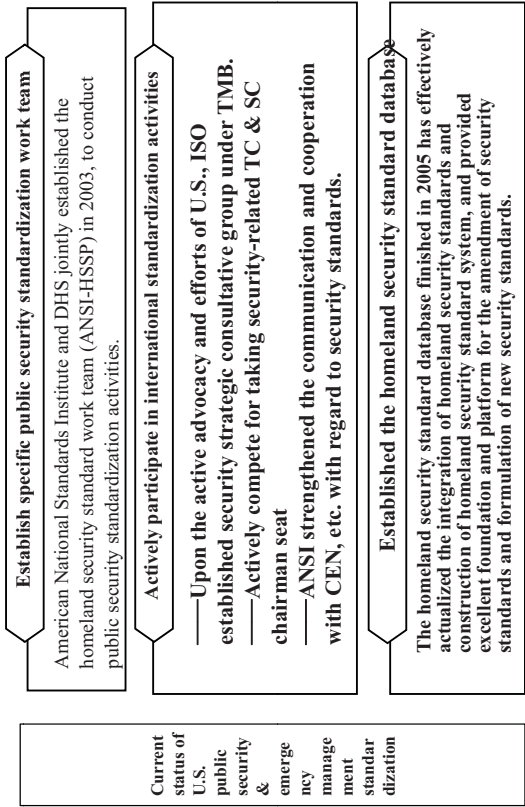
Established the U.S. public security and emergency management standard system



二、国际国外公共安全标准化现状-美国



II. Current status of international public security standardization-U.S.



II. Current status of international public security standardization-U.S.

- Emphasize on the standardization management of emergency equipment
- DHS authorized equipment list (AEL)
Emergency equipment involved in DHS project funding application must be within such AEL scope.
 - Standardization equipment list (SEL) of Inter-Agency Board (IAB)
Including chemical, bio, radioactivity, nuclear explosion accident management equipments, etc.
Mainly handle the quick response, transfer and recovery to large public security incidents (e.g. nuclear explosion)

二、国际国外公共安全标准化现状-美国

- 非常重视应急装备的标准化管理
- 美国国土安全部授权装备目录（AEL）
申请国土安全部项目资助涉及应急装备时，必须是授权目录范围的装备
 - 机构间委员会（IAB）标准化装备目录 (SEL)
包括化学、生物、放射性、核爆炸事故处理等装备
 - 主要应对较大公共安全事件（如核爆炸事故）发生后的快速响应、转移与恢复

二、国际国外公共安全标准化现状-美国

非常重视应急装备的标准化化管理

美国国土安全部授权装备和产品目录包括21大类，709个子类。

1. 个人防护装备

2. 防爆装备

3. 核生化处置、搜救设备

4. 信息系统有关设备

5. 网络安全有关设备

6. 互联及通讯设备

7. 探测设备

8. 洗消设备

9. 医疗设备

10. 供电设备

11. 核爆事件（CBRNE）有关参考资料

12. 核爆事件处置的车辆设备

13. 反恐设备

14. 物理防护设备

15. 安检设备

16. 动植物检疫设备

17. 核爆事件预防和处置的船舶设备

18. 核爆事件处置的航空设备

19. 核爆事件处置的后勤支援设备

20. 介入器材

21. 其他授权设备

II. Current status of international public security standardization-U.S.

Emphasize on the standardization management of emergency equipment

DHS authorized equipment and product list includes 21 classes and 709 subclasses.

1. Personal protective equipment

2. Anti-explosion equipment

3. NBC disposal, search and rescue equipment

4. Info system related equipment

5. Network security related equipment

6. Internet and communication equipment

7. Detecting equipment

8. Decontamination equipment

9. Armamentarium

10. Power supply equipment

11. CBRNE related reference data

12. CBRNE disposal vehicles

13. Anti-terrorist equipment

14. Physics protective equipment

15. Security inspection device

16. Animal and plant quarantine

17. CBRNE prevention and disposal ships

18. CBRNE disposal aeronautical facilities

19. CBRNE logistic support equipment

20. Interventional equipment
21. Other authorized equipments

二、国际国外公共安全标准化现状-日本

■日本应急管理概况

➢应急管理法律法规体系完善

应急管理以政府为主导，日本各级政府间以法律和法规的形式规范各自的行动边界，各级政府行为的调节由法律法规来进行规定。

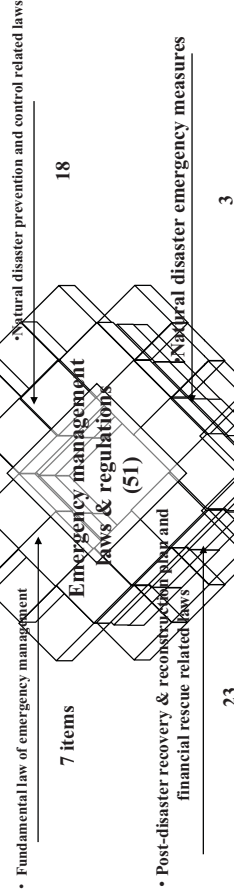


II. Current status of international public security standardization-Japan

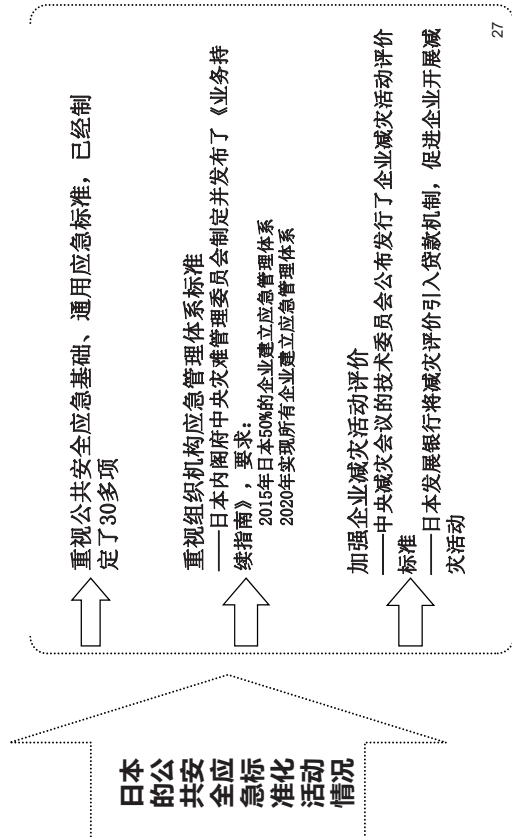
■Emergency management in Japan

Perfection of emergency management law & regulation system

Led by the government, local governments in Japan regulate their action borders in the form of laws and regulations. Action coordination between different government levels is regulated by laws and regulations.

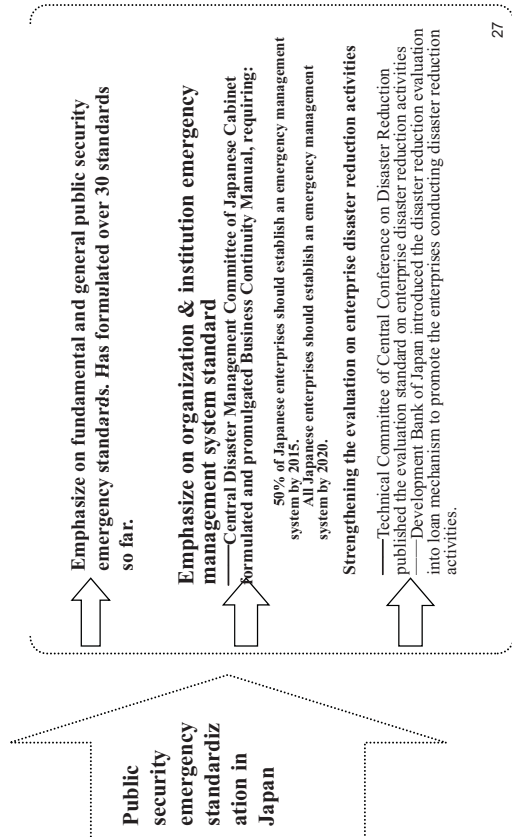


二、国际国外公共安全标准化现状-日本



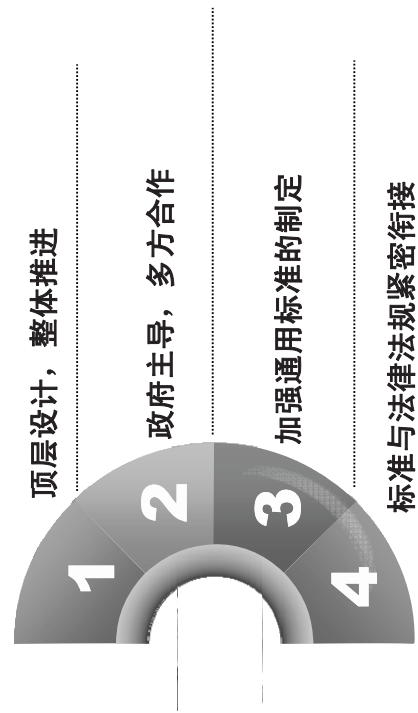
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II. Current status of international public security standardization-Japan



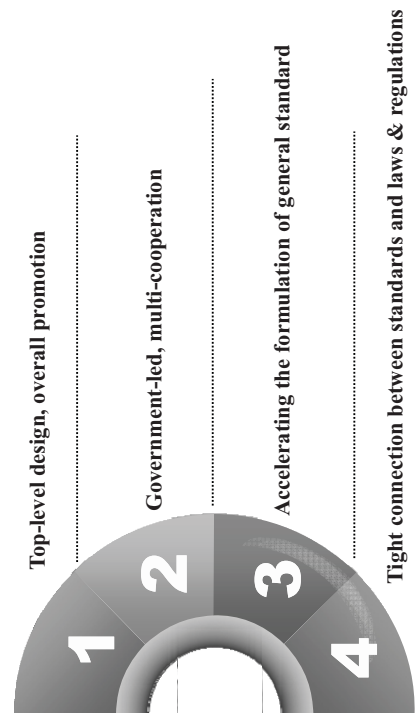
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二、国际国外公共安全标准化现状-经验启示



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II. Current status of international public security standardization -experience and inspiration



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三、我国公共安全基础标准化

- 1

重视公共安全标准化规划
- 2

组建全国公共安全基础标准化技术委员会
- 3

加强公共安全标准化重大项目研究

III. The standardization of public security infrastructure in China

- 1

Focus on public security standardization plan
- 2

Establish National Technical Committee of Basic Public Security Standardization
- 3

Strengthen the researches on public security standardization related major projects

三、我国公共安全基础标准化

1. 重视公共安全标准化规划

中长期发展规划纲要	《国家中长期科学和技术发展规划纲要》将公共安全作为重点领域与优先主题
国民经济十五规划纲要	《国民经济和社会发展第十一个五年规划纲要》明确提出要加强公共安全建设
标准化十五规划	《标准化“十五”发展规划》明确提出要大力推进公共安全领域标准化工作
国民经济十二五规划纲要	《国民经济和社会发展第十二个五年规划纲要》要求加强公共安全体系建设，健全突发事件应急体系
标准化十二五规划	《标准化事业发展“十二五”规划》明确提出要加强公共安全领域标准研究
公共安全科技十二五专项规划	《国家公共安全科技发展“十二五”专项规划》将公共安全标准体系建设作为其重点方向之一

III. The standardization of public security infrastructure in China

i. Focus on public security standardization plan

Long-term development plan	National Long-term Scientific and Technological Development Plan puts public security as major field and priority theme
11th Five-Year Plan for National Economic Standardization	11th Five-Year Plan for National Economic and Social Development explicitly presented to strengthen the public security construction.
11th Five-Year Plan for Standardization	11th Five-Year Plan for Standardization explicitly presented to significantly promote the standardization in public security field.
12th Five-Year Plan for National Economic Standardization	12th Five-Year Plan for National Economic and Social Development requires to strengthen the public security system construction and perfect the emergency incidents response system.
12th Five-Year Plan for Standardization	12th Five-Year Plan for Standardization Development explicitly presented to strengthen the researches on public security standards.
12th Special Five-Year Plan for Public Security S & T	12th Special Five-Year Plan for Public Security S & T Development puts public security standard system construction as one of its key points.

三、我国公共安全基础标准化

2. 组建全国公共安全基础标准化技术委员会

- (1) 2008年11月6日SAC/TC351成立
- 经国家标准化管理委员会批准，全国公共安全基础标准化技术委员会成立。
 - SAC/TC351是ISO/TC223和ISO/TMB/SAG-S中国对口单位

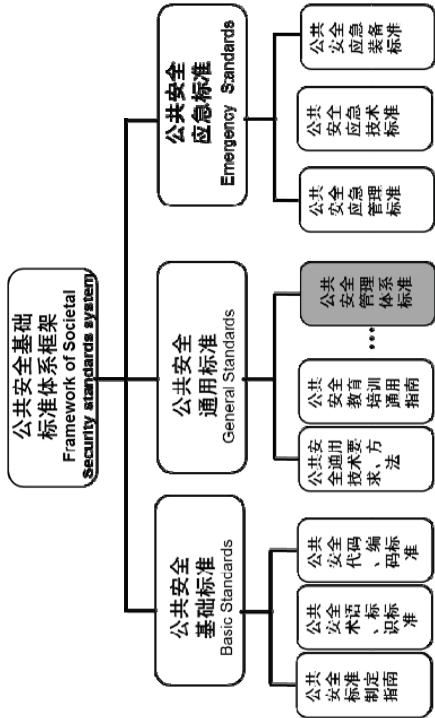
III. The standardization of public security infrastructure in China

ii. Establish National Technical Committee of Basic Public Security Standardization

- (i) SAC/TC351 was established in November, 6th, 2008.
- National Technical Committee of Basic Public Security Standardization was founded under the approval of National Standardization Management Committee.
 - SAC/TC351 is the counterpart of ISO/TC223 and ISO/TMB/SAG-S in China.

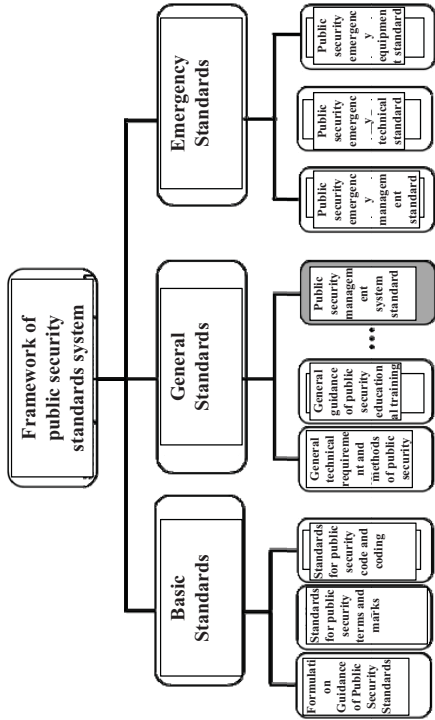
三、我国公共安全基础标准化

(2) 公共安全基础标准体系框架



III. The standardization of public security infrastructure in China

ii. Framework of Societal Security Standards system



三、我国公共安全基础标准化

(3) SAC/TC351近期重点工作

- 研制公共安全术语、标识等基础标准（十一一五）
- 研制业务连续性管理体系标准（工作重点）
- 研究建立公共安全应急标准体系（十一一五）
- 研制公共安全重点领域应急标准（十二五）

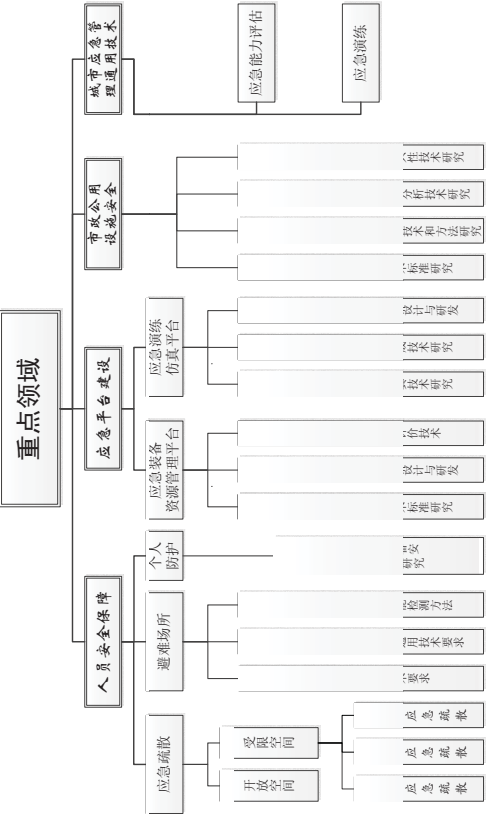
III. The standardization of public security infrastructure in China

(iii). Recent major tasks of SAC/TC351

- Study basic standards for public security terms, marks, etc. (11th Five-Year Plan)
- Study business continuity management system standard (key job)
- Study the establishment of public security emergency meeting standard system (11th Five-Year Plan)
- Study the emergency meeting standard for major fields of public security (12th Five-Year Plan)

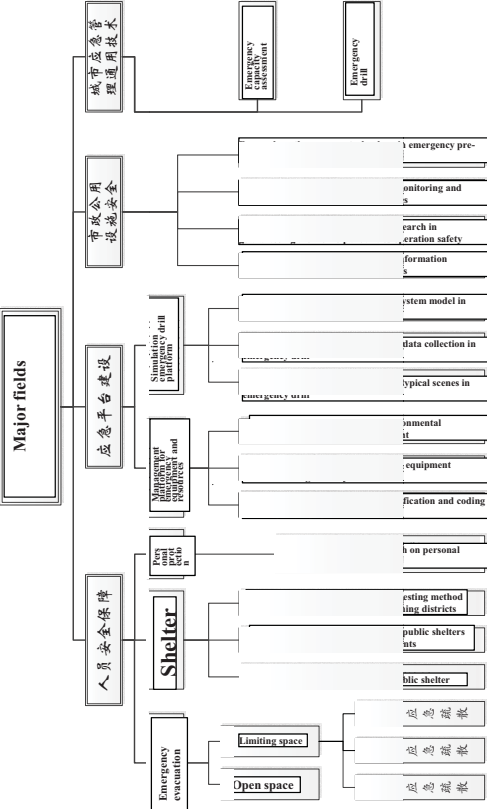
三、我国公共安全基础标准化

(4) 近期标准研制的重点领域



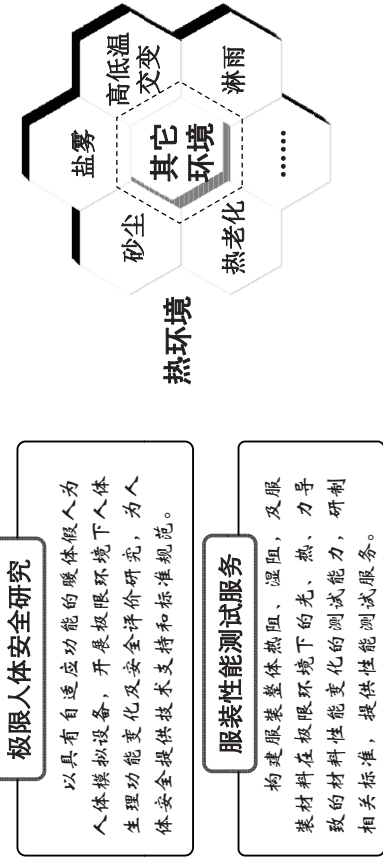
III. The standardization of public security infrastructure in China

iv. Recent major standard study & formulation fields



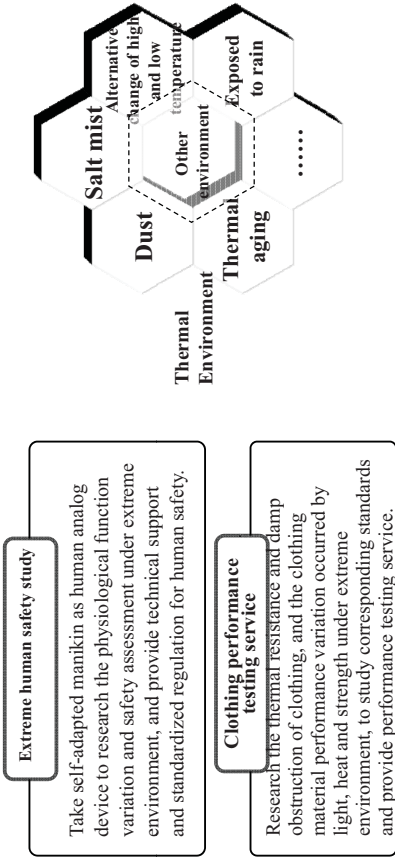
三、我国公共安全基础标准化

(5) 近期标准研制的重点领域
——“人体安全防护风险评估”实验室



III. The standardization of public security infrastructure in China

V. Recent major standard study & formulation fields
——"Risk Assessment on Personal Safety Protection" Lab.



三、我国公共安全基础标准化

(6) 技术委员会标准制修订列表（24）

类别	标准名称	类别	标准名称
基础通用 10	公共安全术语 基础通用	基础设施 4	城市燃气设施运行安全信息分类与基本要求
	突发事件应急能力评估通则		城市供热设施运行安全信息分类与基本要求
	公共安全-应急管理-公众预警		地铁安全疏散标准
	公共安全-应急管理-预警颜色编码		公共避难场所通用技术要求
	公共预警通知系统建设规范	毒气 泄漏 突发事件 应急响应 4	重大毒气泄漏事故公众应急疏散方案编制与管理指南
	公共预警通知系统建设规范		重大毒气泄漏事故公共避难场所通用技术要求
	突发事件应急避难规范		重大毒气泄漏事故应急计划区划分方法
	应急演练模拟仿真系统通用技术要求		应急计划区内公共避难场所毒气防护性能检测方法
	应急物资分类及编码 第1部分:应急装备	人体 防护 4	用出汗人体模型测量服装湿阻值的标准试验方法
	应急物资分类及编码 第2部分:应急用基本生活保障物资		用出汗人体模型测量服装湿阻值的标准试验方法
管理体系 2	应急物资分类及编码 第3部分:应急工程材料		防护服人体模拟试验的标准试验方法
	公共安全-业务持续管理体系-要求		测定穿着者对防护服套袋的生理反应标准实施规程
	公共安全-业务持续管理体系-指南		用出汗人体模型测量人体冷却系统散热率的標準试验方法

III. The standardization of public security infrastructure in China

vi. Standard formulation and amendment list by Technical Committee (24)

Type	Name of standard	Type	Name of standard
Public security terms--basic and general	Public security terms--basic and general	Infrastructure 4	Information classification and basic requirements for the safe operation of city gas facilities
	General rules for emergency capacity assessment		Information classification and basic requirements for the safe operation of city heat supply facilities
	Public security--emergency management-public pre-warning		Subway safety evacuation standards
	Public security--emergency management-public pre-warning color code		General technical requirements for public shelters
Basic and general standards 10	Notification system construction and regulation of public pre-warning	Poison gas leak emergency 4	Public emergency evacuation plan editing and management guideline for serious poison gas leak incidents
	Emergency drill specification		General technical requirements for public shelters under serious poison gas leak incidents
	General technical requirement for analog simulation system of emergency drill		Division methods for emergency planning districts under serious poison gas leak incidents
	Classification and code of emergency supplies Part I: emergency equipment		Poison gas prevention performance testing method of public shelters in emergency planning districts

三、我国公共安全基础标准化

(7) 积极参与国际标准化活动

- 以P成员参加ISO/TC 223公共安全标准化技术委员会的工作，参与ISO/TMB SAG-S公共安全战略顾问组活动。
- 实质参与起草ISO/TC 223《公共安全应急演练与测试》、《公共安全指令与控制》等10余项国际标准。
- 正在主导制定《组织机构应急能力评估》国际标准。

III. The standardization of public security infrastructure in China

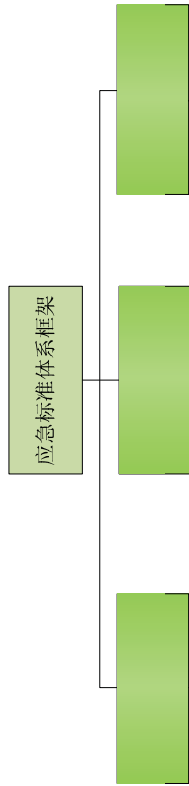
vii. Actively participate in international standardization activities

- Participate in ISO/TC 223 public security standardization technical committee as a member, participate in ISO/TMB SAG-S public security strategic consultative group.
- Essentially participate in drafting over 10 international standards, e.g. *ISO/TC 223 Public Security Emergency Drill and Testing*, *Public Security Instructions and Controlling*, etc.
- Is leading the formulation of *Emergency Capacity Assessment of Organizations and Institutions*.

三、我国公共安全基础标准化

3. 加强公共安全标准化重大项目研究

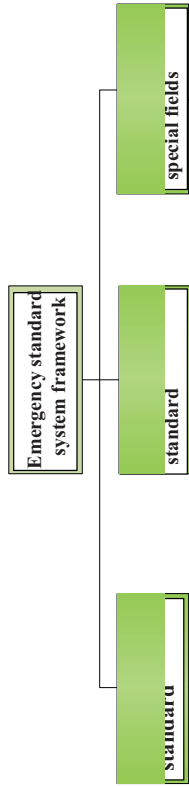
- “十一五”技术标准重点专项《国家应急技术标准体系与关键技术标准研究》——体系框架



III. The standardization of public security infrastructure in China

iii. Strengthening researches on major public security standardization projects

- Key special project of 11th Five-Year Plan in technical standards
Research on National Emergency Technical Standard System and Key Technical Standards ----- system framework



三、我国公共安全基础标准化

- 《国家应急技术标准体系与关键技术标准研究》
——重要标准
- (1) 《公共安全应急基础术语和定义》
- (2) 《应急标准指南》
- (3) 《突发事件应急能力评估通则》
- (4) 《突发事件应急演练规范》

III. The standardization of public security infrastructure in China

- Research on National Emergency Technical Standard System and Key Technical Standards
——Major standards
- (1) Basic Terms and Definition of Public Security Emergency
- (2) Emergency Standard Guideline
- (3) General Rules for Emergency Capacity Assessment
- (4) Emergency Drill Specifications

三、我国公共安全基础标准化

- #### 3. 加强公共安全标准化重大项目研究
- 国家重点工程项目《应急平台体系关键技术与装备的研究》

中国标准化研究院参与完成的“应急平台体系关键技术与装备的研究”重点工程项目获国家科技进步一等奖

由清华大学主持，30多个单位以及1000多名研究人员参与完成的“应急平台体系关键技术与装备的研究”重点工程项目，对国家应急平台体系建设做出了贡献，我院的主要贡献是，负责建立了应急平台标准体系，与有关单位合作研制了8项应急平台标准。

III. The standardization of public security infrastructure in China

- #### iii. Strengthening researches on major public security standardization projects
- Major national project *Research on the Key technique and Equipment of Emergency Platform System*

China National Institute of Standardization participated in and completed the "Research on the Key technique and Equipment of Emergency Platform System", and won the first prize of National Science and Technology Progress Award.

Hosted by Tsinghua University, with the participation of over 30 institutions and 1,000 researchers, the major project of "Research on the Key technique and Equipment of Emergency Platform System" is a contribution to the national emergency platform system construction. Our major contribution is: being in charge of establishing of the emergency platform standard system and having formulated 8 emergency platform standards jointly with relevant institutions.

四、公共安全业务连续性管理体系标准

- 1 业务连续性管理概念
- 2 国外业务连续性管理发展
- 3 我国业务连续性管理体系标准进展

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IV. Business continuity management system standards of public security

- (1) The concept of business continuity management
- (2) Overseas business continuity management development
- (3) Domestic business continuity management progress

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四、公共安全业务连续性管理体系标准

什么是业务连续性管理？

业务连续性管理是一个完整的管理流程，用于识别组织潜在威胁，分析潜在威胁发生后可能对业务运行产生的影响，提供了一个用于建立基于有效响应能力的组织韧性，保护关键利益相关方的利益、声誉、品牌和创造价值活动的框架。

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IV. Business continuity management system standards of public security

What's business continuity management?

Business continuity management is a complete management process to identify potential organization threat, analyze the influence such potential threat might occur to business operation, and provide a framework based on effective response ability in protecting the major interested parties' interests, reputation, brand and value-creating activities.

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四、公共安全业务连续性管理体系标准

- 在全球化、买方市场、投资过度及生产力过剩的宏观经济环境下，根据预测：
 - 美国 40%的企业在第一年内倒闭
80%的企业在五年内倒闭
96%的企业在十年内倒闭
 - 日本 10年寿命的企业只占18.5%
20年寿命的企业只占8.5%
30年寿命的企业只占5%
 - 中国 45.2%的企业处于一般危机
40.4%的企业处于中度危机
14.4%的企业处于高度危机



四、公共安全业务连续性管理体系标准

- 接受调查的公司中有72%曾经经历过至少一次供应链的中断
- 83%曾经经历过全面的



2008年南方大雪 2008年5.12汶川大地震 2001年9/11恐怖袭击



2009年7.5新疆暴乱 2005年卡特里娜飓风

IV. Business continuity management system standards of public security

- Under the macro economic environment of globalization, buyer market prevailing, overcapitalization and overcapacity, according to the prediction:
 - U.S. 40% enterprises would bankrupt in the first year
80% enterprises would bankrupt within 5 years
96% enterprises would bankrupt within 10 years
 - Japan only 18.5% enterprises can survive for 10 years
only 8.5% enterprises can survive for 20 years
only 5% enterprises can survive for 30 years
 - China 45.2% enterprises are in ordinary crisis
40.4% enterprises are in moderate crisis
14.4% enterprises are in serious crisis



IV. Business continuity management system standards of public security



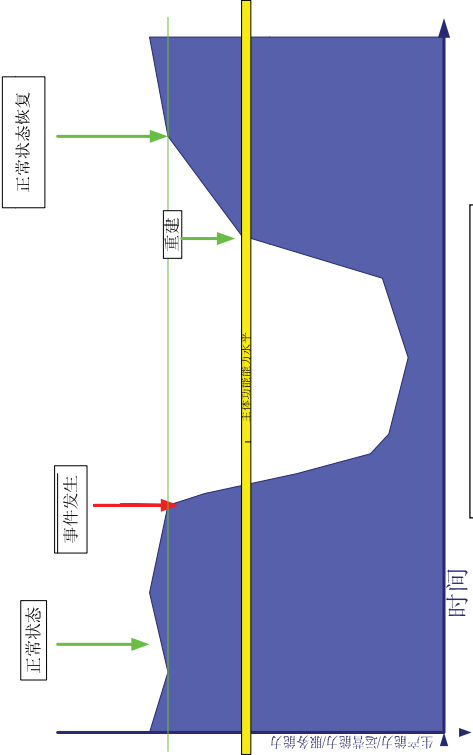
2008 Heavy snow in southern China 5.12 Wenchuan Earthquake in 2008 9/11 Terrorist attack in 2001



7.5 Xinjiang revolt in 2009 Katrina hurricane in 2005 2005 Wenchuan Earthquake

- 72% enterprises in the survey had suffered from supply chain disruption at least once.
- 83% enterprises in the survey had suffered from overall disruption.

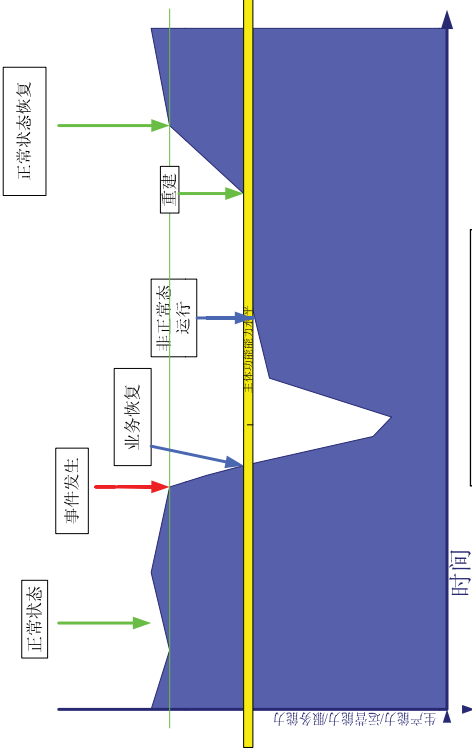
四、公共安全业务连续性管理体系标准



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不具备业务持续的应急管理

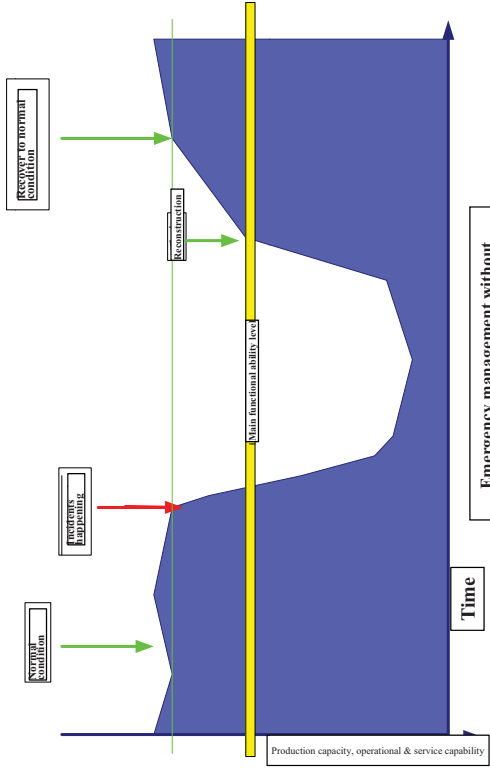
四、公共安全业务连续性管理体系标准



46

具备业务持续的应急管理

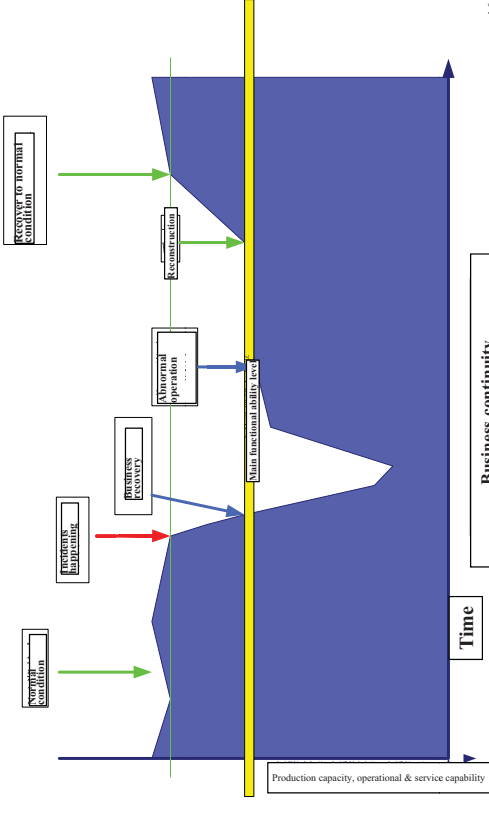
IV. Business continuity management system standards of public security



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Emergency management without business continuity

IV. Business continuity management system standards of public security

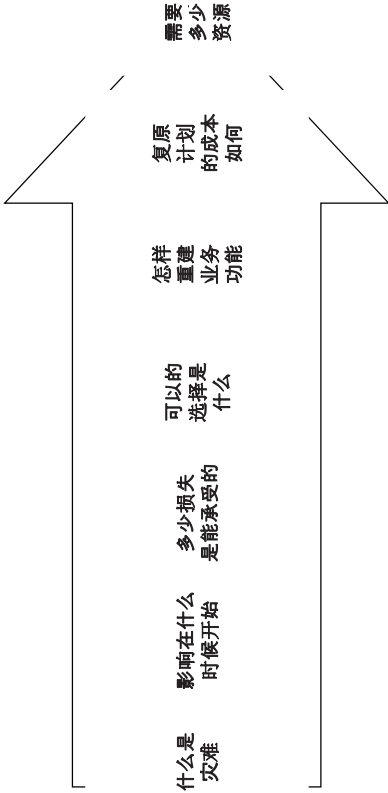


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Business continuity emergency management

四、公共安全业务连续性管理体系标准

公共安全业务连续性管理（BCM）能告诉我们



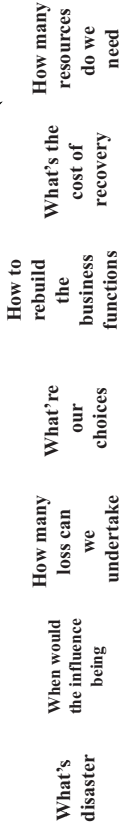
四、公共安全业务连续性管理体系标准

——2007年，我国颁布了《中华人民共和国突发事件应对法》，初步形成了以“一案三制”，即各级应急预案，体制、机制和法制为核心的应急管理体系

中国对突发事件管理体系在管理思想上与业务连续性管理的理念和方法有很多交汇之处。

IV. Business continuity management system standards of public security

Business continuity management (BCM) of public security can tell us:



IV. Business continuity management system standards of public security

——China published *Emergency Response Law of the PRC* in 2007 and formed the emergency management system with "One Plan and Three Methods" as the core: emergency plan, system, mechanism and law.

There're many similarities between emergency management system and business continuity management with regard to concept and ideas.

四、公共安全业务连续性管理体系标准

《公共安全 业务连续性管理体系 要求》国家标准制定过程

- 2007年，中国标准化研究院向国家标准化管理委员会提出制定《业务持续管理》国家标准计划并得到批准（编号：20070189-T-469）。
- 为保持与国际接轨、遵循国际统一规则，等同采用ISO 22301《公共安全 业务连续性管理体系 要求》。
- 广泛征求了来自应急办、民政部、认监委、清华大学等单位以及英国国际业务持续协会（BCI）和国际灾难协会（DRII）等组织相关专家的意见。
- 2013年3月1日召开《公共安全 业务连续性管理体系 要求》国家标准审查会，形成标准报批稿。
- 与会专家一致认为，该标准有利于提高我国公共安全管理水平，应尽快推动该标准成为认证标准。

IV. Business continuity management system standards of public security

Formulation process of the *Requirement of Public Security Business Continuity Management System*:

- In 2007, China National Institute of Standardization submitted the national standard formulation plan to National Standardization Management Committee with regard to *Business Continuity Management* and got the approval (No. 20070189-T-469).
- To be united with international approach, adopting by equation of the ISO 22301 *Requirement of Public Security Business Continuity Management System*.
- Extensively solicited experts opinions from Emergency Office, Ministry of Civil Affairs, CNCA, Tsinghua University, BCI and DRII, etc.
- Convened national standard review meeting for *Requirement of Public Security Business Continuity Management System* in March.1st, 2013.
- The experts think of this beneficial to improve our national public security management level, therefore should promptly promote this standard as a certified standard.

四、公共安全业务连续性管理体系标准

BCM下一步工作

- 2013年组建业务连续性管理标准化工作组
- 2013年研究业务连续性管理体系标准的体系架构

◆核心标准

公共安全业务连续性管理体系要求
公共安全业务连续性管理体系指南
公共安全业务连续性管理体系评价
.....

◆支持性标准

业务影响分析、演练等标准

Next step of BCM

- Established business continuity management standardization work team in 2013.
- Research the system framework of business continuity management system standards in 2013

◆Core standard

Requirement of public security business continuity management system
Guideline of public security business continuity management system
Assessment of public security business continuity management system
.....

◆Supportive standards

Business influence analysis standard, drill standard, etc.

四、公共安全业务连续性管理体系标准

- 3. 2013年5月启动《公共安全 业务连续性管理体系 指南》国家标准研制工作，争取年底前形成报批稿。
- 4. 2013年12月完成《公共安全 业务连续性管理体系 要求》国家标准宣贯教材编写工作。
- 5. 业务连续性管理体系标准技术交流会

时 间： 2014年1月
主 题： 国家标准发布
 国家及行业对业务连续性管理的需求
 良好实践及案例分析
主办单位： 中国标准化研究院

IV. Business continuity management system standards of public security

- 3. Started to study the Guideline of public security business continuity management system in May,2013, trying to finish the submitting report by the year end.
- 4. Finished the textbook compilation for Requirement of public security business continuity management system in December, 2013.
- 5. Technical exchanging meeting for business continuity management system standards.

Time: January, 2013
Theme: Releasing of national standard
 National and industrial demand to business
 continuity management
 Analysis on excellent practice and cases
Organizer: China National Institute of Standardization

谢谢！
敬请批评指正！

Thanks!
Open to be criticized!

静电保护和标准化会议

技术进步及其对标准的影响

Nathaniel Peachey博士
美国静电放电协会标准业务部经理

美国静电放电协会

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- RF Micro Device, Inc. 工程部经理

John Kinnear

- 负责管理ESDA 工厂认证项目
- IBM公司一名经理人

Terry Welscher博士

- 美国静电放电协会高级副总裁
- 行业顾问

Conference on Electrostatic Protection and Standardization

Technology Advances and Their Impact on Standards

Nathaniel Peachey, PhD
ESDA Standards Business Unit Manager

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John Kinnear

- Manage the ESDA Factory Certification Program
- Manager at IBM

Terry Welscher, PhD

- Senior Vice President of the ESD Association
- Industry Consultant

目标

- 提供关于设备静电放电要求和工厂控制之间相互依存性方面的内容。
- 展示关于静电放电标准的技术路线图和影响的概况。
- 为静电放电标准发展方面的国际合作提供依据。

幻灯片 3

Objectives

- Provide an understanding of the interdependence of device ESD requirements and factory control
- Present an overview of the technology roadmap and implications for ESD Standards.
- To provide a basis for international cooperation and coordination of ESD Standards development.

Slide 3

纲要

- I. 简介
- II. 技术路线图
- III. 设备测试进展
- IV. 对工厂的影响及工厂标准
- V. 探讨标准开发进程

幻灯片 4

Outline

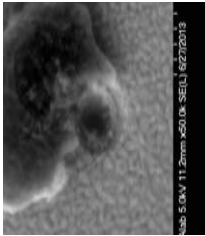
- I. Introduction
- II. Technology Roadmap
- III. Device Testing Developments
- IV. Implications for Factories and Factory Standards
- V. Discuss a Standards Development Process

Slide 4

简介

案例研究

客户返回的产品显示电容器的静电放电损伤

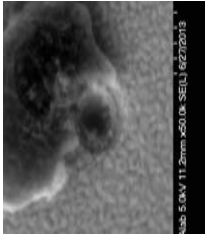


某些管芯具有相同的信号曲

Introduction

Case Study

Customer return showing ESD damage to capacitor

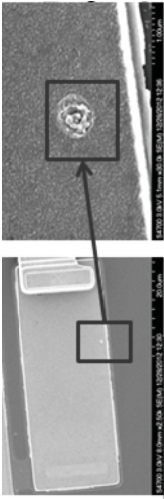


Several die had the same signature

简介

产品静电放电测试记录

测试类型	被测数量	测试电压	每个电压等级的部件具有规定信号曲的有故障部件数量
ESD CDM	12	200, 300, 500, 1000	3
ESD HBM 累计	12	250, 500, 750, 1000	3
			2 (在 1000V时出现故障)
			0

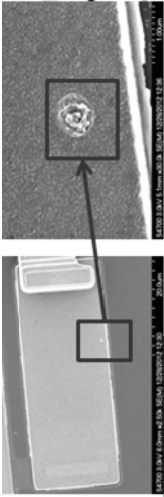


- ❖ 以1000V CDM测试再现工厂故障。
- ❖ 展示工厂性能与CDM设备级结果之间的联系。

Introduction

Product ESD Testing History

Test Type	Number Tested	Voltages Tested	Parts Per Level	Number Failed with Specified Signature
ESD CDM	12	200, 300, 500, 1000	3	2 (Failed at 1000V)
ESD HBM Cumulative	12	250, 500, 750, 1000	3	0



- ❖ Factory fail was reproduced by a 1000V CDM test.
- ❖ Demonstrates the connection between factory performance and CDM device level results.

简介

- 这些标准相互关联。设备标准将推动工厂内的进程。
- 技术路线图将影响设备级要求和工厂静电放电控制。
- 标准和认证须与设备级要求和功能保持同步。
- 探讨标准开发进程的方法和程序。

幻灯片 7

Introduction

- Standards are inter-related. Device standards will drive what happens in factories.
- The Technology Roadmap will impact the device level requirements and the factory ESD controls.
- Standards and Certifications will need to keep pace with the device level requirements and capabilities.
- Discussion of the methodology and procedure of a standards development process.

Slide 7

技术路线图

“考虑到如此大的管芯尺寸，CDM 250V是我们的瓶颈...(该行业须考虑)100V CDM，因为在如今，在大型模块上时，250V CDM确实令人头痛，它会向上或略高于CDM的1A/100V。”

- Robert Gauthier, IBM公司 ESD技术开发 经理

“我对2015年标准的投入为：

- 200V HBM和100V CDM为控制目标
- 200V HBM和125V CDM为最低设计目标

在我看来，为控制专家提供更保守的数字作为预测，这样更好。随着3D集成电路即将问世，我们必须准确地制定我们的目标。”

- Charvaka Duvvury, 德州仪器雇员，已退休

幻灯片 8

Technology Roadmap

“CDM 250V is the bottleneck for us given such large die sizes...(The industry needs to consider) 100V CDM because today 250V CDM is the headache when on large modules you get upwards or slightly more than 1A/100V for CDM.”

- Robert Gauthier, ESD Tech. Dev. Manager, IBM

“...my inputs for 2015 levels are:

- 200V HBM and 100V CDM as control targets
- 200V HBM and 125V CDM as minimum design targets

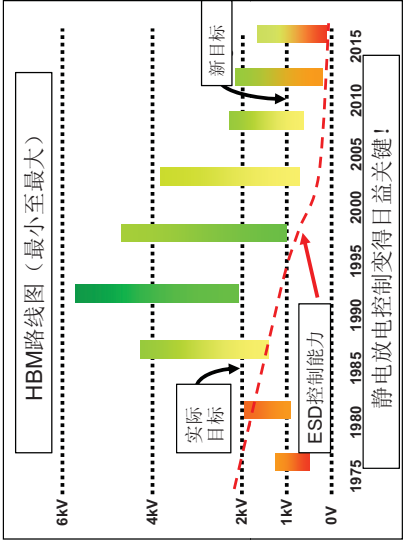
In my opinion it is better to offer the control experts the more conservative numbers as projections. With the 3-D ICs coming soon, we have to be aiming correctly.”

- Charvaka Duvvury, Fellow, Texas Instruments, retired

Slide 8

技术路线图

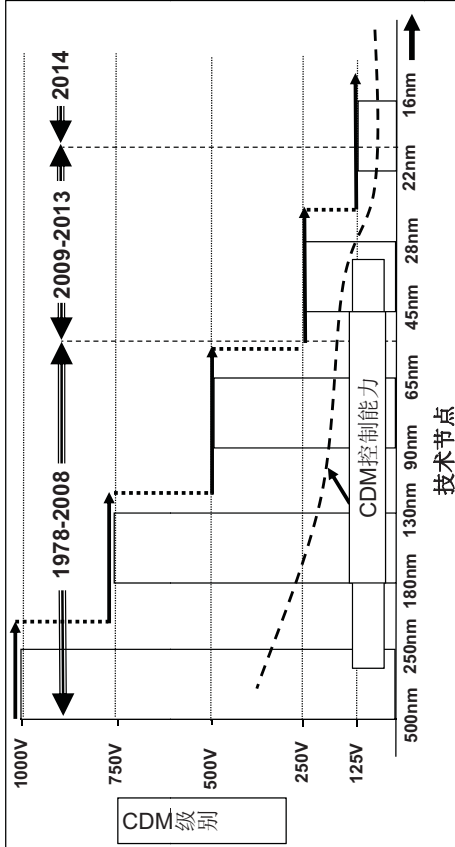
人体模型 (HBM)



人体模型保持了本行业内广为接受的静电放电稳健型度量标准。

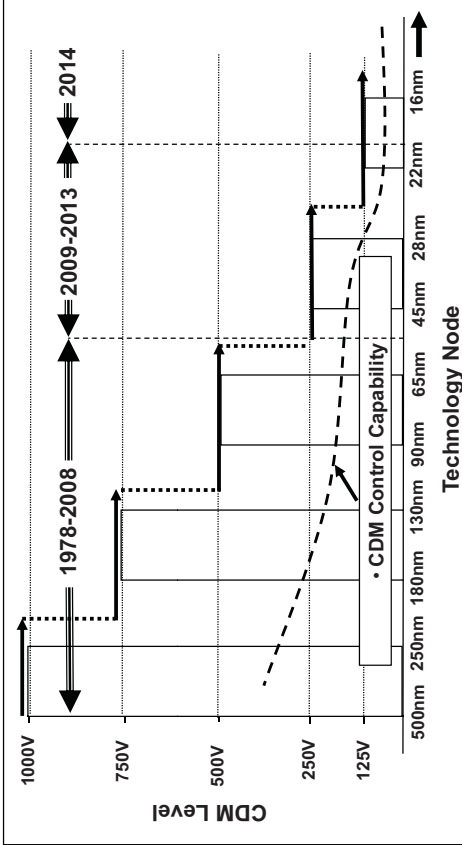
技术路线图

带电设备模型 (CDM)



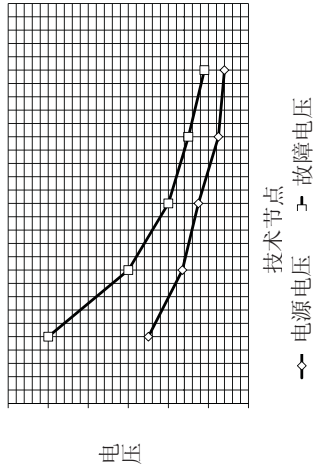
技术路线图

Charged Device Model (CDM)



技术路线图

- ❖ 由于电源电压和击穿电压均降低以及减少其分布，HBM值随着工艺变小而降低。

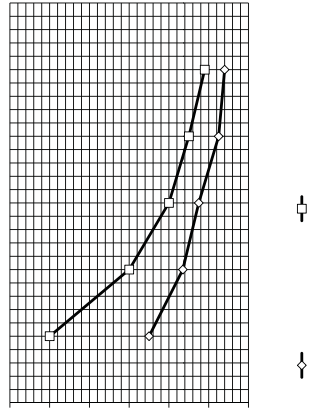


- ❖ 由于栅氧化层故障电压降低以及管芯不断变大，CDM值不断下降。

幻灯片11

Technology Roadmap

- ❖ HBM values are lowering with smaller technology since supply voltage and breakdown voltages are both lowering and reducing their spread



- ❖ CDM values are dropping since gate oxide failure voltages are lowering and dies are becoming larger

Slide 11

设备测试进展

HBM (ANSI/ESDA/JEDEC JS-001)

- 首个ESDA-JEDEC共同文件于2010年发表。
- 将“快速立法”写入IEC（国际电工委员会）标准。
- 2011版中具有一些非常重要的变化
 - A. 可进行2-引脚测试。该测试避免了测试仪固有的异常现象。
 - B. 对分类级别做出了一些修订。
 - C. 在删除了I/O引脚的跨域测试之处增加了修订的测试表。

幻灯片12

Device Testing Developments

HBM (ANSI/ESDA/JEDEC JS-001)

- First joint ESDA-JEDEC document was published in 2010.
- Document “fast-tracked” into the IEC.
- Some very significant changes were made to the 2011 version
 - A. Allowed 2-pin testing. This testing avoided the tester parasitic anomalies.
 - B. Made some modifications to classification levels.
 - C. A revised test table was added where cross-domain testing of I/O pins was eliminated.

Slide 12

设备测试进展

HBM (ANSI/ESDA/JEDEC JS-001)

- 2012版中具有一些附加的变化：
 - A. 规定某项测试为用于验证低电容测试仪及提供更多关于引脚组合的信息。
 - B. 提供更多关于引脚组合的信息。
 - C. 允许减少通过RDL层连接至单个引脚的引脚测试。
- 下个版本将允许用于大型引脚计数设备的取样方法。

幻灯片 13

Device Testing Developments

HBM (ANSI/ESDA/JEDEC JS-001)

- 2012 version made additional changes:
 - A. A test was defined for verifying low capacitance testers as well as providing more information about pin combinations.
 - B. Provided more information about pin combinations.
 - C. Allowed the reduction of testing of pins connected by an RDL layer to a single pin.
- Next version will allow sampling methods for large pin count devices.

Slide 13

设备开发进展

CDM

- 大部分业内公司使用JEDEC JESD14-C101 标准。
- 联合ESDA/JEDEC工作小组已运作数年，并将发表统一的文件。
- 该进程接近尾声，并且该共同文件将于2014年初夏发表。
- 该文件届时将迅速地进入IEC系统并创造出其相应的文件。

幻灯片 14

Device Testing Developments

CDM

- Most of the industry uses the JEDEC JESD14-C101 Standard.
- The joint ESDA/JEDEC working group has been working for several years to come out with a harmonized document.
- This process is nearing an end and the joint document will be published by early-summer 2014.
- This document will then be fast-tracked into the IEC to create its corresponding document.

Slide 14

设备测试进展

机器模型 (MM)

- 该模型旨在测试防带电金属表面放电的保护。
- 据发现，其故障类型很大程度上类似于HBM故障。
- 据发现，CDM模拟工厂所需的静电放电保护，效果更好。
- 所有标准机构均将MM的等级降低。
- 全球范围内无标准机构推荐继续将MM用于合格性测试。

幻灯片 15

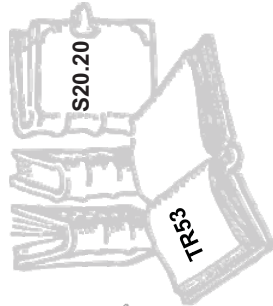
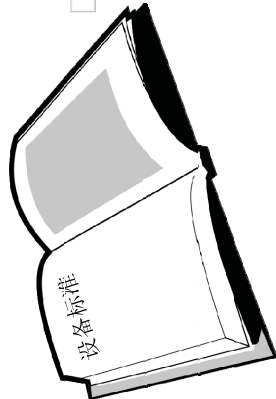
Device Testing Developments

Machine Model (MM)

- This model was intended to test for protection against discharges from charged metal surfaces.
- It was found that the failure modes largely mimicked HBM failures.
- CDM was found to model electrostatic discharge protection needed in the factory much better.
- MM has been downgraded by all standards bodies.
- There is no standards body world-wide that recommends the continued use of MM testing for qualification.

Slide 15

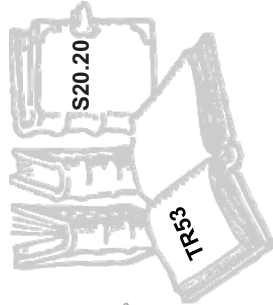
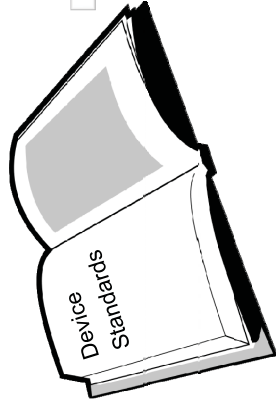
设备标准和工厂



- 工厂标准以 设备功能为基础。
- 设备功能 通过设备标准进行测量。
- 因此，设备标准带动工厂标准的发展。

幻灯片 16

Device Standards and Factories



- Factory Standards are built on Device Capabilities.
- Device Capabilities are measured by Device Standards.
- Thus Device Standards drive Factory Standards.

Slide 16

设备标准和工厂

设备灵敏度变化的影响

技术报告 (TR-17)

“本技术报告描述了可用于表示处理ESD灵敏度项目的进程的一组方法、技巧和工具。”

“过程评估的目的为通过设备测试模型（人体模型（HBM），机器模型（MM）以及带电设备模型（CDM），描述某过程安全地处理ESD灵敏设备的能力。

幻灯片 17

Device Standards and Factories

Implications of Device Sensitivity Changes

Technical Report (TR-17)

“This technical report describes a set of methodologies, techniques, and tools that can be used to characterize a process where ESD sensitive items are handled.”

“The goal of Process Assessment is to characterize the ability of a process to safely handle ESD sensitive devices that have been characterized by device testing models (Human-Body Model (HBM), Machine Model (MM), and Charged-Device Model (CDM)).”

Slide 17

设备标准和工厂

ANSI/ESDA S20.20 工厂控制

“本文件适用于制造、加工、装配、安装、包装、贴标、维修、测试、检验、运输或操作易受到大于或等于100伏特HBM，200伏特CDM静电放电损伤影响的电气或电子部件、装配件和设备”。

- 节选自拟订更新版ANSI/ESDA S20.20

幻灯片 18

Device Standards and Factories

ANSI/ESDA S20.20 Factory Control

“This document applies to activities that manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 volts HBM, 200 volts CDM...”

- Excerpt from proposed updated version of ANSI/ESDA S20.20

Slide 18

设备标准和工厂

- ❖ 设备功能和工厂标准之间的联系侧重于：
 1. ESD控制项目符合各项标准的发展。
 2. 对ESD控制项目进行有效的审查。
 3. 为了合规，而必须进行某些类型的认证项目。
- ❖ 已知的故障分析可作为工厂内问题的早期检测。

幻灯片 19

Device Standards and Factories

- ❖ Connection between device capabilities and factory standards places an emphasis on:
 1. Development of standards-compliant ESD control programs.
 2. Effective audits of the ESD control program.
 3. Necessity for some type of certification program to verify compliance.
- ❖ Informed failure analysis can also serve as early detection of problems in the factory.

Slide 19

设备标准和工厂

工厂问题案例研究

- ✓ 在从装配线返回的管芯上发现较高的缺陷数量。
- ✓ 部件用于射频应用。
- ✓ 数个引脚尤其对ESD敏感。
- ✓ 最低仅1个引脚通过了250V CDM和300V HBM。

幻灯片 20

Device Standards and Factories

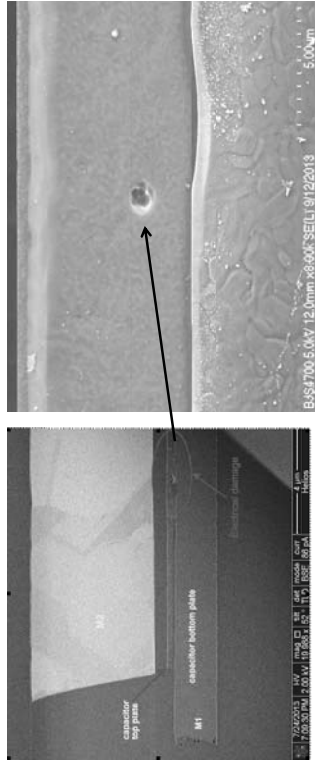
Factory Issue Case Study

- ✓ *High defect count found on die returning from assembly.*
- ✓ Part was for RF applications.
- ✓ Several pins were especially ESD sensitive.
- ✓ At least 1 pin passed only 250V CDM and 300V HBM.

Slide 20

设备标准和工厂

工厂问题案例研究



横截面图

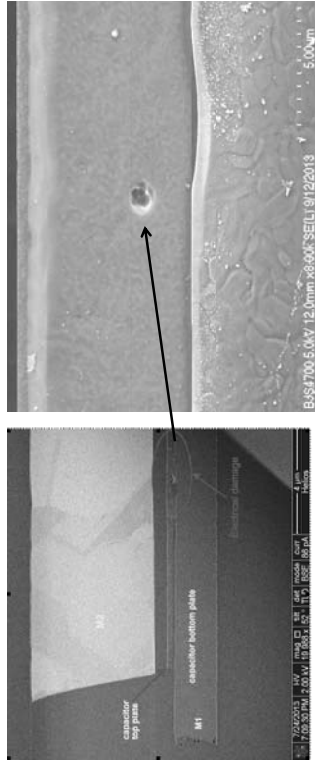
平面图

某电容器故障问题证明

幻灯片 21

Device Standards and Factories

Factory Issue Case Study



Cross Section View

Plane View

Issue manifests as a capacitor failure

Slide 21

设备标准和工厂

工厂问题案例研究

- 诸多故障分析结果显示非常类似的缺陷。
- 根据电容器故障，焦点转移至寻找某些类型的类似 CDM 的事件。
- 开始调查工厂内使用的处理器。

幻灯片 22

Device Standards and Factories

Factory Issue Case Study

- Numerous FA results showed very similar defects.
- Based on the capacitor failures the focus was shifted to looking for some type of CDM-like event.
- Began to investigate the handlers used in the factory.

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设备标准和工厂

工厂问题案例研究

批次	站	处理器	测试次数	测试数量	存在故障的数量	直接零件标记	备注
A341	NN7B19	BP115	第1次测试	1039	2	1925	每次在材料进行重复测试时，均出现故障
			第2次测试	993	8	8056	
			第3次测试	937	4	4269	
			第4次测试	878	16	18223	
A341	SR8A21	BN122	第1次测试	998	0	0	无故障
			第2次测试	989	0	0	
			第3次测试	983	0	0	
			第4次测试	982	0	0	
N254	SR8A21	BN122	第1次测试	1000	0	0	较旧材料的重新测试
			第2次测试	386	0	0	
			第3次测试	368	0	0	

幻灯片 23

Device Standards and Factories

Factory Issue Case Study

Lot No.	Station	Handler	Test Times	Test QTY	Failed QTY	DPM	Comment
A341	NN7B19	BP115	1 st test	1039	2	1925	Failures occurred each time the material was retested
			2 nd test	993	8	8056	
			3 rd test	937	4	4269	
			4 th test	878	16	18223	
A341	SR8A21	BN122	1 st test	998	0	0	No failures
			2 nd test	989	0	0	
			3 rd test	983	0	0	
			4 th test	982	0	0	
N254	SR8A21	BN122	1 st test	1000	0	0	Retest of older material
			2 nd test	386	0	0	
			3 rd test	368	0	0	

Slide 23

设备标准和工厂

工厂问题案例研究

项目	BH135	BN122	BP115	备注
电离剂的平衡电压	测试结果 -35v 至 +35v	测试结果 -35v to +35v	测试结果 -35v to +35v	备注 通过
端子接地	通过	通过	通过	通过
扬声器支架接地	<100 ohm	<100 ohm	<100 ohm	通过
打墨接地	<200 ohm	<200 ohm	<200 ohm	通过
黑色托盘的接地电压	0.1 ohm	0.1 ohm	0.1 ohm	通过
黑色托盘的表面电阻	5 v	5 v	5 v	通过
拾音头的电阻	10*7 ohm	10*7 ohm	10*7 ohm	通过
拾音头的电阻	10*9 ohm	10*9 ohm	10*9 ohm	通过
测试头的电阻 (工作压力)	10*12 ohm	10*12 ohm	10*12 ohm	通过
测试头的接地电压 (工作压力)	70 v	70 v	70 v	通过
检测设备区域的衰变时间 (1000v 至 50v)	2.9 s	2.5 s	4.5 - 5.8 s	临界故障 (额定值为 5 秒)

幻灯片 24

Device Standards and Factories

Factory Issue Case Study

Item	BH135	BN122	BP115	Comment
Balance voltage of ionizer	Test Result -35v to +35v	Test Result -35v to +35v	Test Result -35v to +35v	Comment Pass
Grounding of shuttle	Test Result <100 ohm	Test Result <100 ohm	Test Result <100 ohm	Comment Pass
Grounding of pickup arm	Test Result <200 ohm	Test Result <200 ohm	Test Result <200 ohm	Comment Pass
Grounding of machine	Test Result 0.1 ohm	Test Result 0.1 ohm	Test Result 0.1 ohm	Comment Pass
Tribovoltage of black tray	Test Result 5 v	Test Result 5 v	Test Result 5 v	Comment Pass
Surface resistance of black tray	Test Result 10*7 ohm	Test Result 10*7 ohm	Test Result 10*7 ohm	Comment Pass
Resistance of pickup head	Test Result 10*9 ohm	Test Result 10*9 ohm	Test Result 10*9 ohm	Comment Pass
Resistance of test head (workpress)	Test Result 10*12 ohm	Test Result 10*12 ohm	Test Result 10*12 ohm	Comment Pass
Tribovoltage of test head (workpress)	Test Result 70 v	Test Result 70 v	Test Result 70 v	Comment Pass
Decay Time in DUT area (1000v to 50v)	Test Result 2.9 s	Test Result 2.5 s	Test Result 4.5 - 5.8 s	Comment Marginal Fail (SPEC limit is 5s)

Slide 24

设备标准和工厂

案例研究 – 结论和措施

- ❑ 即使处理器BP115处于规定范围内，该机器仍为测试后损伤的原因。
- ❑ 增加BP115上电离剂内的气流可将衰变时间降低至3秒。
- ❑ 更改ESD控制项目要求，以使电离剂的衰变时间为3秒或更短的时间。

此实例显示该如何调整静电放电控制项目，以适应今后更为敏感的设备。

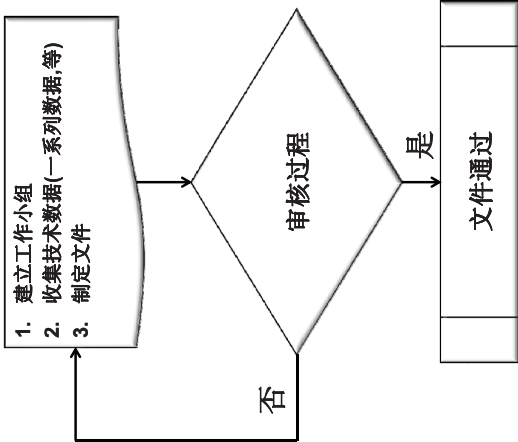
Device Standards and Factories

Case Study – Conclusions and Actions

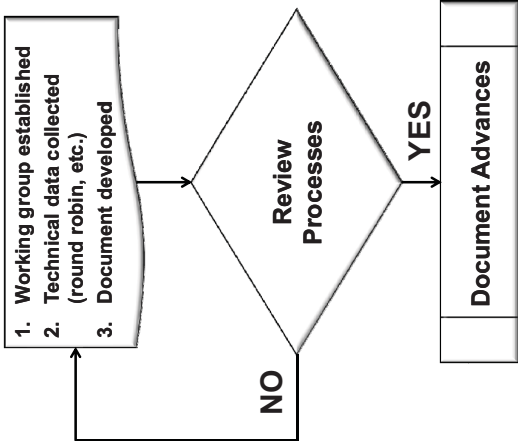
- ❑ Even though handler BP115 was marginally in spec, this machine was the cause of the post-test damage.
- ❑ Increasing the airflow in the ionizers on BP115 could reduce the decay time to 3 seconds.
- ❑ The ESD control program requirements were changed to require the decay time for ionizers to be 3 seconds or less.

This is an example of how ESD control programs may need to be adjusted to accommodate more sensitive devices in the future.

标准开发



Standards Development



标准开发

标准开发工作小组

- 通常，至少由5或6人组成，如人数更多则更好。
- 来自不同团体和公司的代表。
- 工作小组不得被某种单一的利益所支配。
- 工作小组内的成员资格不限于美国静电放电协会的成员资格。

幻灯片 27

Standards Development

Standards Development Working Groups

- Typically a minimum for 5 or 6 people, preferably more.
- Representation from varied groups and organizations.
- Working groups cannot be dominated by a single interest.
- Membership in a working group is not limited to membership in ESDA.

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标准开发

审核过程

1. 技术援助和支持（TAS）委员会。该委员会由在进行下一阶段之前，审核所有文件的一群行业专家（10至12人）组成。
2. 标准委员会(STDCOM)。该委员会由用户、供应商和顾问/利益相关方所组成，成员数量为30至50人。在进行至下一阶段之前，所有标准文件必须由STDCOM进行审核与批准。
3. 行业审核。在发布标准文件之前，标准文件必须由行业代表审核。任何人可要求审核文件并提供意见。在发表文件以前，必须考虑及裁定所有意见。

幻灯片 28

Standards Development

Review Processes

1. Technical Assistance and Support (TAS) Committee. This committee is a group of industry experts (10 to 12) who review all documents prior to advancing to the next level.
2. Standards Committee (STDCOM). This committee is a balance of users, suppliers and consultants/interested parties and consists of 30 to 50 people. All standards documents must be reviewed and approved by STDCOM prior to advancing.
3. Industry Review. Prior to being released for publication, standards documents must be reviewed by representatives from the industry. Anyone can request to review a document and provide comments. All comments must be considered and adjudicated prior to release of the document.

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标准开发

关键参数

1. 一致的意见。标准开发过程不得由某一人或某种利益所支配。
2. 透明。该过程必须做到对所有人透明，且必须记录并遵守所有步骤和程序。
3. 数据驱动。标准要求必须由行业认可的数据收集和分析过程所支持。
4. 富有意义的反对和申诉机制。必须考虑正当、合理的不同意见。
5. 及时的审核周期。所有标准须有定期的审核周期。这样可以确保该标准保持有效效力。

幻灯片 29

Standards Development

Critical Parameters

1. **Consensus body.** The standards development process cannot be dominated by a particular person or interest.
2. **Transparent.** The process must be transparent to everyone and all steps and procedures must be documented and followed.
3. **Data Driven.** Standards requirements must be supported by industry accepted data collection and analysis processes.
4. **Mechanisms for meaningful objection and appeal.** Legitimate dissent must be considered.
5. **Timely Review Periods.** All standards should have regularly scheduled review periods. This helps insure that the standard remains current and up to date.

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总结

- ❖ 精心开发的标准为该行业提供了相当大的贡献。
 - ✓ 为适当操作和制造提供方向
 - ✓ 提供过程控制指导和方向
 - ✓ 提供关于减轻静电放电操作的标准化
- ❖ 了解各种标准文件如何关联将有助于设计静电放电控制项目。
- ❖ 可靠的标准开发过程可确保所形成的文件对该行业至关重要。

幻灯片 30

Summary

- ❖ Well-developed standards provide a considerable service to the industry.
 - ✓ Provides direction for proper handling and manufacturing
 - ✓ Provides process control guidance and direction
 - ✓ Provides standardization of ESD mitigation practices
- ❖ Understanding how the various standards documents relate to each other is helpful in design of ESD control programs.
- ❖ A solid standards development process can help insure that the resulting documents will remain vital to the industry.

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粉体静电学
国内外研究动态与进展

(仅供演讲报告使用，不供文字发表)

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Powder Electrostatics
International & Domestic Research Review
and Developing Tendency
(For presentation only rather than publication)

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Deputy Director of Professional Committee of Electrostatics, Chinese
Director of Professional Committee of Electrostatics, Shanghai Society
of Physics

粉体静电学
国内外研究动态与进展

1. 粉体放电形态的新发现
2. ESD 点燃性的新认识
3. 安全评价的新思维
4. 放电时电荷转移量等能量新的实验规律
5. 粉体ESD安全评价:典型参考值
6. 我国粉体静电学的新进展

Powder Electrostatics
International & Domestic Research Review and Developing
Tendency

- 1. New Discoveries In Powder Discharge Pattern
- 2. New Knowledge On ESD Ignitability
- 3. New Thinking About Safety Assessment
- 4. New Experimental Laws of Charge Transfers Equivalent Energy During Discharge
- 5. Powder ESD Safety Assessment: Typical Reference Value
- 6. New Developing Tendency of Powder Electrostatics In China

防静电工作服的分类及性能要求

上海晨隆静电科技有限公司

黄建华

2013/10/8

www.esd-world.com



防静电工作服的分类及性能要求

目 录

- 1、概述
- 2、防静电服装的基本要求
- 3、防静电工作释放静电的机理
- 4、防静电工作服的分类
- 5、易燃易爆环境中防静电服装的要求
- 6、电子工业应用的防静电服装的要求
- 7、洁净环境中防静电服装的技术要求

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Classification and performance requirements of anti-static working clothes

Shanghai Chenlong Electrostatic Technology Co., Ltd.

Huang Jianhua

2013/10/8

www.esd-world.com



Classification and performance requirements of anti-static working clothes

Content

- 1. Overview
- 2. Basic requirements of anti-static clothes
- 3. The mechanism of electrostatic discharge of anti-static working clothes
- 4. Classification of anti-static working clothes
- 5. Requirements of anti-static clothes in flammable and explosive environments
- 6. Requirements of anti-static clothes in electronic industry
- 7. Technical requirements of anti-static clothes in clear environments

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防静电工作服的分类及性能要求

1、概述：

- 半个多世纪以来，防静电工作服无论是材料、款式、性能要求等各方面都在不断发展；
- 材料的不均匀性使防静电工作服的绩效评价成为难题；
- 无论是在标准制定还是实际应用中都存在大量问题。

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防静电工作服的分类及性能要求

2、防静电服装的基本要求：

- 具有适当的静电释放通路
- 具有不易产生静电的特性
- 具有良好的耐久性
- 在低湿度条件下仍能保持良好的防静电性能

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Classification and performance requirements of anti-static working clothes

1. Overview

- Anti-static working clothes are developing from half century in material, style, performance requirements and other aspects;
- Material inhomogeneity makes performance evaluation of anti-static working clothes become a problem;
- A great number of problems exist in standard setting or actual application of anti-static working clothes

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Classification and performance requirements of anti-static working clothes

2. Basic requirements of anti-static clothes

- With proper electrostatic discharge path
- With characteristics of not easy to produce static electricity
- With good durability
- Can keep good anti-static performance under low humidity condition

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防静电工作服的分类及性能要求

2、防静电服装的基本要求：

2.1、具有适当的静电释放通路

服装释放静电的途径主要有：吸收空气中的水分以中和静电；接地释放静电；通过电晕放电释放静电。应根据环境及实际要求，合理地设计及选择静电释放的方式。如果是用接地方式释放静电的，就必须选择表面导电型的导电纤维，并且在服装缝制时使用导电缝纫线，以保证服装整体静电导通。

防静电工作服的分类及性能要求

2、防静电服装的基本要求：

2.2、具有不易产生静电的特性

服装的静电主要是摩擦产生的，通常天然纤维，如棉的吸水性比较好，摩擦不容易产生静电。如果工作环境没有洁净要求，则尽可能选择全棉或含棉的面料制作服装。评价织物摩擦起电特征的标准可参考GB/T 12703.5-2010以及EN 1149-3:2004方法1。

Classification and performance requirements of anti-static working clothes

2. Basic requirements of anti-static clothes

2.1 With proper electrostatic discharge path

Main ways for clothing electrostatic discharge: absorb moisture from air to neutralize static electricity; grounded electrostatic discharge; discharge static electricity by corona discharging. It should rationally design and select electrostatic discharge mode based on environment and actual requirements. If it release static electricity by grounding method, you must select surface conductive type of conductive fibers and use conductive sewing thread in sewing cloths in order to ensure overall electrostatic conduction on cloths.

Classification and performance requirements of anti-static working clothes

2. Basic requirements of anti-static clothes

2.2 With characteristics of not easy to produce static electricity

Clothing electrostatic is mainly generated by friction. In general, for natural fibers with good water absorbent, such as cotton, friction is not easy to produce static electricity. If work environment has no clean requirements, it should choose cotton or cotton-containing fabrics to make clothing as far as possible. For evaluation of triboelectrification characteristics of fabrics, refer to standard GB/T 12703.5-2010 and Method 1 of EN 1149-3:2004.

防静电工作服的分类及性能要求

2、防静电服装的基本要求：

2.3、具有良好的耐久性

通常，采用嵌织导电纤维的织物制作的服装，其静电性能的耐久性都是比较好的，但也有一些例外，如渗破型导电纤维，其导电表面会因为洗涤、摩擦而剥落。也有一些涤纶复合或涤纶复合型导电纤维，也可能在减量、染色时结构被破坏，造成导电表面部分分离并随着洗涤、摩擦而脱落。这种情况一般用高倍显微镜可识别。

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防静电工作服的分类及性能要求

2、防静电服装的基本要求：

2.4、在低湿度条件下仍能保持良好的防静电性能

现行国外主要的防静电标准都规定了必须在相对湿度12%±3%的条件下测试防静电产品的静电性能，包括服装。如IEC 61340-4-9、ESD STM 2.1。当然，如果使用环境常年在高湿状态的，仍可以考虑采用吸湿性助剂处理的方式使服装具有防静电功能。

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Classification and performance requirements of anti-static working clothes

2. Basic requirements of anti-static clothes

2.3 With good durability

Generally, for clothing made of embedded conductive fibers in woven fabric, the durability of its electrostatic properties are relatively good, but there are some exceptions, such as carburizing conductive fiber, its conductive surface will be peeling due to washing and rubbing. For some polyester propylene composition or polyester and nylon composition type of conductive fibers, their structure may be damaged in reduction or dyeing to cause conductive surface portion to separate and fall off with washing and friction. This case can be identified generally with a powerful microscope.

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Classification and performance requirements of anti-static working clothes

2. Basic requirements of anti-static clothes

2.4 Can keep good anti-static performance under low humidity condition

Current existing major foreign anti-static standards request that static properties of anti-static products must be tested under conditions of relative humidity of 12% ± 3%, including clothing. Such as IEC 61340-4-9, ESD STM 2.1. Of course, if use environment is in high humidity state all year round, you can still consider to use ways of hygroscopic additives treatment to make clothing with anti-static function.

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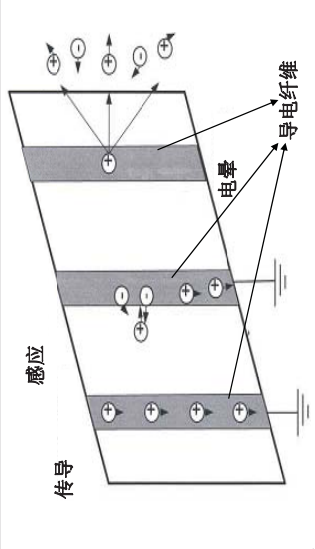
防静电工作服的分类及性能要求

3、防静电工作服释放静电的机理：

消除服装上的静电，除了用助剂吸收水分中和静电以外，其余就是依靠在织物中嵌织的导电纤维发挥作用了。根据 ESTAT-Garments项目的报告，导电纤维消散织物上静电的机制有三种：传导放电、感应放电和电晕放电。

防静电工作服的分类及性能要求

防静电服的三种静电消散机制：



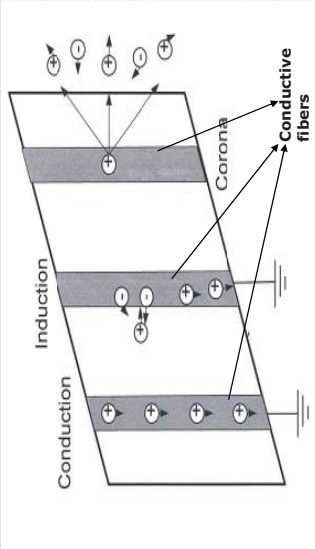
Classification and performance requirements of anti-static working clothes

3. The mechanism of electrostatic discharge of anti-static working clothes

In order to eliminate static electricity on clothing, except absorbing moisture and electrostatic by additives, rest is to rely on embedded conductive fibers in woven fabric. According to report of ESTAT-Garments project, there are three mechanisms for conductive fiber fabric to dissipate static electricity: conduction discharge, inductive discharge and corona discharge.

Classification and performance requirements of anti-static working clothes

Three mechanisms for anti-static cloths to dissipate static electricity:



防静电工作服的分类及性能要求

3、防静电工作服释放静电的机理：

3.1传导放电

若将织物接地，则位于导电纤维表面或其附近的静电荷将会导入到地下。导电机制依靠于：导电纤维的电阻；基础纤维的电阻以及服装整体的静电导通性。

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Classification and performance requirements of anti-static working clothes

3. Mechanisms for anti-static cloths to discharge static electricity

3.1 Conduction discharge

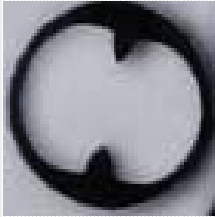
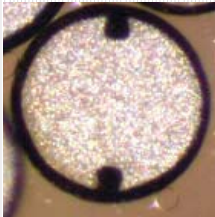
If ground fabric, static charge on surface or near of conductive fiber will be conducted into ground. Conduction mechanisms relies on: resistance of conductive fibers, resistance of basic fibers and overall electrostatic continuity of clothing.

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防静电工作服的分类及性能要求

典型的传导放电型导电纤维：



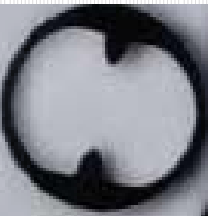
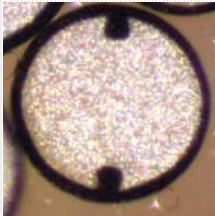
表面导电型

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Classification and performance requirements of anti-static working clothes

Typical conduction discharge type of conductive fiber



Surface conduction type

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防静电工作服的分类及性能要求

3、防静电工作服释放静电的机理：

3.2 感应放电

基础纤维（一般为绝缘的涤纶纤维）上面的静电荷在接地的导电纤维表面感应出相反极性的电荷，并导致总电荷的部分中和。这种机制可以理解成因为导电纤维接地而增加了服装的电容，降低了服装静电压。

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Classification and performance requirements of anti-static working clothes

3. The mechanism of electrostatic discharge of anti-static working clothes

3.2 Inductive discharge

Electrostatic on basic fiber (usually insulation polyester fiber) induced opposite polarity charge at surface of grounded conductive fibers and resulted to total charge be neutralized partially. This mechanism can be understood as increase clothing capacitors due to conductive fiber ground and reduces static voltage of clothing.

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防静电工作服的分类及性能要求

3、防静电工作服释放静电的机理：

3.3 电晕放电

当导电纤维表面的静电达到一定强度时可引发电晕放电，所形成的空气离子可部分中和基础纤维表面的静电。电晕放电的机制与导电纤维的结构有关。

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Classification and performance requirements of anti-static working clothes

3. The mechanism of electrostatic discharge of anti-static working clothes

3.3 Corona discharge

When electrostatic on surface of conductive fiber reaches to a certain intensity, it can cause corona discharge, The formed air ions can partially neutralize electrostatic on fiber surface. Mechanism of corona discharge is related to conductive fiber structure.

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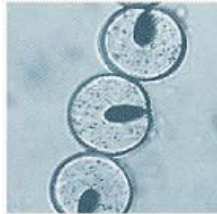
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防静电工作服的分类及性能要求

典型的电晕放电型导电纤维：



多点外露型



偏心海岛型

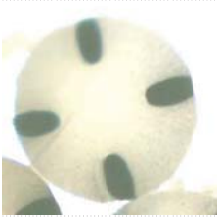


导电短纤维

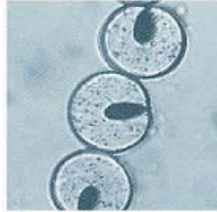
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Classification and performance requirements of anti-static working clothes

Typical corona discharge type of conductive fibers:



Multi-point exposed type



Eccentric island type



Conductive short fibers

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防静电工作服的分类及性能要求

4、防静电工作服的分类：

防静电工作服根据其使用环境及技术特征可分为如下三类

类别	技术特征		主要放电机制	作用	典型应用行业
	静电要求	洁净要求			
A类 易燃易爆行业	是	否	电晕	防止静电放电引发安全事故	石油、化工、火工品
B类 微电子工业	是	否	接地 感应	防止静电放电对ESDS的损害以及EMI干扰	SMT
C类 洁净室及相关受控环境	是	是	电晕 接地 感应	防止静电吸附灰尘影响产品质量以及静电放电可能对产品（如半导体）的损害	医药、食品、半导体

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Classification and performance requirements of anti-static working clothes

4.Classification of anti-static working clothes

Anti-static work clothes can be divided into following three categories according to its technical features and use environment

Categories	Technical features		Main discharge mechanism	Action	Typical application Industry
	Static requirements	Cleanliness requirements			
Sort A and Flammable explosive industry	Yes	No	Corona	To prevent safety accidents caused by electrostatic discharge	Petroleum, chemicals, explosives
Sort B Microelectronic industry	Yes	No	Ground induction	Prevent electrostatic discharge damage to ESDS and interference for EMI	SMT
Sort C Clean and associated controlled environments	Yes	Yes	Corona ground induction	Prevent electrostatic attracted dust affecting product quality and electrostatic discharge damage to product (such as semiconductors)	Medicine, food, semiconductor

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防静电工作服的分类及性能要求

4、防静电工作服的分类：

4.1 A类

A类防静电工作服是最早被应用的，也是目前使用数量最多的一种防静电工作服。其特征在于织物使用电晕放电型导电纤维嵌织或混纺加工而成。由于使用环境没有洁净要求，因此可选择吸水性良好的全棉或涤棉防静电织物。

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防静电工作服的分类及性能要求

4、防静电工作服的分类：

4.2 B类

B类防静电工作服是目前技术要求最高的一种防静电服，随着微电子工业的精细化发展，对B类服装防静电性能的要求也会越来越高。其特征在于通过防静电服装系统有效控制服装表面的静电电压。B类服装一般选用网格状嵌织表面导电型导电纤维的织物，并且在服装缝制时使用导电缝纫线以保证整件服装的电气连续性。同时使用导电或防静电袖口罗纹增强服装与人体皮肤的贴合度，以利于服装上的静电通过人体的接地腕带安全释放。同样由于使用环境没有洁净要求，因此可选择吸水性良好的全棉或涤棉防静电织物。

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Classification and performance requirements of anti-static working clothes

4.Classification of anti-static working clothes

4.1 Sort A

Sort A is anti-static work clothes that first are applied and is also the largest number of anti-static clothes that are currently used. Its characteristics are use a corona discharge type of conductive fiber in fabric by weaving or blending embedded processing. Due to no clean requirement in application environment, it may choose cotton or polyester anti-static fabric with a good water absorbent.

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Classification and performance requirements of anti-static working clothes

4.Classification of anti-static working clothes

4.2 Sort B

Sort B of anti-static work clothes are current anti-static clothing with the highest technical requirements. Along with the refinement development of microelectronic industry, it will be higher for Sort B of anti-static clothing performance requirements. Its characteristics are to effectively control electrostatic voltage of apparel surface by anti-static clothing system. Sort B clothing generally selects weaving fabric of a grid-like embedded surface conduction type of conductive fiber and use conductive sewing thread in garment sewing to ensure electrical continuity. At the same time, use conductive or anti-static ribbed cuffs to reinforce fit between clothing and human skin in order to facilitate static on clothing to safe release through body's grounding strap. Also because there is no clean requirements for use environment, it may choose cotton or polyester anti-static fabric with good absorbent.

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防静电工作服的分类及性能要求

4、防静电工作服的分类：

4.3 C类

C类防静电工作服是伴随着现代医药及半导体工业而发展起来的，其静电释放模式既可选择A类模式，也可选择B类模式，选择的依据取决于静电放电是否会伤害产品。其特征是由于环境有洁净要求，所以织物必须用合成纤维长丝织造，并且要有较高的密度以阻隔人体自身灰尘的穿透。

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Classification and performance requirements of anti-static working clothes

4. Classification of anti-static working clothes

4.3 Sort C

Sort C of anti-static work clothes are developed with modern pharmaceutical and semiconductor industries. Its electrostatic discharge modes can select Sort A mode, also can select Sort B mode. The basis of selection depends on whether electrostatic discharge will damage products. Its characteristics are that due to environment clean requirements, it must be woven by synthetic filament fabric and have a higher density to block body's own dust penetration.

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防静电工作服的分类及性能要求

5、易燃易爆环境中防静电服装的要求：

绝大部分的易燃易爆环境是不设置人员接地装置的，其地面也不是防静电地面，因此防静电服是通过电晕放电的方式将人体及内在服装所产生的静电缓慢释放，避免剧烈的静电放电使周围的可燃物发生燃爆。服装静电性能指标的阈值取决于周围可燃物的最小点火能量。

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Classification and performance requirements of anti-static working clothes

5. Requirements of anti-static clothes in flammable and explosive environments

Most of explosive atmosphere is not set personnel grounding device and its floor is not anti-static ground, so anti-static clothing is to slow release static electricity generated by human body and clothing in way of corona discharge to avoid strenuous electrostatic discharge to make surrounding combustible material explosion. Threshold of clothing electrostatic performance depends on minimum ignition energy of surrounding combustibles.

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相关标准:

GB 12014-2009 防静电服
GB/T 23316-2009 工作服 防静电性能的要求及试验方法
JIS T 8118-2001 静电危害防护工作服

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Classification and performance requirements of anti-static working clothes

Relative standards:

GB 12014-2009 Static protective clothing
GB/T 23316-2009 Anti-static requirement and test methods of working clothing
JIS T 8118-2001 Working wears for preventing electrostatic hazards

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GB12014标准是国家强制标准，最初是在1989年颁布的，其在中国防静电服装发展历程中起着非常重要的作用。
GB12014在2009年作出了重大的调整，改版后的标准对服装静电性能的要求如下：

测试项目	技术要求		注
	A级	B级	
点对点电阻/ Ω （面料）	$1 \times 10^5 \sim 1 \times 10^7$	$1 \times 10^7 \sim 1 \times 10^{11}$	强制条款
带点电荷量/ $(\mu C/\text{件})$ （服装）	<0.20	$0.20 \sim 0.60$	推荐条款

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Classification and performance requirements of anti-static working clothes

GB12014 standard is national mandatory standards and is originally released in 1989, which plays a very important role in development course of China's anti-static clothing. GB12014 is made a major adjustment in 2009. The revised standard requirements for electrostatic properties of clothing are as follows:

Test item	Technical requirements		Note
	Class A	Class B	
Point to Point Resistance/ Ω (fabric)	$1 \times 10^5 \sim 1 \times 10^7$	$1 \times 10^7 \sim 1 \times 10^{11}$	Mandatory article
Amount of charge with point/ $(\mu C/\text{piece})$ (clothes)	<0.20	$0.20 \sim 0.60$	Recommended article

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GB 12014-2009是采标日本JIS T 8118-2001编制的，而GB/T 23316-2009同样也是采标JIS T 8118-2001，遗憾的是GB/T 23316-2009的内容几乎与GB 12014-1989完全相同。

新版GB 12014将面料电阻作为一项重要的分级指标，业内对此有很多争议。因为材料表面电阻率或点对点电阻，与点燃危险之间，没有相关性。许多具有导电纤维的衣料，若未接地，可能是ESD点燃源之一。

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Classification and performance requirements of anti-static working clothes

GB 12014-2009 is prepared using Japanese standard JIS T 8118-200 and GB/T 23316-2009 standard is also adopting JIS T 8118-2001, unfortunately GB/T 23316-2009 and GB 12014-1989 contents are almost identical.

New version of GB 12014 uses fabrics resistance as an important indicator of classification. There is a lot of controversy on this problem in the industry. Because surface resistivity or point to point resistance of materials have no correlation to danger of ignition. there is, many conductive fiber cloth, if they are not grounded, it may be one of ESD ignition sources.

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防静电工作服的分类及性能要求

6、电子工业应用的防静电服装的要求：

电子工厂中防静电工作服是在静电放电保护区（EPA）中穿着的，其目的是通过接地释放的方式最小化带电衣物对敏感电子产品进行静电放电的故障风险，服装的防静电技术要求取决于EPA中静电敏感元器件（ESDS）对人体模型（HBM）及带电器件模型（CDM）的静电放电的敏感度。

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Classification and performance requirements of anti-static working clothes

6. Requirements of anti-static clothes in electronic industry

Anti-static work clothes in electronic factory are dressed in electrostatic discharge protected area (EPA) and its purpose is to minimize failure risk of electrostatic discharge of charged clothing to sensitive electronics by ground discharge way. anti-static technical requirements of clothing depend on electrostatic discharge sensitivity of electrostatic sensitive components (ESDS) in EPA on human body model (HBM) and charged device model (CDM).

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防静电工作服的分类及性能要求

EPA中因带电服装所致的ESD故障:

- 1、因带电服装的静电场感应而导致ESDS带电，并发生场强感应型CDM类型的放电。
- 2、因带电服装与ESDS直接接触（特别是袖子部位）而引发的近似HBM类型的放电。

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Classification and performance requirements of anti-static working clothes

ESD failures in EPA caused by charged clothing:

1. Due to electrostatic field induction of charged clothing, cause ESDS charged and field induction type of CDM discharge occur.
2. Due to charged clothing direct contact with ESDS (especially sleeve portion), cause an approximate HBM type of discharge.

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防静电工作服的分类及性能要求

EPA中服装的接地可通过多种方式实现:

- 通过一个导电罗纹，直接与接地操作人员的皮肤接触;
- 通过一个单独的接地线，直接连接于服装上的接地点;
- 通过与ESD座椅相接触，并且座椅通过ESD地板进行接地。

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Classification and performance requirements of anti-static working clothes

Clothing in EPA grounded may be realized by a variety of ways:

- Direct contact with skin of ground operator by an electrically conductive rib;
- Direct contact to ground point on the clothing by a separate ground wire;
- Ground by contacting with ESD seat and seat being grounded by ESD floor.

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防静电工作服的分类及性能要求

相关标准:

- ANSI/ESD S20.20-2007 建立一个静电放电控制方案——电气和电子零件、装置和设备（不包括电动引爆装置）的保护
- ANSI/ESD STM2.1-1997 工作服
- IEC 61340-5-1-2007 静电现象中电子装置的保护 一般要求
- IEC 61340-4-9-2010 专用的标准试验方法、服装

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Classification and performance requirements of anti-static working clothes

Relative standards:

- ANSI/ESD S20.20-2007 Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (excluding electric incendiary device)
- ANSI/ESD STM2.1-1997 Work cloths
- IEC 61340-5-1-2007 Protection of electronic devices from electrostatic phenomena - General requirements
- IEC 61340-4-9-2010 Standard test methods for specific applications -- Garments

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防静电工作服的分类及性能要求

- ANSI/ESD S20.20中规定，在EPA中表面电压超过**2000**伏的绝缘体，应距离ESDS最少**30**厘米的距离。
- IEC 61340-5-1中规定，ESDS位置处的静电场不应超过10000V/m。
- 服装是EPA中最必不可少且与ESDS近距离接触的绝缘体，即使是防静电服，其98%以上的材质是绝缘材料。**
- 一般要求服装表面的静电电压不超过**500**伏，目前有越来越多的工厂对服装的摩擦静电电压提出了不超过**100**伏的要求。
- EPA中最佳的防静电服装是全棉短袖的防静电T恤衫。

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Classification and performance requirements of anti-static working clothes

- ANSI / ESD S20.20 stipulates that distance of insulator with surface voltage exceeding 2000V in EPA should be at least 30 cm from ESDS.
- IEC 61340-5-1 stipulates that electrostatic field at ESDS should be not more than 10000V/m.
- Clothes are the most essential insulators in EPA and close contact with ESDS, even if anti-static clothing, over 98% of its materials are insulating materials.**
- Commonly request static voltage of clothing surface not exceeding 500V. More and more factories ask friction static voltage of clothing not exceeding 100 V now. The best anti-static clothing in EPA is anti-static cotton short-sleeve T-shirt.

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防静电工作服的分类及性能要求

7、洁净环境中防静电服装的要求：

洁净室及相关受控环境中防静电服装又称为防静电洁净服，其目的是避免带电衣物吸附灰尘影响产品质量。如果是半导体等微电子类工厂，还必须避免带电衣物对ESDS进行静电放电的故障风险。由于洁净室中必须控制化学污染物，因此不能用吸湿性助剂处理织物及服装。同时，服装面辅料必须全部使用合成纤维长丝织造，并具有较高密度以保证服装具有低发尘及高滤尘能力。

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Classification and performance requirements of anti-static working clothes

7. Technical requirements of anti-static clothes in clear environments

Anti-static clothing in clean rooms and associated controlled environments is also known as anti-static clean clothes. Its purpose is to avoid charged clothing adsorbing dust to affect product quality. If it is semiconductor and microelectronics factories, it also must avoid risk of failure due to charged clothing for electrostatic discharge ESDS. Because chemical contaminants must be controlled in clean room, it can not use hygroscopic additives to treat fabric and clothing. Meanwhile, clothing accessories must use all synthetic filament to weave and have a high density to ensure that clothing with low dust and high filter ability.

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相关标准：

FZ/T 80014-2012	洁净室服装	通用技术规范
FZ/T 80012-2012	洁净室服装	点对点电阻检测方法
FZ/T 80013-2012	洁净室服装	易脱落大微粒检测方法
IEST-RP-CC003.3	洁净室及其他受控环境	服装要素
GMP	药品生产质量管理规范	(2010年修订)
GB/T 25915.5-2010	洁净室及相关受控环境	第5部分：运行

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Classification and performance requirements of anti-static working clothes

Relative standards:

FZ/T 80014-2012	Cleanroom garment-General technical regulations
FZ/T 80012-2012	Cleanroom garment-Test method of point-to-point resistance
FZ/T 80013-2012	Cleanroom garment-Test method of easy shed large particles
IEST-RP-CC003.3	Garment System Considerations for Cleanrooms and Other Controlled Environments
GMP	Pharmaceutical manufacturing practices (2010 Revision)
GB/T 25915.5-2010	Cleanrooms and associated controlled environments—Part 5:Operations

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FZ/T 80014-2012 《洁净室服装 通用技术规范》对服装静电性能的要求：

洁净室服装的静电性能技术要求

项目	等级		
	一级	二级	三级
点对点电阻/ Ω	$1.0 \times 10^8 \leq R < 1.0 \times 10^9$	$1.0 \times 10^9 \leq R < 1.0 \times 10^{11}$	
摩擦电压/ V	≤ 200	≤ 1000	≤ 2500

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防静电工作服的分类及性能要求

FZ/T 80014-2012 《洁净室服装 通用技术规范》对服装洁净性能的要求：

洁净室服装的洁净性能技术要求

项目	微粒直径	要求		
		一级	二级	三级
发尘率 / (个/分钟/套)	$\geq 0.3 \mu m$	< 2000	$2000 \sim 20000$	$20000 \sim 200000$
空气粒子过滤效率 / %	$0.5 \mu m$ $1 \mu m$ 纤维	≥ 50 ≥ 70 ≤ 100	≥ 35 ≥ 50 ≤ 500	≥ 20 ≥ 30 ≤ 1750
易脱落大微粒 / m^2	$> 5 \mu m$	≤ 9990	≤ 99990	≤ 250000

注1：空气粒子过滤效率可根据需要选择一个粒径进行考核。也可根据需要，测试更小粒径。
注2：洁净性能指标也应参照客户要求考查其耐洗涤性能。

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Classification and performance requirements of anti-static working clothes

FZ/T 80014-2012 <Cleanroom garment-General technical regulations> gives requirements for clothing electrostatic properties:

Technical requirements of electrostatic properties of garments in cleanroom

Item	Class		
	Class I	Class II	Class III
Point-to-point resistance / Ω	$1.0 \times 10^8 \leq R < 1.0 \times 10^9$	$1.0 \times 10^9 \leq R < 1.0 \times 10^{11}$	
Friction voltage/ V	≤ 200	≤ 1000	≤ 2500

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Classification and performance requirements of anti-static working clothes

FZ/T 80014-2012 <Cleanroom garment-General technical regulations> gives requirements for clothing electrostatic properties:

Technical requirements of electrostatic properties of garments in cleanroom

Item	Particle diameter	Requirement		
		Class I	Class II	Class III
Dust rate/ (piece/minute/set)	$\geq 0.3 \mu m$	< 2000	$2000 \sim 20000$	$20000 \sim 200000$
Air particle filter rate/ %	$0.5 \mu m$	≥ 50	≥ 35	≥ 20
	$1 \mu m$	≥ 70	≥ 50	≥ 30
Easy shed large particles piece/ m^2	Fiber	≤ 100	≤ 500	≤ 1750
	$> 5 \mu m$	≤ 9990	≤ 99990	≤ 250000

Note 1: Air particle filter rate can be assessed by selection of a size according to requirement. It also may test a smaller particle size.
Note 2: Clean performance indicators should also refer to customer requirements and to examine their resistance to washing.

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介绍完毕

敬请批评指正！

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Classification and performance requirements of anti-static working clothes

That' s all the introduction.

Appreciate for any comment and correction advice.

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防静电产品生产企业标准体系构建

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标准基本情况

防静电产品配备和功能来讲，可分为人体防护、制程防护以及环境防护三大系统。

- 人体静电防护产品包括：防静电服、防静电无尘服、防静电鞋、防静电手套、手腕带；
- 制程防护产品包括：无尘擦拭布、离子风机、电子保护膜、防静电屏蔽袋、防静电吸塑推盘等；
- 环境防护产品包括：防静电监控系统、粘尘地垫等。

目前企业生产中标准基本情况：

- 防静电产品种类繁多，随着对产品静电防护要求的不断提高，静电防护新产品不断出现，亟待完整产品标准体系出现
- 除了产品的防静电要求，目前客户对于洁净性能要求有所提高，标准中需要完善
- 国际/国家行业标准和企业标准相互补充构成公司防静电生产企业产品标准体系

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Brief Introduction of the Standard

In terms of the functions, it can be divided into 3 systems: Body protection, process protection and environmental protection.

- The body antistatic products including: antistatic clothing, antistatic dust-free clothing, antistatic shoes, antistatic gloves and antistatic wrist band;
- Process protection products including: dust-free wipes, ion fan, electronic protective film, antistatic shielding bags, antistatic plastic push plate, etc.;
- Environmental protection products including: antistatic monitoring system, sticky mats, etc.

Present standardization status in enterprise production:

- There're various antistatic products and as the constantly increasing of protection requirement towards antistatic products, new antistatic protection products have appeared, therefore a complete production standard system is desperately needed.
- Besides the antistatic demand, clients also have an increasing requirement towards the products' cleaning performance, which needs to be perfected in the standard.
- International/national/industrial standard and corporate standard mutually complement to be a set of standard system for antistatic production enterprises.

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标准体系构建的主要内容

防静电产品的生产标准体系的构建是包括下面几个方面进行：

1、采用国际标准

美国静电放电协会ANSI/ESD标准系列

国际电工委员会标准IEC61340标准系列

美国环境科学和技术协会标准IEST-RP-CC系列

前两个标准组织主要关注于产品的防静电性能的测试方法

后者主要关注于产品的无尘性能测试和规定

2、采用国家/行业标准

防静电鞋采用国家标准 GB21147-2007 《个体防护装备 防护鞋》

防静电服采用国家标准 GB12014-2009 《防静电服》

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Major Content of the Standard Establishment

The establishment of the antistatic production standard system including:

1. applying international standards

ANSI/ESD standard established by the American Electrostatic Discharge Association

IEC61340 standard established by the International Electro-technical Commission

IEST-RP-CC series established by the Environmental Science and Technology Association of America

The first two standardization organizations mainly focus on the testing method towards the product's antistatic performance

The last organization mainly focus on the dust-free testing and regulation towards products

2. applying national/industrial standards

Antistatic shoes uses national standard GB21147-2007 *Personal Protective Equipment Protective Footwear*

Antistatic clothing uses national standard GB12014-2009 *Antistatic Clothing*

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标准体系构建的主要内容

3、制定国家和行业标准

SJ/T 11446—2013离子化静电消除器通用规范

SJ/T 11412-2010防静电洁净工作服及织物通用规范

防静电无尘屏蔽袋国家标准立项中

4、制定企业标准

针对公司中无相应产品国家标准、行业标准制定企业标准，保证所有的产品都按严格执行标准生产。

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Major Content of the Standard Establishment

3. Formulating the national and industrial standards

SJ/T 11446—2013 General specification on ionizing electrostatic eliminator

SJ/T 11412-2010 General specification on antistatic cleaning working garment and fabrics

National standard for antistatic dust-free shielding bag is in the process.

4. Formulating the corporate standards

Formulate corporate standards for products without corresponding national or industrial standards to guarantee that each production is conducted following the standard.

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1、采用国际标准

美国静电放电协会ANSI/ESD标准系列
离子化静电消除器系列产品采用的标准主要为
ANSI/ESD STM3.1 静电消除器
ANSI/ESD S20.20 保护电气和电子器件， 组件及设备静电放电控制大纲
ESD STM3.1 是一个比较详细的标准， 规定静电消除器产品的测试方法和安全方面的需求， 采用比较广泛。测试方法和测试点布局 和IEC61340-5-1 对于消静电器规定基本一致。
除了产品的防静电性能之外增加了 人身安全、电气安全、臭氧、放射性、X射线等安全需求方面的内容， 这对于使用者和生产企业来讲有重大的参考价值。

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1. Applying International Standard

ANSI/ESD standard established by the American Electrostatic Discharge Association
The main standards adopted by ionizing electrostatic eliminator are:
ANSI/ESD STM3.1 electrostatic eliminator
ANSI/ESD S20.20 Control program for protecting electrical and electronic devices, components and equipment electrostatic discharge
ESD STM3.1 is a detailed standard to regulate the testing method and safety requirement towards electrostatic eliminator with extensive application. It has similar testing methods and testing point distribution to IEC61340-5-1 towards electrostatic eliminator.
Besides the antistatic performance requirement, it added requirement towards body safety, electric safety, ozone, radioactivity, x-ray, etc., which has great reference value for users and production enterprises.

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1、采用国际标准

环境温湿度对于静电消除器的影响很重要。
ESD STM3.1 中测试没有相应的规定。
更偏重于供应商和用户之间的协商。
产品的技术参数要求往往采用ANSI/ESD S20.20标准的规定， 对于静电消散时间没有规定。
没有具体的噪音、风速和电磁辐射要求。
同时， 防静电性能的稳定性随着使用时间的增加， 衰减时间和平衡电压也会变化， 在正常维护的基础上， 如果标准中能增加稳定性的规定对于产品本身将会是一个更大的提升和约束。

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1. Applying International Standard

Ambient temperature and relative humidity has important influence to electrostatic eliminator.
There's no corresponding testing description in ESD STM3.1.
It mostly focuses on the coordination between supplier and client.
ANSI/ESD S20.20 is usually adopted in terms of the technical parameters of products, and there's no specific regulation towards the static elimination time.
There's no specific requirement towards noise, wind speed and electromagnetic radiation.
Also, as the hours of use increase, the stability of antistatic performance, attenuation time and balanced voltage would change correspondingly.
Thus, it would be a big improvement and binding towards the products if the **regulation towards stability can be added** into the standard under normal maintenance.

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1、采用国际标准

此外，ANSI/ESD STM11.11 静电耗散材料的表面电阻测量
ANSI/ESD S541 静电放电敏感物体之包装材料
ANSI/ESD STM11.13静电放电敏感元件的保护两点电阻测量
在屏蔽袋测试时有所使用。
对于手腕带和接地要求，参考下面的标准
ANSI/ESD S1.1防静电手腕带
ANSI/ESD S6.1接地
这两个标准对于手腕垫监控仪和设备接地监测仪系统设计有所参考。

ANSI/ESD标准是比较详细的标准体系，该标准体系基本可以涵盖整个防静电体系产品标准化需求，后期将会对其进行更加细致的分析和了解。

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1. Applying International Standard

Furthermore, ANSI/ESD STM11.11 surface resistance measurement of static dissipative materials
ANSI/ESD S541 packing materials of electrostatic discharge sensitive objects
ANSI/ESD STM11.13 resistance measurement towards two protective points for electrostatic discharge sensitive components
are used in the shielding bag test.
Following standards would be referred to in terms of wrist strap and grounding requirement:
ANSI/ESD S1.1 antistatic wrist strap
ANSI/ESD S6.1 grounding
These two standards are referred to in designing the wrist pad monitor and equipment grounding monitor system.
ANSI/ESD standard is a more specific standard system, which basically have covered the standardization requirement of overall antistatic products, and we would have a more detailed analysis in the following.

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1、采用国际标准

- 国际电工委员会标准IEC61340标准系列
- IEC61340 - 5 - 1： 电子器件的静电防护—基本要求
- 该标准既有产品要求又有测试方法，涵盖内容比较全面，因此该标准使用也比较广泛。
- IEC 61340-4-3:2001 静电测试方法 第4-3部分：对于专门用途鞋类的标准测试方法，该标准对于鞋子的电性能测试的控制环境规定为3个等级，比较细致。

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1. Applying International Standard

- IEC61340 standard established by the International Electrotechnical Commission
- IEC61340 - 5 - 1： static protection for electron device -- basic requirements
- This standard includes both product requirement and testing methods, thus enjoys an extensive application.
- IEC 61340-4-3:2001: static testing methods Section 4-3: standard testing methods for shoes with specific usages. This standard divides the control environment of electric performance test for shoes into 3 levels.

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1、采用国际标准

美国环境科学和技术协会标准 IEST-RP-CC 系列
主要参考标准为
IEST-RP-CC3.3 洁净室及相关受控环境服装要素
IEST-RP-CC4.3 洁净室及相关受控环境擦拭材料性能评估
关注产品本身的洁净性能，如 IC、particle、NVR 等，这些参
数为很多硬盘磁头、半导体、芯片、液晶生产企业所关注。

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1. Applying International Standard

IEST-RP-CC standard established by Environmental Science and Technology Association of America
Major reference standards are:
IEST-RP-CC3.3: clothing factors in the clean room and relevant controlled environment
IEST-RP-CC4.3: performance evaluation for the wiping cloth in clean room and relevant controlled environment
It focuses on the clean performance of the products, e.g. IC, particle, NVR, etc. These parameters have got the attention of enterprises producing drive head, semiconductors, chips, LCD, etc.

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2、采用国家和行业标准

企业采用的主要标准为国家标准和电子行业标准。
防静电鞋、防静电服产品每年送到国家相关部门检验，采用国家强制标准 GB21147-2007《个体防护装备 防护鞋》和 GB12014-2009《防静电服》
屏蔽袋采用的标准为 GB/T21302-2007《包装用复合膜、袋通则》
电子行业标准 SJ/T10694《电子产品制造与应用系统防静电检测通用规范》规定了电子产品制造与应用系统防静电的测试方法。本规范适用于电子产品制造与应用系统防静电的检测，如：接地系统、地面（地垫）、墙体、工作台、台垫、工作椅、工位器具、物流传递器具、包装用品、人体静电防护用品、操作维修工具、离子静电消除器等。
该标准是通用标准，主要关注产品的防静电性能，不能作为独立的产品标准使用。
其他的产品标准和测试方法标准，如周转箱标准、电阻测试标准等。

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2. Applying National and Industrial Standards

Major standards adopted by enterprises are national standards and electron industrial standards.
Antistatic shoes and antistatic clothing should be delivered to relevant national government departments for inspection annually with the adoption of national mandatory standards GB21147-2007 *Personal Protective Equipment Protective Footwear* and GB12014-2009 *Antistatic Clothing*
Shielding bag uses GB/T21302-2007 *General Rules for Packing Composite Membrane and Bag*
Electron industrial standard SJ/T10694 *General Norms for the Antistatic Testing towards Electronics Manufacturing and Application System* stipulated testing methods for the above-mentioned issues.
This norm applies to the antistatic testing towards electronics manufacturing and application system, e.g.: grounding system, ground (mat), wall, operating platform, cushion, working chair, station appliance, logistics transporting appliance, packing materials, personal antistatic equipment, operation & maintenance instrument, ionizing electrostatic eliminator, etc.
This is a general standard with the major focus on antistatic performance of the products, and can not be used as a standalone standard.
Other product standard and testing methods standard, e.g. container standard, resistance test standard, etc.

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3、参与制定国家/行业标准

天华公司积极参与国家和行业标准制定，目前参与制定的标准有两项发布：

SJ/T 11446-2013 《离子化静电消除器通用规范》

SJ/T 11412-2010 《防静电洁净工作服及织物通用规范》

公司拟参与制定国家标准防静电无尘屏蔽袋，该标准立项中。

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3、参与制定国家/行业标准

《离子化静电消除器通用规范》 离子化静电消除器的定义、产品结构分类、技术要求、测试方法、检验规则以及标志、使用说明书、包装、运输和贮存。

对于客户和供应商所关注的下述指标和测试做了规定：

- 外观检查
- 电性能---残余电压和静电消散时间测试方法
- 臭氧浓度
- 电磁骚扰特性
- 电气安全性能
- 噪声
- 洁净性能

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3. Participating in Formulating National/Industrial Standards

CanMax has been an active participant in formulating the national and industrial standards. Two standards with our participation have now been established:

SJ/T 11446-2013 *General Norms for Ionizing Electrostatic Eliminator*

SJ/T 11412-2010 *General Norms for Antistatic Cleaning Clothing and Fabrics*

We are supposed to participate in formulating the national standard for antistatic dust-free shielding bags, which is in the process.

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3. Participating in Formulating National/Industrial Standards

General Norms for Ionizing Electrostatic Eliminator includes definition of ionizing electrostatic eliminator, category and structure of the product, technical requirement, testing methods, inspection rule, mark, operation instruction, packing, transportation and storage.

It has regulations on the following indexes and tests as focused by the clients and suppliers:

- Visual inspection
- Electrical performance ---testing methods for the decay time of residual voltage and static
- ozone concentration
- Electromagnetic disturbance characteristics
- Electric safety
- Noise
- Cleaning performance

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3、参与制定国家/行业标准

《防静电洁净工作服及织物通用规范》防静电洁净工作服及织物的定义、分类、要求、试验方法、检验规则和标志、包装、运输、贮存。

主要技术要求和测试方法包括：

- 外观、结构、接缝、织物的断裂强力、织物的透气性、织物的透湿量
- 防静电性能
- * 电荷面密度、带电电荷量、摩擦衰减电位、点对点电阻
- 洁净性能
- * 尘粒数（P/C）、不挥发性残留物（NVR）、离子污染物（IC）
- 耐洗涤性能

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3. Participating in Formulating National/Industrial Standards

General Norms for Antistatic Cleaning Clothing and Fabrics includes definition, category, requirement, testing methods, inspection rules, mark, packing, transportation and storage of antistatic cleaning clothing and fabrics.

Major technical requirements and testing methods including:

- Exterior, structure, joint, breaking force of the fabric, air permeability of the fabric and water vapor transmission rate of the fabric
- Antistatic performance
- * Surface charge density, electric charge, friction attenuation potential, peer resistance
- Cleaning performance
- * P/C, nonvolatility (NVR) and ionic contaminants (IC)
- Laundering durability

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3、参与制定国家/行业标准

两项标准均为产品标准，规定内容比较详细和具体，并且测试的项目规定兼顾洁净室使用环境要求。

这两项标准制定过程中联合相关防静电产品生产或使用企业，将多年来生产产品关注性能和先进测试方法写在标准中，希望能得到相关静电产品生产企业和使用企业的关注和采用。

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3. Participating in Formulating National/Industrial Standards

- These two standards are products standards, with detailed and specific content. And the service environment requirement of cleaning room has been taken into the test project regulation's account.
- Enterprises producing and using antistatic products have been united in the process of formulating these two standards, to put the focused performance of the products and the advanced testing methods into the standard, hopefully it can be adopted and emphasized by relevant enterprises producing and using the antistatic products.

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4、制定企业标准

制定企业标准，做到所有产品严格执行产品标准，有章可循。

随着电子防静电和无尘保护产业的发展，该领域内的产品出现了种类多、要求高的趋势，在国际标准、国家和行业标准尚未出台的情况下，企业需根据国家标准的制定方法制定自己的企业标准。

目前公司的企业标准在进一步的规范中。

企业产品标准主要涵盖下述的产品：

粘尘垫产品、无尘擦拭布、电子保护膜、静电监控仪、防静电吸尘托盘、防静电椅等产品。

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4. Formulating Corporate Standards

To formulate the corporate standards, each product should strictly implement such standard.

Along with the development of antistatic and dust-free industries, the product types and requirements to it have been updated. Under the circumstance that there's no suitable international, national or industrial standards so far, enterprises should formulate their own corporate standard in accordance with corresponding national standard technique.

Corporate standard still needs to be further improved.

Corporate product standard mainly covers the following products:

Sticky mat products, dust-free wiping cloth, electronic protective film, static monitoring device, antistatic plastic tray, ESD chairs, etc.

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标准体系构建

```
graph TD; A[企业标准体系构建] --> B[采用国际标准]; A --> C[国家/行业标准制定]; A --> D[采用国家/行业标准]; A --> E[制定企业标准]
```

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Establishment of the Corporate Standards System

```
graph TD; A[Establishing the corporate standards system] --> B[Adopting international standards]; A --> C[Formulating national/industrial standards]; A --> D[Adopting national/industrial standards]; A --> E[Formulating corporate standards]
```

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静电消除器标准基本情况

- ST/T11446 《离子化静电消除器通用规范》标准的计划代号为S08001-T，归口单位为中国电子技术标准化研究所，由苏州天华超净科技股份有限公司、上海安平静电科技有限公司、深圳长城开发科技股份有限公司及深圳市中明科技开发有限公司负责起草。
- 本规范在编写过程中结合我国国情，本着面向市场、服务防静电产业的原则，充分考虑国内外行业现状及技术发展趋势，力求内容体现公平性、严谨性、通用性、先进性，可操作性强，并具有普遍的指导意义。
- 2013年4月25日，中华人民共和国工业和信息化部发布，2013年6月1日开始实施。

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Brief Introduction of Electrostatic Eliminator Standard

- ST/T11446 The program code of General Norms of Electrostatic Eliminator is S08001-T, belongs to China Electronics Standardization Institute, and was drafted by CanMax, Shanghai Anping Electric Technology Co., Ltd., Shenzhen Kaifa Technology Co., Ltd. and Shenzhen HORB Co., Ltd..
- This Norm was edited combining Chinese situation, following the principle of facing to the market, serving the antistatic industry, taking domestic & overseas industrial status and technical development trend into consideration, with the efforts of being fair, precise, general, advanced and operational, trying to be a general industrial guideline.
- It was promulgated by the Ministry of Industry and Information Technology of the People's Republic of China on April.25th, 2013, and was implemented as of June. 1st, 2013.

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标准主要内容及编写的意义

- 主要内容：离子化静电消除器的定义、产品结构分类、技术要求、测试方法、检验规则以及标志、使用说明、书、包装、运输和贮存。
- 主要内容的论据：国内外最新版本的相关标准是参考的主要资料，同时编写组提供了大量的国内外产品的主要数据，作为制定参数的依据。
- 标准编制的意义：本规范的制定弥补了国内无离子化静电消除器相关标准的空白，为国内企业生产、销售该产品提供了技术标准。通过使用该规范来增强国内产品的竞争能力，提升国内产品在市场上的占有率是我们的最终目标。

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Main Content and Significance of the Standard

- Main content: definition, structure category, technical requirement, testing methods, inspection rules, marks, ionizing electrostatic eliminator.
- Argument basis: consult the latest version of the relevant standards at home and abroad, and the parameters are confirmed based on domestic and overseas testing data.
- Significance: this formulation is a compensation for domestic standard towards non-ionizing electrostatic eliminator, and has provided technical standard for the production and sales of domestic enterprises. This standard can improve the competitiveness of domestic products. Increasing the occupancy of domestic products in the market is our final goal.

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1、范围

本规范规定了离子化静电消除器的定义、产品结构分类、技术要求、测试方法、检验规则以及标志、使用说明、包装、运输和贮存。

本规范适用于外加电源使空气分子电离，形成正和负两种离子来消除带电物体表面静电荷的离子化静电消除器。其它类似结构的离子化静电消除器可参照本规范执行。

本规范不适用于易燃、易爆场所，也不适用于放射性辐射和感应式静电消除器。

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2、规范性引用文件

GB/T 191-2008 包装储运图示标志

GB/T 2828.1-2003 计数抽样检验程序 第1部分：按接收质量限(AQL)检索的逐批检验抽样计划

GB 4706.45-2008 家用和类似用途电器的安全 空气净化器的特殊要求

GB 4793.1-2007 测量、控制和实验室用电设备的安全要求 第1部分：通用要求

GB 4824-2004 工业、科学、和医疗 (ISM) 射频设备电磁骚扰特性的测量方法和限值

GB/T 6882-2008 声学 噪声源声功率级测定 消声室和半消声室精密法

GB 50073-2001 洁净厂房设计规范

GBZ 2.1-2007 工作场所所有有害因素职业接触限值 化学有害因素

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1.Scope

This Norm regulated the definition, structure category, technical requirement, testing methods, inspection rules, marks, instruction manual, packing, transportation and storage of ionizing electrostatic eliminator.

This Norm applies to ionizing electrostatic eliminators which ionize the air molecules via additional power supplies, to form the positive ion and anion in eliminating the surface static charge of electrified object. Other ionizing electrostatic eliminators with the similar structure can refer to this Norm.

This Norm doesn't apply to inflammable and explosive place, nor does it apply to radioactive radiation and induction electrostatic eliminators.

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2.Normative references

GB/T 191-2008 Graphical marks for packing, storage and transportation.

GB/T 2828.1-2003 Procedures of sampling inspection by counting Section 1: lot by lot inspection and sampling via AQL search

GB 4706.45-2008 Safety of family appliance or appliance with similar purpose Special requirement of air cleaner

GB 4793.1-2007 Safety requirement in measuring, controlling and lab electrical equipment Section 1: General requirement

GB 4824-2004 Measuring methods and limiting value of the electromagnetic disturbance characteristics off industrial, scientific and medical (ISM)RF equipment

GB/T 6882-2008 Acoustics Measuring of acoustic power level of the noise source Precision methods of the anechoic room and semi-anechoic room

GB 50073-2001 Design specifications of the clean workshop

GBZ 2.1-2007 OEL (occupational exposure limit) of the harmful factor in workplace harmful chemical factors

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3、术语和定义

离子化静电消除器 ionizing electrostatic eliminator

离子风机 ionizing air blower

离子风枪ionizing air gun

离子风嘴ionizing air nozzle

充电板检测仪 charge plate monitor

静电消散时间 static decay time

使带电体上静电电位减少到起始值的设定百分数（通常10%）所需要的时间。

残余电压 offset voltage

离子化静电消除器正常工作情况下，充电板检测仪测量的某一位置的电压值。

两个术语统一了静电行业中“衰减时间”和“平衡电压”的讲法，更具科学性

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3.Terms and Definition

ionizing electrostatic eliminator

ionizing air blower

ionizing air gun

ionizing air nozzle

charge plate monitor

static decay time

Time needed in decreasing the electrostatic potential of electrified body to setting percentage (usually 10%) of the initial value.

offset voltage

Voltage value measured by charge plate monitor at certain position under the normal working condition of ionizing electrostatic eliminator.

These two terms unified the description of "fall time" and "balanced voltage" in static industry, and are more scientifically precise.

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4、技术要求及测试方法

标准规定下如下项目的技术要求：

外观

电性能

臭氧浓度

电磁骚扰

电气安全性

噪声控制

洁净性能

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4. Technical Requirement and Testing Methods

The standard regulated technical requirements for the following items:

Exterior

Electrical properties

Ozone concentration

Electromagnetic disturbance

Electrical Safety

Noise control

Clean Performance

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canmax 4、技术要求及测试方法

①电性能

表1 离子化静电消除器电性能要求

类型	级别	残余电压绝对值 V	静电消除时间、 s
离子风机	A	≤ 5	≤ 20
	B	≤ 10	
	C	≤ 50	
离子风枪或风嘴	A	≤ 10	≤ 20
	B	≤ 50	
	C	≤ 200	
离子棒	A	≤ 20	≤ 50
	B	≤ 50	

* 静电消除时间是按充电电压从±1000V降到±100V的时间间隔。

对于电性能测试，我们选择了各种类型的离子化静电消除器，分别对直流单口台式离子风机、直流三口悬挂式离子风机、交流单口台式离子风机、交流两口悬挂式离子风机、交流卧式离子风机、离子风枪、气源型离子棒、无气源型离子棒进行试验。

具体的测试点见规范附录A《离子化静电消除器电性能测试方法》。确定测试时间为20天，每天8:30/11:30/14:30/17:30采集4个数值，每台在试验期间共记录80个数值，作为一个数据组。为了确保稳定和可靠性，每种类型的静电消除器的试验都进行了20天。

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canmax 4. Technical Requirement and Testing Methods

①Electrical properties

Table 1: Electrical property requirements of ionizing electrostatic eliminator

Type	Grade	Absolute value of the residual voltage V	Static decay time * s
Ionizing air blower	A	≤ 5	≤ 20
	B	≤ 10	
	C	≤ 50	
Ionizing air gun or nozzle	A	≤ 10	≤ 20
	B	≤ 50	
	C	≤ 200	
Ionizing bar	A	≤ 20	≤ 50
	B	≤ 50	

*Static decay time refers to time span needed to decrease the electrostatic pressure monitored by charge plate monitor from ±1000V to ±100V.

With regard to electrical property test, we selected kinds of ionizing electrostatic eliminators to conduct tests towards DC single-port desktop ion fan, DC three hanging ion fan, AC single-port desktop ion fan, ion exchange two hanging fan, AC horizontal ion fan, ion air guns, air ion bar and airless ion bar.

Specific test point please see Appendix A *Electrical Property Testing Methods for Ionizing Electrostatic Eliminators*. The confirmed testing time is 20 days. Collect 4 values at 8:30/11:30/14:30/17:30 everyday, and record 80 values for each device during the testing period to form a data group. To guarantee the stability and reliability of the test, each type of electrostatic eliminator has been tested for 20 days.

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canmax 4、技术要求及测试方法

测试方法和环境的确定

- 国外来讲主要的标准为ANSI/ESDSTM3.1-2006《ESD Association Standard for the Protection of Electrostatic Discharge Susceptible Item-Ionization》
- IEC61340-5-1《电子器件静电现象的防护基本要求》。
- ANSI/ESDSTM3.1-2006是美国国家标准学会与美国静电放电协会标准，该标准为检测、评价和选择离子化静电消除器和消静电系统提供了依据。
- 国际电工委员会标准IEC61340-5-1非常详细的介绍了对于静电放电敏感器件的保护措施和对电离器的测试方法。
- 中国电子行业标准SJ/T10694-2006《电子产品制造与应用系统防静电检测通用规范》，等同采用了IEC61340-5-1中离子化静电消除器电性能测试的方法。
- 《离子化静电消除器通用规范》电性能测试方法主要参考ANSI/ESDSTM3.1-2006和IEC61340-5-1
- 静电测试对环境的反应是相当敏感的，因此，在测试静电产品的性能时，对环境温度和湿度都必须作些规定。我们结合离子化静电消除器在电子行业中实际应用情况，采用ANSI/ESDS20.20和IEC61340系列静电测试的一般环境条件：温度为（23±3）℃，相对湿度为（50±5）%作为测试条件。

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canmax 4. Technical Requirement and Testing Methods

Confirmation of testing methods and environment

- Major international standard is ANSI/ESDSTM3.1-2006 *ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Item-Ionization*
- IEC61340-5-1 *Basic Protection Requirement of Electrostatic Phenomenon of Electron Devices*
 - ANSI/ESDSTM3.1-2006 is a standard applied by American National Standards Institute and the American Association of Electrostatic Discharge, which has provided foundation for testing, evaluating and choosing ionizing electrostatic eliminator and static elimination system.
 - IEC61340-5-1 established by international Electrotechnical Commission gives a detailed description of the protective approaches towards the electrostatic discharge sensitive device and testing methods towards electro-dissociator.
 - Chinese electron industrial standard SJ/T10694-2006 *General Norm on the Antistatic Test towards Manufacturing and Application System of Electronics* adopted the electric performance testing methods for ionizing electrostatic eliminators stipulated in IEC61340-5-1.
 - Electric performance testing methods in *General Norm of Ionizing Electrostatic Eliminator* mainly consulted the ANSI/ESDSTM3.1-2006 and IEC61340-5-1.
 - Static test has sensitive response to the environment. Therefore, specific rules towards the temperature and humidity when testing the performance of static elimination products must be stipulated. By combining the actual application situation of ionizing electrostatic eliminator in electron industry, we adopt the normal environmental condition for static tests stipulated in ANSI/ESDS20.20 and IEC61340 with the temperature of (23±3) °C and relative humidity of (50±5) % as the test condition.

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4、技术要求及测试方法

测试仪器及测试条件的规定

充电器测试仪应满足以下性能：
a) 静电电压测试范围：±(1~1020)V，最大允许偏差±1%；
b) 静电放电时间测试范围：(1~99.9)s，最大允许偏差±1.5%，最小分辨率0.1s；
c) 充电板安装在充电器中充电有漏电时的最小电容：15pF；
d) 测试电路的总电容：(20±2) pF；
e) 充电板的尺寸：150mm×150mm；
f) 接地平面接地面积：≥150mm²。
A.4 测试条件
A.4.1 电性能测试应在优于 8 级洁净室中进行。
A.4.2 测试环境应无扰动气流的影响。
A.4.3 温度为 (23±3) °C，相对湿度为 (50±5) %。
A.4.4 测试时要求操作人员应采取静电防护措施。
A.5 测试程序
A.5.1 测试前准备
A.5.1.1 保证属于化静电消除器测试前已连续通电运行 48h。
A.5.1.2 开机稳定运行 5min 后，方可开始测试。
A.5.1.3 测试环境中不存在干扰气流和干扰电磁场。
A.5.1.4 记录测试环境的各项参数，如温度、湿度、环境洁净度等。
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4. Technical Requirement and Testing Methods

Specifications of test instrument and test condition

Charge plate monitor should be accord with the following performances:
a) testing scope of static voltage: ±(1-1020)V; Maximum allowable deviation ±1%;
b) testing scope of static decay time: (1-99.9)s; maximum allowable deviation ±1.5%; minimum resolution 0.1s;
c) minimum capacitance of charging plate when being installed in the fixture without power supply: 15pF
d) total capacitance of the test circuit: (20±2)pF;
e) size of charging plate: 150mm x 150mm;
f) grounding area: ≥150mm2.
A.4 Testing conditions
A.4.1 Electrical performance test should be conducted in cleaning room above grade 8.
A.4.2 Testing environment should not have air disturbance.
A.4.3 Temperature (23±3)°C, relative humidity (50±5)%.
A.4.4 Operator should adopt static protection measures.
A.5 Testing procedure
A.5.1 Preparation
A.5.1.1 Make sure that the ionizing electrostatic eliminator has been in continuous power running for 48h.
A.5.1.2 Shall not start the test until it has been operated for 5min.
A.5.1.3 There shall be no air disturbance and electromagnetic interference in the testing environment.
A.5.1.4 Record the parameters, e.g. temperature, humidity, environmental cleanliness, etc.
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4、技术要求及测试方法

②臭氧浓度

对静电消除器静电放电，主要是电晕放电产生的臭氧浓度进行规定。
参考标准：中华人民共和国国家职业卫生标准《工作场所有害因素职业接触限值-化学有害因素》
臭氧浓度应符合GBZ 2.1-2007的规定，不得超过0.3mg/m3。
ANSI ESD STM3.1-2006 4.0安全要求4.3条款指出了对臭氧的要求，具体的数值没有做说明，SJ/T11446-2013主要是考虑到臭氧对劳动者的影响，参考了职业卫生的标准。
测试方法采用GB 4706.45-2008 家用和类似用途电器的安全 空气净化器的特殊要求。
在一个密闭的房间内进行试验。房间的尺寸为:2.5 m×3.5 m×3.0 m,墙壁表面要覆盖聚乙烯板,空气净化器和说明书要放置。在桌面上使用的空气净化器放置在离地高度约 750 mm 的房间中央。房间保持温度约 25 °C和相对湿度约 50%,空气净化器以额定电压通电 24 h。如果拆换过滤器为较不利状态,则应拆除过滤器。
臭氧取样管放置在距空气净化器空气出口 50 mm 的位置,试验开始前先测量本底臭氧浓度,然后将试验中测得的最大浓度减去本底臭氧浓度。
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4. Technical Requirement and Testing Methods

②Ozone concentration

The main regulation towards electrostatic discharge for electrostatic eliminator is about ozone concentration occurred in the process of corona discharge.
Reference standard: national occupational health standards of the People 's Republic of China: *OEL of Hazardous Factors in Workplace -- Harmful Chemical Factors*
Ozone concentration should be accord with specifications stipulated in GBZ 2.1-2007, and shall not exceed 0.3mg/m³.
ANSI ESD STM3.1-2006 4.0: safety requirement in Provision 4.3 points out requirement towards the ozone. There's no specific instruction on the value. SJ/T11446-2013 mainly thinks about the influence ozone has to labors. It consulted the occupational healthy standard.
The testing methods adopt special requirement stipulated in GB 4706.45-2008 for safety of family appliance and electric appliances with the similar purpose and the air cleaner.
Conduct the test in an airtight room with the room size of 2.5m x 3.5m x 3.0m. The wall shall be covered with polyethylene sheet and the air cleaner should be positioned following the instruction of the desk.
The temperature shall be maintained at around 25°C with the humidity of around 50%, and change the air cleaner at the rated voltage for 24h. If it's less favorable condition when eliminating the filter, then the filter should be eliminated.
Ozone sampling tube shall be positioned at 50mm from the air outlet of the air cleaner. Measure the background concentration of ozone at the test start, and then deduct such background concentration from the maximum concentration we've got from the test.
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4、技术要求及测试方法

③电磁干扰EMI

不同频段的电磁干扰限值应符合GB 4824-2004《工业、科学和医疗(ISM)射频设备电磁骚扰特性限值和测量方法》中1组B类设备的规定。
设定该项目主要是考虑到尖端放电对周围设备和人体健康的影响。
*ANSI/ESD ADV3.2-1995《静电放电保护——离子化静电消除器选择与测试》中提到EMI/RFI必须小于某一值，但是没有指出具体的数值。通过查阅国内外相关标准，选择GB4824-2004《工业、科学、和医疗(ISM) 射频设备电磁骚扰特性的测量方法和限值》作为测试方法和限值的依据。

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4. Technical Requirement and Testing Methods

③EMI

Limiting value of EMI at different frequency bands shall be accord with specifications stipulated in GB 4824-2004 *Limiting Value and Measuring Methods for the Electromagnetic Disturbance of ISM RF Equipment for equipment of Group 1, Category B.*
The designing of this project mainly considers the influence point discharge would have to surrounding equipment and body health.
*ANSI/ESD ADV3.2-1995 *Electrostatic Discharge Protection --- Selection and Test of Ionizing Electrostatic Eliminator* mentioned that EMI/RFI must be lower than certain value, but it doesn't point out the specific value. By looking at domestic and overseas standards, we choose GB4824-2004 *Measuring Methods and Limiting Value of Electromagnetic Disturbance of ISM and RF Equipment* as the foundation of our testing methods and limiting value.

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4、技术要求及测试方法

④电气安全性

- 离子化静电消除器电气安全性应符合GB 4793.1-2007《测量、控制和实验室用电气设备的安全要求第1部分：通用要求》的规定。
- 电气设备的通用安全要求

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4. Technical Requirement and Testing Methods

④Electric safety

- Electric safety of the ionizing electrostatic eliminator should be accord with GB 4793.1-2007 *Safety Requirement of Measuring, Controlling and Lab Electrical Equipment Section 1: General Requirement.*
- General safety requirement of electrical equipment

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4、技术要求及测试方法

⑤噪声控制

离子化静电消除器噪声应符合GB 50073-2001 洁净厂房设计规范的规定，不应大于65dB(A)。

该项目规定避免静电消除器对周围环境和人体健康造成伤害。

*离子化静电消除器设计时，应该考虑运行时设备组件发出的噪声，避免对工作人员的干扰，设计时选择低噪声的风扇或气源组件，离子化静电消除器噪声测试按照标准GB/T6882《声学 噪声源声功率级测定 消声室和半消声室精密法》的规定进行。

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4. Technical Requirement and Testing Methods

⑤Noise control

Noise of ionizing electrostatic eliminator should be accord with specifications regulated by GB 50073-2001 for clean workshop designing, and shall not exceed 65dB(A).

This project can prevent the ionizing electrostatic eliminator from hurting surrounding environment and body health.

*When designing the ionizing electrostatic eliminator, noise occurred by the equipment components shall be taken into consideration to avoid the disturbance to workers. Fan or air components with low noise shall be selected and the noise test towards ionizing electrostatic eliminator shall be accord with GB/T6882 Acoustics Measuring of Acoustic Power Level of the Noise Source Precision Methods of the Anechoic Room and Semi-anechoic Room

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4、技术要求及测试方法

⑥洁净性能要求项目制定

离子化静电消除器工作一段时间后，设备本身会扩散出一定数量的颗粒物，对空间环境造成影响，本规范提供了技术要求和测试方法，将这一参数作为可裁剪内容，具体的要求由供需双方商讨确定，供方应该供给需方符合洁净性能要求的消静电设备。

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4. Technical Requirement and Testing Methods

⑥Formulation of clean performance requirement

After a while of working, the ionizing electrostatic eliminator would spread certain PM, which would affect the environment. This specification provides technical requirement and testing methods which would be regarded as editable content and the specific requirement can be mutually coordinated by the supplier and demand side. The supplier shall supply the demand side with static elimination equipment that is accord with the clean performance requirement.

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4、技术要求及测试方法

⑥洁净性能要求

离子化静电消除器在各种洁净度等级的环境中运行时，产生的粒径大于或等于0.5μm的悬浮粒子数应满足以下要求：
在洁净度为4级（ISO14644-1 class 4）对应十级无尘室）环境中，悬浮粒子数小于或等于352粒/米³；
在洁净度为5级（ISO14644-1 class 5，对应百级无尘室）环境中，悬浮粒子数小于或等于3520粒/米³；
在洁净度为6级（ISO14644-1 class 6，对应千级无尘室）环境中，悬浮粒子数小于或等于35200粒/米³；
在洁净度为7级（ISO14644-1 class 7，对应万级无尘室）环境中，悬浮粒子数小于或等于352000粒/米³；
在洁净度为8级（ISO14644-1 class 8，对应十万级无尘室）环境中，悬浮粒子数小于或等于3520000粒/米³

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4. Technical Requirement and Testing Methods

⑥Requirement of clean performance

When ionizing electrostatic eliminator is working in environment with various cleanliness classes, the suspended particles with grain size over or equals with 0.5 μm shall meet the following requirements:

When the cleanliness class is 4 （ISO14644-1 class 4), corresponding dust-free room class is ten, the suspended particles shall be less than or equals with 352/m³.
When the cleanliness class is 5 （ISO14644-1 class 5), corresponding dust-free room class is 100, the suspended particles shall be less than or equals with 3520/m³;
When the cleanliness class is 6 （ISO14644-1 class 6), corresponding dust-free room class is 1000, the suspended particles shall be less than or equals with 35200/m³;
When the cleanliness class is 7 （ISO14644-1 class 7), corresponding dust-free room class is 10,000, the suspended particles shall be less than or equals with 352,000/m³;
When the cleanliness class is 8 （ISO14644-1 class 8), corresponding dust-free room class is 100,000, the suspended particles shall be less than or equals with 3,520,000/m³;

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4、技术要求及测试方法

ISO14644-1 ISO Class	FED STD 209E English	Metric	Number of Par Cubic Meter by Micrometer Size							
			0.1um m³	0.2um m³	0.3um m³	0.5um μ³	0.5um m³	5um		
1		ISO1	10	2						
2		ISO2	100	26	10		4			
3	1	M1.5 ISO3	1,000	265	106		35			
4	10	M2.5 ISO4	10,000	2,650	1,060	10	353			
5(百级)	100	M3.5 ISO5	100,000	26,500	10,600	100	3,530	29		
6(千级)	1,000	M4.5 ISO6	1,000,000	265,000	106,000	1000	35,300	293		
7(万级)	10,000	M5.5 ISO7				10000	353,000	2,930		
8(十万级)	100,000	M6.5 ISO8				100000	3,530,000	29,300		
9		ISO9				1000000	35,300,000	293,000		

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4. Technical Requirement and Testing Methods

ISO14644-1 ISO Class	FED STD 209E English	Metric	Number of Par Cubic Meter by Micrometer Size							
			0.1um m³	0.2um m³	0.3um m³	0.5um μ³	0.5um m³	5um		
1		ISO1	10	2						
2		ISO2	100	26	10		4			
3	1	M1.5 ISO3	1,000	265	106		35			
4	10	M2.5 ISO4	10,000	2,650	1,060	10	353			
5(100 grade)	100	M3.5 ISO5	100,000	26,500	10,600	100	3,530	29		
6(1,000 grade)	1,000	M4.5 ISO6	1,000,000	265,000	106,000	1000	35,300	293		
7(10,000 grade)	10,000	M5.5 ISO7				10000	353,000	2,930		
8(100,000 grade)	100,000	M6.5 ISO8				100000	3,530,000	29,300		
9		ISO9				1000000	35,300,000	293,000		

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4、技术要求及测试方法

- B.5 测试程序
- B.5.1 离子化静电消除器不开机，进行空白测试，将空气粒子计数器置于正对静电消除器离子出口 15cm 处，采样测试悬浮粒子浓度作为空白值。
- B.5.2 静电消除器至少运行 5min 后，将空气粒子计数器的采样器放置于正对静电消除器离子出口 15cm 处，采样测试静电消除器使用时的悬浮粒子浓度。
- B.5.3 用静电消除器使用时的悬浮粒子浓度减去空白值，即得到单位体积产生的悬浮粒子数。计算公式如下：

$$X = \frac{A_1}{V_1} - \frac{A_2}{V_2}$$

- 式中：
- X —— 静电消除器工作时产生的悬浮粒子浓度，单位为粒每立方米（粒/米³）；
- A_1 —— 静电消除器工作时的采样气体中的悬浮粒子数，单位为粒；
- A_2 —— 空白测试的悬浮粒子数，单位为粒；
- V_1 —— 静电消除器工作时气体采样量，单位为立方米（m³）；
- V_2 —— 空白测试的采样量，单位为立方米（m³）。

国内外标准对比

标准名称	标准主要性质	相关标准内容
ESD STM3.1	方法标准	对离子化静电消除器和离子化消除静电系统的测试做了说明，没有对静电消除器的电性能做出具体的要求。只能作为一个方法来采用。
ANSI/ESD S20.20	防静电体系的评价标准	包含了 EPA 所有静电控制项目的要求，静电消除器只是其中的一项，只有一个电性能参数。注重项目的电性能要求，对于职业保护和其他方面没有说明。
IEC 61340-5-1	防静电体系、离子化静电消除器和静电系统评价	包含了 EPA 所有静电控制项目的要求，静电消除器电性能要求和测试方法只是其中的一个项目。对于职业保护和其他方面没有说明。
SJ/T10694	电子产品制造与防静电系统防静电检测通用规范	静电消除器部分重复引用 IEC 61340-5-1 测试方法和电性能评价标准
SJ/T11446-2013	电子行业的离子化静电消除器通用规范	规定了离子化静电消除器的定义、产品结构分类、技术要求、测试方法、检验规则以及标识、使用说明、包装、运输和贮存。技术要求中加入了职业保护的内容。本标准是一个完全针对离子化静电消除器产品的标准，包括产品的评价标准、测试方法、检验方法。对于离子化静电消除器生产、检验、使用方面的选择都能起到指导作用，本标准比较全面、实用性、可操作性比较强。

4. Technical Requirement and Testing Methods

- B.5 Testing procedure
- B.5.1 Turn off the ionizing electrostatic eliminator for a blank test. Put the sampling instrument of air particle counter at the opposite of ionizing electrostatic eliminator exit with a distance of 15cm, test the TSP as a blank value.
- B.5.2 After no less than 5min of the ionizing electrostatic eliminator running, put the sampling instrument of air particle counter at the opposite of ionizing electrostatic eliminator exit with a distance of 15cm, test the TSP when the ionizing electrostatic eliminator is in the process of running.
- B.5.3 Deduct the blank value from the TSP, get the TSP occurred in the unit volume, with the formula as follows:

$$X = \frac{A_1}{V_1} - \frac{A_2}{V_2}$$

- In the formula,
- X --- TSP occurred when the ionizing electrostatic eliminator is working, with the unit of particles/m³
- A_1 --- number of suspended particles in the sampling air when the ionizing electrostatic eliminator is working, with the unit of particles;
- A_2 --- number of suspended particles in blank test, with the unit of particles;
- V_1 --- sampling volume of the air when the ionizing electrostatic eliminator is working, with the unit of m³;
- V_2 --- sampling volume in blank test, with the unit of m³.

Comparison of domestic and overseas standards

Name of standard	Main characteristics	Relevant content
ESD STM3.1	Standard methods	Have instructions on testing the ionizing electrostatic eliminator and ionizing static elimination system, no specific requirement for the electrical performance of static eliminator. Can only be adopted as a method.
ANSI/ESD S20.20	Evaluation standard of antistatic system	Including requirement for all the static controlling projects of EPA and static eliminator is only one of them with one electrical performance parameter. Focus on electrical performance of the projects, doesn't have instruction on occupational protection and other issues.
IEC 61340-5-1	Evaluation of antistatic system controlling electrostatic static elimination system	Including requirement for all the static controlling projects of EPA and the electrical performance requirement and testing methods for static eliminator is only one of them. Doesn't have instruction on occupational protection and other issues.
SJ/T10694	General specifications of antistatic inspection and testing methods for manufacturing and application systems of PCB products	The static eliminator section directly consulted IEC 61340-5-1 Testing Methods and Electrical Performance Evaluation Standard
SJ/T11446-2013	General specifications of ionizing electrostatic eliminator in electron industry	Stipulated the definition, structure category, technical requirement, testing methods, inspection and testing methods, occupational protection, safe transportation and storage of ionizing electrostatic eliminator. Occupational protection has been added into the technical requirement. This specification is a standard completely focus on ionizing electrostatic eliminators, including the evaluation standard, testing methods and inspection methods for the products. It can guide the production & inspection of ionizing electrostatic eliminator, and the selector of the user. This specification is pretty comprehensive, applicable and feasible.

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国内外标准对比

相关标准	关键性能符合性要求
ESD S20.20-2007	静电消散时间 用户自定 残余电压 < ± 50 volts
IEC 61340-5-1 SJ/T10694	静电消散时间 < 20 s 残余电压 < ± 50 volts

本规范

类型	类别	残余电压 U ₀ V
离子风机	A	≤5
	B	≤10
	C	≤30
离子风枪或风嘴	A	≤10
	B	≤30
	A	≤20
离子棒	A	≤20
	B	≤30

内部资料 不得外传

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Comparison of domestic and overseas standards

Relevant standards	Compliance requirements of key performance
ESD S20.20-2007	Static decay time User-defined Residual voltage <± 50 volts
IEC 61340-5-1 SJ/T10694	Static decay time <20s Residual voltage <± 50 volts

This specification

Specify the static elimination performance of ionizing electrostatic eliminator with different types and classify the electrostatic eliminator according to the static decay time <20s, residual voltage <± 50 volts. Ionizing air blower can be classified into 3 classes: A, B and C. Ionizing air gun, nozzle and bar can be classified into 2 classes: A and B. Such classification can provide more choices for producer and buyer and satisfy the need of antistatic work area.

Type	Class	Residual voltage U ₀ V
ionizing air blower	A	≤5
	B	≤10
	C	≤30
Ionizing air gun or nozzle	A	≤10
	B	≤30
	A	≤20
Ionizing bar	A	≤20
	B	≤30

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总结

- 本规范对离子化静电消除器产生的臭氧、电磁干扰、安全性能危害、噪声和洁净性能等都提供了相应的测试方法和参考标准、限值，目的是为行业生产提供更详细的试验操作规范，也为客户选择产品提供更好的依据。
- 本规范的制定可以为国内企业提供技术支持，同时对产品的生产和进入市场进行制约，有利于本行业的健康发展。同时本规范将产品涉及的自身功能、对环境设备的影响和对使用人员的保护等7项指标全部规定了技术要求、试验方法，使生产者将本规范用于生产时，对应达到的技术要求更加明确。

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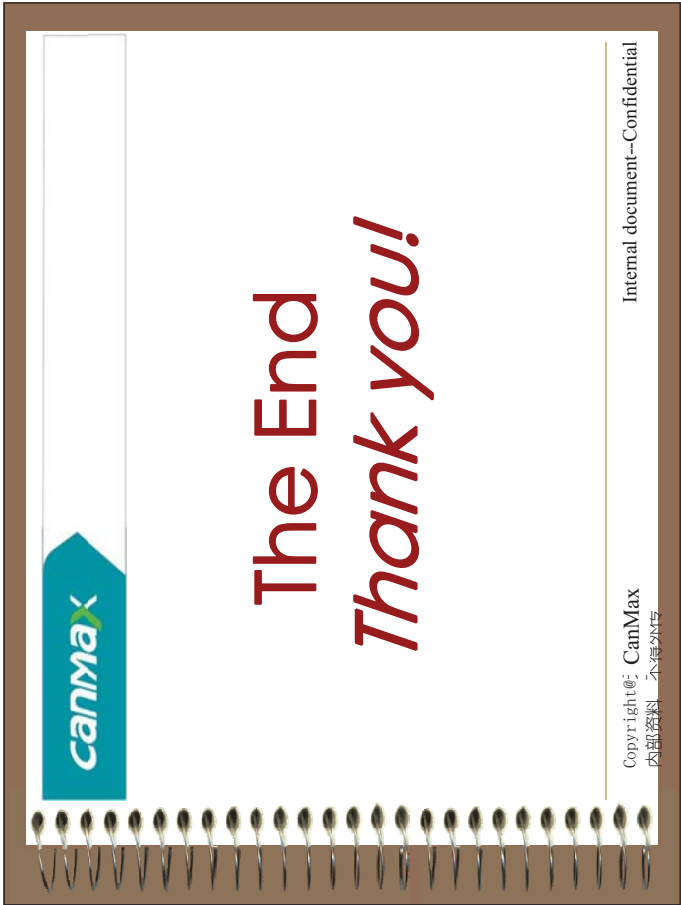
Conclusion

- This specification has provided corresponding testing methods and reference standards for the ozone, electromagnetic interference, harm to safety performance, noise and cleanliness with respect to ionizing electrostatic eliminators, aiming at providing a more specific testing operation specification for the industrial production and a better foundation for clients in selecting the products.
- The formulation of this specification can provide technical support for domestic enterprises and supervise & restrict the production and market access of this product, which is beneficial for a healthy industrial development. Furthermore, this specification has stipulated technical requirement and testing methods for 7 indexes, e.g. functions of the products, influence to the environment and equipment, protection of the user, etc., which makes it clear for the producer about the target technical requirement in the process of production.

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静电保护和标准化会议

20.20 项目进展- 接地

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ESDA 设施认证主席

ESD 协会

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Conference on Electrostatic Protection and Standardization

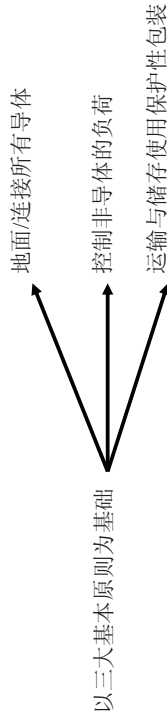
20.20 Program Development - Grounding

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ANSI/ESD S20.20



方案决定项目:

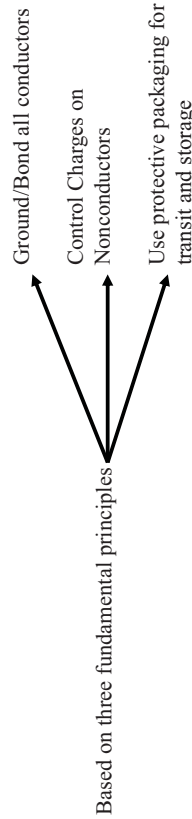
管理性要求

- 方案记录
- 训练方案
- 一致性验证方案

技术性要求

- 接地/连接
- 人员接地
- 保护区要求
- 包装要求

ANSI/ESD S20.20



The "Plan" defines program:

Administrative Requirements

- Documented Plan
- Training Plan
- Compliance Verification Plan

Technical Requirements

- Grounding/Bonding
- Personnel Grounding
- Protected Area Requirements
- Packaging Requirements

技术性要求

📍 ESD项目必须解决以下问题:

- A. 接地 / 连接系统
- B. 人员接地
- C. 设立ESD保护区域, 挑选包括绝缘材料在内的可选要素, 形成ESD保护
- D. 选择ESD保护性包装
- E. 如果必要的话, 选择标识 (产品/包装)

Technical Requirements

📍 The ESD program must address:

- A. Grounding / bonding systems
- B. Personnel grounding
- C. Establish an ESD protected area and select optional elements used to achieve ESD protection including a plan for “insulative” materials
- D. Address ESD protective packaging
- E. Determine if Marking (product/packaging) is required

A. 接地/ 连接系统

📍 根据ANSI/ESD S6.1-2009, 选择ESD接地/连接控制

- I. 电气系统的设备接地导体 (EGC)
- II. 辅助 (ESD) 接地
- III. 等电位 (等势) 连接

📍 依附于选择的参考点——决定公共接地点或公共连接点

📍 ESD接地系统电阻限值

📍 引入“2级”技术元件概念

- 📍 通过其他ESD控制元件接地的物件
- 📍 通过地板接地的推车/人员/椅子
- 📍 通过ESD工作表面毡接地的零件盒

A. Grounding / Bonding Systems

📍 Select ESD ground / bonding reference based on ANSI/ESD S6.1-2009

- I. Equipment grounding conductor (EGC) from the electrical system
- II. Auxiliary (ESD) ground
- III. Equipotential (Equal Potential) bonding

📍 Attaching to the selected reference point - define common point ground or common connection point

📍 ESD Grounding System Resistance Limits

📍 Introduced concept of “Level 2” Technical elements

- 📍 Items grounded THROUGH other ESD control elements
- 📍 Cart/person/chairs through floor
- 📍 Parts bin through ESD work surface mat

选择接地系统

📍 From ANSI/ESD S20.20 – 2007

表1：接地/等电位连接要求

技术要求	安装流程	测试方法	要求限值（s）
接地/连接系统	设备接地导体	ANSI/ESD S6.1	<1.0欧姆阻抗
	辅助接地	ANSI/ESD S6.1	至设备接地导体间，<25欧姆
	等电位连接	ANSI/ESD S6.1	<1.0x10 ⁹ 欧姆 ¹

¹任何ESD技术元件与公共接地点之间的最大电阻

Select Grounding Systems

📍 From ANSI/ESD S20.20 - 2007

Table 1. Grounding / Equipotential Bonding Requirements

Technical Requirement	Implementing Process	Test Method	Required Limit(s)
Grounding / Bonding System	Equipment Grounding Conductor	ANSI/ESD S6.1	< 1.0 ohm impedance
	Auxiliary Ground	ANSI/ESD S6.1	< 25 ohms to the Equipment Grounding Conductor
	Equipotential Bonding	ANSI/ESD S6.1	< 1.0 x 10 ⁹ ohms ¹

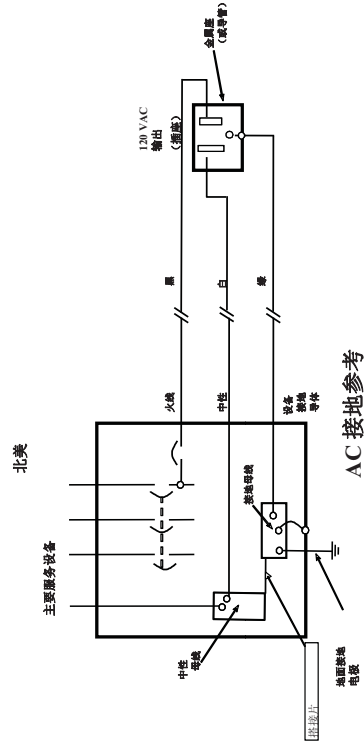
¹ The maximum resistance between any ESD technical element and the common connection point.

设备接地导体

EQUIPMENT GROUNDING
CONDUCTOR

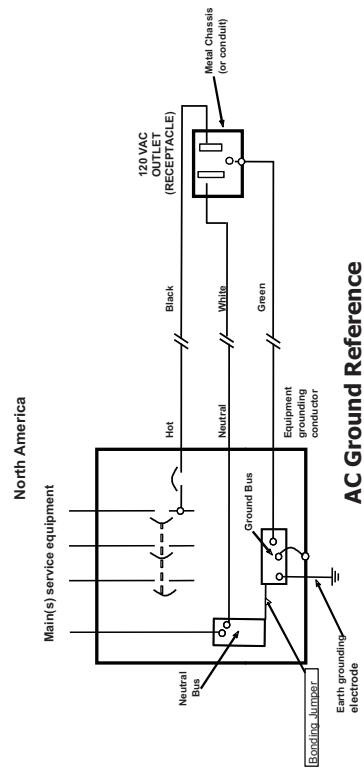
选择一个ESD参考点

I. 设备（AC）接地



Select an ESD reference point

I. Equipment (AC) Ground



设备（AC）接地

- 测试要求 – 电气系统
 - 保证有中性线和设备接地线，但是不在插座处相连
 - 保证火线和中心线没有接反
 - 保证存在火线和接地线，但是没有接反
 - 设备接地导体的阻抗小于1欧姆

Equipment (AC) Ground

- Test requirements - Electrical System
 - Ensure neutral and equipment ground wires present but not connected at outlet
 - Ensure hot and neutral wires not reversed
 - Ensure hot and ground are present and not reversed
 - Impedance of the equipment grounding conductor less than 1 ohm

测试设施/设备接地



To Test Facility/Equipment Ground



测量接地导体电压



To Measure Voltage on Ground Conductor



测量接地导体阻抗



To Measure Ground Conductor Impedance



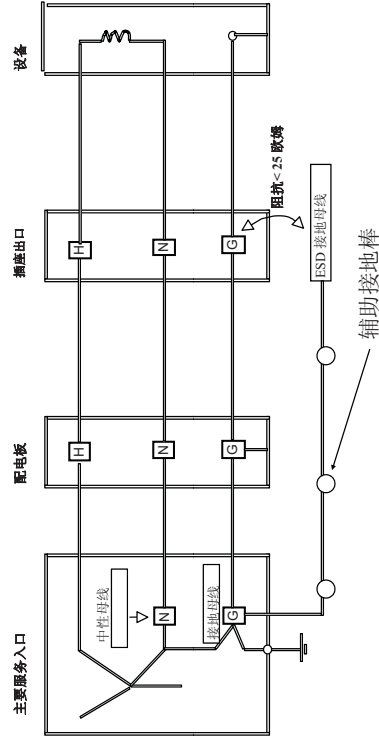
辅助接地

AUXILIARY GROUND

选择一个ESD参考点

II. 辅助接地

辅助接地 – “使用单独的补充接地导体，而不是通用的设备接地”



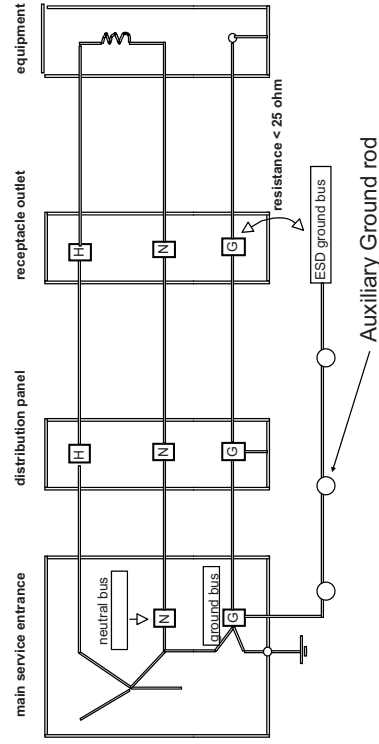
辅助接地

- 测试要求
 - 测试必须包含AC接地测试
 - 辅助接地到设备接地导体之间的DC电阻必须小于25欧姆（北美电气标准）
 - 符合当地特殊标准要求

Select an ESD reference point

II. Auxiliary Ground

Auxiliary Ground – “a separate supplemental grounding conductor for use other than general equipment grounding.”



Auxiliary Ground

- Test requirement
 - Tests must still be made to verify AC ground
 - DC resistance measurement from auxiliary ground to Equipment Grounding Conductor must be less than 25 ohms (North American Electric Code)
 - Use your country specific requirements

设备连接

在没有接地的情况下，连接ESD控制部件

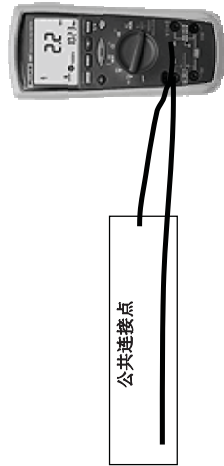
EQUIPOTENTIAL BONDING

Bonding of ESD control Items together without a ground connection

选择一个ESD参考点

III. 等电位连接

等电位 – “具有相同的电势，或统一的势能”
没有接地的情况下使用

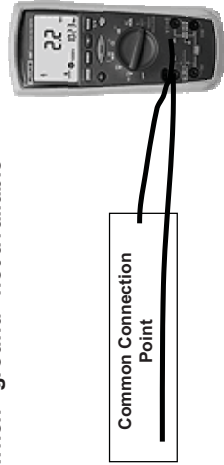


$R_{CCP} < 1 \text{ 欧姆}$

Select an ESD reference point

III. Equipotential Bonding

Equipotential – “having the same electrical potential; of uniform potential throughout”
Used when “ground” not available



$R_{CCP} < 1 \text{ ohm}$

等电位连接示范



Equipotential Bonding Example



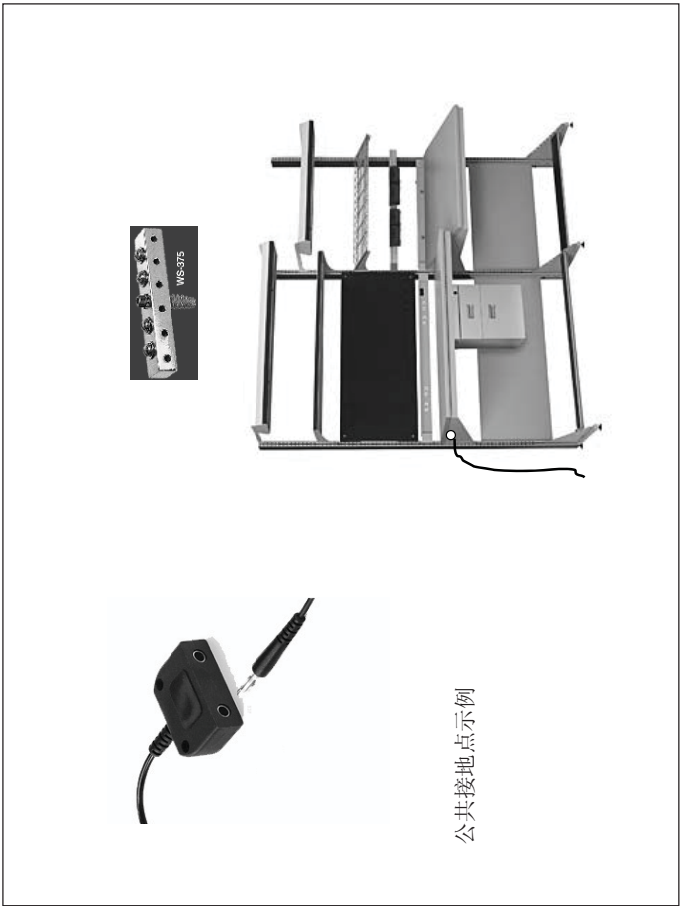
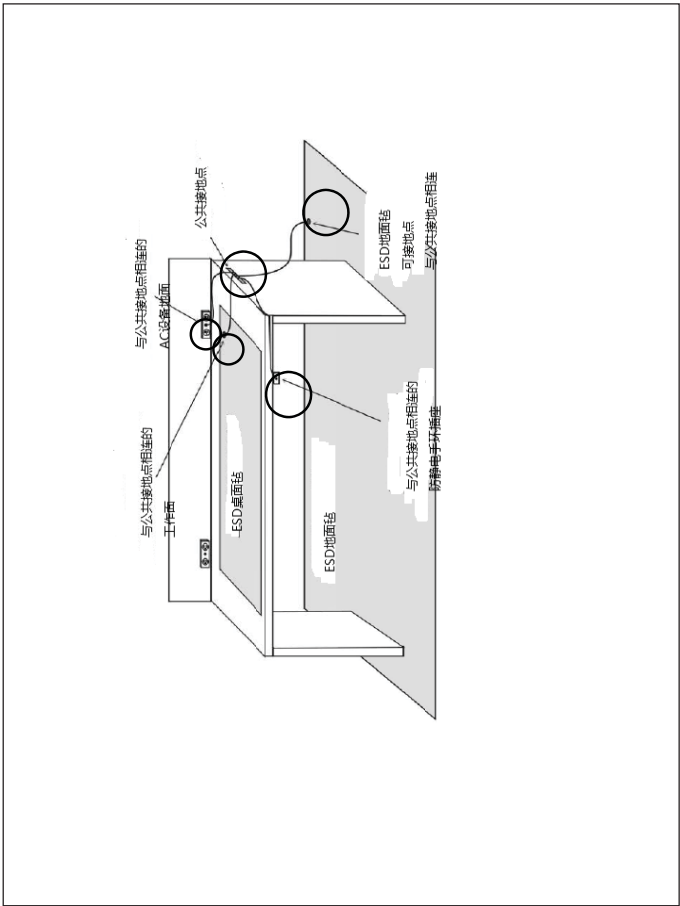
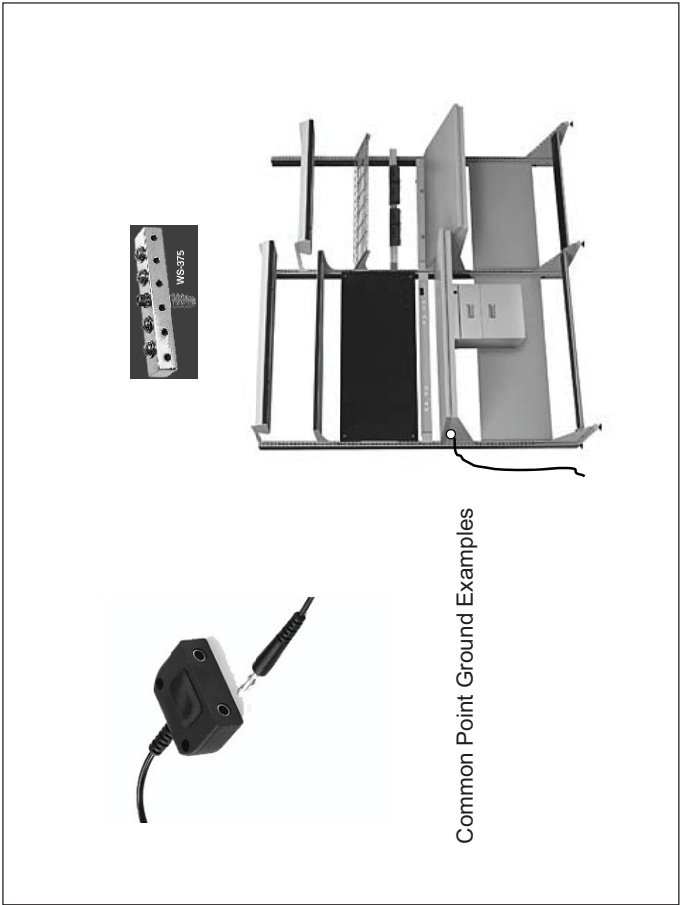
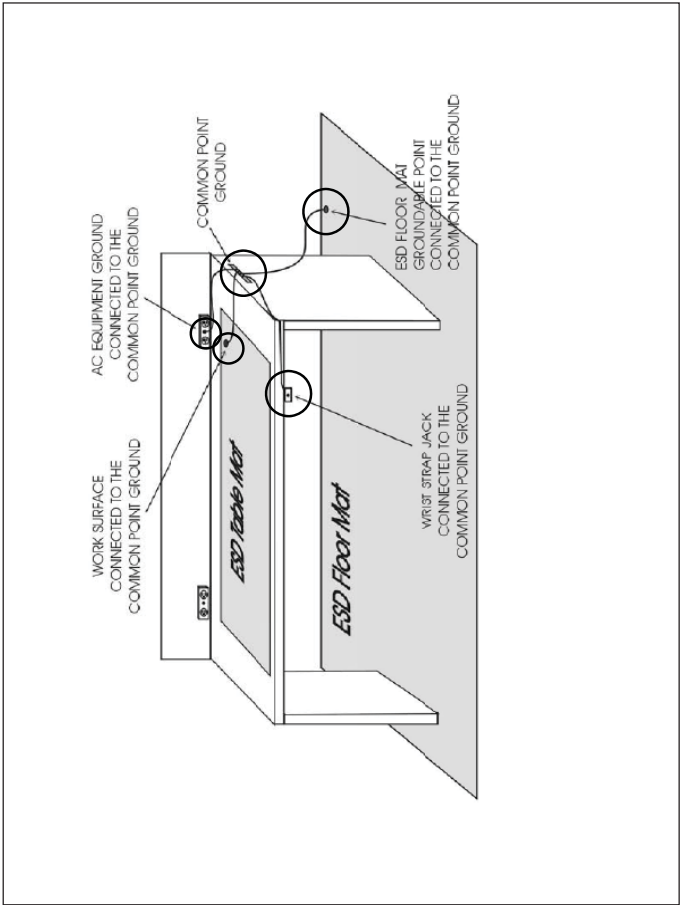
依附选择的ESD参考点

- 公共接地点（CPG）
 - 定义（ANSI/ESD S6.1-2005）：
 - “连接有一个或多个技术元件导体的接地设备或地点。”
- 适用于AC或辅助接地参考
- 要求：
 - “同一个ESD中的ESD技术元件（除了2级技术元件）的所有接地导体将终止在电势相同的同一点上。”
 - “电势相同”是指电气相连的点与点之间阻抗小于1欧姆。
 - 例如：接线板、完整的防静电手环/ESD毡连接器、金属工作站框架。

Attaching to Selected ESD Reference

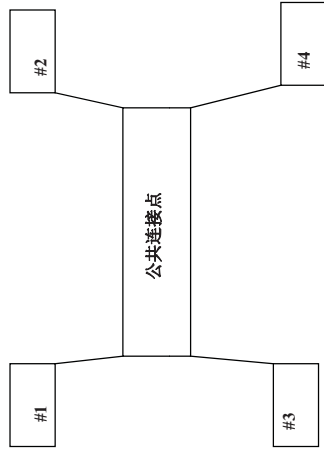
- Common Point Ground (CPG)
 - Definition (ANSI/ESD S6.1-2005):
 - “A grounded device or location where the conductors of one or more technical elements are bonded.”
- Applies to AC or Auxiliary ground references
- Requirement:
 - “All of the grounding conductors from each of the ESD technical elements (excluding level 2 technical elements) used within an EPA shall be terminated to the same electrically equivalent point.”
 - “Electrically equivalent” is defined as electrically continuous with a point to point resistance of less than 1 ohm.
 - Examples – terminal block, integral wrist strap / ESD mat connector, metal workstation frame

讲演题目6/Topic6



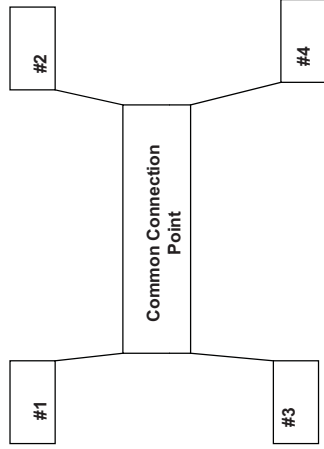
依附于挑选的ESD参考点

- 等电位连接



Attaching to Selected ESD Reference

- Equipotential bonding

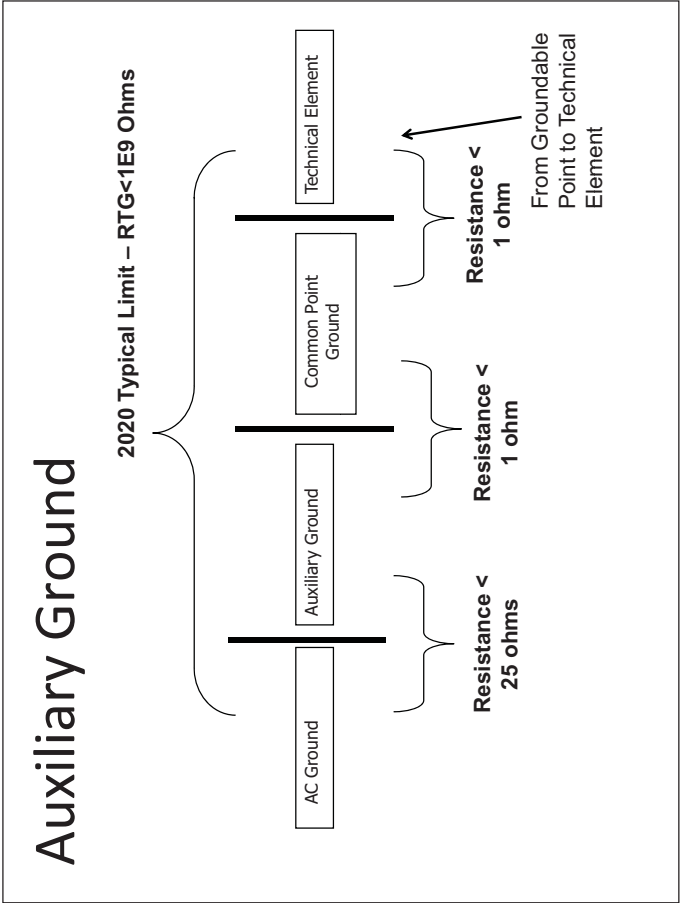
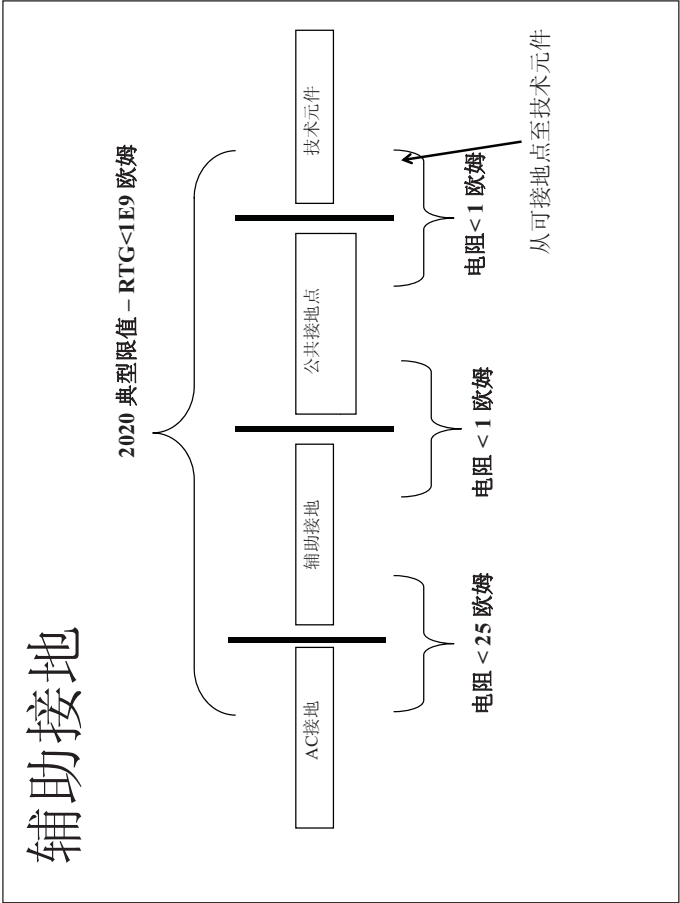
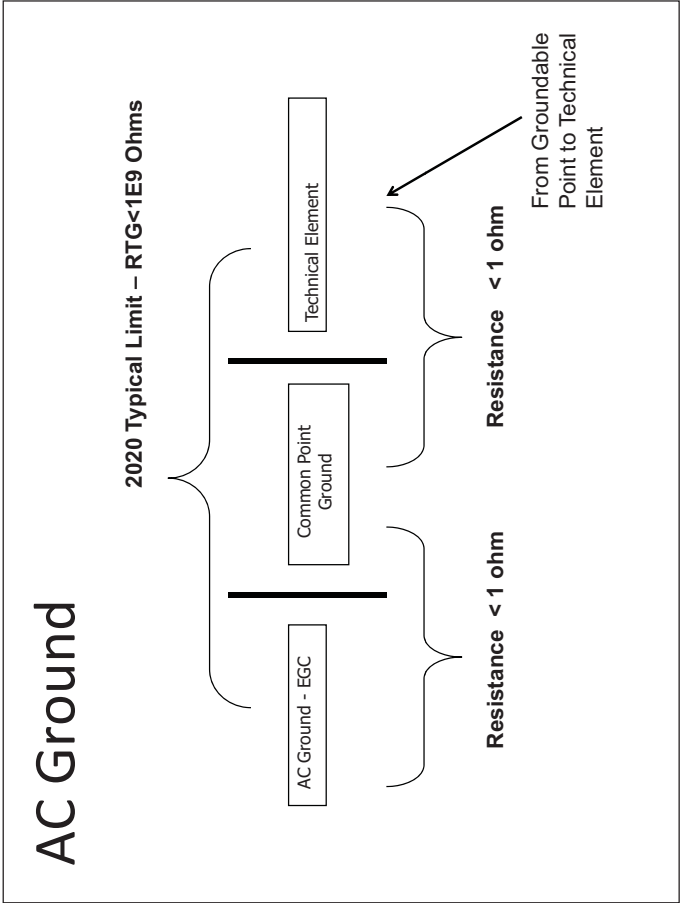
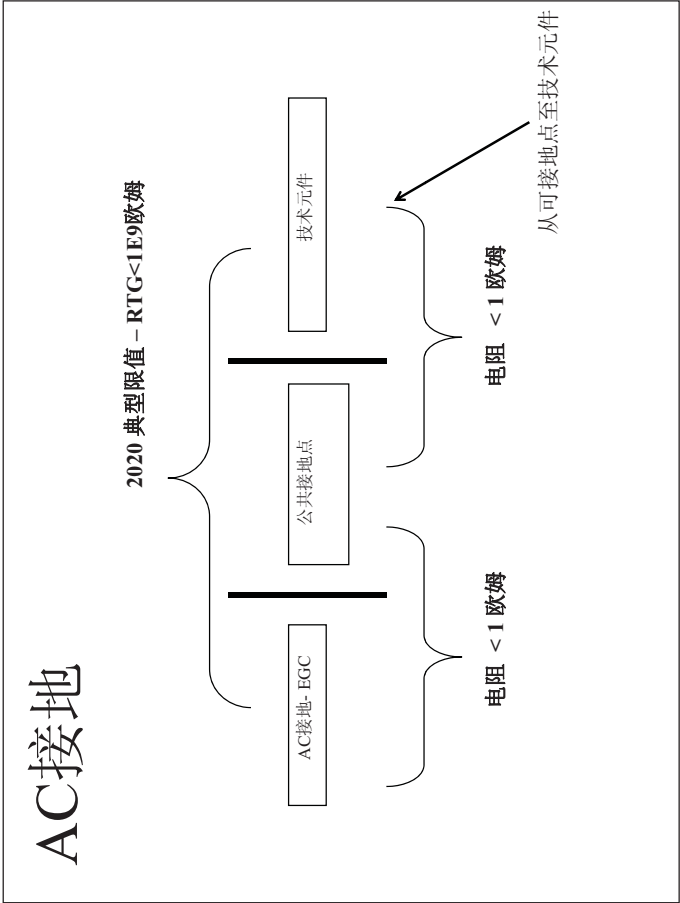


系统阻抗限值

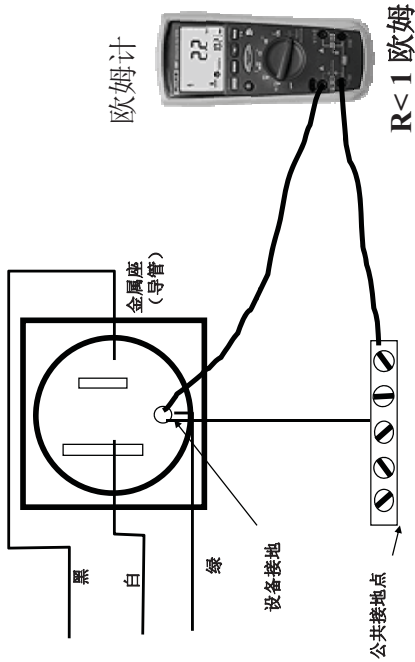
- 接地导体
 - 至CPG的技术元件
 - CPG至AC接地
 - CPG至辅助接地
 - 等电位连接
- 2020 典型RTG要求

System Resistance Limits

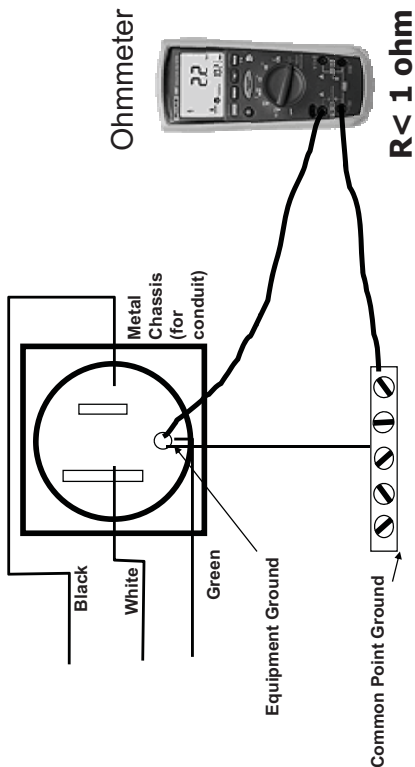
- Grounding conductors
 - Technical element to CPG
 - CPG to AC Ground
 - CPG to Auxiliary Ground
 - Equipotential bonding
- 2020 typical RTG requirements



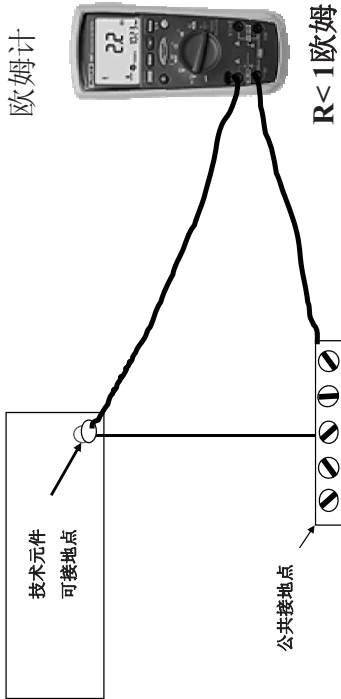
阻抗测量



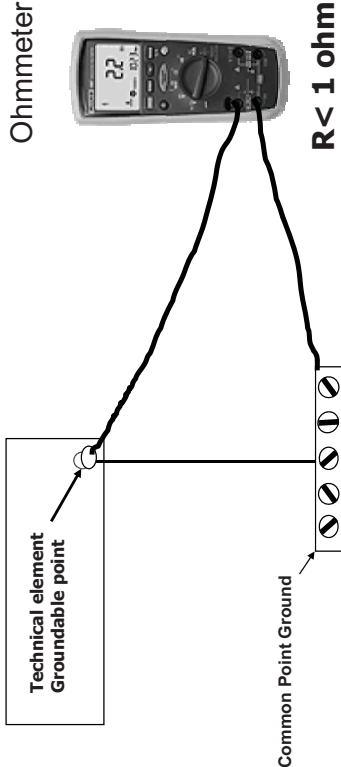
Resistance Measurements



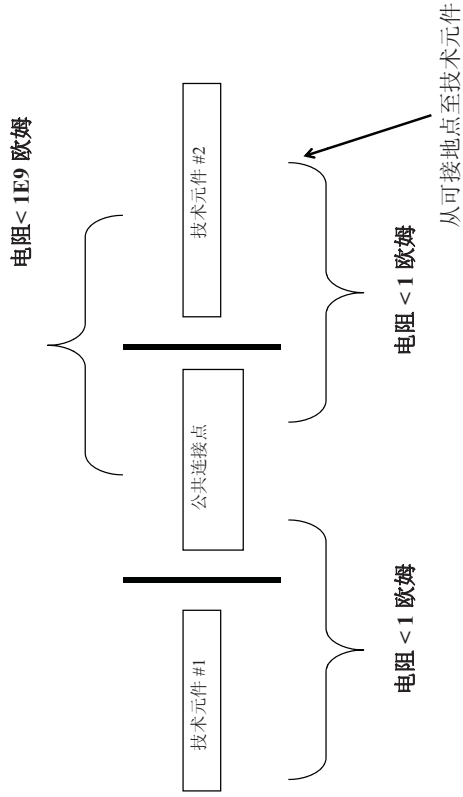
阻抗测量



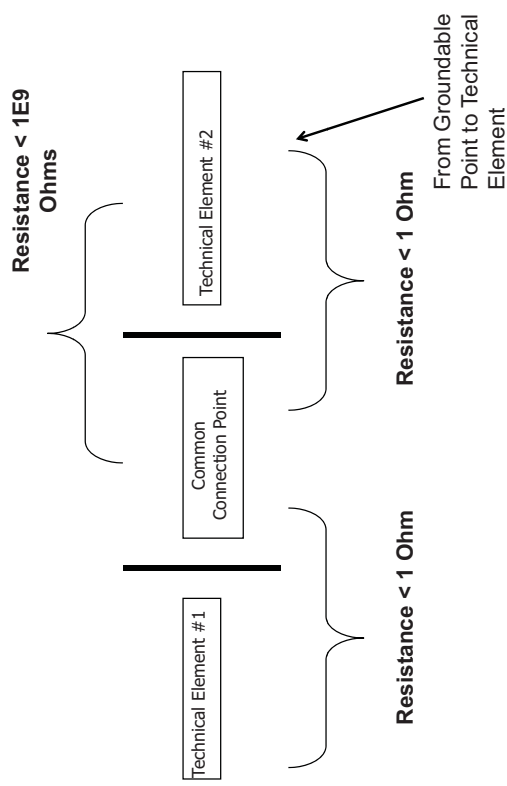
Resistance Measurement



等电位连接



Equipotential Bonding

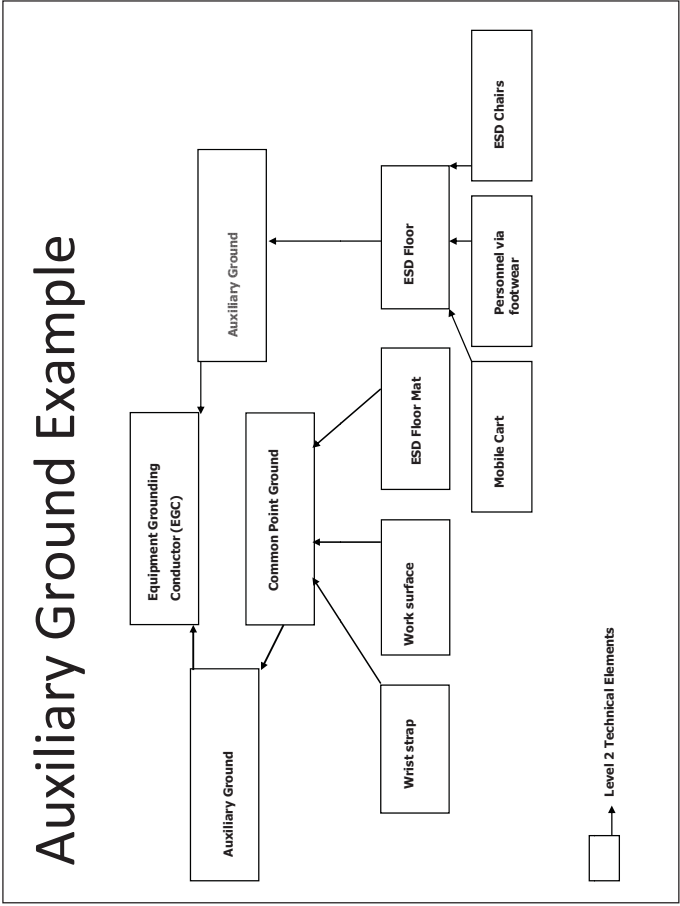
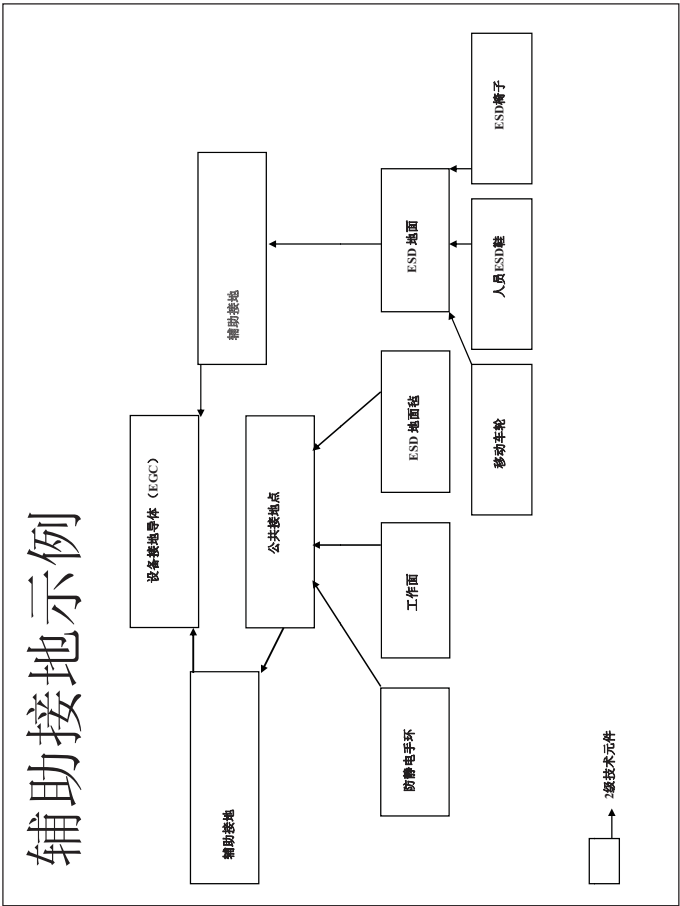
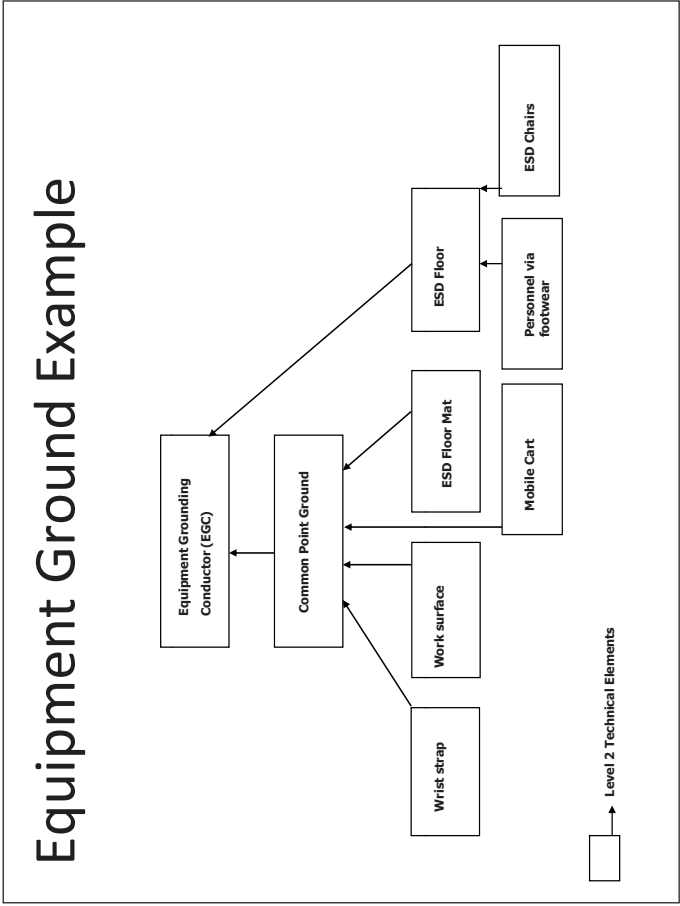
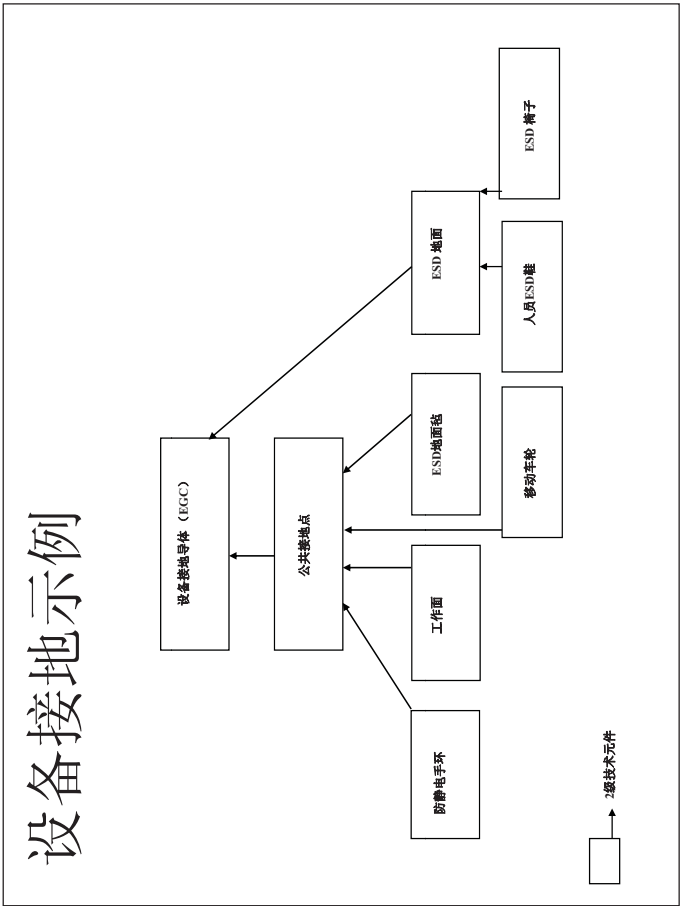


2级技术元件

- 2级元件是指依赖于1级ESD技术元件运作的元件
 - 2级元件一般通过ESD面与选定的接地系统相连
- 例如：
 - 装有导电车轮或牵引链的推车
 - 穿着ESD鞋的人

Level 2 Technical Element

- Level 2 Items include those that rely on contact to a primary ESD technical element to function
 - Level 2 Items are typically connected to the selected grounding system via an ESD floor
- Examples are:
 - Cart with conductive wheels or drag chain
 - People with ESD Footwear



第2部分：技术性要求

● ESD 项目必须解决以下问题：

1. 接地 / 连接系统
2. 人员接地
3. 设立ESD保护区，挑选可选元素，形成ESD保护
- a. 开发“绝缘”材料方案
4. 选择ESD保护包装
5. 如果必要的话，选择标识（产品/包装）

Part 2 - Technical Requirements

● The ESD program must address:

1. Grounding / bonding systems
2. Personnel grounding
3. Establish an ESD protected area and select optional elements used to achieve ESD protection
 - a. Develop a plan for “insulative” materials
4. Address ESD protective packaging
5. Determine if Marking (product/packaging) is required

● 人员接地

● 目的/技术目标

- 使用所选的接地参考点，将与ESDS接触的人员所承载负荷转移
- 保持项目中最敏感ESD器件的HBM阈值下所产生的身体电压

● Personnel Grounding

● Purpose/Technical Objectives

- Remove charge from personnel who come into contact with ESDS through attachment to selected ground reference
- Keep the generated body voltage under the HBM threshold of the most ESD sensitive item used in the program

📍 人员接地（续）

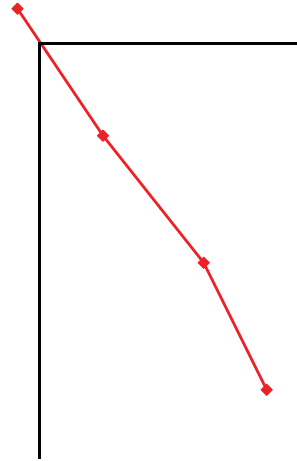
- 📍 考虑/ 事件
- 📍 ANSI/ESD S20.20要求:
 - 📍 在操作ESD敏感设备时，所有人员必须联结在一起，或以电气方式接地。
 - 📍 在坐着操作ESDS的时候，工作人员必须通过防静电手环接地。
 - 📍 ESD程序设计须保证能够保护HBM ESD敏感度大于等于100伏特的设备。
 - 📍 这就要求项目经理懂得“系统”的操作性能。
 - 📍 3.5×10^7 欧姆从哪里来？
 - 📍 它与ANSI/ESD S20.20有什么关系？

📍 Personnel Grounding (continued)

- 📍 Considerations/ Issues
- 📍 ANSI/ESD S20.20 Requirements:
 - 📍 All personnel shall be bonded together or electrically connected to ground when handling ESD sensitive devices.
 - 📍 When seated, personnel handling ESDS shall be grounded via a wrist strap
 - 📍 ESD processes are to be designed to protect devices with an HBM ESD sensitivity of ≥ 100 volts.
 - 📍 This requires the program manager to understand how the “system” performs.
 - 📍 Where did 3.5×10^7 ohms come from?
 - 📍 How does it relate to ANSI/ESD S20.20

人员接地指南

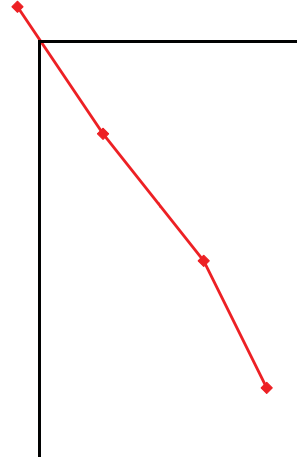
身体电压



阻抗（兆欧）
适用于所有人员接地的情况

Personnel Grounding Guideline

Body Voltage



Resistance (megohms)
Applies to all personnel grounding situations

人员接地阻抗

人员接地		一致性验证	
技术要求	产品标准1	测试方法	要求限值
防静电手环系统2	ANSI/ESD S1.1	ESD TR53 防静电手环章节	$< 3.5 \times 10^7$ ohms
地板/鞋子系统 --方法1	ANSI/ESD STM97.1	ESD TR53 地板章节 ESD TR53 鞋子章节	$< 3.5 \times 10^7$ ohms
地板/鞋子系统 --方法2 (所需装置)	ANSI/ESD STM97.1 ANSI/ESD STM97.2	ESD TR53 地板章节 ESD TR53 鞋子章节	$< 1.0 \times 10^6$ ohms $< 1.0 \times 10^6$ ohms

1 产品标准一般在ESD产品和材料控制初始阶段的时候就要进行控制。可以使用下列任一方法：产品标准重量、独立实验室评估或内部实验室评估

2 当ESD使用防静电手环接地途径的一部分时，整个系统的阻抗（包括人员、衣服和地板等）必须小于 3.5×10^7 欧姆

Personnel Resistance to Ground

Table 2. Personnel Grounding Requirement

Personnel Grounding Technical Requirement	Product Qualification ¹		Compliance Verification	
	Test Method	Required Limit(s)	Test Method	Required Limit(s)
Wrist Strap System ²	ANSI/ESD S1.1 (Section 5.11)	$< 3.5 \times 10^7$ ohms	ESD TR53 Wrist Strap Section	$< 3.5 \times 10^7$ ohms
Flooring / Footwear System – Method 1	ANSI/ESD STM97.1	$< 3.5 \times 10^7$ ohms	ESD TR53 Flooring Section	$< 3.5 \times 10^7$ ohms
Flooring / Footwear System – Method 2 (both required)	ANSI/ESD STM97.1 ANSI/ESD STM97.2	$< 10^6$ ohms < 100 volts	ESD TR53 Flooring Section ESD TR53 Footwear Section	$< 1.0 \times 10^6$ ohms $< 1.0 \times 10^6$ ohms

¹ Product qualification is normally conducted during the initial selection of ESD control products and materials. Any of the following methods can be used: product specification review, independent laboratory evaluation or internal laboratory evaluation.

² For situations where an ESD garment is used as part of the wrist strap grounding path, the total system resistance including the person, garment and grounding cord shall be less than 3.5×10^7 ohms.

人员接地（续）

- 工作人员可通过以下两种方式接地：
 - 防静电手环系统
 - 鞋子 / ESD地板

选择取决于经济和流程要求

- 成本
- 人员流动性
- 所操作产品的ESD 敏感性

Personnel Grounding (continued)

- Personnel can be grounded via one of two methods:
 - Wrist strap system
 - Footwear / ESD flooring

Option chosen depends on financial and process requirements

- Cost
- Mobility of personnel
- ESD sensitivity of product being handled

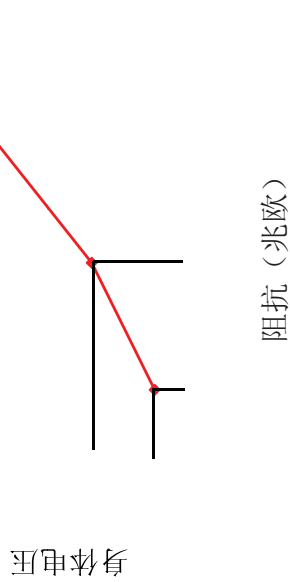
人员接地（续）

- 防静电手环系统
 - 赞成：
 - 易于使用，值得信赖
 - 低RTG保证超敏感设备的安全使用
 - 相对便宜
 - 如果必要的话，可持续监测
 - 员工遵守程度的可视化指示
 - 反对：
 - 限制人员流动
 - 每日记录和相关记录保持（如果不使用持续监测的话）
 - 依赖于员工正确使用和佩戴

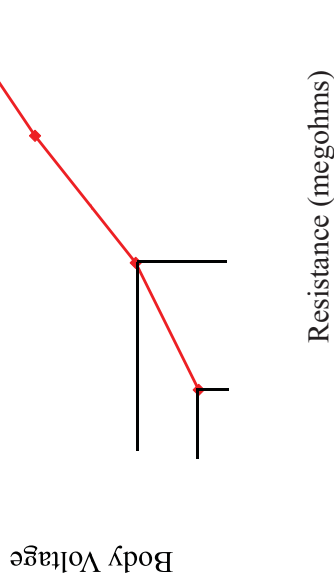
Personnel Grounding (continued)

- Wrist strap system
 - Pros:
 - Easy to use and reliable
 - Low RTG allows safe handling of ultra-sensitive devices
 - Relatively inexpensive
 - Can be used for constant monitoring when required
 - Visual indication of employee compliance
 - Cons:
 - Restricts personnel mobility
 - Daily logging and associated record keeping (if constant monitors not used)
 - Reliance on employees to use and wear properly

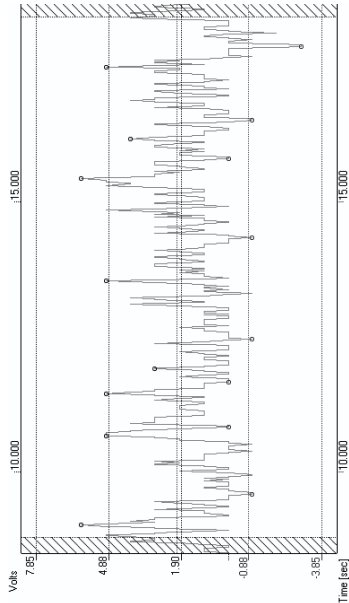
人员接地指南



Personnel Grounding Guideline



防静电手环性能



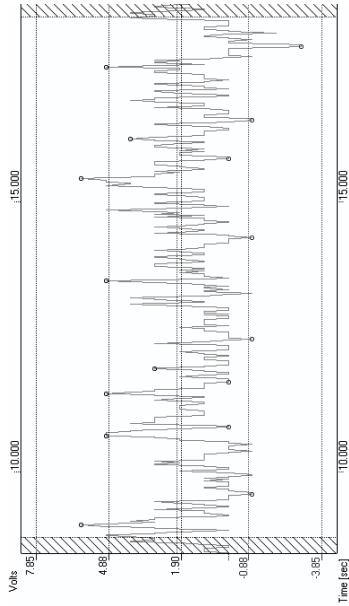
站立可能性

电压 [V]	0.88	1.87	2.86	3.85	4.84	5.83	6.82
几率 [%]	50.00	15.87	2.28	0.13	0.00	0.00	0.00

行走可能性

电压 [V]	1.90	2.89	3.88	4.88	5.87	6.86	7.85
几率 [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

Wrist Strap Performance



Standing Probability

Voltage [V]	0.88	1.87	2.86	3.85	4.84	5.83	6.82
Probability [%]	50.00	15.87	2.28	0.13	0.00	0.00	0.00

Walking Probability

Voltage [V]	1.90	2.89	3.88	4.88	5.87	6.86	7.85
Probability [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

防静电手环接地

有时候，员工会觉得接触ESD毡边缘比将防静电手环棒与公共接地点相连更容易

- 接地阻抗是否改变？
- 这对身体电压是否有不良影响？



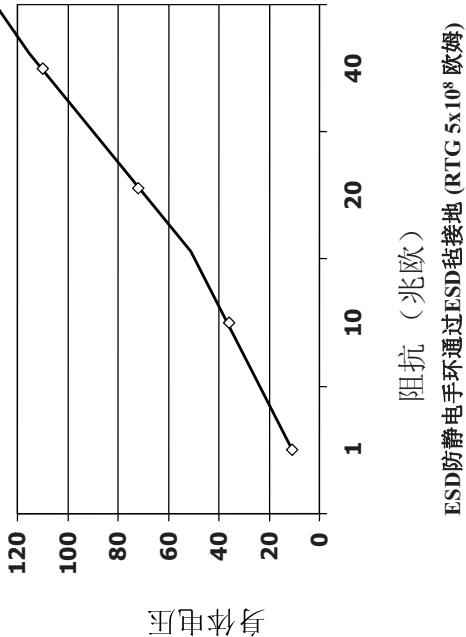
Wrist Strap Grounding

Instead of taking the wrist cord connection to common point ground, employees sometimes find it easier to “clip” to the edge of the ESD mat

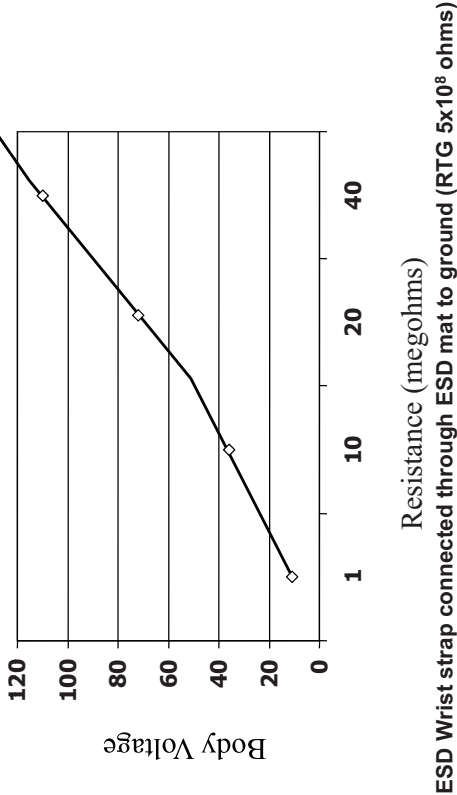
- Does the Resistance to ground change?
- Will this have a negative effect on body voltage?



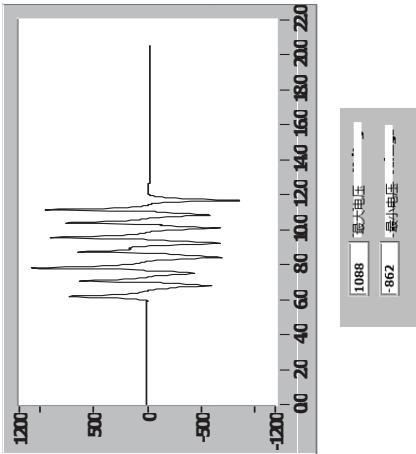
人员接地指南



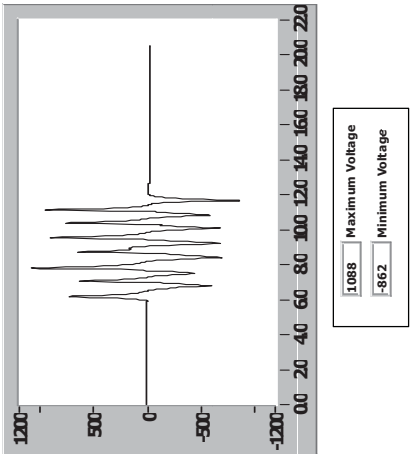
Personnel Grounding Guideline



防静电手环接地



Wrist Strap Grounding



人员接地（续）

- 静电控制鞋
 - 赞成：
 - 员工流动性和舒适性
 - 降低ESDS进程内包装需求
 - 反对：
 - 成本（取决于实地情况，如强制性安全鞋使用）
 - 性能变化大。只能通过测试来确定处理能力
 - 员工不经允许使用内插物，如矫正鞋垫或除臭剂
 - 使用类型须考虑到所安装的地板

Personnel Grounding (continued)

- Static control footwear
 - Pros:
 - Employee mobility and comfort
 - Can reduce need for in-process packaging of ESDS
 - Cons:
 - Cost (depends on situation i.e. mandatory safety shoe use)
 - Widely varying performance. Can't predict process capability without testing
 - Low humidity problems – dry skin, thick socks
 - Employee unauthorized use of shoe inserts – orthotics, odor eaters
 - Type used can be dictated by installed flooring

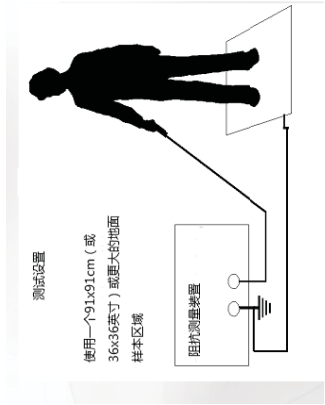
鞋子/地板接地

- 站立操作
 - 操作ESDS时，是否需要走动？
 - 这将决定所需穿的鞋子类型？
 - 鞋跟/趾夹带、脚底滚地鞋或ESD鞋
 - 必须进程测试，以了解整个系统在最恶劣环境条件下的性能：
 - 零件测试—地板和ESD鞋-S7.1和STM 9.1 / STM 9.2
 - 鞋子和地板的系统级别测试– STM 97.1和STM 97.2

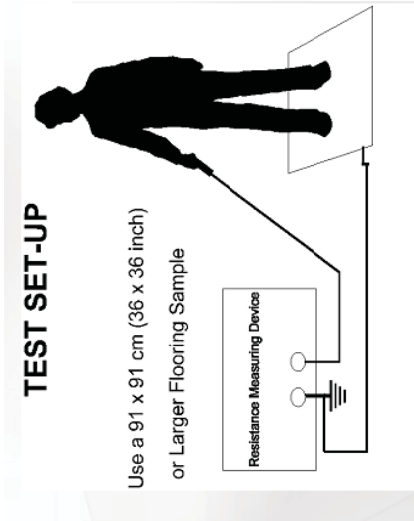
Footwear/Flooring Grounding

- Standing Operations
 - Is Mobility required while handling ESDS?
 - This will determine the type of footwear that is required?
 - Heel/toe straps, sole grounders or ESD shoes
 - Testing mandatory to understand the entire “system” under worst case environmental conditions:
 - Component testing – floors and ESD footwear - S7.1 and STM 9.1 / STM 9.2
 - System level testing of footwear and flooring– STM 97.1 and STM 97.2

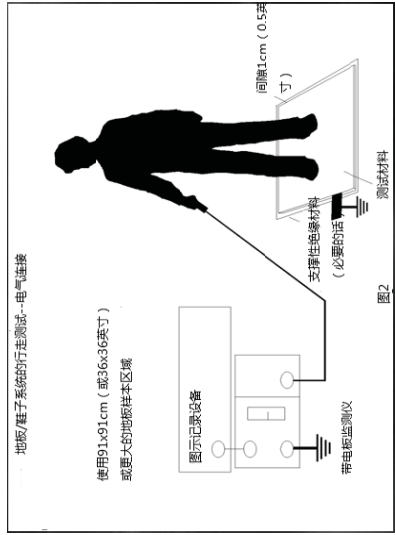
ESD STM 97.1



ESD STM 97.1



ESD STM 97.2



Electrical Connection for Flooring/ Footwear System Walking Test

Use a 91 x 91 cm (36 x 36 inch) or larger Flooring Sample

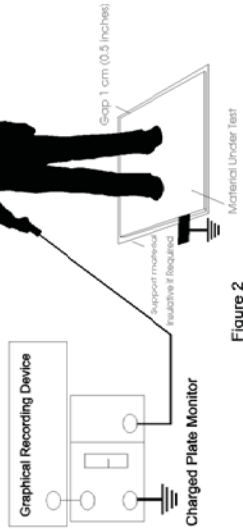
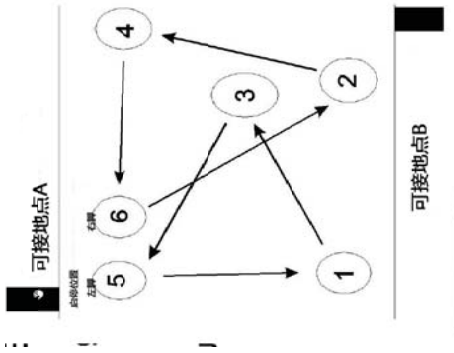


Figure 2

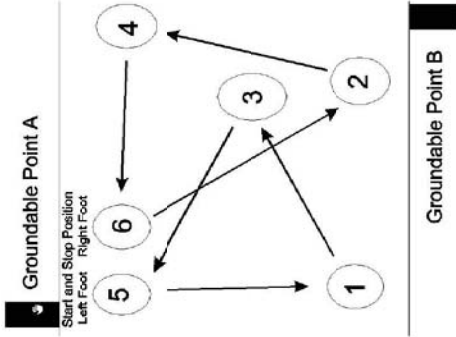
ESD STM 97.2

行走模式



ESD STM 97.2

Walking Pattern



人员接地示例:

- 公司已经安装导电ESD地板。
- 如果必要的话，员工可以边操作ESDS，边移动。
- ESD项目设计意在保护100瓦特的HBM敏感设备
- 项目经理调查了三种鞋子方案：
 - 1号选择 - ESD 鞋子 - 常用
 - 2号选择 - ESD调节带
 - 3号选择 - ESD鞋子

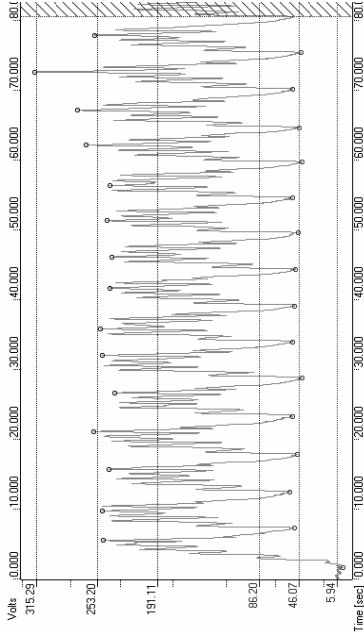
该选择哪种?

- ESD鞋子价格大约为80美元/一双
- ESD 调节带为12美元/一双 (管理层选择)

Personnel Grounding Examples:

- Company has an already installed, conductive ESD floor.
- Employee mobility while handling ESDS required.
- ESD Program designed to protect 100 volt HBM sensitive devices
- Program manager investigates (3) footwear options:
 - Option #1 - ESD footwear - commonly used shoe
 - Option #2 - ESD Heel straps
 - Option #3 - ESD footwear
- Which option should be chosen?
 - ESD footwear pricing approximately \$80/pair
 - ESD heel straps - \$ 12/pair (Management's choice)

1号ESD鞋子在导电地板上



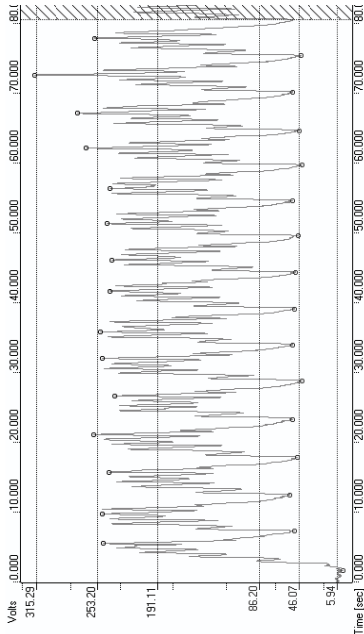
站立电压

电压 [V]	5.94	19.31	32.69	46.07	59.44	72.82	86.20
几率 [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

行走电压

电压 [V]	191.11	211.81	232.50	253.20	273.90	294.59	315.29
几率 [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

ESD shoe #1 on a conductive floor



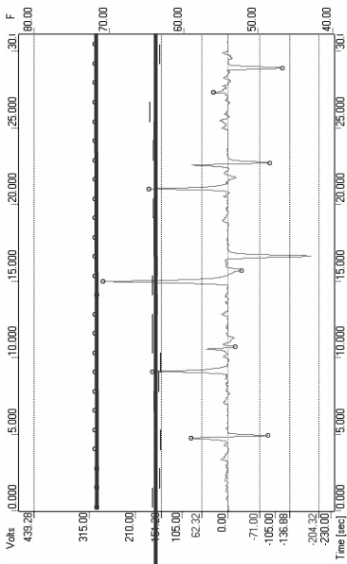
Standing Voltage

Voltage [V]	5.94	19.31	32.69	46.07	59.44	72.82	86.20
Probability [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

Walking Voltage

Voltage [V]	191.11	211.81	232.50	253.20	273.90	294.59	315.29
Probability [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

(2) 调节带在导电地板上



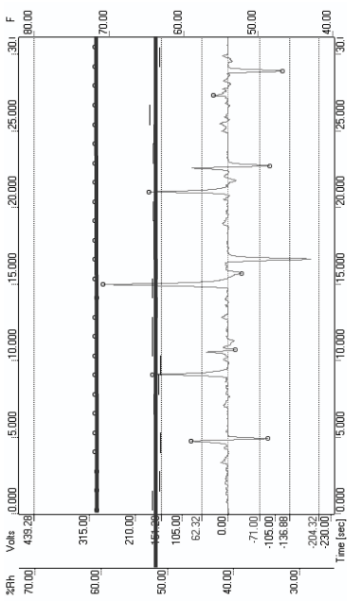
站立电压

电压 [V]	26.56	71.00	115.44	159.88	204.32	248.76	293.21
几率 [%]	84.13	50.00	15.87	2.28	0.13	0.00	0.00

行走电压

电压 [V]	55.17	151.20	247.23	343.25	439.28	535.31	631.34
几率 [%]	84.13	50.00	15.87	2.28	0.13	0.00	0.00

(2) Heel straps on a Conductive Floor



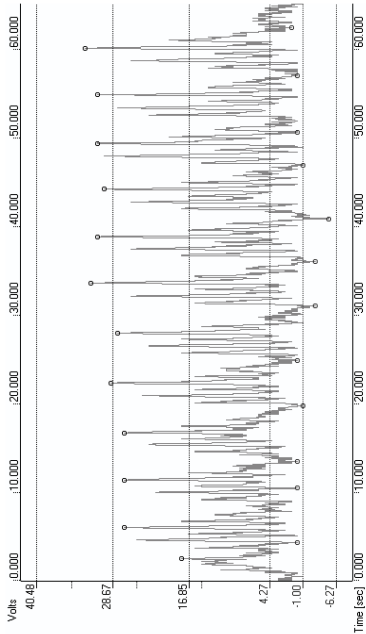
Standing Voltage

Voltage [V]	26.56	71.00	115.44	159.88	204.32	248.76	293.21
Probability [%]	84.13	50.00	15.87	2.28	0.13	0.00	0.00

Walking Voltage

Voltage [V]	55.17	151.20	247.23	343.25	439.28	535.31	631.34
Probability [%]	84.13	50.00	15.87	2.28	0.13	0.00	0.00

2号ESD 鞋子在导电地板上



站立电压

电压 [V]	1.00	2.76	4.52	6.27	8.03	9.79	11.55
几率 [%]	50.00	15.87	2.28	0.13	0.00	0.00	0.00

行走电压

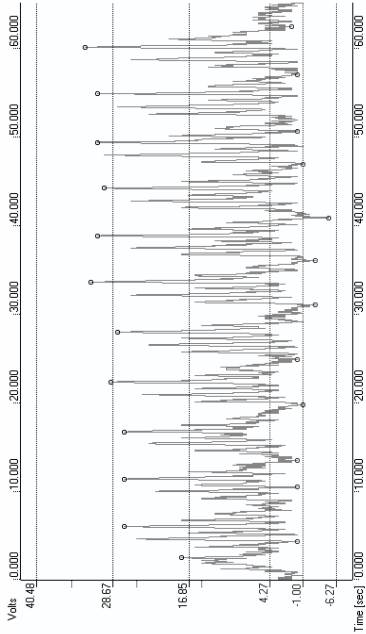
电压 [V]	16.85	20.79	24.73	28.67	32.61	36.54	40.48
几率 [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

人员接地

总结

- 操作ESDS的员工必须接地
- 坐着操作的员工必须佩戴防静电手环
- 须进行移动操作系统阻抗和行走测试（STM 97.1 / STM 97.2），保证ESDS得到恰当的保护。

ESD shoe #2 on a conductive floor



Standing Voltage

Voltage [V]	1.00	2.76	4.52	6.27	8.03	9.79	11.55
Probability [%]	50.00	15.87	2.28	0.13	0.00	0.00	0.00

Walking Voltage

Voltage [V]	16.85	20.79	24.73	28.67	32.61	36.54	40.48
Probability [%]	99.87	99.72	84.13	50.00	15.87	2.28	0.13

Personnel Grounding

Summary

- Employees handling ESDS must be grounded
- Wrist straps are required for seated operations
- For mobile operations system resistance and walking tests (STM 97.1 / STM 97.2) should be conducted to ensure that the ESDS are adequately protected.

STRI

兵器工业静电危害与控制现状

兵器工业静电安全技术研究所

STRI

Electrostatic Hazards and Control Status of Ordnance Industry

Electrostatic Test Center of Safety Technique
Research Institute of Ordnance Industry

一、静电危害机理

静电危害的本质，是静电电荷的积累导致对周围物质或产品产生不希望的结果，工业生产中静电危害主要表现在两方面：一是导致电子器件或设备的损坏（包括对信息系统的干扰），二是造成易燃易爆物质的燃烧爆炸。

I. Electrostatic Hazard Mechanism

- The essence of electrostatic hazards refers to undesirable consequences on the peripheral substances or products caused by the accumulation of electrostatic charges. Electrostatic hazards in industrial production mainly consist of:
 - 1) cause damage to electronic devices or equipment (including interference to the information system); and
 - 2) cause combustion and explosion of flammable substances.

兵器工业行业生产涉及火炸药、弹药、火工品、引信的生产制造、运输和存储，因此，防止燃烧爆炸事故是最重要的安全工作。

The production of Ordnance Industry involves the manufacturing, transport and storage of explosives, ammunition, initiating explosive devices and fuzes, therefore, it is vitally important to prevent combustion explosion accident with regard to safety protection.

静电对电子器件的危害，一般是静电荷产生的高电压（强电场）导致器件内部击穿，而对火炸药等燃烧爆炸品的危害机理，是静电放电能量导致危险品意外点火，发生燃烧爆炸事故，因此，这两种场所静电危害的机理不同，其关键参数也不同。

In general, electrostatic damage to electronic devices is caused by the internal breakdown in the device due to the high voltage generated by electrostatic charge (strong electric field). However, with respect to the hazard mechanism of explosives and other combustion explosive materials, it is mainly caused by the inadvertent ignition of hazardous article due to the electrostatic discharge energy, thereby resulting in combustion explosion accidents. Therefore, the electrostatic hazards in those two different places are subject to different mechanisms and their key parameters are varied.

二、易燃易爆场所防静电标准

兵器工业行业自20世纪70年代末期开始进行静电危害与控制研究，目前我国针对易燃易爆场所的防静电技术标准，大部分是由兵器工业发布的行业标准。

主要现行标准有：弹药生产防静电安全规程、电火工品生产防静电安全规程、发射药生产防静电安全规程、黑火药生产防静电规程、兵器工业爆炸危险场所电气安全技术条件、兵器工业防静电设施用品验收规程等。

II. Standard on ESD Protection of Flammable and Combustible Place

The Ordnance Industry has started to conduct the research on electrostatic hazards and control since the late 1970s. Currently, the majority of technical standards on ESD protection of flammable and combustible places in China are the industrial standards released by the Ordnance Industry.

The main existing standards include: The Safety Code For Preventing Electrostatic Accidents In Manufacturing Gunpowder; The Safety Code For Preventing Electrostatic Accidents In Manufacturing Initiating Explosive Device, The Safety Code For Preventing Electrostatic Accidents In Manufacturing Propellant Powder, The Safety Code For Preventing Electrostatic Accidents In Manufacturing Black Powder; Technical Specifications For Safety Inspection of Electrical Apparatus In Explosion Hazardous Area In Ordnance Industry, Code For The Acceptance of Facilities and Supplies For Preventing Electrostatic Accidents In Ordnance Industry and So On.

这些标准针对不同产品的生产、制造，编制相对独立，危险等级的划分也不尽相同。

These standards are independent for the production, manufacture, preparation of different products, and the classification of hazard level is varied.

三、防静电危害技术现状

到目前为止，兵器工业行业防静电危害控制技术尚停留在上世纪90年代，主要是从工程设施、人员和用品方面进行防护，采用的均是被动防静电技术措施。

III. Current Situation of Electrostatic Hazard Prevention Technologies

As yet, the electrostatic hazard prevention technologies in Ordnance Industry are still stuck in the 1990s, which mainly take protection measures in terms of engineering facilities, personnel and supplies, belonging to passive electrostatic prevention technical measures.

● 包括:

- 防静电地坪
- 人员穿戴防静电工装
- 设备的静电接地
- 作业场所增湿等技术措施

- Including:
- anti-static floor
- personnel should wear antistatic labor suit
- equipment electrostatic grounding
- humidification and other technical measures in the workplace

四、急需解决的问题

1. 标准体系

目前兵器工业制定的易燃易爆场所防静电标准比较零散，各标准之间相对独立，没有形成一个标准体系。

IV. Urgent Issues Needing Resolution

1. Standard System

Currently, the antistatic standards for flammable and explosive places enacted by the Ordnance Industry are relatively fragmented, which are relatively independent without forming a standard system.

特别是缺少一个纲领性的体系文件，
为生产企业提供一个规范建立包含管
理、技术要求、检查、监测等内容的
防静电体系的行业标准。

In particular, there is no programmatic system document to provide the
manufacturers with an industrial standard for the standardized
establishment of a anti-static system involving management, technical
requirements, inspection, monitoring and so forth.

2. 监测技术

在火炸药生产场所，由于普遍存在火炸
药粉尘，生产设备多为大型金属设备，
对于药剂生产装置的静电在线监测，
目前尚没有适用技术手段，其原因在
于：

• 2. Monitoring Technology

- In the production place of explosives and powders, as the ubiquitous
existence of explosive and powder dust, the production equipment is
mostly comprised by large-scale metal equipment, and there is
currently no suitable technical means for the on-line electrostatic
monitoring of pharmaceutical production plant, and the reason lies in:

- 监测装置的防爆安全性
- 监测方法技术难度
- 监测参数（电场强度）与可能发生的放电能量之间的关系

- Anti-explosion Safety of Monitoring Device
- Technical Difficulty of Monitoring Methods
- Relationship Between The Monitoring Parameters (Electric Field Strength) and The Possible Discharge Energy

3. 防静电危害控制技术

在药剂生产过程中，多数物料都具有高电阻特性，混合、搅拌、干燥、输送等工艺过程，都具有较大的静电危险性，如何减少这些工艺工程中物料的静电荷积累，是一个技术难题。

3. Anti-static Hazard Control Technologies

In pharmaceutical production process, the majority of materials are featured by high resistance characteristics, and mixing, stirring, drying, transport and other processes are subject to a greater risk of electrostatic hazard. How to reduce the accumulation of electrostatic charges in materials during the process engineering is a technical problem.

● 在电子领域，离子风静电消除技术已广泛应用，各类离子风机对消除作业环境的静电危害、减少损失起到不可忽视的作用，然而，目前这一技术尚不能在火炸药生产场所应用，作业场所仍然采用增湿的办法来减少静电积累

- In the electronics field, ionic wind electrostatic elimination technology has been widely applied, a variety of ion blowers has played an essential role in eliminating the electrostatic hazards and reducing losses in the operating environment. However, this technology cannot yet be applied in explosive and powder production place, and thus the operating places still use humidification way to reduce the electrostatic accumulation.

然而对高绝缘的火炸药固体，增湿措施的效果有限，且很多情况下工艺要求不允许，这不仅导致静电危险的持续存在，并且导致了一些工艺技术难以在火炸药生产领域的应用，如气力管道输送技术等。

- However, for high-insulation explosive and powder solids, the effect of humidifying measures is limited, but which are is not allowed in many cases, thereby not only leading to the continued existence of electrostatic hazards, but also resulting in the difficulty for the applications of certain process technologies in the production field of explosives and powders, such as the pneumatic pipeline transmission technology, etc.

静电保护和标准化会议

关于工厂和现场中EOS/ESD事件中ESDA的新任务

Terry Welscher博士
美国静电放电协会高级副总裁

美国静电放电协会

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目标

- 提供关于ESDA（美国静电放电协会）中新标准和新
的技术任务的概况
- 介绍在水准更高的组装件、新产品和新应力源方面的
工作进展情况
- 总结当前工作的状况

幻灯片 2

Conference on Electrostatic Protection and Standardization

New Work in ESDA on EOS/ESD Events in Factory and Field

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Objectives

- Provide overview on new standards and new
technical work in the ESDA
- Describe expansion of work into higher levels
assembly, new products and new stress sources
- Summarize status of current work

Slide 2

纲要

- I. 确定新的 EOS/ESD 课题
- II. 当前进展
 - I. 带电板事件 (CBE)
 - II. 电缆放电事件 (CDE)
 - III. 电气过应力 (EOS)
 - IV. 其它
- III. 将来待解决问题

幻灯片 3

Outline

- I. Addressing New EOS/ESD Topics
- II. Some Recent Progress
 - I. Charged-Board Event (CBE)
 - II. Cable-Discharge Event (CDE)
 - III. Electrical Overstress (EOS)
 - IV. Other
- III. Future Issues

Slide 3

通向新标准之路

- 提供分享最佳方法及识别需要普通方法的区域的场所和环境
- 诸多用于形成新标准的理念来源
 - EOS/ESD 座谈会
 - 工厂ESD座谈会 (亚洲)
 - 国际ESD 研讨会 (IEW)
 - 专题报告、研讨会、在线研讨会
 - 技术工作小组
 - 个人及公司建议

幻灯片 4

Pathways to New Standards

- ESDA provides structure and environment to foster sharing of best practices and identification of areas where common approaches are needed
- Many sources of ideas for standards
 - EOS/ESD Symposium
 - Factory ESD Symposium (Asia)
 - International ESD Workshop (IEW)
 - Tutorials, Workshops, On-line Webinars
 - Technical Working Groups
 - Individual and Company Suggestions

Slide 4

完整的标准

新理念、数据、技术

通向新标准之路

- **标准 (S):** 关于一组要求和程序的准确描述
- **标准实验方法 (STM):** 限定性的可复制程序
- **标准惯例 (SP):** 用于执行还未显示出具有可复制特点的程序。
- **技术报告 (TR):** 可支持新标准的多种技术数据和测试结果

关于不完整的定义，请见 www.esda.org

Slide 5

Full Standards

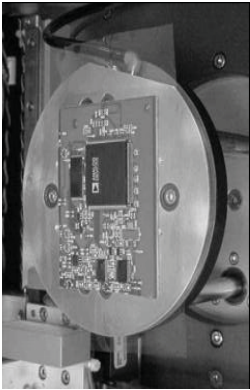
Pathways to New Standards

- **Standard (S):** A precise statement of a set of requirements and procedures
- **Standard Test Method (STM):** A definitive reproducible procedure
- **Standard Practice (SP):** A procedure for performing not yet shown to be reproducible.
- **Technical Report (TR):** A collection of technical data or test results that may support future standards

Not full definitions. See www.esda.org

Slide 5

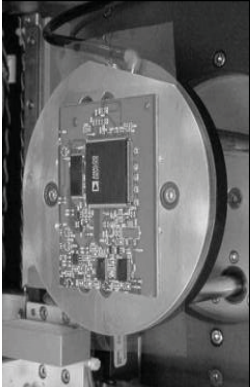
带电板事件 (CBE)



ESDA 专设特别工作小组
计划于2013年年底发行的技术报告

6

Charged-Board Events (CBE)



ESDA ad hoc Working Group
Technical Report planned for issue
by end-of-year 2013

6

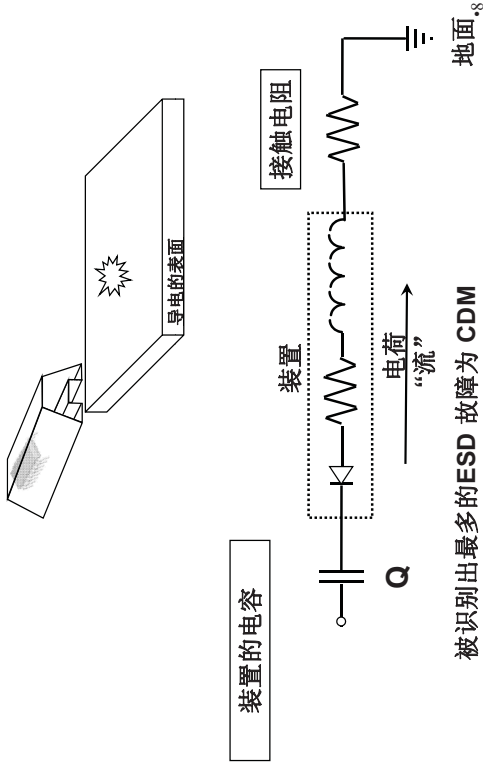
带电板事件 (CBE)- 概况

- CBE 类似于 CDM - PCB 为储存电荷的“装置”。
- 同IC相比，PCB具有更高的电容，因此通常说来，某带电板事件的峰值放电电流大于CDM的放电电流
- 上升时间通常类似于 - ~1纳秒
- CBM 放电损伤通常被误认为电气过应力 (EOS) 损伤。
- 某些报告中声称误诊高达50%

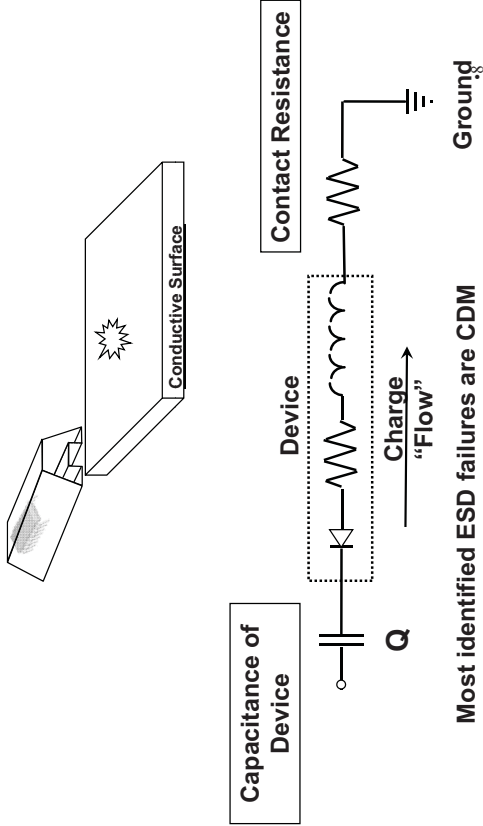
Charged Board Event (CBE)- Overview

- CBE is analogous to CDM - PCB is the “device” which stores the charge.
- PCBs has higher capacitance than an IC, so peak discharge current for a CBE event is typically >> than for a CDM
- Rise time is often similar - ~ 1nsec
- CBM discharge damage easily mistaken for electrical overstress (EOS) damage.
- Some reports of as high as 50% misdiagnosis

带电装置模型



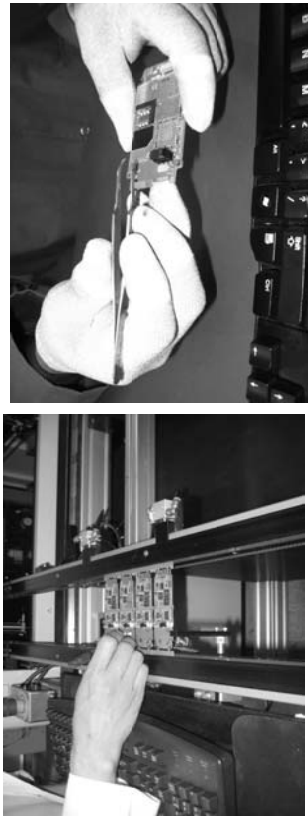
Charged Device Model



Most identified ESD failures are CDM

CBE 背景

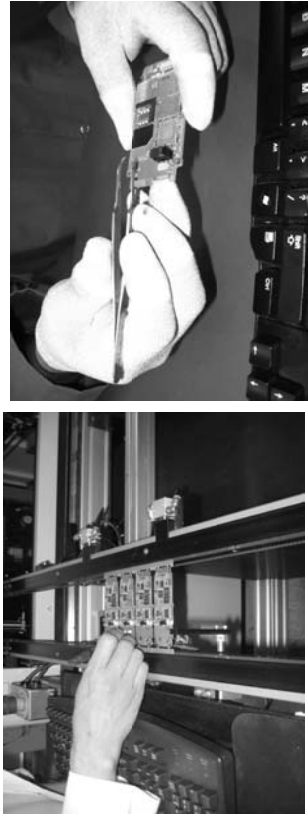
安装于印制电路板上的集成电路ESD故障已于1981年以来被陆续发表。



*有时被称为 CBM (模型)。我们使用CBE (事件)，以强调并无标准的模拟方法。

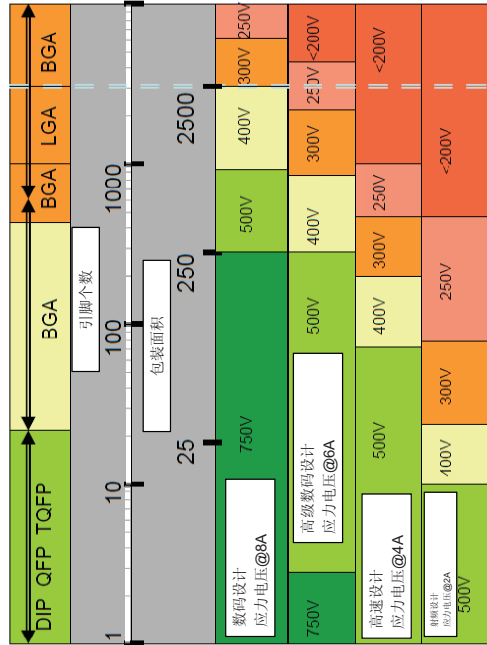
CBE Background

ESD failures of ICs that are mounted on Printed Circuit Boards (PCBs) have been published since 1981.



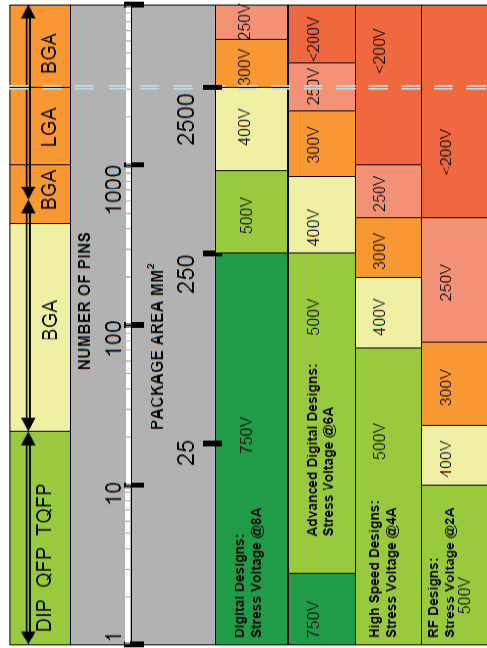
*Sometimes called CBM (model). We use CBE (event) to emphasize that there is no standard simulation method

CDM软件包依赖性



关于ESD目标产业委员会白皮书II-CDM 2009

Package Dependence of CDM



Industry Council on ESD Targets White Paper II - CDM 2009

板级ESD 机构

三种不同的机构

1. 带电者接触电势不同的印制电路板 - **HBM**。
2. 某未接地的印制电路板通过摩擦充电等方式成为带电板，然后该印制电路板接地 - **CBE**
3. 某未接地印制电路板位于某带电物体或表面范围中，这可导致在印制电路板中出现电势或电荷分离，然后该印制电路板接地 - **CBE**

• 11

Board-Level ESD Mechanisms

There are three distinct mechanisms

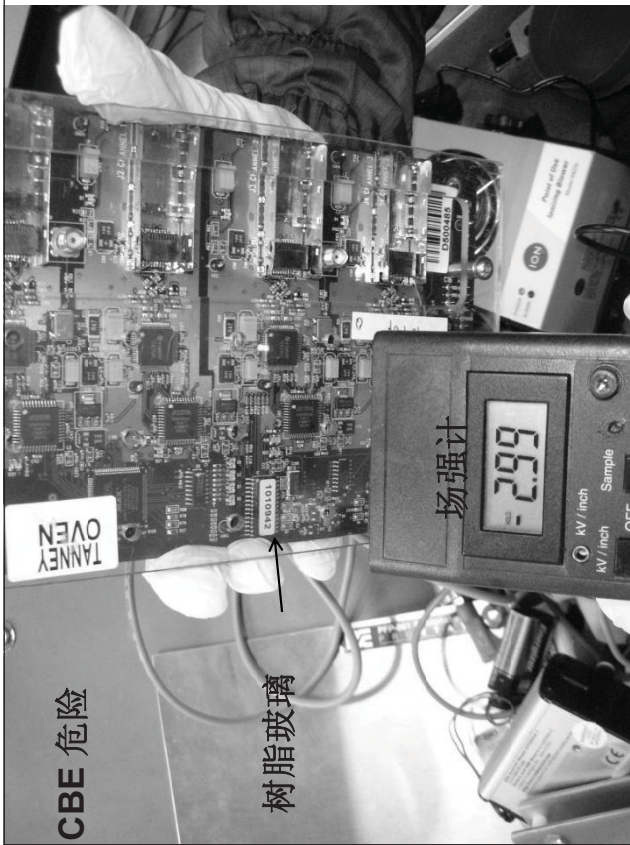
1. A charged person touches a PCB that is at a different potential - **HBM**.
2. An ungrounded PCB becomes charged for example by tribocharging, and the PCB is then grounded - **CBE**
3. An ungrounded PCB is in the field of a charged object or surface, this induces a potential or charge separation on the PCB, and the PCB is then grounded – **CBE**

• 11



CBE 危险

树脂玻璃

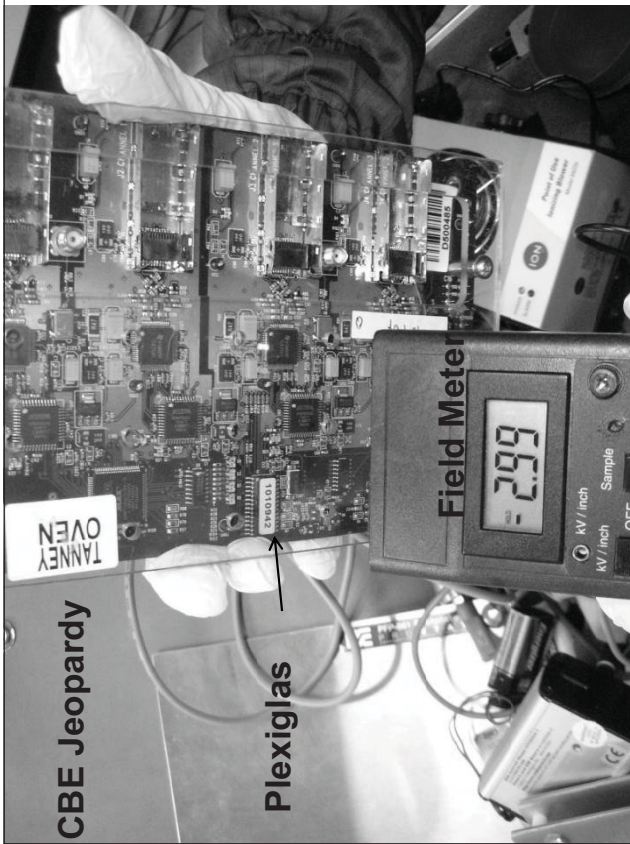


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CBE Jeopardy

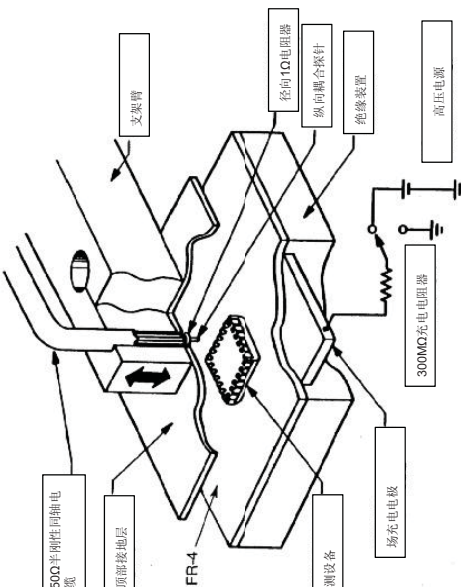
Plexiglas



•13 13

Copyright © 2008 Dangelmayer Associates

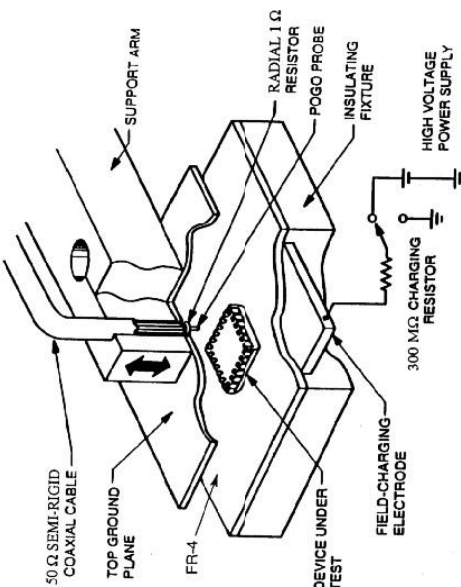
场诱导 CDM 模拟器



集成电路CDM测试的测试设置

•14

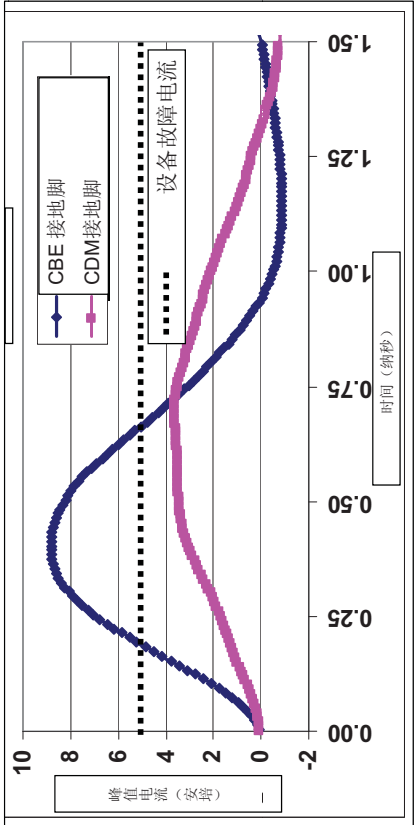
Field-Induced CDM Simulator



Test Setup for CDM testing of ICs

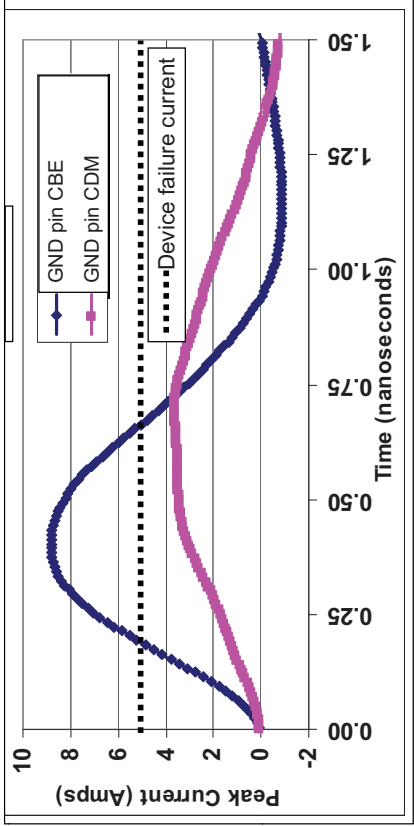
•14

CBE 对比 CDM 放电
波形比较
(250 V)



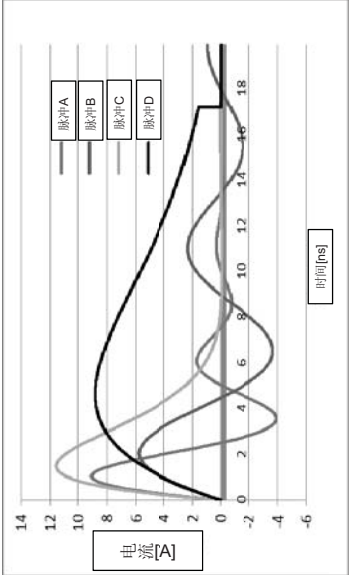
感谢：美国模拟器件公司质量主管 Andrew Olney提供数据

CBE vs. CDM Discharge
Waveform Comparison
(250 V)



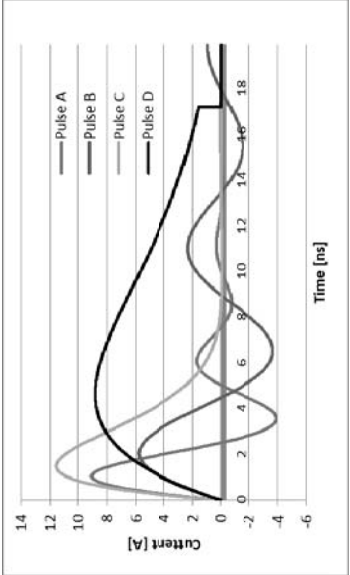
Courtesy: Andrew Olney, Quality Director, Analog Devices

CBE 电流波形



感谢：诺基亚 Pasi Tamminen提供数据

CBE Current Waveforms



Courtesy: Pasi Tamminen, Nokia

CBE ESD损伤
大多数故障分析专家 报告为 EOS

感谢：美国模拟器件公司质量主管 Andrew Olney提供照片

•17

CBE ESD Damage
Most FA Experts Reported as EOS

Photograph courtesy: Andrew Olney, Quality Director, Analog Devices

•17

CDM 和CBE 损伤

(A) CDM损伤
单个设备

(B) CBE 损伤
电路板上的相同设备
与A相同的应力电压

感谢台湾 www.MA-TEK.com - 提供照片

•18

CDM and CBE Damage

(A) CDM Damage
Individual Device

(B) CBE Damage
Same Device on Circuit Board
And Same Stress Voltage as A

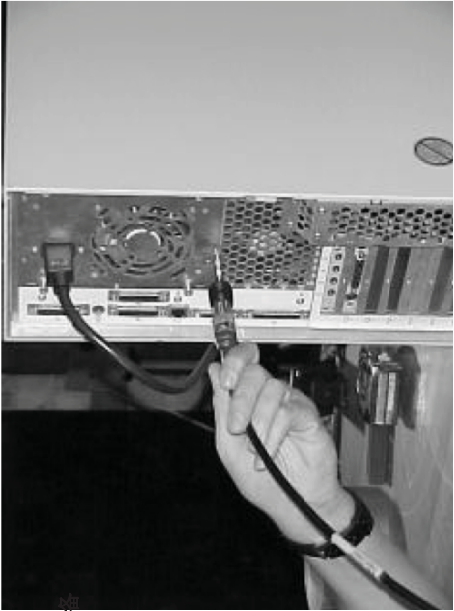
Photos Courtesy of www.MA-TEK.com - Taiwan

•18

电缆放电事件 (CDE)

ESDA WG14

电缆上的电荷可致设备损伤或失效

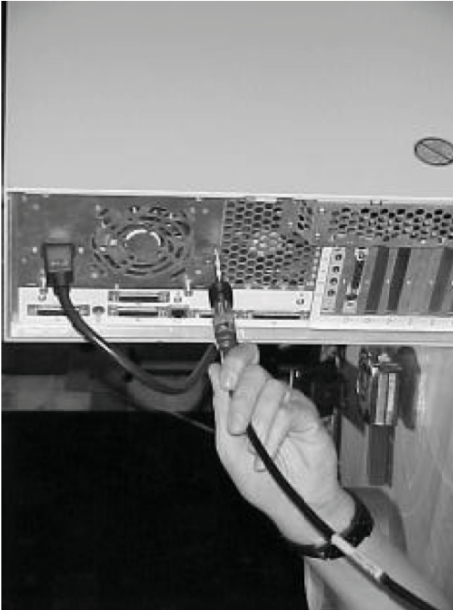


•19

Cable Discharge Events (CDE)

ESDA WG14

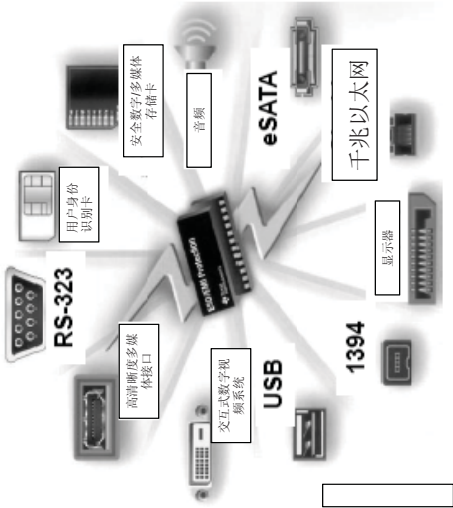
Charge On Cables Can Cause Equipment Damage Or Malfunctions



•19

多种电缆/接口技术

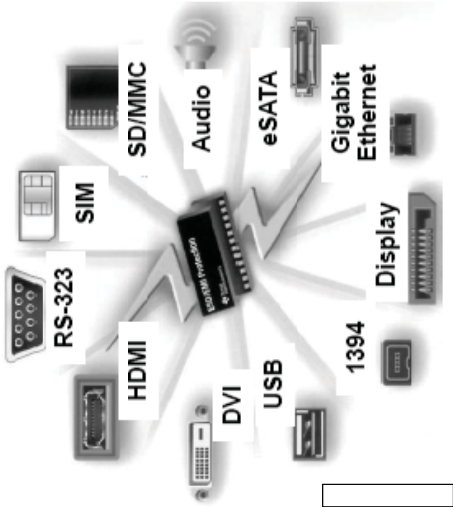
ESDA WG14



•20

Many Cable/Interface Technologies

ESDA WG14

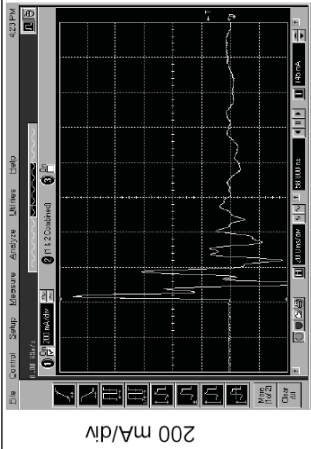


•20

电缆放电事件

CDE波形

- 300V时，1米电缆放电至金属面
- 大约1A的CDE电流，被探针带宽所限制

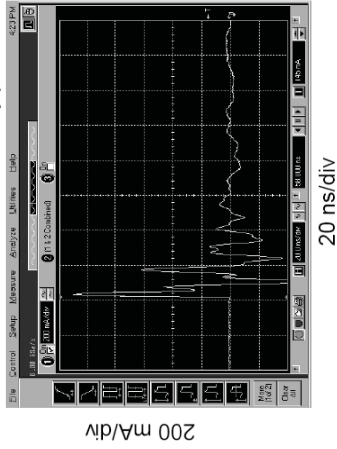


D. C. Smith, Technical Tidbits
2002

Cable Discharge Events

CDE Waveform

- 1m cable at 300V, discharged to a metal plane
- CDE current about 1 A, limited by probe bandwidth

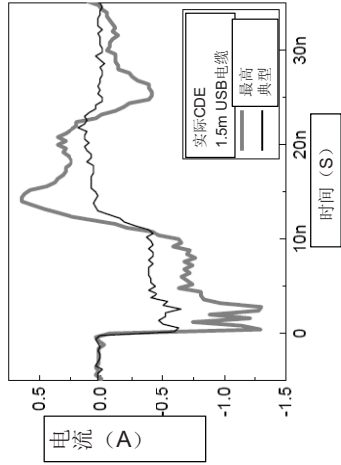


D. C. Smith, Technical Tidbits
2002

场中USB电缆的充电

- 汽车线束的充电
- 通过移动电缆（32%相对湿度） < 220 V
- 通过对屏蔽进行充电（8kV） < 2000 V

USB电缆的实际CDE

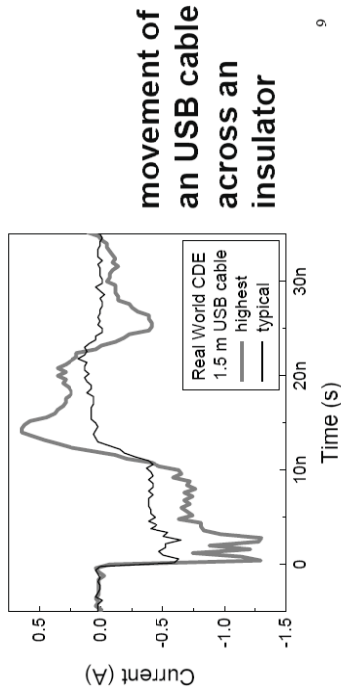


移动——跨绝
缘体的USB
电缆

Brodbeck et al, IEW 2011

Charging of USB cables in the field

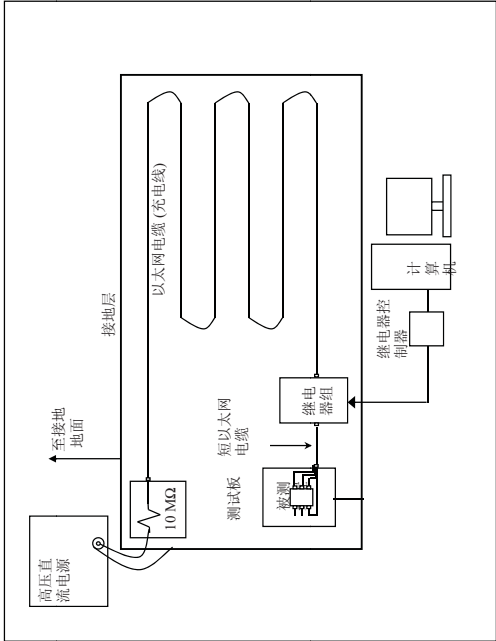
- Charging of automotive wiring harness
- By movement of the cable (32% RH): < 220 V
- By charging of the shielding (8 kV): < 2000 V
- Real World CDE of USB cable



movement of
an USB cable
across an
insulator

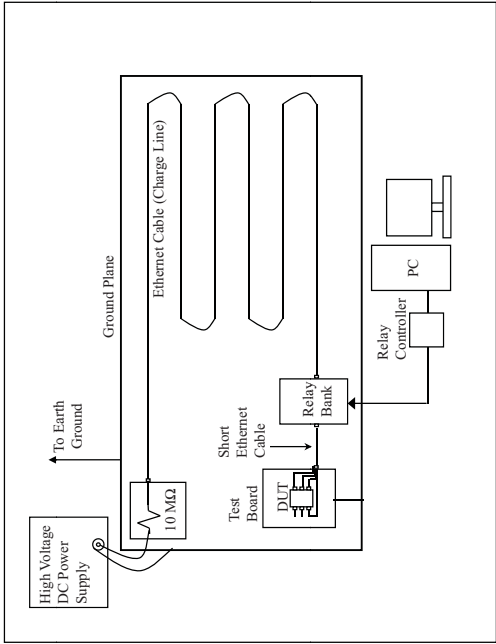
Brodbeck et al, IEW 2011

一项 CDE 测试仪设计



感谢德州仪器提供数据

One CDE Tester Design



Courtesy of Texas Instruments

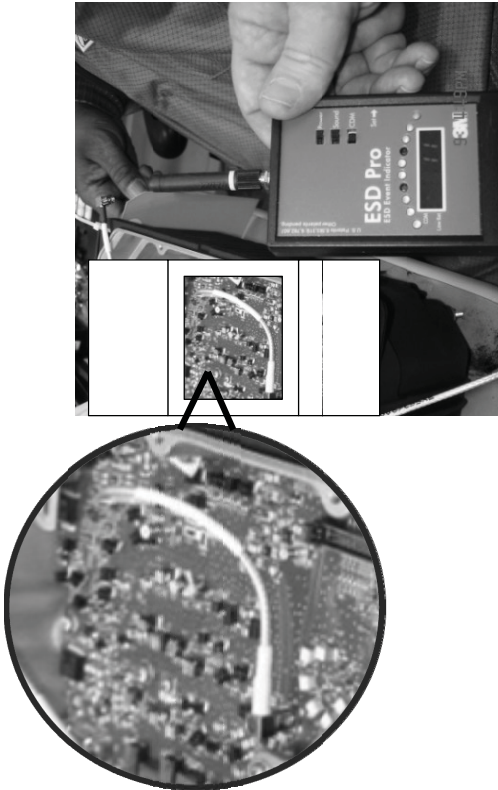
从封装中移除时的电缆充电



Cables Charge When Removed from Packaging

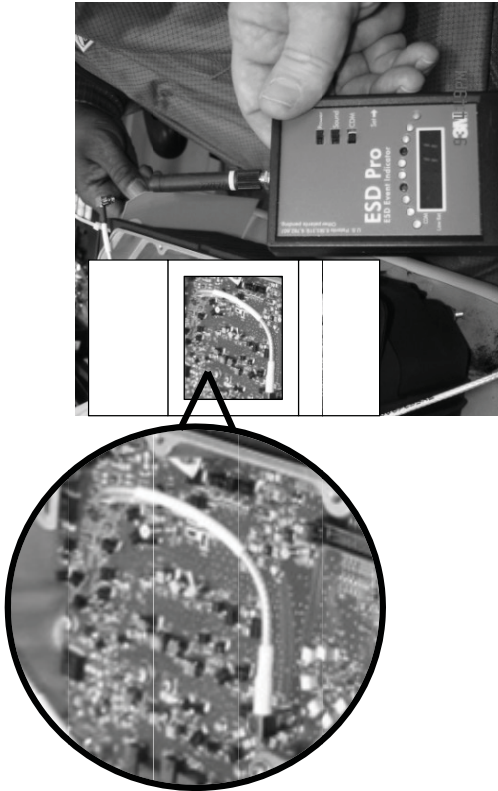


装配中电缆放电



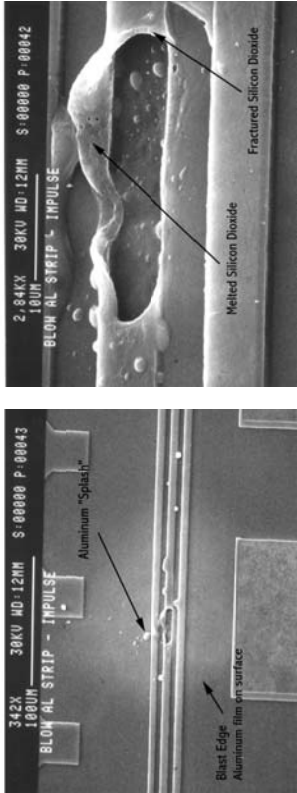
•25

Cable Discharges in Assembly

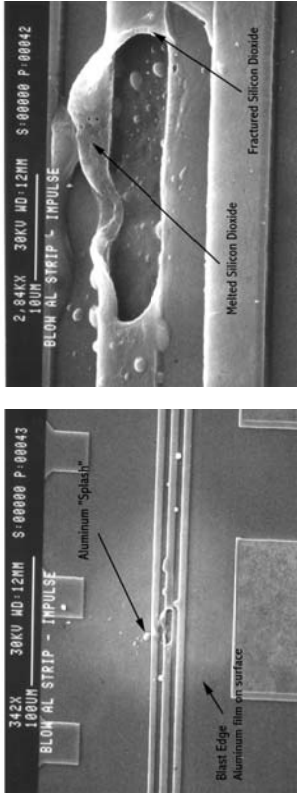


•25

电气过应力 (EOS)



Electrical Overstress (EOS)



为何现在是 EOS?

- 故障数据 –大量未经处理的返回原因
- ESD控制和周密设计
- 设备用户提出不切实际的要求
- 故障和根本原因分析中的困惑
- 原因众多，但解决方案少

Slide 27

Why EOS Now?

- Failure data – large undressed cause of returns
- ESD control and design mature
- Device users imposing unrealistic requirements
- Confusion in failure and root cause analysis
- Many sources and few solutions

Slide 27

EOS/ESD成本

- 诸多公司认为25-35%的故障为EOS/ESD；而某些公司认为该比例更高
- 半导体和板组件的高额负担
- 多年来，故障部分依然持续出现以往的情况
- 难以识别
 - 关于由谁负责的相互指责
 - 通常为非系统状
 - 难以找到根本原因

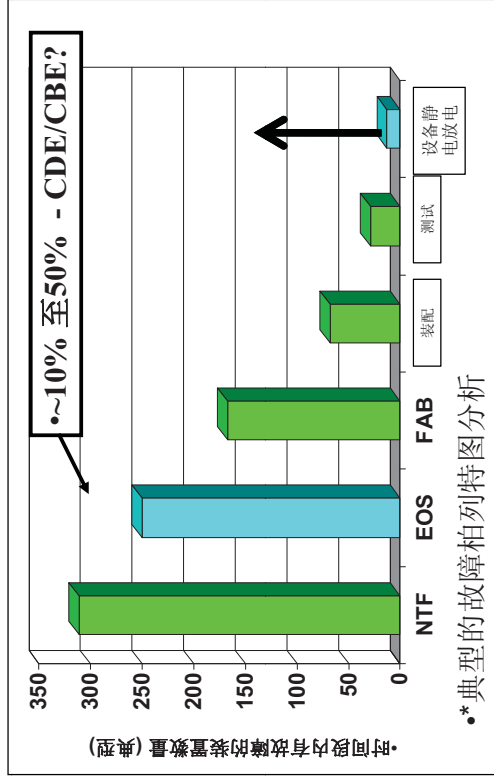
28

Costs of EOS/ESD

- Many companies agree 25-35% of failures are EOS/ESD; some say more
- High burden for semiconductor and board assembly
- Failure fraction has remained about the same over many years
- Difficult to identify
 - Finger pointing about who is responsible
 - Often not systematic
 - Root cause hard to find

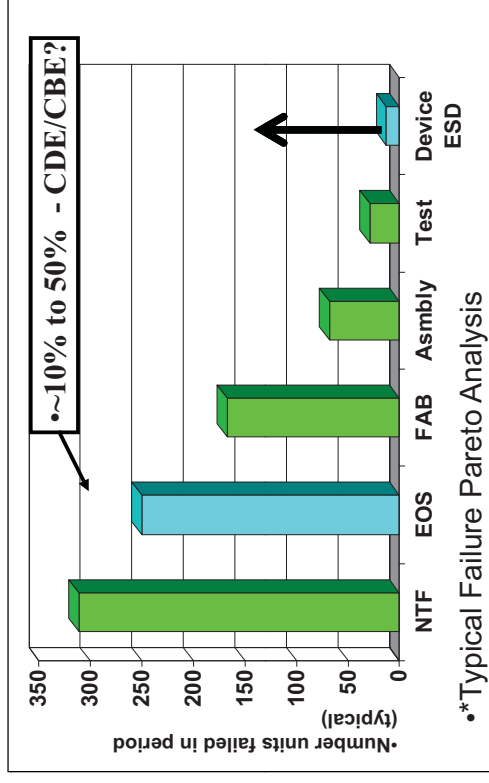
28

EOS:重要故障分类*



9

EOS: Important Failure Category*



9

EOS问题/疑问

- (故障分析诊断)为设备和系统的电气故障的主要原因
- 送去进行故障分析的电气故障返回时的关于EOS或EOS/ESD诊断无深层次信息
- 为了找到根本原因并进行纠正措施需要更多信息
- 关于EOS定义的困惑
- ESD方面取得了较大进展，但EOS却没有。什么原因？

30

EOS Issues/Questions

- EOS (by FA diagnoses) is major cause of electrical failure of device and systems
- Electrical failures sent to FA often return diagnosis of EOS or EOS/ESD without further information
- More information is needed to find root cause and implement corrective action
- Confusion about EOS definition
- Much progress has been made on ESD but not EOS. Why?

30

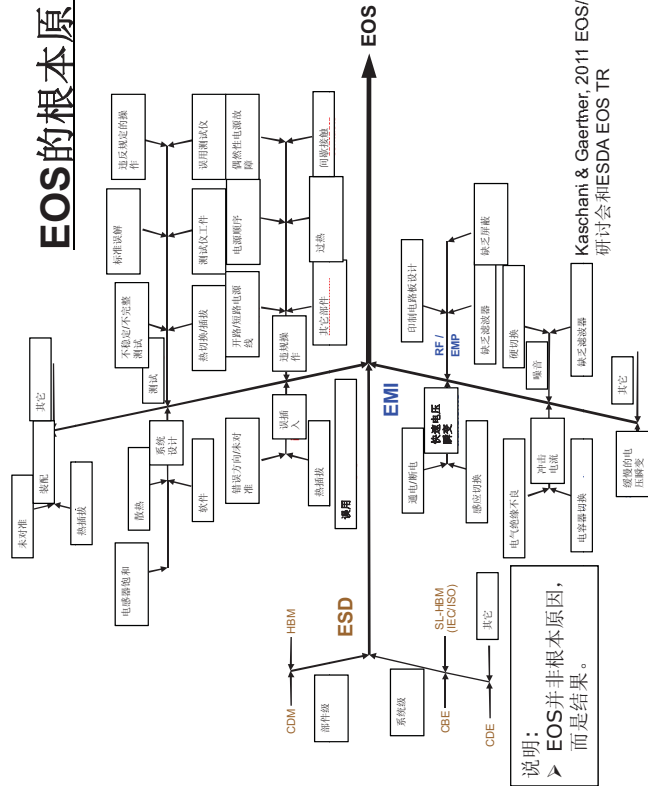
为何ESD比EOS的其它类型的进展大?

- ESD的种类少 (2种) (HBM, CDM)
- 在设备级方面，具有定义明确、被人所接受的模型和测试方法
- “分类” 已成为交流ESD敏感性的有效方法
- 集成电路制造商具有重大责任
- 致使ESD的临界值出现引入注目的持续改善 (1985-2000)

Why more progress on ESD than other types of EOS?

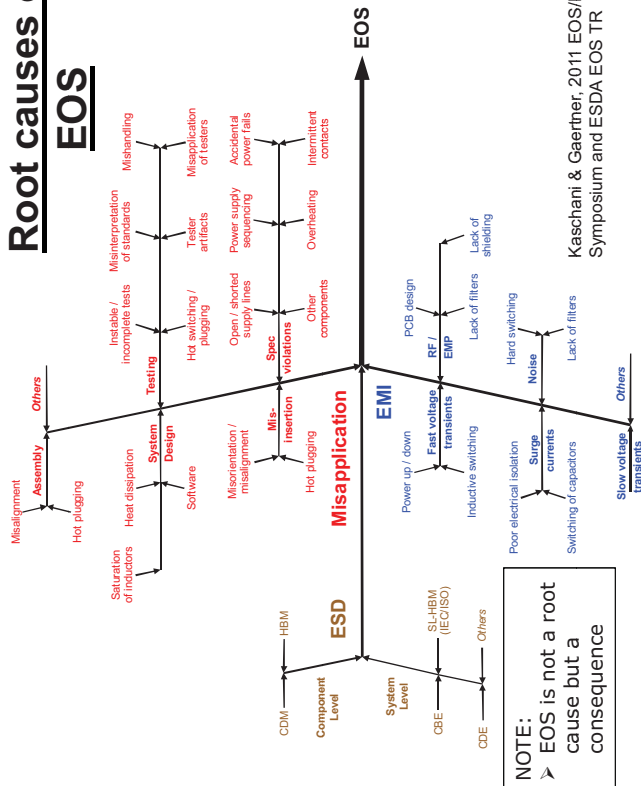
- Small number (~2) of ESD categories (HBM, CDM)
- At device level, well defined accepted models and test methods
- “Classification” has been an effective method for communicating ESD sensitivity
- Significant responsibility taken by IC manufacturers
- Resulted in dramatic continuous improvement in ESD threshold (1985-2000)

EOS的根本原因

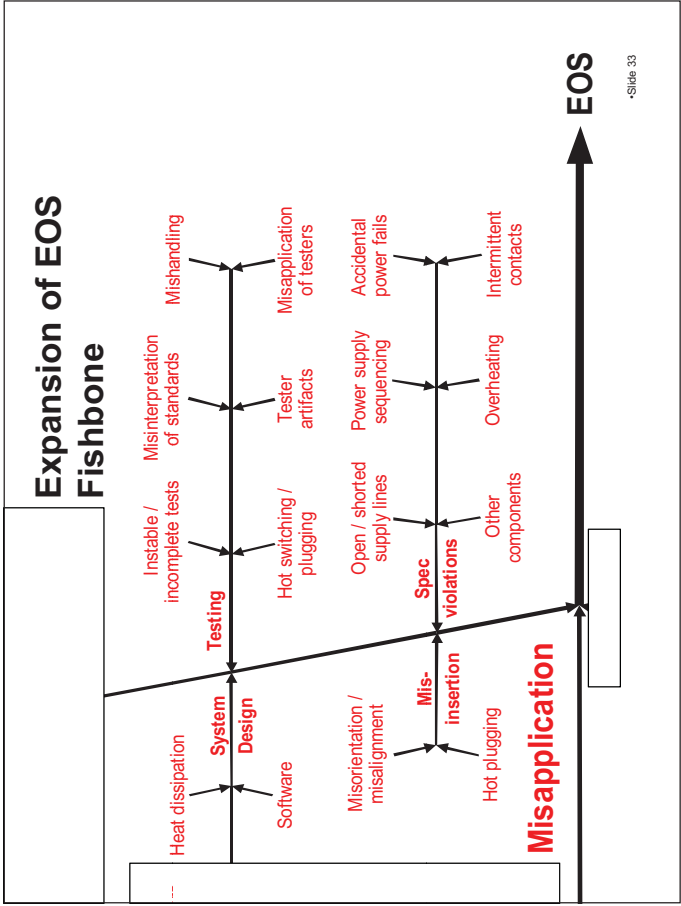
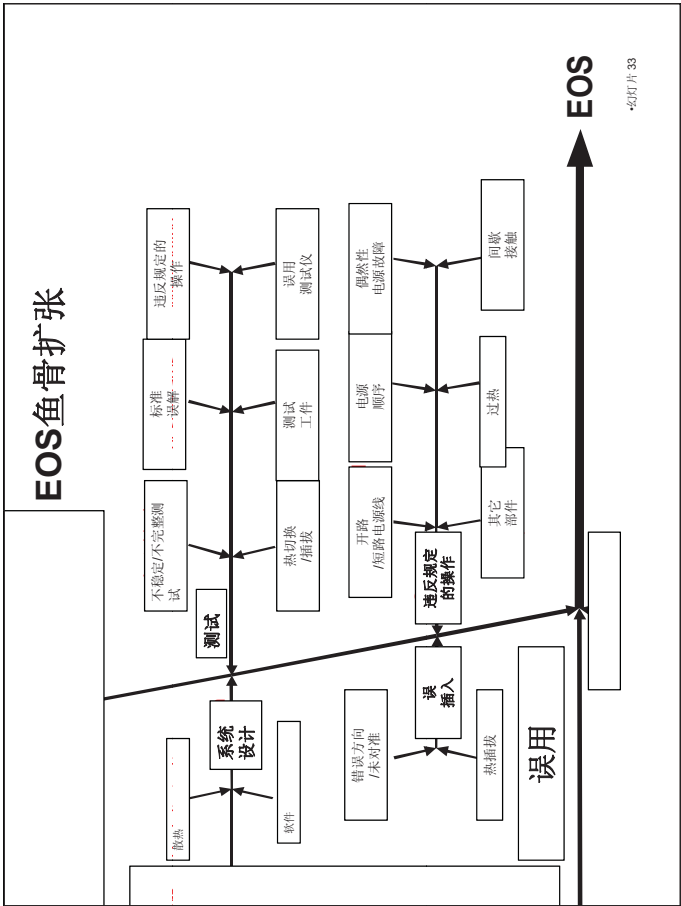


Kaschani & Gaertner, 2011 EOS/ESD Symposium and ESDA EOS TR

Root causes of EOS



Kaschani & Gaertner, 2011 EOS/ESD Symposium and ESDA EOS TR



生产原因

- 烙铁
 - 劣质接地 (无接地, 地面噪音)
 - 电源线上的噪音
 - 开关尖峰脉冲
 - 焊嘴氧化
- 电动工具
- 电源换向



Production Sources

- Soldering Irons
 - Bad Grounding (Loss of Ground, Noise on Ground)
 - Noise on Power Line
 - Switching spikes
 - Tip oxidation
- Power Tools
- Power Supply Commutation



美国静电放电协会 STM13.1-2000
电焊/脱焊手持工具

- EOS标准范例
- 为测量电气泄漏和焊嘴至接地间参考点电阻提供电焊/脱焊手持工具

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ESD Association STM13.1-2000
Electrical Soldering/Desoldering Hand Tools

- Example of EOS Standard
- Provides electric soldering/desoldering hand tool test methods for measuring electrical leakage and tip to ground reference point resistance

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焊接手持工具测试方法修订 (STM13.1)

- 正处于被提升至完整标准的过程之中
- 目前，其范围包括射频工具
- 测试方法的其它改进和说明
- 包括
 - 焊嘴至接地间电阻
 - 焊嘴电压和泄漏电流

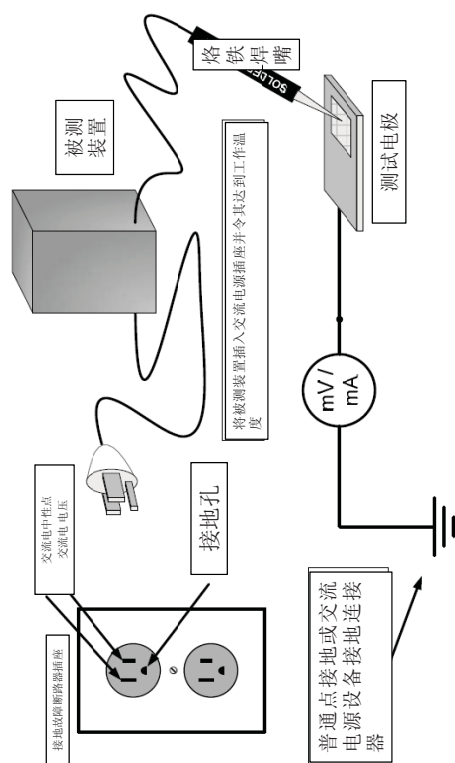
•Slide 36

Revision of Soldering Hand Tool Test
Method (STM13.1)

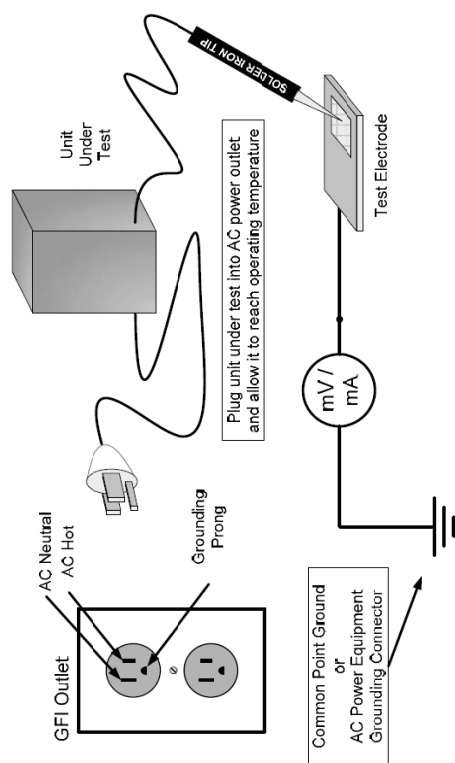
- In process of being elevated to full standard
- Scope now includes RF-based tools
- Other improvements and clarifications to the test methods
- Includes
 - Tip to ground resistance
 - Tip voltage and leakage current

•Slide 36

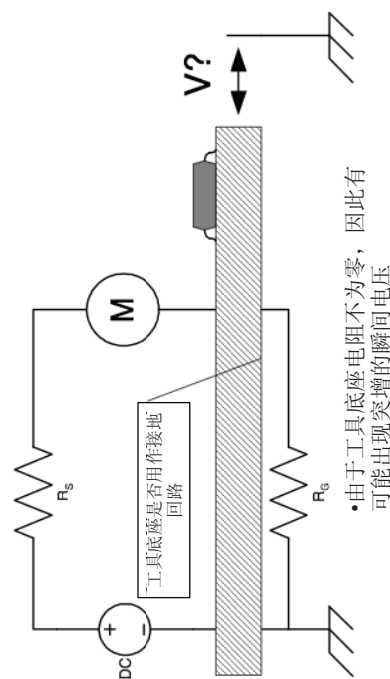
STM13.1.1 测试配置 (V 或 i)



STM13.1 Test Configuration (V or i)

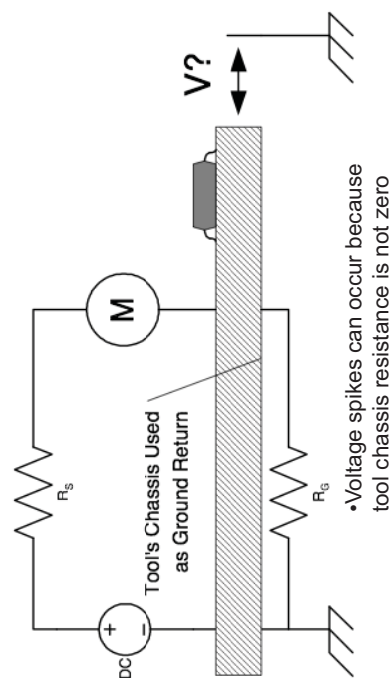


直流电引起的EOS



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DC-Caused EOS



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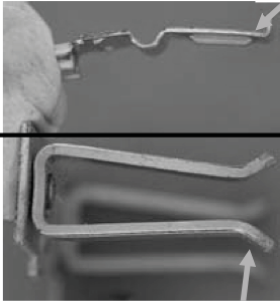
有故障的电源插座

工业级

商用级



- 重负载触头
- 螺旋连接
- “芯柱”接地



- 轻负载触头
- 卡压式连接
- 单面接地

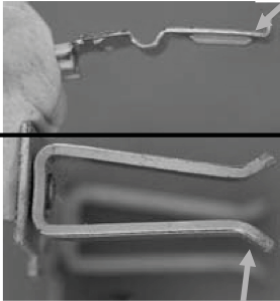
Faulty Power Receptacles

Industrial Grade

Commercial Grade

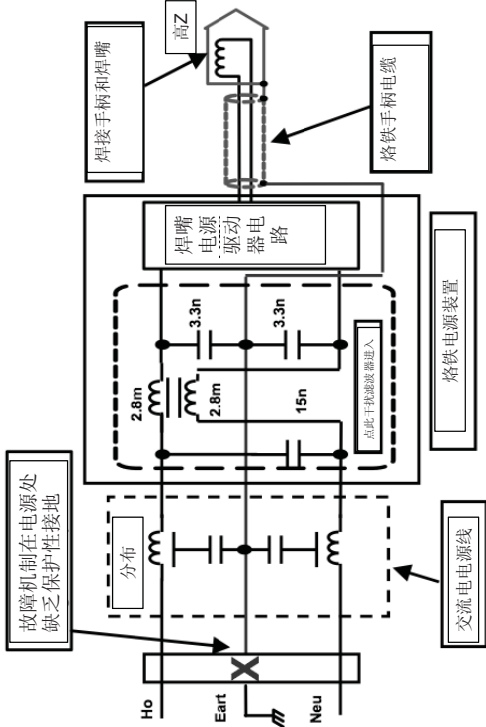


- Heavy contact
- Screw connection
- 'Pinch' ground

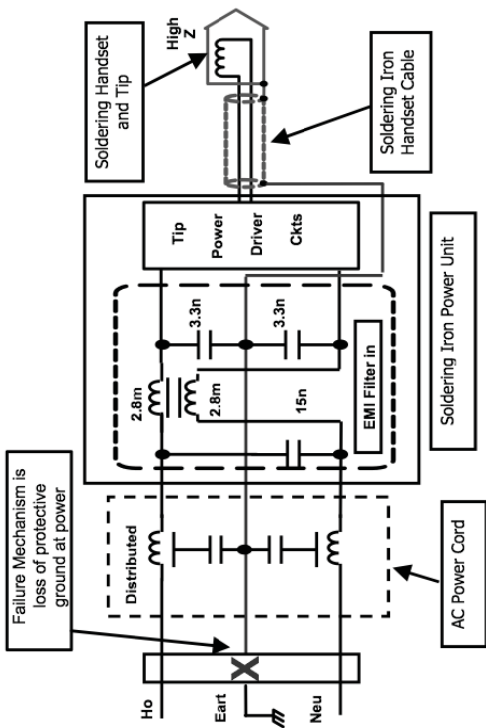


- Light contacts
- Press connection
- Single side ground

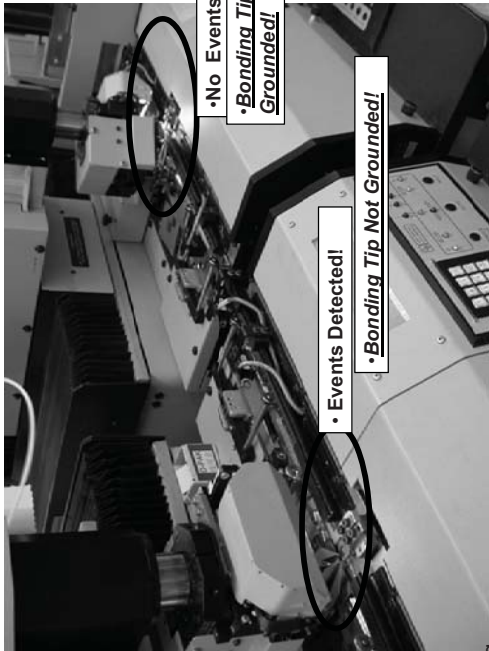
有故障的电源插座 (续)



Faulty Power Receptacles (cont'd)

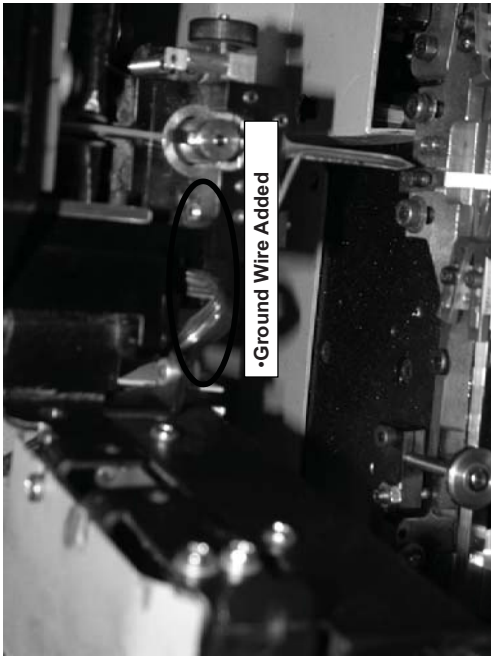


EMI Detection Exposes Faulty Grounding



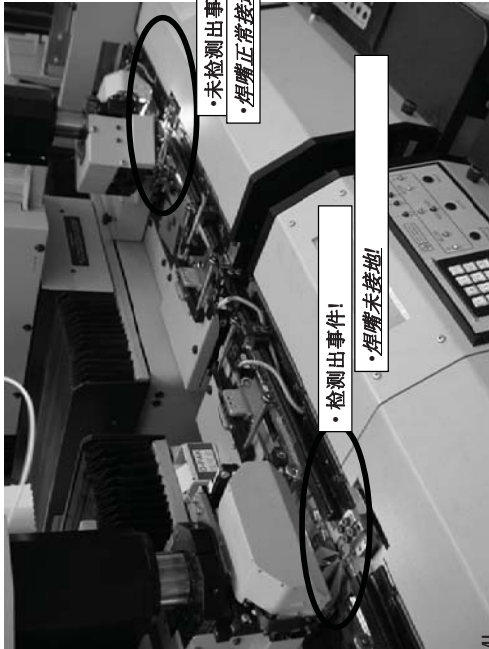
•Video:
Bonding
EMI

Corrective Action — Improved Grounding



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电磁干扰检测暴露有故障接地



•视频:
焊接 EMI

纠正措施 — 改善接地



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生产过程中减少EOS

- 不同于ESD，正式的EOS预防、监控和审查系统在生产过程中并不常见
- 类似于ESD，EOS故障通常为未意识到问题后的结果
- 类似于ESD，EOS也有多个利益相关者
 - 产品设计
 - 测试和生产设备设计
 - 设施设计和维护
 - 质量/过程控制

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EOS Mitigation in Manufacturing

- Unlike ESD, formal EOS prevention, monitoring and auditing systems are not common in manufacturing
- Like ESD, EOS failures are often the result of lack of awareness of the problem
- Like ESD, many stakeholders
 - Product design
 - Test and Production equipment design
 - Facility design and maintenance
 - Quality/process control

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生产过程中减少EOS

- 公司可安排类似于ESD项目（通常合并成责任相同的一个项目）的EOS控制项目
 - 定义并记录要求
 - 合规性审核
 - 向EOS控制项目反馈故障分析信息
- 生产部门建立EOS缺陷检测机制
- 吸收/改进 EOS 控制和监测

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EOS Mitigation in Manufacturing

- The organization could have an EOS control program similar to the ESD program (often can be combined in same responsibility)
 - Defined and documented requirements
 - Compliance verification
 - Feedback FA information to EOS control program
- MFG floor EOS weakness detection
- Incorporate/enhance EOS control, monitor

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EOS审查清单举例

典型的审查项目	测量
交流电电源电缆	基本的电缆插座测试仪
交流电电源质量	电源干扰分析仪 (例如：Fluke 435)
交流/直流电源通电/故障时间	目测
停电后移除板	目测和计时
正确的电源或交流适配器	检查模型要求与应用的兼容性
热交换	目测/事件检测

Example of EOS Audit Checklist

Typical Audit Item	Measurement
AC Power Cables	Basic Cable Socket Tester
AC Power Quality	Power disturbance analyzer (e.g., Fluke 435)
AC/DC power up/down timing	Visual observation
Board removal after power off	Visual observation and timing
Correct Power Supply or AC Adapter	Check model requirements compatibility with application
Hot swapping	Visual observation/Event Detection

EOS减轻EOS

EOS 关注	减轻
部件热交换	定义并审查测试和调试程序-可取决于产品
功能测试电源顺序	定义并审查手动测试程序，确保软件符合电源顺序要求
测试/调试站中所用的交流电源适配器或交流/直流电源	确保符合制造商的规格且使用方法正确
交流电质量和接地	IEC 61000-4-30 A级为很好的指南

EOS Mitigation

EOS Concern	Mitigation
Hot Swapping of Components	Define and audit test & debug procedures – can be product dependent
Functional test power sequencing	Define and audit manual test procedures; insure that software meets power sequence requirements
AC power adapter or AC/DC power supply used at test/debug stations	Be sure that power supplies meet manufacturer specification and are being used correctly
AC power quality and grounding	IEC 61000-4-30 Class A is a good guide

EOS 总结

- EOS为工厂和现场电气故障的主要原因
- ESD为EOS类型中的一种
- 某些ESD (CBE, CDE) 看起来像由电源导致的 EOS
- 由电源导致的EOS的原因为多种情况，通常难以识别出其根本原因
- 可按照管理ESD的方式在工厂中控制由电源导致的EOS
- 减少EOS的发生率，需要做到遵守AMR规定

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EOS Summary

- EOS is a major cause of electrical fail both in factory and in the field
- ESD is a type of EOS
- Some ESD (CBE, CDE) look like power-induced EOS
- Power-induced EOS comes from many sources and root cause often goes unidentified
- Control of power-induced EOS in the factory could be managed like ESD
- Reducing EOS occurrence requires adherence to AMR constraints

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针对EOS的现有ESDA活动

关于EOS的技术报告 – 预定于2013年年底发表
在生产中减少EOS的最佳方法的新建工作小组
—2014年年底的技术报告

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Current ESDA Activities on EOS

Technical Report on EOS – Scheduled for
Publication by end of 2013

New Group working best practices for mitigation
of EOS in manufacturing – technical report by
end of 2014

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其它相关的ESDA举措

- 瞬时闭锁
 - (TLU) 技术报告 – 2012年发表
 - TLU 标准惯例 – 测试方法 – 2015
- 平板显示器
 - 电离测试方法
 - 应力测试方法
- 印制电路板电磁扫描

Other Related ESDA Initiatives

- Transient Latch-Up
 - (TLU) Technical Report – published 2012
 - TLU Standard Practice – Test Methods – 2015
- Flat Panel Displays
 - Ionization Test Methods
 - Stress Test Methods
- Electromagnetic Scanning of PCBs

静电防护工程学与标准化

北京东方计量测试研究所
刘民
研究员
2013年11月



Electrostatic protection engineering and standardization

Beijing Orient Measurement and Testing Institute
Dr. Liu Min
Professor
November, 2013



内容

- 几个静电防护工程问题
- 科学、技术与工程
- 静电防护工程学
- 标准化与静电防护工程学
- 标准化中的技术与科学
- 几点建议



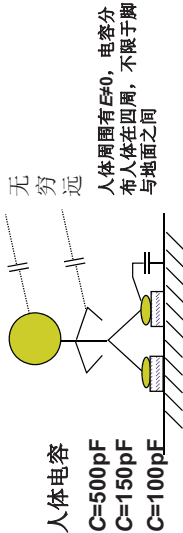
Content

- Several electrostatic protection problems
- Science, technology and engineering
- Electrostatic protection engineering
- Standardization and electrostatic protection engineering
- Technology and science in standardization
- Some suggestions



几个静电防护工程问题

- 关于人体模型
 - 有很多标准提出了不同的人体模型，在易燃易爆物质的静电敏感度试验中，美军标MIL-STD-23659C、我国军用标准GJB376.11-90规定人体静电放电模型为（ $C=500\text{pF}$ ， $R=5\text{k}\Omega$ ）。
 - 在电子设备、产品静电抗扰度试验中IEC 61000-4-2、GB/T17626.2，规定人体静电放电模型为（ $C=150\text{pF}$ ， $R=330\Omega$ ）。
 - 在电子元件静电敏感度等级测试中，美国标准ANSI/ESD STM5.1，我国军用标准GJB1649-93规定人体模型为（ $C=100\text{pF}$ ， $R=1500\Omega$ ）。
- 为什么几个人体模型的电容不同？哪个更科学？

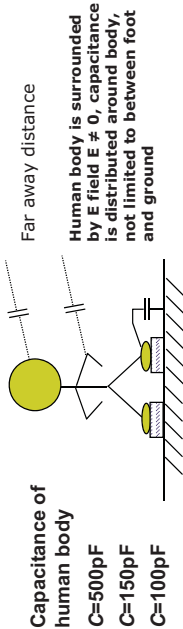


几个静电防护工程问题

- 关于接地电阻
 - 静电防护技术标准中对于接地已经不作要求
 - 要求静电接地点到保护地（PE）交流阻抗小于 1Ω
 - 或者静电接地点到辅助接地线阻抗小于 25Ω
 - 为什么要求交流阻抗，频率范围是多少？ 1Ω 或 25Ω 有科学依据吗？

Problem 1

- About human body model
 - Many standards propose different human body model. In an explosive substance electrostatic sensitivity test, U.S. military standard MIL-STD-23659C, our military standard GJB376.11-90 provide human body electrostatic discharge model ($C = 500\text{pF}$, $R = 5\text{k}\Omega$).
 - In electronic equipment, products electrostatic immunity test, IEC 61000-4-2, GB/T17626.2 provide human body electrostatic discharge model ($C = 150\text{pF}$, $R = 330\Omega$).
 - In ESD sensitivity level testing of electronic components, American Standard ANSI / ESD STM5.1, our military standard GJB1649-93 provide human body model ($C = 100\text{pF}$, $R = 1500\Omega$).
- Why capacitances of several human body model are different mannequin? Which is more scientific?



Problem 2

- About grounding resistance
 - Technical standards of electrostatic protection for grounding have already not been required
 - Request AC impedance between electrostatic grounding point and protective earth (PE) to be less than 1Ω
 - Or impedance between static grounding point and auxiliary ground wire is less than 25Ω
 - Why request AC impedance, how many the frequency range is? If 1Ω or 25Ω has a scientific support?

几个静电防护工程问题

- 绝缘物控制
 - EPA中的绝缘物能否存在超过100V的电压？
 - 在相同表面电压情况下，绝缘物与人体相比，谁的接触放电能量更大？绝缘物ESD放电模型是什么？
 - 考虑CDM模型，EPA中的绝缘物表面电场超过2000V/inch，应采取远离30cm或消电措施，这是定量要求还是定性要求，有科学依据吗？

本讲并非要解答这些问题，而是引出技术标准工程化方法与科学、技术之间的关系。阐述静电防护工程学----一门新兴的交叉学科。

Problem 3

- Insulating material control
 - If insulating materials in EPA can exist voltage of over 100V?
 - Under same surface voltage, insulation materials and human body are compared, which contact discharge energy is more? what is insulating material ESD discharge model?
 - Considering CDM model, if surface field of insulating material in EPA is over 2000V/inch, it should be taken away from 30cm or required ionization airflow, which is quantitative or qualitative requirements, has it a scientific support?

This lecture is not to answer these questions, but raises relationship between technical standard engineering methods and science, technology. Describe Electrostatic Protection Engineering ---- a new cross- knowledge.

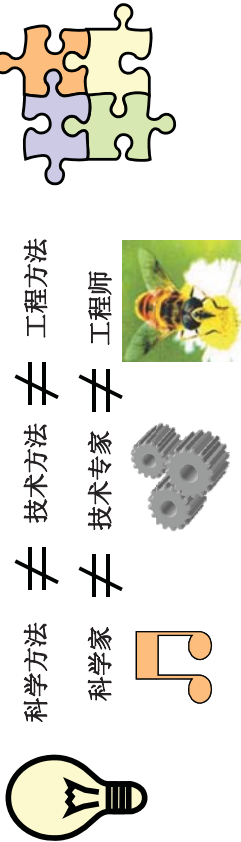
科学、技术与工程

- 科学、技术、工程是三个不同的概念
 - 科学是总结规律、揭示规律的知识体系
 - 技术是利用规律实现目标的方法和程序
 - 工程是在具体目标实现过程中，人-机-料-法-环-软件的有效组合。
- 从实现具体目标来说，工程包含技术和科学
- 从研究范围来说，科学大于技术，技术大于工程
- 从历史发展来看，先有工程知识体系，后出现技术知识体系，最后诞生了科学知识体系

Science, technology and engineering

- Science, technology, engineering are three different concepts
 - Science is a knowledge system that summary of laws and reveals laws
 - Technology is methods and procedures to achieve goals by means of laws
 - Engineering is valid combinations of human - machine - material - method - environment- software during achieving specific goal process.
- From achieving specific goal, engineering includes technology and science.
- From scope of study, science is greater than technology, technology is greater than engineering
- From historical development, first is engineering knowledge, then it is technical knowledge appears, finally it is birth of scientific knowledge

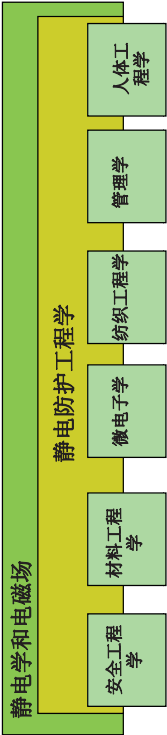
科学、技术与工程



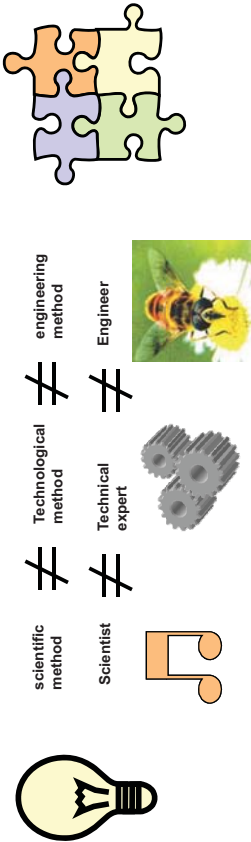
静电防护工程学作为一门新兴学科是科学、技术与工程的统一体。

静电防护工程学

- 静电防护工程学是研究静电危害及其防护工程的一门交叉学科。它的研究对象是静电起电-消散机理、静电危害机理、防护材料、防护方法、测量及评价方法。它是为产品与人员安全防护、产品质量与可靠性服务的学科。它以现代静电学和电磁场理论为基础，涉及到安全工程学、材料工程学、微电子学、纺织工程学、管理学等多个学科。
- 静电危害机理及其测量方法研究则是当前静电防护工程学中最为活跃的研究领域之一。



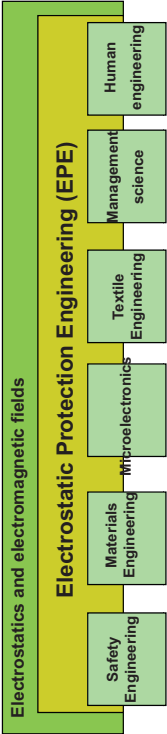
Science, technology and engineering



As an new discipline of science, Electrostatic Protection Engineering is a entia of tecnology, science and engineering

Electrostatic Protection Engineering (EPE)

- ESD protection engineering (EPE) is a new cross-knowledge that study electrostatic hazards and protection engineering. Its research object is electrostatic charging - dissipation mechanism, mechanism of electrostatic hazards, protective materials, protection methods, measurement and evaluation methods. It is a discipline intended for products and personnel safety, product quality and reliability services. It is based on modern electrostatic and electromagnetic theory, related to safety engineering, materials engineering, microelectronics, textile engineering, management science, and so on many knowledge.
- Study of electrostatic hazards mechanism and measurement methods are one of currently the most active research areas in electrostatic protection engineering .

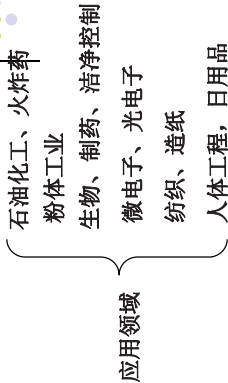


静电防护工程学

- 静电防护工程学产生背景
 - 1966年日本菅义夫主持编写了《静电手册》，系统总结了之前的科学家们在静电起电机理、静电测量方法、静电灾害危害及防护、静电应用等方面的研究成果，这是在静电学理论基础上最为接近工程应用的系统知识体系。1978年北京理工大学王学英、鲍重光等人组成翻译组将《静电手册》译成中文，1981年科学出版社出版。
 - 1987年北京工业学院出版了鲍重光编译的《电子工业静电危害》，书中区分了“纯学术的静电学”与“为建立防害系统所必需的静电学”，该书总结了电子工业静电防护的理论和方法
 - 1988~1995年国外静电防护技术标准引进，建立了静电防护工程的应用基础。
 - 1998年刘尚合出版《静电理论与防护》，书中确立“静电安全工程学”，“防止静电危害问题已经发展成为利用系统工程理论对静电起电机理、静电作用机理、ESD模型、静电测试技术和防护理论与措施进行全面研究的新学科。”该书为静电防护提供了系统的知识体系。
 - 刘尚合院士在2000年《中国工程科学》“静电防护工程研究与进展”论文中，在2007年《自然杂志》“静电及其研究进展”论文中，明确提出了“静电防护工程学”是一门新兴的学科。
 - 孙可平于1994年出版了《工业静电》，2007年出版《电子工业静电放电（ESD）防护与控制技术》，系统总结了电子工业静电防护工程的知识体系。

静电防护工程学

- 静电防护工程学主要研究内容
 - 静电起电-消散机理
 - 静电危害机理
 - 防护材料
 - 防护方法（设计、技术与管理）
 - 测量及评价方法
- 静电防护工程学研究特点
 - 模型工程化：激励模型（ESD）、响应模型（点燃、电流和20、500Ω）
 - 测量多样化：电阻、电压、电场、电能量、电荷量、衰减时间、波形
 - 应用标准化：技术要求、管理要求、产品规范



EPE's Background

- "Electrostatic Handbook" was prepared under auspices of Japan's Kan Yoshio in 1966, which system summarizes early scientist's research results on electrostatic charging mechanism, electrostatic measurement methods, electrostatic disaster / hazards and protection applications on theory of electrostatics. Wang Xueying, Bao Chongquan in Beijing Institute of Technology composed a translation group and "Electrostatic Handbook" was translated into Chinese in 1978 and was published by Science Publishing House in 1981.
- BIT University published "electronic industrial electrostatic hazards" compiled by Bao Chongguang in 1987. The book distinguished between "purely academic electrostatics" and "necessary electrostatics for establishment of proof-harm system" and the book summarized ESD theories and methods in electronic industry.
- Foreign technology standards for electrostatic protection are introduced from 1988 to 1995 and establish basis of electrostatic protection engineering applications
- Liu Shanghe published "Electrostatic theory and protection" in 1998. The book establishes "static safety engineering", "prevent electrostatic hazards has developed into a new disciplines that carry out comprehensive study for electrostatic charging mechanism, electrostatic interaction mechanism, ESD model, static testing techniques and protective theory and measures be means of system engineering theory." The book provides a system knowledge for electrostatic protection
- Liu Shanghe academican clearly stated that "static protection engineering is a emerging disciplines" in paper of "research and development electrostatic protection engineering" in "China Engineering Science" in 2000 and in paper of "Electrostatic and its research progress" in "Nature magazine" in 2007.
- Prof. Sun Keping published "Industrial electrostatic" in 1994 and published "Electronic Industry Electrostatic discharge (ESD) protection and control technology" in 2007, which system summarizes knowledge of electronics industry electrostatic protection engineering.

Electrostatic Protection Engineering (EPE)

Electrostatic Protection Engineering (EPE) range

- Main research content of Electrostatic Protection Engineering (EPE)
 - Electrostatic charging - dissipation mechanism
 - Mechanism of electrostatic hazards
 - Protection methods (design, technology and management)
 - Measurement and evaluation methods
 - Research Features of EPE
 - Model engineering: Excitation model (ESD), Response model (ignite model, the current target 2Ω, 500Ω energy model)
 - Measuring diversity: resistance, voltage, electric field, electric energy, charge decay time, waveform
 - Application Standardization: technical requirements, management requirements, product specifications
- Application areas
- Petrochemicals, explosives
Powder Industry
Biological, pharmaceutical, clean control
Microelectronics, optoelectronics
Textile, paper
Human engineering, daily necessities

静电防护工程学

- 静电防护工程学与其他学科的关系
 - 静电学
 - 静电应用工程
 - 静电防护工程
- 静电防护工程学与电磁兼容技术的交叉关系
 - 在应用方面：电子产品；易燃易爆、洁净污染、静电敏感器件、静电吸附；
 - 接地的概念
 - 屏蔽概念

Electrostatic Protection Engineering (EPE) Relationships

- Relationships of EPE with other disciplines
 - Electrostatics
 - Electrostatic Application Engineering
 - Electrostatic Protection Engineering
- Cross relationship of EPE and electromagnetic compatibility (EMC) technology
 - In application areas: electronic products; flammable, clean pollution, electrostatic sensitive devices, electrostatic adsorption;
 - Concept of ground
 - Shielding concept

静电防护工程学

- 为什么要建立静电防护工程学？
 - 为学者、专家明确研究领域（资金渠道）
 - 为人才培养明确方向（就业、立项）
 - 为标准化研究和应用开辟独立空间

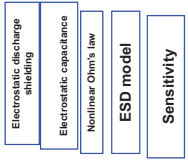
静电防护工程学当前的任务

- 建立概念：名词术语
- 危害评价研究：潜在失效
- 建立模型：响应模型
- 制、修订标准：技术标准、管理标准、产品规范



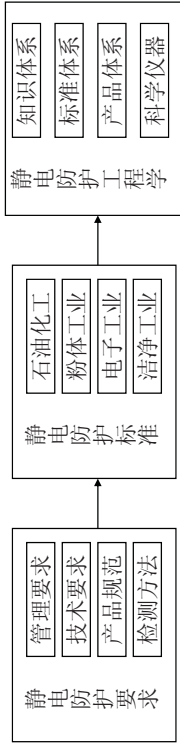
Electrostatic Protection Engineering (EPE) functions

- Why create Electrostatic Protection Engineering (EPE)?
 - Make clear research field for scholars, experts (funding sources)
 - Make clear direction for personnel training (employment, project)
 - Open independent space for standardization research and applications
- Current task of electrostatic protection engineering
 - Establish concepts: Terminology
 - Hazard assessment: Potential failures
 - Establish model: Response model
 - Develop and revise standards: Technical standards, management standards, product specifications



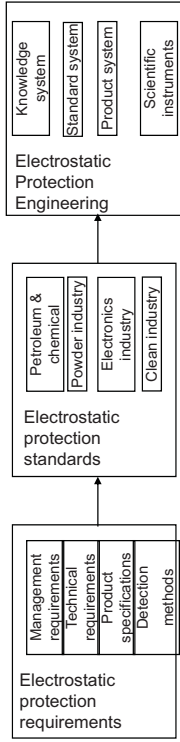
标准化与静电防护工程学

- 标准化，是在一定的范围内获得最佳秩序，对实际的或潜在的问题制定共同的重复使用的规则的活动。
- 静电防护工程学提出之前，静电防护要求和标准结合在一起形成当今各行各业，多种版本的静电防护“标准群”。
- 静电防护“标准群”推动了静电防护产业，聚集了厂商、学者、管理者、专业技术人员、标准化工作者。
- 这些静电防护工作者总结了静电防护的知识体系，提出了静电防护工程学。
- 进而，静电防护工程学所建立的知识体系将再作用于“标准群”，使之更加实用和规范。



Standardization and EPE

- Standardization is actions of getting best order and developing a common repeated use rules for actual or potential problems in a certain range.
- Before EPE is raised, ESD requirements and standards together form today's "standard group" of industries, many versions of ESD protection.
- "Standard group" of ESD protection promotes ESD protection industry, bringing together manufacturers, academics, managers, professional and technical personnel, standardization worker.
- These ESD static protection workers summed up knowledge system of ESD protection and propose ESD protection engineering.
- Further, knowledge system established by ESD protection engineering will be used in "standard group" again to make it more practical and norms.



标准化中的技术与科学

- 标准化不等于技术与科学
 - 标准有管理属性，因而有利益倾向，标准是实用的
 - 科学技术是客观的，但没有符合性的规定
 - 但是标准化不能违反技术规律、不能违背科学原理
- 标准化是工程中重要的组成部分
- 工程要素：人员-设备仪器-材料-方法-环境-软件，都可成为标准化的要素
 - 工程化方法往往成为标准化的方法
- 科学技术发展必然要求标准不断更新发展。

Technology and science in standardization

- Standardization does not mean technical and scientific
 - Science and technology are objective, but there is no requirement of conformity
 - However, standardization can not violate technical rules, can not be contrary to scientific principles
- Standardization is an important part of engineering
- Project elements: personnel - equipment and instruments - materials - methods - environment – software may become standardized elements
 - Engineering methods often become standardized methods
- Development of science and technology resuests standards to constantly update and develop.

几点建议

- 模型是静电防护工程学的重要理论基础，需要更加深入地研究激励模型和响应模型
 - 激励模型：HBM、MM、CDM等
 - 响应模型：点燃模型、电流靶2Ω、电能靶500Ω、人体靶、立即失效
- 静电防护技术标准建立在ESD模型基础上，没有这些模型就没有技术标准，也就没有通用的测量仪器了。因此新的模型就必须有新的测量方法和测量仪器。
- 由于静电现象的重复性和再现性差，用科学方法和实验室技术往往不能复现一致的结论，因此工程化的方法、依靠经验的方法、统计概率的方法往往成为标准化的依据。标准使用者应该根据具体情况选择使用标准的一些技术要求和方法，不应教条地把标准条文理解为科学依据。
- 电子元器件失效的判断：除了立即失效判据外，更应该研究性能下降的潜在失效的测量方法，形成技术标准。

Some suggestions

- Model is an important theoretical basis of EPE and needs for more in-depth study of Excitation model and response model
 - Excitation model: HBM、MM、CDM etc.
 - Response model: Ignite model, current target 2Ω, energy target 500Ω, human target, immediately invalidated
- ESD protection technology standards are established on basis of ESD models. There would be no technical standard models without these models and there is no universal measuring instrument. Therefore, a new model must has new measurement methods and measuring instruments.
- Due to poor repeatability and reproducibility of electrostatic phenomena, scientific methods and laboratory technology often fail to reproduce same conclusion, so engineering methods, relying on empirical methods, statistical probability methods often become standardized basis. Standard users should choose to use some of technical requirements and methods of standards according to specific circumstances and should not understand standard provisions dogmatically as a scientific basis.
- Criterion for judgment of electronic component failure: In addition to immediate failure criterion, it also should research measurement method for potential failure of performance decreasing and form technical standards.

科学高效掌握ESD控制关键技术，
充分合理选择ESD控制项目

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iNARTE ESD Engineer, Since 2002

Scientific and Efficient Mastering of ESD Control Key Technologies,
Sufficient and Rational Selection of ESD Control Projects

Dr. Jiusheng Huang

Beijing Institute of Special Electromechanical Technology

iNARTE ESD Engineer, Since 2002

国内标准有哪些关键技术？

1980'年代静电标准

• 自主研制探索

1990'年代静电标准

• 制定各行业标准

2000'年代静电标准

• 引进国外

2010'.....

GB 12158 防止静电事故通用导则

4.1 典型静电放电的特点和相对引燃能力表

放电种类	发生条件
电晕放电	当电极曲率半径、在电极表面尖端或突出部位电场强度足够大时发生
刷形放电	在带电体与接地的导体等体与导体间发生
火花放电	在带电体与接地的导体金属导体间发生
传播型刷形放电	仅发生在具有表面放电的场所，当静电非导体厚度小于5mm，其表面电阻率不大于等于 $2 \times 10^{10} \Omega/m^2$ 时容易发生

本文将讨论ESD方案中关键技术与控制项目。

What kind of key technologies and projects in the domestic standards?

1980's Electrostatic Standard

• Independent Research and Exploration

1990's Electrostatic Standard

• Development of Various Industry Standards

2000 'S Electrostatic Standard

• Introduction of Foreign Standards

2010'.....

This article will discuss the key technologies and control projects in the ESD solutions.

GB 12158 General Guidelines for Preventing Electrostatic Accidents

the characteristics of typical electrostatic discharge and its relative ignition capability as shown in Table

Discharge Type	General Conditions
Corona Discharge	When the electrodes are far apart, tips or protruding parts on the surface of an object with strong electric field is prone to generate Corona Discharge.
Brush Discharge	Brush Discharge is prone to generate between the electrostatic non-conductor and conductor with relatively high charge potential.
Spark Discharge	Spark Discharge should be generated between the charged metal conductor with close proximity.
Brush Discharge With Propagation Form	Brush Discharge With Propagation Form should be generated in the situation with high-speed electrification, which is prone to take place when the thickness of electrostatic non-conductor is less than 5mm, and its surface charge density is greater than or equal to $2.7 \mu C/m^2$.

美国ESD控制方案

- 管理的关键词
(Administrative)
 - 制定方案计划 (Program, Training & Audit Plan)
 - 指定ESD经理, 协调员 (Manager, Coordinator)
- 关键技术
 - 接地系统 (Grounding / Equipotential Bonding)
 - EPA的控制项目
 - ESD控制设计 (DUT, EUT)
- Shall be or Should be?

S20.20-1999, 2007

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[illegible]

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S20.20-1999, 2007

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U.S. ESD Control Projects

- Key Administration Projects (Administrative)
 - Development of Program and Plan (Program, Training & Audit Plan)
 - Designation of ESD Manager, Coordinator (Manager, Coordinator)
 - Key Technologies
 - Grounding System (Grounding/Equipotential Bonding)
 - EPA Control Project
 - ESD Control Design (DUT, EUT)
- Shall be or Should be?

S20.20-1999, 2007

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[illegible]

消除静电or ESD控制?

- 接触分离可产生静电
- 摩擦的本质是不断接触与分离



铜、镍	银、黄铜	金、白金	碱磺	醋酸纤维维	聚酯	赛璐珞	硅	聚四氟乙烯
丝	铝	纸	棉花	钢	木材	琥珀	封腊	硬橡胶
(+)	兔毛	玻璃	云母	人发	尼龙	羊毛	毛皮	铝

10/29/2013

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4

Eliminate Static Electricity or ESD Control?

- contact separation may generate static electricity
- The essence of friction is constant contact and separation



(+) ^a	Silk ^a	Copper, Nickel, ^a
Cony Hair ^a	Aluminum ^a	Silver, Brass ^a
Glass ^a	Paper ^a	Gold, Platinum ^a
Mica ^a	Cotton ^a	Sulfur ^a
Human Hair ^a	Steel ^a	Acetate Fiber ^a
Nylon ^a	Timber ^a	Polyester ^a
Wool ^a	Amber ^a	Celoid ^a
Fur ^a	Sealing Wax ^a	Silicon ^a
Lead ^a	Hard Rubber ^a	PTFE ^a

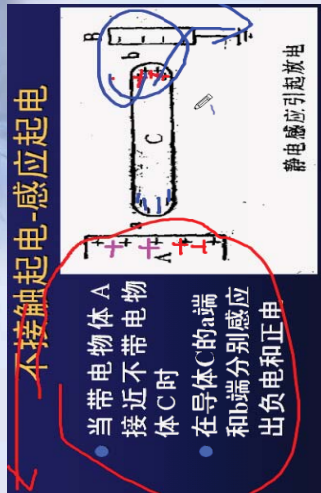
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不接触能产生静电吗？

- 不接触，感应也能产生静电
 - 当带电物体靠近不带电物体时，会感应电荷
- 任何物质（气体，液体，固体）都会产生静电，能消除静电？
- 控制放电(ESD)，而不是消除静电



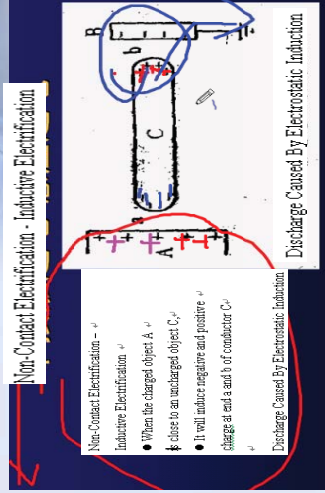
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5

Non-contact may generate static electricity?

- even if no contact, induction can also generate static electricity
 - When a charged object approaches an uncharged object, it will be induced charges
- Any substance (including gas, liquid, and solid) will generate static electricity, and can eliminate static electricity?
- Control **Electronic Static Discharge (ESD)**, but not eliminate static electricity



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5

防静电工作区等级 or 元件静电敏感度分类？

1.0.5 防静电工作区设计标准应分为三级，一级标准应为室内控制静电电位绝对值不大于 100V；二级标准应为室内控制静电电位绝对值不大于 200V；三级标准应为室内控制静电电位绝对值不大于 1000V。



电子工程防静电设计规范

g) EPA 分为 A、B 级区域。操作静电敏感度在 -100V~100V 之间的 ESDS 产品的区域为 A 级区域，其他为 B 级区域。A 级区域所用不直接接触 ESDS 产品的防静电用品(装备)应采用防静电用品；B 级区域采用静电耗散用品。 **GJB 3007A-2009 防静电工作区技术要求**

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6

Level of Electrostatic Discharge Protected Area Or Classification of Component Electrostatic Sensitivity?

1.0.5 The design criteria ESD protected area can be divided into three levels. Level I should refer to control the absolute value of the interior electrostatic potential not greater than 100V, Level II should refer to control the absolute value of the interior electrostatic potential not greater than 200V, and Level III should refer to control the absolute value of the interior electrostatic potential not greater than 1000V.



GB 50611-2010 Code For Design of Protection of Electrostatic Discharge In Electronic Engineering

g) EEP A is divided into Level A and Level B Area. ESDS products with the operating static sensitivity between -100 V - 100 V should be categorized as Level A Area, while others should be categorized as Level B Area. The anti-static products (equipment) for non direct contact ESDS products used in Level A Area should adopt electrostatic conductive supplies; while Level B Area should adopt electrostatic dissipative supplies. **GJB 3007A-2009 Requirements For Electrostatic Discharge Protected Area**

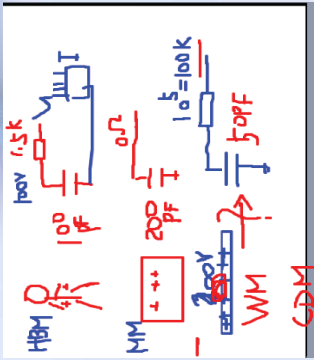
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6

静电电位 or 模型

- ESD模型 (>95%)
 - HBM (100V, S20.20)
 - MM (?V)
 - CDM (2000V/inch?)
 - HMM (?V)
 -



接地电阻 or 接地阻抗?

GJB 3007A-2009 防静电工作区技术要求

表1 EPA 防静电要求一览表

项目名称	检测指标	单位
防静电接地电阻	接地电阻	Ω
EPA 静电电位*	空间对地电位	V

S20.20-1999 <1.0

Technical Requirement	Implementing Process	Area	Test Method	Standard or Range	Recommended Range
Grounding / Bonding	Equipment Ground	0	ANSI ESD S20.20	ESD 9.1.1	ESD 9.1.1
	Auxiliary Ground	0	ANSI ESD S20.20	ESD 9.1.1	ESD 9.1.1
	Equipment Bonding	0	ESD S20.20	ESD 9.1.1	ESD 9.1.1
	Common Point Ground	0	ANSI ESD S20.20	ESD 9.1.1	ESD 9.1.1

Table 1: ESD Control Program Technical Requirements Summary

(See paragraph 4.2 for further guidance regarding alternate test methods)

10年有效期

ANSI ESD S20.20

ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

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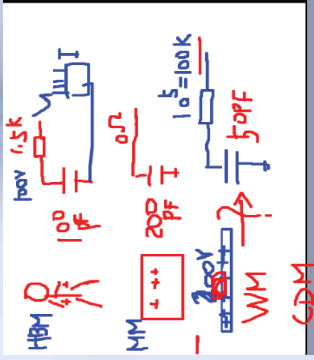
ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

Electrostatic Potential or Model

- ESD Model (>95%)
 - HBM (100V, S20.20)
 - MM (?V)
 - CDM (2000V/inch?)
 - HMM (?V)
 -



Ground Resistance or Impedance Grounded?

GJB 3007A-2009 Requirements For Electrostatic Discharge Protected Area

Project Name	Monitoring Indicators	Unit	Technical Indicator Requirements
Anti-Static Grounding Resistance	Grounding Resistance	Ω	≤ 100
EPA Electrostatic Potential	Air-to-Ground Potential	V	≤ 100

S20.20-1999 <1.0

Technical Requirement	Implementing Process	Area	Test Method	Standard or Range	Recommended Range
Grounding / Bonding	Equipment Ground	0	ANSI ESD S20.20	ESD 9.1.1	ESD 9.1.1
	Auxiliary Ground	0	ANSI ESD S20.20	ESD 9.1.1	ESD 9.1.1
	Equipment Bonding	0	ESD S20.20	ESD 9.1.1	ESD 9.1.1
	Common Point Ground	0	ANSI ESD S20.20	ESD 9.1.1	ESD 9.1.1

Table 1: ESD Control Program Technical Requirements Summary

(See paragraph 4.2 for further guidance regarding alternate test methods)

10年有效期

ANSI ESD S20.20

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ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

ESD 9.1.1

墙面，顶棚，门要防静电？

1 一级防静电工作区的地面和墙面、柱面应选用导电材料。导电电阻、表面电阻、对地电阻应满足下列技术指标：
1) 表面电阻、对地电阻应为 $2.5 \times 10^4 \Omega \sim 1.0 \times 10^6 \Omega$ ；
2) 摩擦起电电压绝对值不应大于 100V；
3) 静电半衰期不应大于 0.1s。

2 二级防静电工作区的墙面、柱面、顶棚和门表面、软帘应选用静电耗散型材料。静电耗散型地面、墙面、柱面、顶棚和门表面应满足下列技术指标：
1) 表面电阻、对地电阻应为 $1.0 \times 10^5 \Omega \sim 1.0 \times 10^9 \Omega$ ；
2) 摩擦起电电压绝对值不应大于 200V；
3) 静电半衰期不应大于 1s，但软帘的摩擦起电电压绝对值可不大于 300V。
GB 50611-2010 电子工程防静电设计规范
3 三级防静电工作区的地面、墙面、柱面视工艺技术要求可
选用静电耗散材料或低起电材料。顶棚和门表面等可选用低起电材料。选用静电耗散材料的地面、墙面和柱面，应满足本条第 2 款的技术指标；选用低起电材料的地面、墙面、柱面、顶棚和门表面等，应满足摩擦起电电压绝对值不大于 1000V 的要求。

10/29/2013

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现有国内标准成本分析

- 按GB, GJB...几百元/人，几百元/m2
 - 接地，工作台，地垫，腕带，工作服，鞋，座椅，车，手套，指套，帽，墙面，天花板，窗帘，工具，周转箱...
 - 小厂：100人，1000平米：费用数十万元
 - 中厂：几千人：几万平米：费用数百万元
 - 大厂：几万人：数十万平米：费用数千万元
- 管理？重技术轻管理，几乎不管！

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Whether walls, ceiling and doors need ESD?

1. The floor, wall, and cylinder surface of Level I ESD protected area should adopt the electrostatic conductive material. The electrostatic conductive floor, wall, and cylinder surface shall meet the following specifications:
1) Surface resistance, resistance to ground should be
2) The absolute value of triboelectrification voltage should not exceed 100 V
3) The electrostatic half-value period should not be greater than 0.1s

2. The floor, wall, cylinder surface, ceiling and door surface of Level II ESD protected area should adopt the electrostatic conductive material. The electrostatic conductive floor, wall, cylinder surface, ceiling and door surface shall meet the following specifications:
1) Surface resistance, resistance to ground should be
2) The absolute value of triboelectrification voltage should not exceed 200 V
3) The electrostatic half-value period should not be greater than 1s, but the absolute value of triboelectrification voltage for soft curtain may not be higher than 300 V

3. The floor, wall and cylinder surface, of Level III ESD protected area may adopt the electrostatic conductive material or low electrification voltage material depending on the processing technical requirements. Ceiling and door surfaces, etc., may adopt the low electrification voltage material. The floor, wall, cylinder surface, ceiling and door surface, etc., adopted electrostatic dissipative materials should meet the requirements that the absolute value of triboelectrification voltage should not be higher than 1000 V

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Cost Analysis of Existing Domestic Standards

- According to GB, GJB ... several hundred yuan/person, several hundred yuan /m2
 - Ground, workbench, ground mat, wrist strap, fatigue dress, shoes, chairs, vehicles, gloves, fingerstall s, hats, walls, ceilings, curtains, tools, crates ...
 - Small-sized Factory: 100 persons, 1000 square meters: hundreds of thousands of yuan for cost
 - Medium-sized Factory: thousands of persons: tens of thousands of square meters: sever millions of yuan for cost
 - Large-sized Factory: tens of thousands of persons: tens of thousands of square meters: tens of millions of yuan for cost
- Management? Technology Focusing and Management Ignoring, almost no management!

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ESD控制关键技术?

- 哪些是ESD控制关键技术?
 - 接地（导体，人体，防静电器材...接地）
 - 所有能接地的全部接地，形成等电位
 - 控制绝缘体电场（30厘米，离子...）
<2000V/inch.

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ESD Control Key Technologies?

- What are the ESD Control Key Technologies?
 - Ground (conductor, human body, anti-static equipment ... Ground)
 - All that can be grounded should be grounded completely to form a equipotential bonding
 - Control the electric field of insulators (30cm, ion ...) <2000V/inch.

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如何接地?

- 接地技术:
 - 等电位原理（ESDs, Human body, Equipment....）
 - 安全原则（正常工作，故障情况下..）

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How to ground?

- Grounding Technique:
 - Equipotential principle (ESDs, Human body, Equipment)
 - Safety principle (normal working, fault conditions ..)

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等电位！？

- $\Delta U = I \cdot Z$ ($f=0$ 时, $Z=R$)
 - 正常工作情况下, 设备对地电位差 $\Delta U = I \cdot Z$
 - 故障情况下, 设备对地电位差 $\Delta U = I \cdot Z$
 - 人员活动时: 起电与衰减
- 完成等电位? 要么电流 $I=0$, or $Z=0$
 - 生产实际过程, 完全等电位是不可能的

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Equipotential !?

- $\Delta U = I \cdot Z$ ($f=0$, $Z=R$)
 - Under normal operating conditions, the equipment-to-ground potential difference is $\Delta U = I \cdot Z$
 - Under fault conditions, the equipment-to-ground potential difference is $\Delta U = I \cdot Z$
 - Personnel Activities: electrification and attenuation
- To complete equipotential? Either the current $I=0$, or $Z=0$
- During the actual production process, completely equipotential is impossible.

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接大地 or 接设备地？

- 接大地 (GB, GJB... <100 Ohms)
 - 变电站地网 (4Ω)、水火电厂、微波避雷针 (10Ω)
- 接设备地, 保护地, 第三条导线... (ANSI/ESD S20.20)
 - AC $|Z| < 1.0$ Ohms
 - 辅助接地 R < 25 Ohms



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Earth Ground or Equipment Ground?

- Earth Ground (GB, GJB ... <100 Ohms)
 - Substation Ground Network (4Ω), Hydraulic and Thermal Power Plant Station (10Ω), and Lightning Rod (10Ω)
 - Equipment Ground, protective ground, 3rd conductor ... (ANSI/ESD S20.20)
 - AC $|Z| < 1.0$ Ohms
 - Auxiliary Ground: R < 25 Ohms

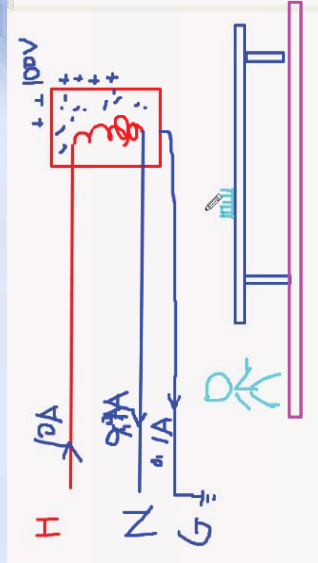


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独立接地？

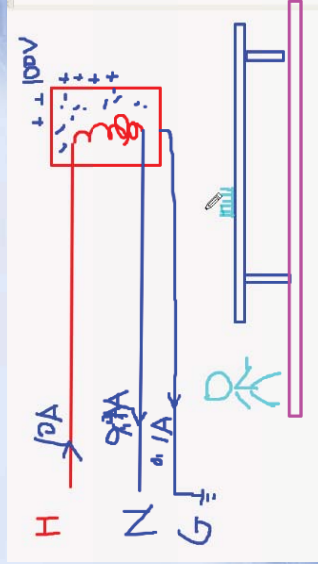


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Separate Ground?

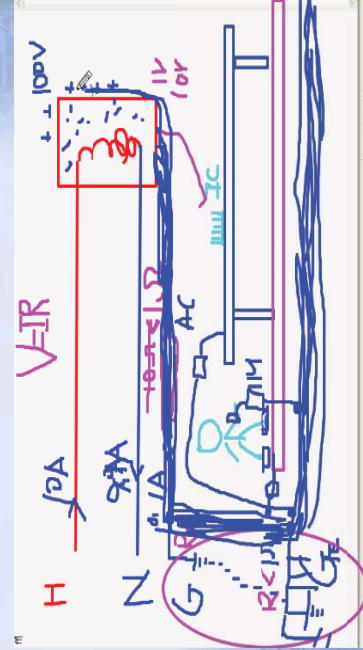


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接地（等电位）

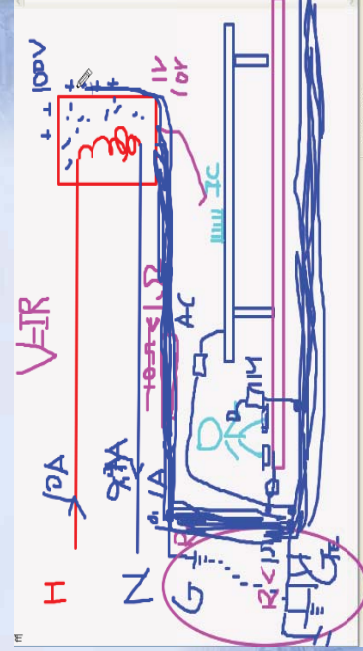


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Ground (Equipotential)

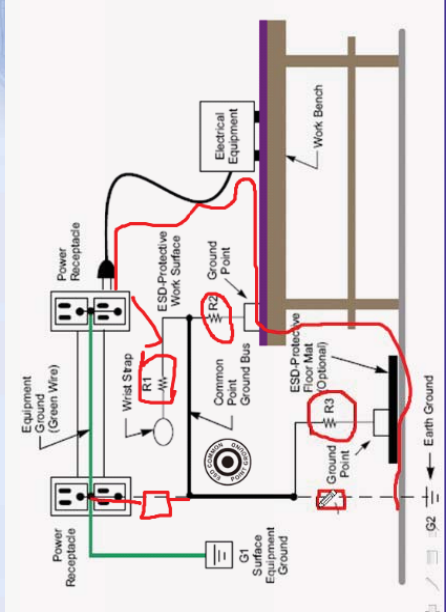


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接地 (Grounding)

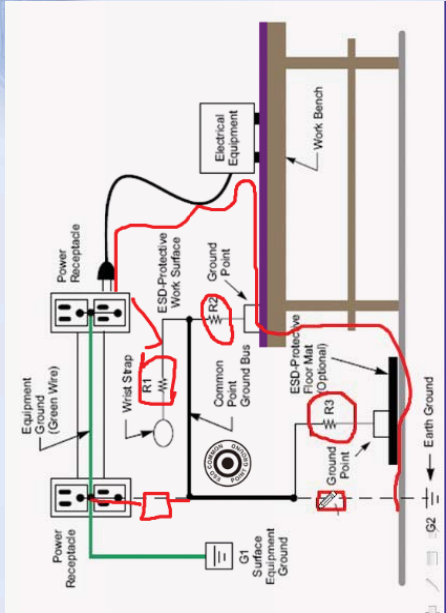


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Grounding



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独立接地问题！



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Separate Ground Problem!



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独立接地 等电位?



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Separate Ground Equipotential?

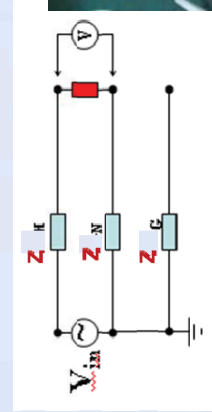


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阻抗测试方法



1. $(V_{in}-V)=(Z_h+Z_n)*I$
2. $V_{ng}=I^2*Z_n$
3. $V_{hg}=(Z_h+Z_g)*I_g$

注意，第三步测量时，地线中有电流，漏电保安器
Ground fault circuit interrupters (GFCI)会动作。

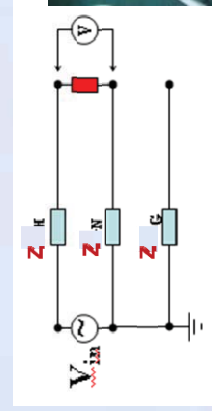


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Impedance Test Method



1. $(V_{in}-V)=(Z_h+Z_n)*I$
2. $V_{ng}=I^2*Z_n$
3. $V_{hg}=(Z_h+Z_g)*I_g$

It should be noted that, during the third step measurement, the
Ground Fault Circuit Interrupters (GFCI) will be activated in
the event of current in the ground wire.



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接地电阻为负值？



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Grounding resistance is negative?



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掌握关键技术，节省成本分析

- 一米铜导线成本<10元
- 小于1 Ohms的接地桩，成本至少10万元
- 投入10元，节省10万元
- 收益=10万元/10元=1,000,000%
 - 远超过捡黄金！

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Master Key Technologies, Saving Cost Analysis

- Cost of Copper Wire Per Meter < RMB 10
- The cost of ground stud less than 1 Ohms should be at least RMB 100,000
- Invest RMB 10, save RMB 100,000
- Revenue = RMB 100,000/RMB 10 = 1,000,000%
 - Far more than picking up the gold!

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人员接地有几种方式？

- 手->腕带
- 脚->鞋->地面
- 人-服装-公共地



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How many ways of Personnel Grounding?

- Hand -> Wrist Strap
- Foot -> Shoe -> Ground
- Person -> Clothing -> Common Ground

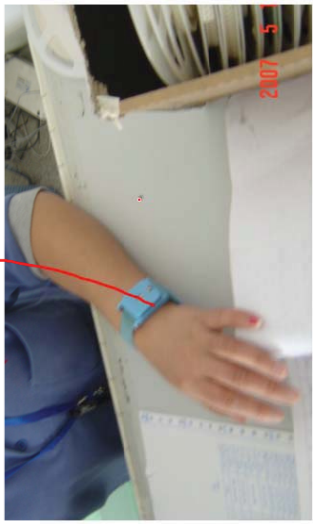


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无线腕带



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Wireless Wrist Strap



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CDM控制

4.8kV



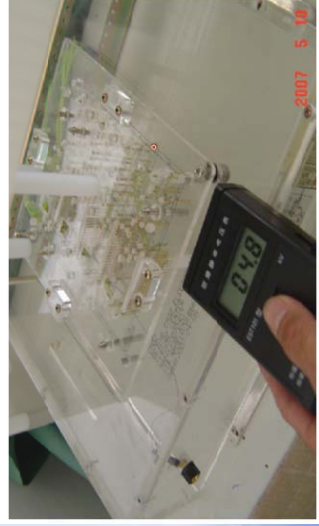
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CDM Control

4.8kV

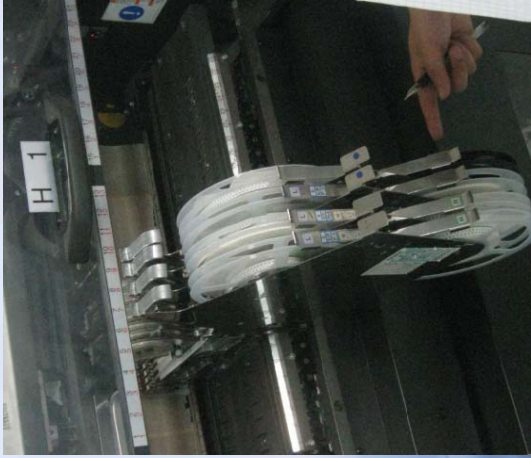


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讲演题目10/Topic10



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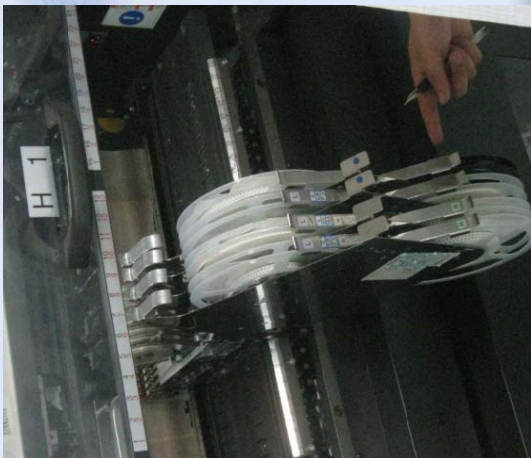
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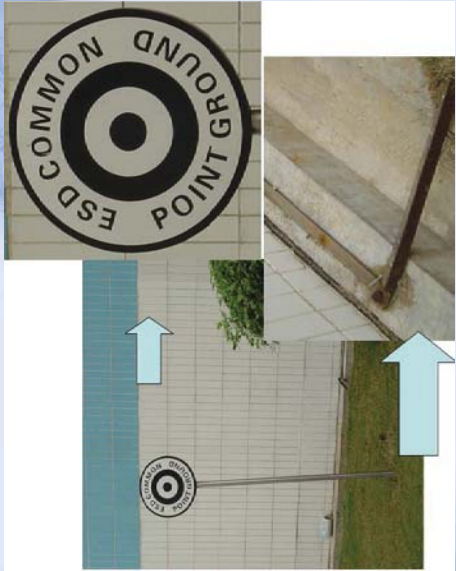
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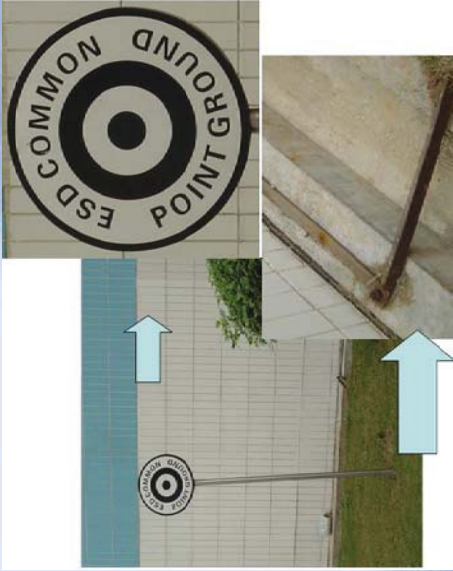
共同点接地 or 接地阻抗？

- 接地电阻R
- 接地阻抗|Z|



Common Ground Point or Ground Impedance?

- Ground Resistance R
- Ground Impedance |Z|



标示的误用



Misuse Label



标识的误用

- 不能区别这两个标示



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Misuse Label

- Cannot distinguish these two labels



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ESD控制关键技术

- 接地或接地系统
- 人员接地
- 控制电场

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ESD Control Key Technologies

- Grounding or Earthing System
- Personnel Grounding
- Control Electric Field

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ESD控制&设计技术

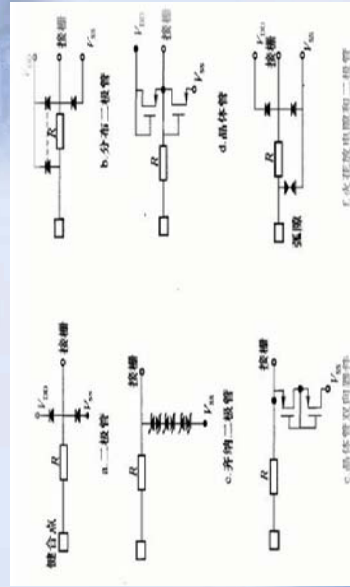
- **控制:** 在操作等过程中控制静电，使其不能达到危害的程度 (所有工作人员、工具、设备与环境)
 - 静电的产生
 - 控制静电放电 (ESD, EOS)
- **设计:** 元器件(DUT)、组件(PCB)及整机(EUT)的抗静电能力 (TLP, Design and Debug)

ESD Control & Design Technology

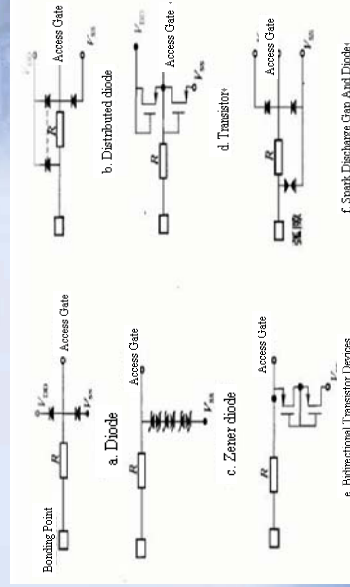
- **Control:** control static electricity during operations, etc., so that it cannot reach the extent of hazard (including all employees, tools, equipment and environment)
 - Generation of static electricity
 - Control ESD (ESD, EOS)
- **Design:** antistatic capability of parts and components (DUT), elements (PCB) and complete unit (EUT) (TLP, Design and Debug)

优化设计产品提高抗静电能力

原理



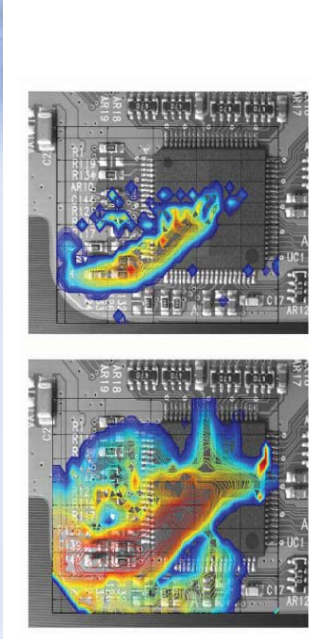
原理



IEC 61000-4-2

ISO 10605

PCB & System level TLP



Susceptibility scanning using pulse techniques on Product A (left) and Product B (right)
(Courtesy of Amber Precision Instruments)

http://www.esda.org/documents/IndustryCouncilWhitePaper3_PII.pdf

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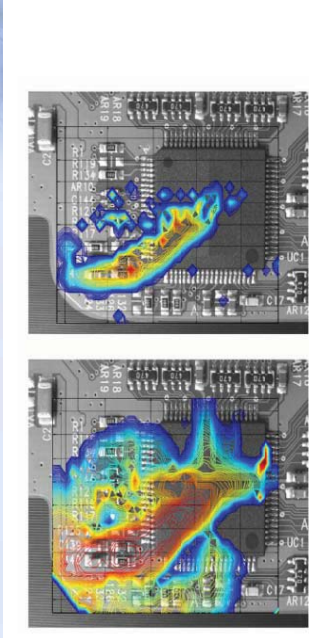
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IEC 61000-4-2

ISO 10605

PCB & System level TLP



Susceptibility scanning using pulse techniques on Product A (left) and Product B (right)
(Courtesy of Amber Precision Instruments)

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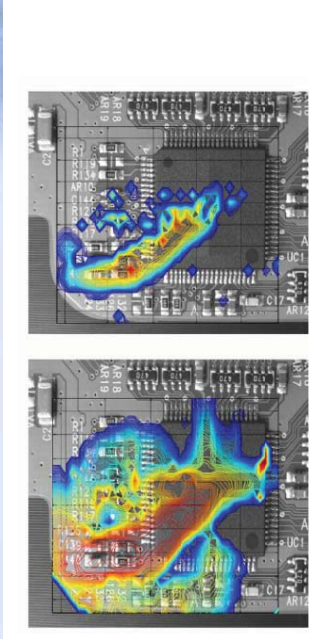
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IEC 61000-4-2

ISO 10605

PCB & System level TLP



Susceptibility scanning using pulse techniques on Product A (left) and Product B (right)
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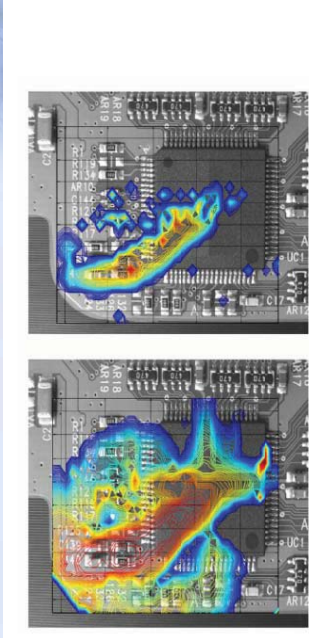
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IEC 61000-4-2

ISO 10605

PCB & System level TLP



Susceptibility scanning using pulse techniques on Product A (left) and Product B (right)
(Courtesy of Amber Precision Instruments)

http://www.esda.org/documents/IndustryCouncilWhitePaper3_PII.pdf

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Wafer & IC level晶元及IC设计

- 通过科技设计，提高元件的敏感度，
- 减小工厂生产中控制ESD的成本，
- 减小系统级损坏成本，即提高整机的抗静电能力



- Through science and technology design to improve the sensitivity of parts & components
- Reduce the cost of controlling ESD in factory production
- Reduce the system-level damage cost, namely, improve ESD capacity of complete unit

TLP Tester



ESDEMC Technology

ANSI/ESD STM5.5.1-2008

轻便，新技术，价格低

Barthelectronics

体积大，传统型，价格高

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TLP Tester



ESDEMC Technology

ANSI/ESD STM5.5.1-2008

Lightweight, Innovative, Low Price

Barthelectronics

Bulky, Traditional, High Price

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晶元及元器TLP I-V

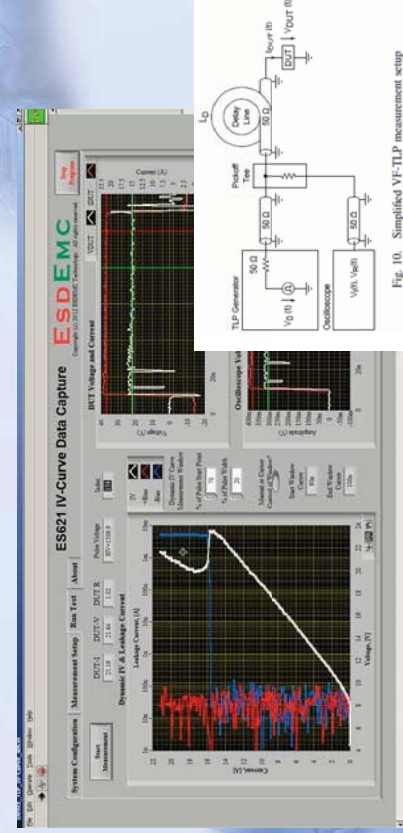


Fig. 10. Simplified VF-TLP measurement setup

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Wafer and Elements TLP IV

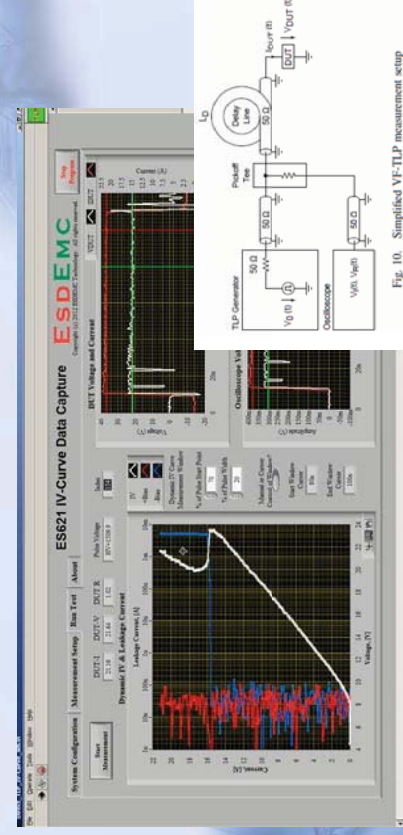


Fig. 10. Simplified VF-TLP measurement setup

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结论

- 增加与修改国标，掌握控制ESD关键技术，
 - 目前缺少对应的国外的ESD标准有....
- 组织选择合适的ESD控制项目，节省成本和管理费用，提高投入产出效益。
 - 根据不同的实际情况，选择合适项目，组织节省成本
- 设计元器件，提高器件抗静电放电能力
 - 减小ESD控制成本和降低ESD风险
- 设计PCB和系统，提高整机抗静电能力和可靠性
 - ESD对整机系统造成的损失远比对元件造成的损坏大。

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Conclusions

- Supplement and Modify GB, Master Control ESD Key Technologies,
 - Currently, lack of a corresponding foreign ESD standards
- Organize and select suitable ESD control projects, saving costs and management costs, improve input and output efficiency.
 - Depending on the actual situation, select the appropriate projects and organize saving costs
- Design parts and components, improve their immunity to electrostatic discharge
 - Reduce ESD Control costs and lower ESD Risk
- Design PCB and system to improve the ESD capacity and reliability of complete unit
 - The loss of the complete system caused by ESD is significantly greater than that on the parts and components

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感谢大家！

- 欢迎大家提出问题

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Thank you!

- Q&A

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电子元器件ESD损伤分析

演讲人：来 萍
中国赛宝实验室

laiping@ceprei.com, 1360626600

中国赛宝

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Analysis on the ESD Damage of Electronic Parts and Components

Speaker: Lai Ping
China CEPREI Laboratory

laiping@ceprei.com, 1360626600

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1



主要内容

- 引言
- 1 ESD损伤的失效定位技术
- 2 ESD损伤的确认分析
- 3 结论

电子制造过程的静电防护及检测技术

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Main Contents

- Introduction
- 1. ESD Damage Failure Location Technology
- 2. ESD Damage Confirmation Analysis
- 3. Conclusions

Electrostatic Protection and Detection Technology in Electronics Manufacturing Process

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2



引言

- 电子元器件ESD损伤分析的重要性
 - 对电子元器件ESD损伤分析来说，最重要的是确定损伤是ESD造成的，而不是其他电过应力造成的，也不是因为存在工艺缺陷在加电工作时发生的。
 - 只有明确电子元器件损伤的根本原因是ESD，才能从设计、工艺或者应用防护方面进行改进和控制，从而减少ESD对电子元器件造成损伤。

电子制造过程的静电防护及检测技术

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Introduction

The Importance of ESD Damage Analysis for Electronic Parts and Components

- With respect to the ESD damage analysis to electronic parts and components, the most important thing is to determine that the damage is caused by ESD, rather than other electrical overstress, nor operating in energized conditions due to the existence of process flaws.
- Unless ascertaining that the root cause for the damage of electronic parts and components is ESD, it is able to improve and control in terms of design, technology or protection application, thereby reducing ESD damage to electronic parts and components.

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引言

- 电子元器件ESD损伤分析是失效分析的一种，也需遵循相同的方法和步骤。
- **失效分析** (Failure Analysis) 一是对已失效器件进行的一种事后检查。使用电测试以及先进的物理、金相和化学的分析技术，验证所报告的失效，确定其失效模式，找出失效机理。(GJB548)
- 失效分析工作必须采用适当的方法和技术，遵循合理的程序，才能迅速而准确进行失效定位，分析失效机理，寻找失效原因。

电子制造过程的静电防护及检测技术

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Introduction

- ESD Damage Analysis of electronic parts and components is a kind of failure analysis, and also needs to abide by the same methods and procedures.
- Failure Analysis is a post testing for the failure components. The electrical test and advanced physical, metallurgical and chemical analytical techniques are applied to verify the reported failure, determine their failure modes, and identify the failure mechanisms. (GJB548)
- Failure Analysis must adopt the appropriate methods and techniques and comply with the reasonable procedures in order to quickly and accurately locate failure, analyze failure mechanisms, and look for the causes of failure.

Electrostatic Protection and Detection Technology in Electronics Manufacturing Process

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引言

- 失效分析的原则：
 - 先进行非破坏性分析，后进行破坏性分析；
 - 先外部分析，后内部（解剖分析）；
 - 先调查了解与失效有关的情况（线路、应力条件、失效现象等），后分析失效元器件。

电子制造过程的静电防护及检测技术

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Introduction

- Failure Analysis Principles:
 - conduct non-destructive analysis at first, and then conduct destructive analysis;
 - conduct external analysis at first, and then conduct internal analysis (anatomical analysis);
 - investigate and understand the circumstances (including lines, stress conditions, failure phenomena, etc.), related to failure, and then analyze the failure components.

Electrostatic Protection and Detection Technology in Electronics Manufacturing Process

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1 ESD损伤的失效定位分析技术

- 1.1 ESD损伤的电学测试
- 1.2 ESD损伤的无损定位分析
- 1.3 开封定位分析
- 1.4 破坏性分析
- 1.5 小结

电子制造过程的静电防护及检测技术

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1. ESD Damage Failure Location and Analysis Technology

- 1.1 ESD Damage Electrical Test
- 1.2 ESD Damage Non-destructive Location Analysis
- 1.3 Un-packaging Location Analysis
- 1.4 Destructive Analysis
- 1.5 Summary

Electrostatic Protection and Detection Technology in Electronics Manufacturing Process

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1.1 ESD损伤的电学测试

电学测试的目的是确认失效，可能的失效管脚定位。具体包括：

- (1) 功能参数测试
 - 是确认失效的基本手段，但对VLSI等复杂电路来说，存在两个缺点：
 - 一是全参数测试成本昂贵
 - 二是可能无法确认失效引脚
- (2) 端口I-V特性检测
 - 测试方法简单，可以通过良品或者同功能引脚对比测试定位可能失效的引脚。
 - 缺点是：失效的样品I-V特性不能反应

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1.1 ESD Damage Electrical Test

The purpose of electrical test is to confirm failure and location the possible failure pins, specifically including:

- (1) Functional Parameter Test
- Functional Parameter Test is the fundamental means to confirm failure, but which has two drawbacks for VLSI and other complex circuits, including:
 - 1) cost for full parameter test is expensive; and
 - 2) may be unable to confirm the failure pins
- (2) Port I - V Characteristic Test
- The test method is simple, and it is able to locate the possible failure pins through comparison test of non-defective sample or pins with identical functions.
- Drawback: The IV characteristics of failure sample cannot react

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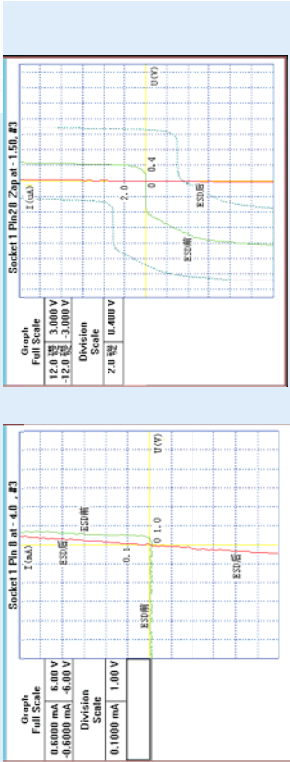
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(2) 端口I-V特性检测

由于ESD损伤一般都发生在器件或IC的某个端口，因此端口I-V特性检测可以有效地对损伤端口进行定位



在实际检测中两个失效端口在ESD前后的I-V特性曲线

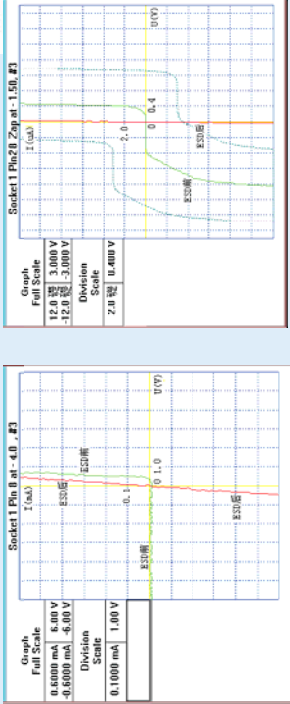
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(2) Port I - V Characteristic Test

As ESD damage generally occurs in a certain port of the component or IC, thus the port I - V Characteristic Test can effectively locate the damaged port.



In the actual test process, it refers to the I - V characteristic curve of two failure ports before and after ESD.

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1.1 ESD损伤的电学测试

相关仪器和设备

- 各种元器件的专用测试仪器
 - 阻容感测试仪 (RCL)
 - 晶体管图示仪
 - 半导体参数测试仪
 - 晶体管测试仪
 - 示波器
 - ATE
- RF及微波测试系统
-



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1.1 ESD Damage Electrical Test

Related Instruments and Equipment

- Dedicated Test Equipment For Various Parts and Components
 - R-C-L Tester (RCL)
 - Transistor Tracer
 - Semiconductor Parameter Tester
 - Transistor Tester
 - Oscilloscope
 - ATE
- RF and Microwave Test System
-



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1.2 ESD损伤的无损定位分析

原则上说，所有ESD损伤都会在器件内留下痕迹，找到这些痕迹就是失效定位。

无损分析又称非破坏性的内部分析，是用于检查元器件内部状态而不打开或移动封装的分析技术，适用于ESD损伤定位的有：

- (1) X射线显微分析
- (2) 红外热像定位分析
- (3) 磁显微分析



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1.2 ESD Damage Non-destructive Location Analysis

In principle, all ESD damages can leave marks inside the component, and failure location is to find these traces.

Non-destructive analysis is also known as the non-destructive internal analysis, which is designated to check the internal status of components without opening or removing the package, and the technologies applicable for ESD damage location include:

- (1) X-ray Microscopic Analysis
- (2) Infrared Thermography Location Analysis
- (3) Magnetic Microscopic Analysis



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(1) X射线显微分析

- 当ESD损伤造成内部金属化明显损伤时，在不开封的情况下，可用X射线显微分析技术进行分析定位。
- 基本原理是：根据样品不同部位对X射线吸收率和透射率的不同，利用X射线通过样品各部位衰减后的射线强度检测样品内部缺陷的一种方法。X射线衰减的程度与样品的材料品种、样品的厚度和密度有关。

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(1) X-Ray Microscopic Analysis

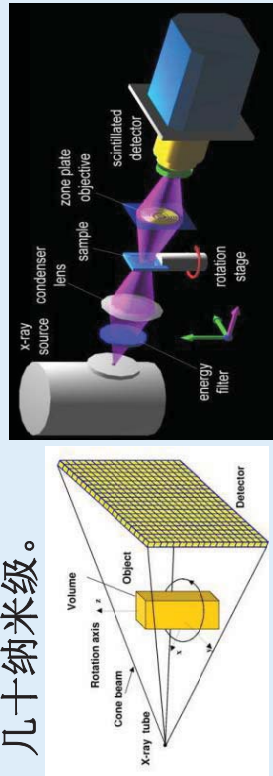
- When ESD damage results in obvious damage to the internal metallization, it may adopt the X-ray microscopic analysis technique for location analysis without opening the package.
- Basic Principle: In accordance with the difference in absorptivity and transmissivity on X-ray for different parts of the sample, apply the attenuated ray intensity of X-ray after passing through various parts of the sample and then detect the internal defects of the sample. The attenuation degree of X-ray is in correlation with the material variety, thickness and density of the sample.

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(1) X射线显微分析

- 利用分层扫描和计算机图形重构等技术手段，从2D（二维）发展到3D（三维）
- 空间分辨率：从微米、亚微米量级发展到几十纳米级。



传统CT：没有X光学透镜，用相似三角形关系得到几何放大效果。

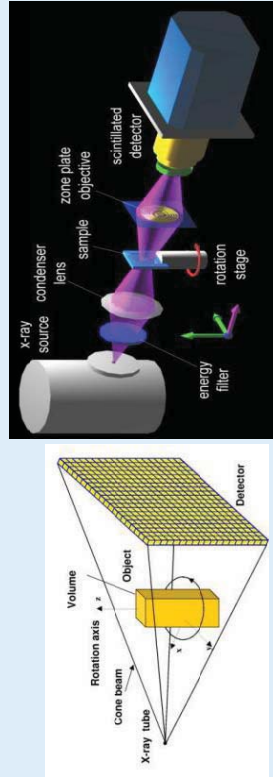
Xradia 采用独有的透镜聚焦光学和探测系统，用光学放大得到放大效果

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(1) X-Ray Microscopic Analysis

- Application of hierarchical scanning, computer graphic reconstruction and other technical means, developed from 2D (two-dimensional) to 3D (three dimensional)
- Spatial Resolution: developed from micron, sub-micron to tens of nanometer.



Traditional CT: no X optical lens, attain the geometric magnification effect by virtue of similar triangles relations.

Xradia applies a unique lens focusing optics and detection system, achieving the magnification effect through optical collargment.

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(1) X射线显微分析

1.6um

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(1) X-Ray Microscopic Analysis

1.6um

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(2) 红外热像定位分析

- ESD导致的缺陷常常会在加电情况下有异常的热点，通过探测热点就可能进行损伤点定位。
- DCG推出的一种增强型带锁定功能的红外热像技术（LIT - Enhanced Lock-IN Thermal Emission），又称ELITE IR Systems，可以在不开封的情况下对芯片热点进行探测。
- ELITE 的功率敏感度和温度分辨率可以分别达到1uW 和 10uK 的水平
- 用一定的频率去激发一个存在缺陷或热敏感部分的电路就可以实现锁定功能，同时采用光谱响应范围在3um 到5um 的红外照相机连续捕捉经过两正交相关函数（sine 和cosine）加权过的图像。用加电时捕捉到的图像和断电时捕捉到的图像做异或处理，经过以上这种操作的同相位的结果就可以用来表示最基本的锁定功能。

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(2) Infrared Thermography Location Analysis

- The defects caused by ESD often generate abnormal hot spots in the case of energization, and it is able to perform damaged point location by detecting the hot spots.
- An enhanced infrared thermography technology (LIT - Enhanced Lock-IN Thermal Emission) with lock function launched by DCG, also known as ELITE IR Systems, can detect the hot spots on the chip under unopened conditions.
- The power sensitivity and temperature resolution of ELITE can be reached up to 1uW and 10uK.
- The use of a certain frequency to excite a circuit with defective or heat-sensitive parts can achieve the lock function, while the infrared camera with the spectral response range of 3um to 5um is adopted to continuously capture the images weighted by two orthogonal correlation functions (sine and cosine). The captured images after power-up and power-down shall be subject to XOR processing, and then they obtained results in the same phase can be used to represent the basic locking function.

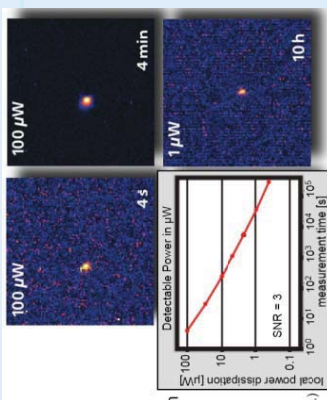
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(2) 红外热像定位分析

- 帶封装的热点测试 (DCG提供)



topography

amplitude image

phase image

topography

amplitude image

phase image

(2) 红外热像定位分析

- 相位数据分析技术可以实现3D 的失效定位
- 在同质材料情况下可以达到±5%的精准度
- 可以在甚至超过8 层堆叠封装下定位失效点



Figure 1: Thermal sources may be located in the Z-dimension, even through packaging material. (Photograph courtesy of Christian Schmidt, Fraunhofer Institute for Mechanics of Materials)

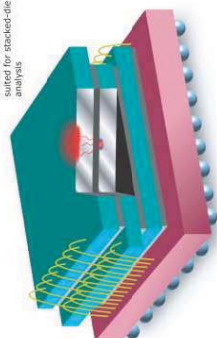
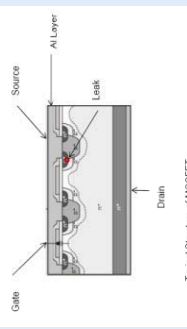


Figure 2: The ability to allocate a thermal source in three dimensions makes the ELITE well-suited for stacked-die analysis

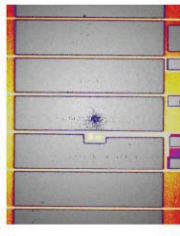


(2) 红外热像定位分析

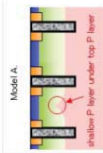
- ELITE芯片热点测试



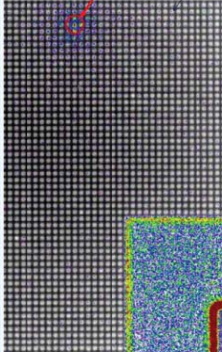
Typical Structure of MOSFET



Power : 9mW
Time : 3min



Model A



Power : 20mW
Time : 5min

Located about

To Source Via

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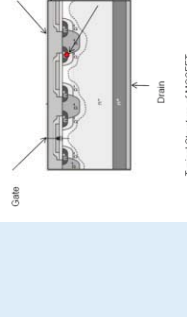
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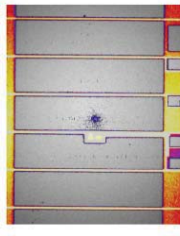


(2) Infrared Thermography Location Analysis

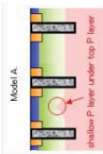
- ELITE chip hot spot test



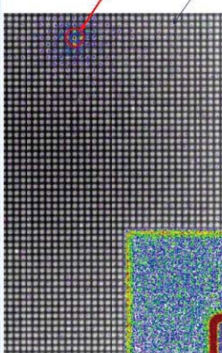
Typical Structure of MOSFET



Power : 9mW
Time : 3min



Model A



Power : 20mW
Time : 5min

Located about

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(3) 磁显微分析

- ESD导致的缺陷会另器件的磁场发生变化，通过探测封装器件内部磁场的特性，也可以实现无损ESD损伤定位分析。
- Neocera研制的磁感应显微镜，采用SQUID技术，对样品施加外部电流，产生磁场，利用右手螺旋法则来判断内部磁场方向，通过探测磁场的变化，从而对开路，短路，漏电流等缺陷进行失效定位。
 - 1) 可实现非破坏性、非接触式的缺陷定位
 - 2) 单台设备可实现全部静态缺陷（短路、开路和漏电）的定位
 - 3) 可实现3D封装芯片（如，TSV等）的缺陷定位

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(3) Magnetic Microscopic Analysis

- The defects caused by ESD will result in the changes in the magnetic field of components, and detecting the characteristics of magnetic field inside the packaged components is also able to attain the non-destructive ESD damage location analysis.
- The magnetic induction microscope developed by Neocera applies SQUID technology to exert external current to the sample in order to generates a magnetic field and to determine the magnetic field direction o by the right hand screw rule, thereby performing fault location on open-circuit, short circuit, electric leakage and other defects by detecting the changes in the magnetic field.
 - 1) able to achieve non-destructive, non-contact defect location;
 - 2) able to achieve the location of all static defects (short circuit, open circuit and electric leakage) by a single device
 - 3) able to achieve the defect location of 3D packaging chips (e.g., TSV, etc.)

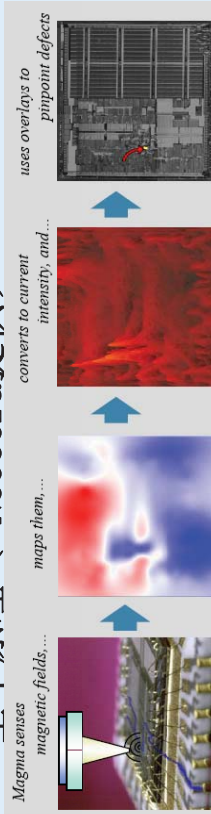
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(3) 磁显微分析

基本原理 (Neocera提供)



Lowest non-contact current sensitivity available

Helps eliminate false positives

Helps eliminate false positives

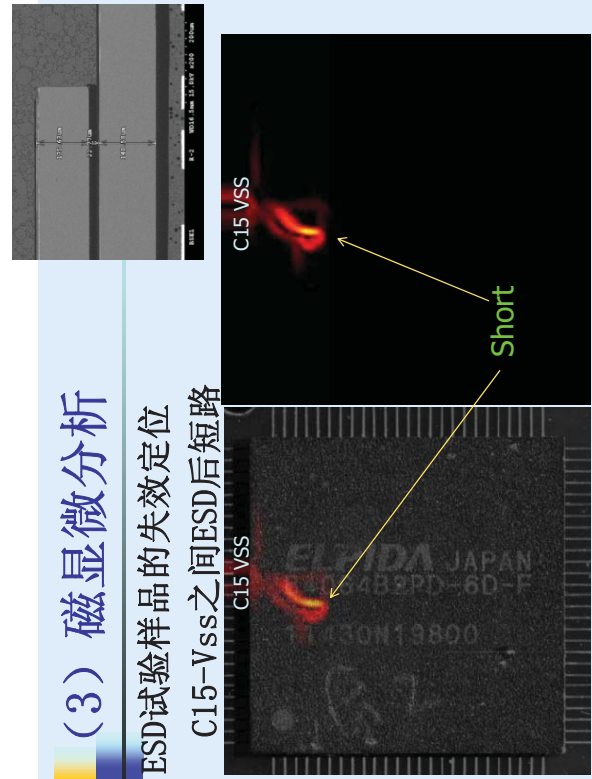


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(3) 磁显微分析

- ## ESD试验样品的失效定位



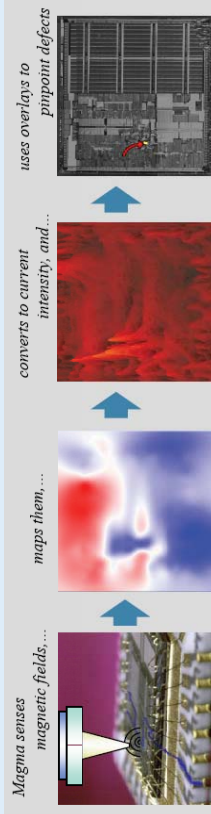
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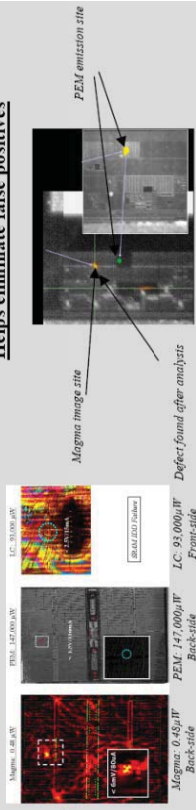
(3) Magnetic Microscopic Analysis

Fundamental Principles (provided by Neocera)



Lowest non-contact current sensitivity available

Helps eliminate false positives

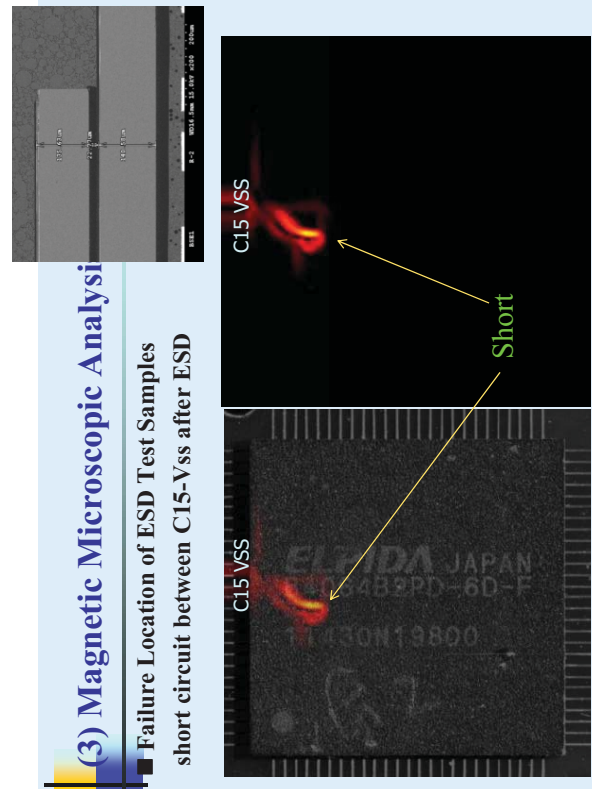


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(3) Magnetic Microscopic Analysis

- **Failure Location of ESD Test Samples**
short circuit between C15-Vss after ESD



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1.3 开封定位分析

- (1) 光学显微观察
- (2) 扫描电镜分析
- (3) 液晶分析
- (4) 光辐射显微分析技术

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1.3 Un-packaging Location Analysis

- (1) Optical Microscopic Observation
- (2) Scanning Electron Microscopy (SEM) Analysis
- (3) Liquid Crystal Analysis
- (4) Optical Radiation Microscopic Analysis Technology

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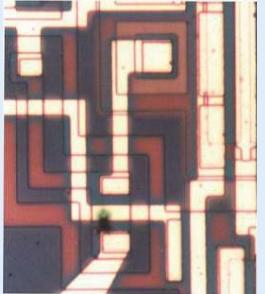
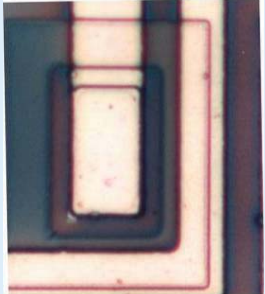
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(1) 光学显微镜观察

有些器件的ESD损伤比较明显，样品开封后在光学显微镜下就可以看到明显的损伤痕迹



(a) 金属化窗口拐角处发生介质击穿
实际观察到的两个器件的ESD损伤的光学显微图像

(b) 输入保护网络的损伤

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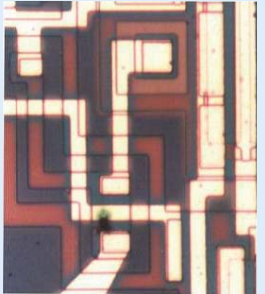
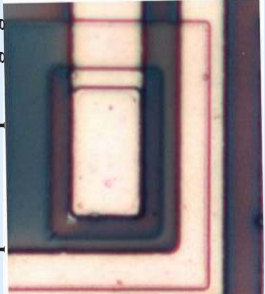
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(1) Optical Microscopic Observation

The ESD damage of certain components is relatively obvious and it can catch sight of obvious signs of damage under an optical microscope after un-packaging the sample.



(a) dielectric breakdown occurred at the corner of metalizing window
(b) damage of input protection network

The optical microscope image of ESD damage for actually observed two components

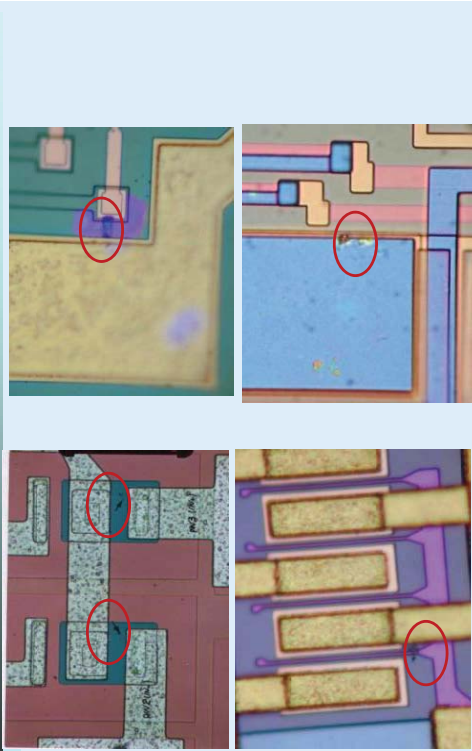
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(1) 光学显微观察



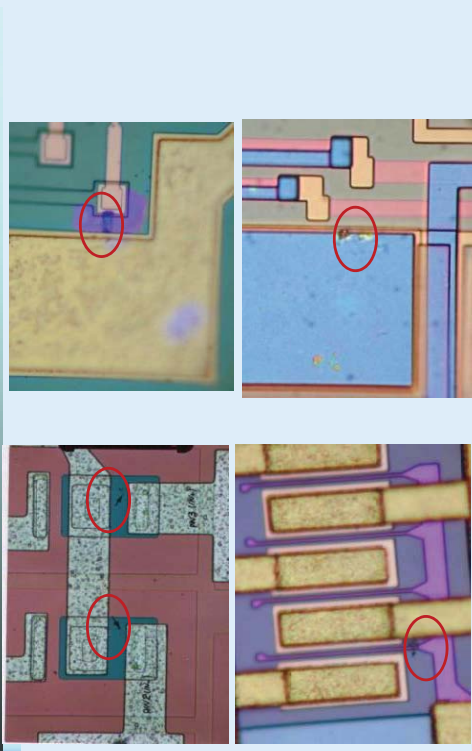
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(1) Optical Microscopic Observation



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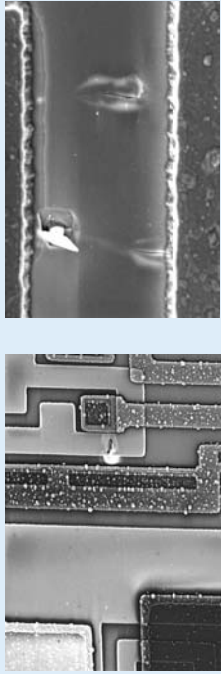
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(2) 扫描电镜分析

有些器件的ESD损伤在光学显微镜下观察不到或不能确定，这时可采用扫描电镜（SEM）的二次电子像及其束感生电流像（EBIC）技术进行观察分析。



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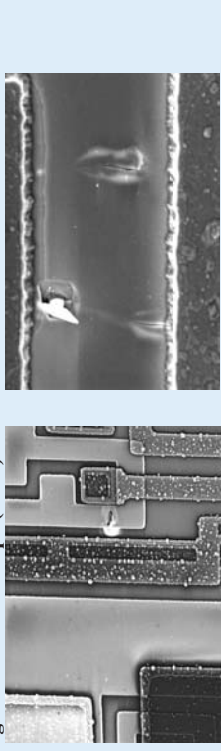
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(2) Scanning Electron Microscopy (SEM)

The ESD damage of certain components cannot be observed or determined under an optical microscope, but which can be observed and analyzed by applying the secondary electron image and Electron Beam Induced Current (EBIC) of an scanning electron microscope (SEM).



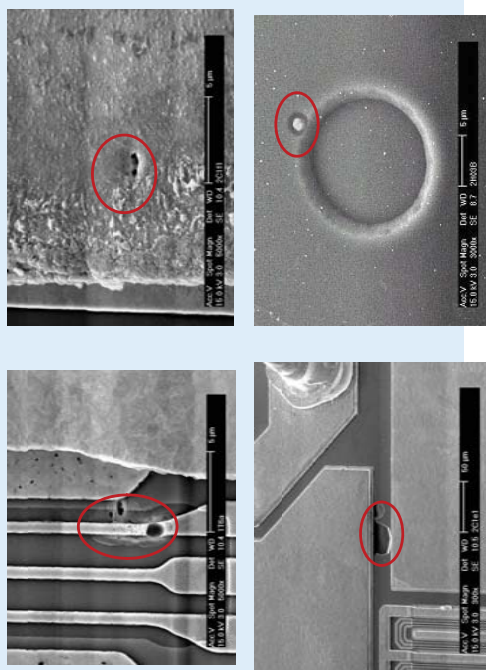
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(2) 扫描电镜分析



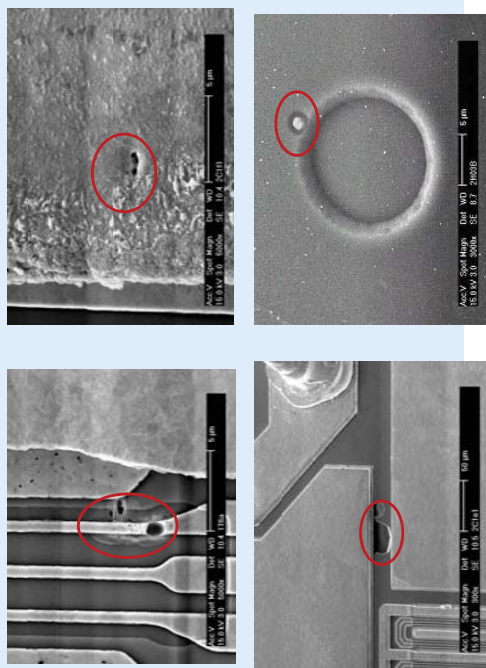
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(2) Scanning Electron Microscopy (SEM)



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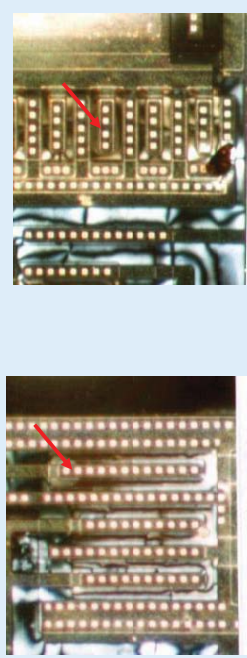
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(3) 液晶分析

当有些器件的ESD损伤在光学显微镜和SEM下都观察不到明显的损伤现象，这时可采用液晶分析技术。即在管芯表面涂敷适当厚度的液晶，再对器件施加直流偏置，在光学显微镜下观察是否有晶相明显变化的区域，以确定损伤点。



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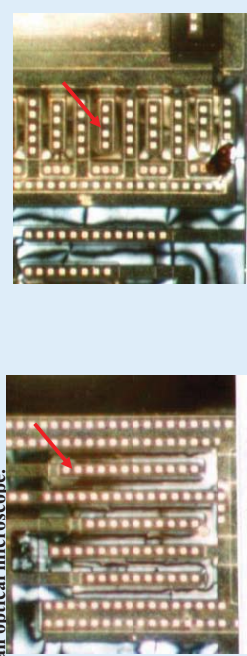
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(3) Liquid Crystal Analysis

When the ESD damage of certain components cannot be observed significant damage phenomenon under an optical microscope and SEM, then it may adopt the liquid crystal analysis technology. Indeed, it just needs to apply an appropriate thickness of liquid crystal on the die surface, and exert DC bias to the component, then it can determine the damage point by observing whether the existence of areas with significant changes in crystal phase under an optical microscope.



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(4) 光辐射显微分析技术

器件的ESD损伤在特定的电应力条件下会产生漏电，并伴随载流子的跃迁而导致光辐射，因此，光辐射显微分析技术是探测器件ESD损伤的非常有效的技术。

(a) CMOS IC输入保护网络的ESD损伤
两个器件ESD损伤的光辐射显微照片

(b) JFET的ESD损伤

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(4) Optical Radiation Microscopic Analysis Technology

The ESD damage to components may generate electric leakage in a particular electrical stress conditions and may result in optical radiation accompanied with the transitions of charge carriers. Therefore, the Optical Radiation Microscopic Analysis Technology is a very effective technique to detect ESD damage of components.

(a) ESD damage of CMOS IC input protection network

(b) ESD damage of JFET

The optical radiation photomicrograph of ESD damage for two components

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(4) 光辐射显微分析技术

失效品异常光点的光辐射成像

(a) CMOS IC输入保护网络的ESD损伤
两个器件ESD损伤的光辐射显微照片

(b) JFET的ESD损伤

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(4) Optical Radiation Microscopic Analysis Technology

The optical radiation imaging of abnormal spot for failure sample

(a) CMOS IC输入保护网络的ESD损伤
两个器件ESD损伤的光辐射显微照片

(b) JFET的ESD损伤

The optical radiation imaging of abnormal spot for failure sample

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1.4 破坏性分析

- (1) FIB 分析
- (2) 分层剥离分析

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1.4 Destructive Analysis

- (1) FIB Analysis
- (2) Delamination & Peeling Analysis

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(1) FIB 分析

- 聚焦离子束（FIB）分析技术在微观尺度上对半导体器件表面进行微米纳米尺度上的制样技术；可以实现微区剖面、金属切割以及金属搭桥等“显微外科手术”，对已经定位的ESD损伤点可进行剖面损伤确认。
- 原理：利用电透镜将离子聚焦成非常小尺寸的离子束，再经过二次聚焦至试片表面，利用物理碰撞来达到切割之目的。

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(1) FIB Analysis

- The Focused Ion Beam (FIB) analysis technology is to prepare sample at the micro-and nanometer-scale on the semiconductor component surface in the microscopic scale; and it is able to attain the micro-cell section, metal cutting, metal bypass and other "microsurgeries". In addition, the already located ESD damage points can be recognized cross-sectional damage.
- Principle: Ions are focused into a very small size of ion beam by electro lens and then transmitted to the test block surface by secondary focus, thereby achieving the purpose of cutting by physical collision.

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(1) FIB 分析

失效品芯片形貌

ESD损伤点的FIB切割剖面

良品FIB切割剖面

良品ESD损伤显微形貌

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(1) FIB Analysis

Failure Sample Chip Morphology

FIB Cutting Section of ESD Damage Point

FIB Cutting Section of Non-Defective Sample

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(2) 分层剥离分析

分层腐蚀则需要将器件表面的钝化层、金属化等剥离掉，以暴露下层的ESD损伤。这虽然会破坏器件的电性能，但在ESD损伤的失效分析中却是一种简单又快速的分析手段。

(a) CC4081 2kV ESD

(b) SM16321 1.5kV ESD

两个ESD损伤器件在去除掉钝化层后观察到的损伤图像

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(2) Delamination & Peeling Analysis

Delaminated corrosion needs to peel the passivation layer, metallization, etc., on the surface of components in order to expose the substrate ESD damage. Although this will destroy the component's electrical properties, it is indeed a simple and fast means of analysis in the failure analysis of ESD damage.

(a) CC4081 2kV ESD

(b) SM16321 1.5kV ESD

The damage image observed after peeling the passivation layer of two ESD damage components

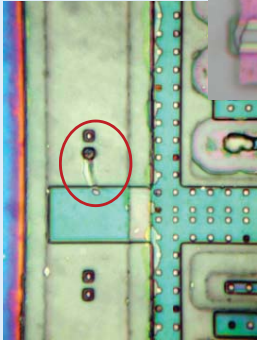
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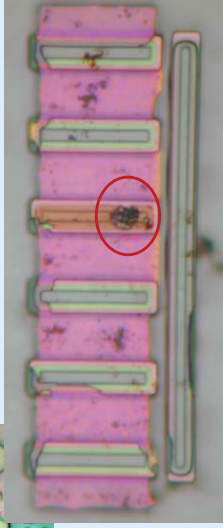
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(2) 分层剥离分析



钝化层去除后的ESD损伤形貌



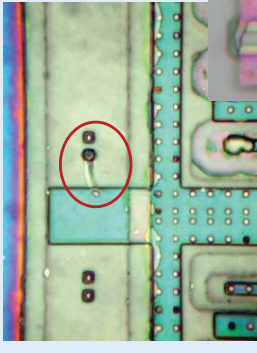
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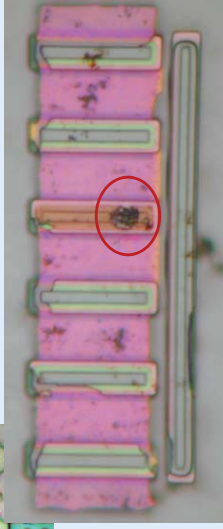
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(2) Delamination & Peeling Analysis



The ESD damage morphology after peeling the passivation layer



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1.5 小结

- 以上介绍的是在ESD损伤的失效定位和分析中最常用和有效的几项技术，各种手段还可以相互验证、互为补充。在实际应用中要根据具体情况选择一种或多种技术手段，达到简便、快速和有效的目的。



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1.5 Summary

- The most common and effective technologies used in the failure localization and analysis of ESD damage are described above, and which can be authenticated and complemented each other. In practical application, it shall select one or more technical means according to the specific circumstances in order to achieve the purpose of simple, fast and effective.



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2 静电损伤确认分析

- 1.1 常见的静电敏感器件
- 1.2 损伤样品背景信息收集
- 1.3 损伤样品失效定位及分析
- 1.4 失效验证试验和分析
- 1.5 静电来源追溯

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2. Electrostatic Damage Confirmation and Analysis

- 1.1 Common Electrostatic Sensitive Components
- 1.2 Collection of Background Information For Damaged Samples
- 1.3 Failure Location and Analysis of Damaged Samples
- 1.4 Failure Location and Analysis of Damaged Samples
- 1.5 Trace ESD Source

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1.1 常见的静电敏感器件

- 首先要了解哪些器件可能是敏感器件
 - 基本了解
 - 特定器件资料数据
 - 检测评价结果

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2.1 Common Electrostatic Sensitive Components

- It must ascertain which kind of components may be sensitive component
 - General Knowledge
 - Specific Component Information and Data
 - Test and Evaluation Results

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2.1 常见的静电敏感器件

- 基本了解

Device type	ESD withstand voltage sensitivity (V) HBM
MR heads, RF FETs	10 - 100
Power MOSFETs PIN diodes, laser diodes	100 - 300V
Pre - 1990 VLSI	400 - 1000V
Modern VSLI	1000 - 3000V
HC MOS	1500 - 3000V
CMOS B Series	2000 - 5000 V
Linear MOS	800 - 4000 V
Small geometry older bipolar	600 - 6000 V
Small geometry modern bipolar	2000 - 8000 V
Power bipolar	7000 - 25000 V
Film resistor	1000 - 5000 V

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2.1 Common Electrostatic Sensitive Components

- General Knowledge

Device type	ESD withstand voltage sensitivity (V) HBM
MR heads, RF FETs	10 - 100
Power MOSFETs PIN diodes, laser diodes	100 - 300V
Pre - 1990 VLSI	400 - 1000V
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Film resistor	1000 - 5000 V

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2.1 常见的静电敏感器件

- 检测评价结果 (HBM)

- 光电二极管: 50V~300V
- RF FET及MMIC (单片电路) : 100~500V
 - GaAs , GeSi 等
- 高频声表面波器件 (SAW) : 300~1000V
- 模拟IC: 500V~4000V
- 数字IC: 1000V~8000V

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2.1 Common Electrostatic Sensitive Components

- Test and Evaluation Results (HBM)
- Photodiode: 50V ~ 300V
- RF FET and MMIC (monolithic circuit): 100 ~ 500V
- GaAs, GeSi, etc.
- High-frequency Surface Acoustic Wave Devices (SAW): 300 ~ 1000V
- Analog IC: 500V ~ 4000V
- Digital IC: 1000V ~ 8000V

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2.2 损伤样品背景信息收集

- 收集失效样品的背景信息非常重要
 - 失效样品数统计分析：是否批次性？
 - 样品失效现场分析：发现失效的具体环节？
 - 经历的制成过程分析：经历过哪些工序？

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2.2 Collection of Background Information for Damaged Samples

- It is very important to collect the background information of failure samples.
 - Statistical Analysis of Failure Samples Quantity: batch property?
 - Sample Failure Filed Analysis: specific aspects to discover failure?
 - Experienced Manufacturing Process Analysis: What steps have been experienced?

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2.3 损伤样品失效定位及分析

- 采用各种手段进行失效定位
 - 重点关注IC的I/O的保护网络以及电源端
 - RF FET的栅源及电容和电阻
- 尽可能区分ESD和EOS

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2.3 Failure Location and Analysis of Damaged Samples

- Adopt a variety of means for failure location
 - Focus on IC's I/O protection network and power supply terminal
 - RF FET's gate-source and capacitance and resistance
 - Distinguish ESD and EOS to the maximum extent

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2.3 损伤样品失效定位及分析

- 区分ESD和EOS
 - 可见损伤 — 最不易区分
 - 样品开封后在显微观察下就可以看到明显的损伤痕迹。
 - ESD损伤多数发生在电极或扩散区之间，往往有明显的指向性。
 - 有时也会有金属化损伤，但相对于EOS损伤来说，损伤区域小，不会像EOS那样有大面积的金属化熔融和烧断的现象。

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2.3 Failure Location and Analysis of Damaged Samples

- Distinguish between ESD and EOS
 - Visible Damage - The Most Difficult To Distinguish
 - The sample can be observed obvious signs of damage under the microscope after un-packaging.
 - ESD damage occurs mostly between the electrodes or the diffusion zones generally accompanied with a significant directivity.
 - Sometimes there is metallization damage, but which has small damage area compared with OS damage, without large-area of metallization melting and burnout phenomenon like EOS damage.

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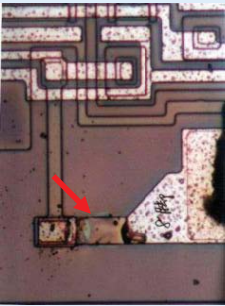
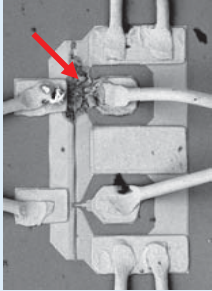
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2.3 损伤样品失效定位及分析

EOS由于作用时间长、能量大对器件造成的损伤一般都有明显的痕迹。往往有金属化熔融、材料表面颜色或形态发生变化等现象，而且损伤面积较大。



(a) GaAsMBSFET栅区域熔融 (b) CMOS输入端金属化大电流烧毁
典型的EOS失效样品的形貌像

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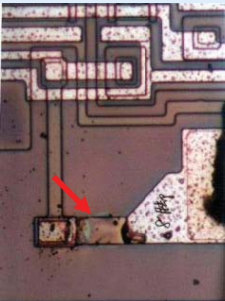
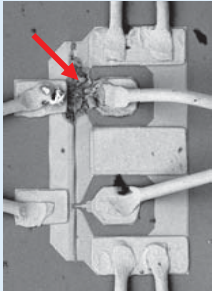
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2.3 Failure Location and Analysis of Damaged Samples

In general, the damage caused by EOS on parts and components has obvious trace due to long duration of action and high energy, which is prone to be accompanied with the metallization melting, changes in material surface color or shape, etc., and large damage area.



(a) GaAsMESFET gate zone melting (b) CMOS input terminal metallization large current overburning
The morphology diagram of typical EOS failure sample

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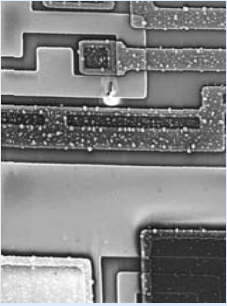
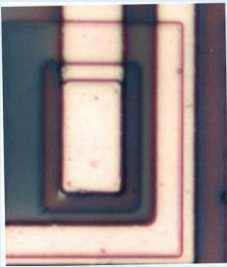
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2.3 损伤样品失效定位及分析

- ESD指向性损伤



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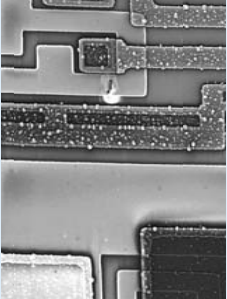
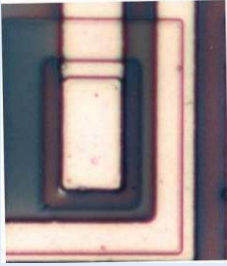
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2.3 Failure Location and Analysis of Damaged Samples

- ESD Directional Damage



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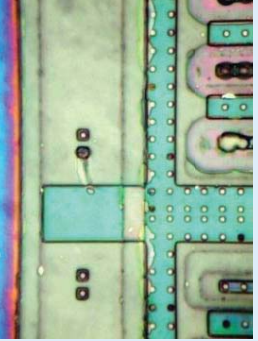
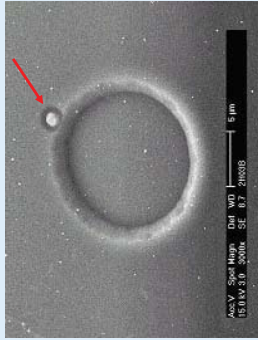
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2.3 损伤样品失效定位及分析

- ESD小区域损伤



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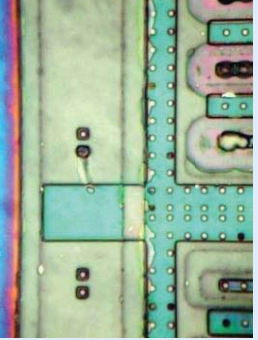
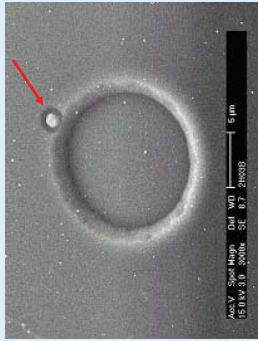
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2.3 Failure Location and Analysis of Damaged Samples

- ESD Micro-region Damage



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2.3 损伤样品失效定位及分析

- 区分ESD和EOS
 - 下层损伤
 - 有些器件的ESD损伤在光学显微镜和SEM下都观察不到明显的损伤现象，需要应用前面所介绍的液晶分析、光辐射显微分析以及分层剥离等手段来进行EOS的失效定位和分析。

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2.3 Failure Location and Analysis of Damaged Samples

- Distinguish between ESD and EOS
 - Substrate Damage
 - The ESD damage of certain components cannot be observed obvious damage phenomenon under the optical microscope and SEM, and requires the application of previously described liquid crystal analysis, light radiation microscopic analysis, delamination & peeling, and other means for EOS failure location and analysis.

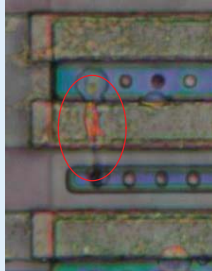
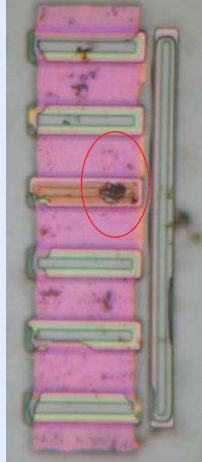
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2.3 损伤样品失效定位及分析

- 下层损伤
 - 
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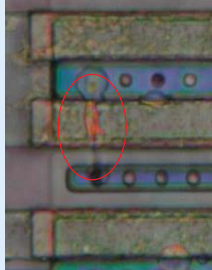
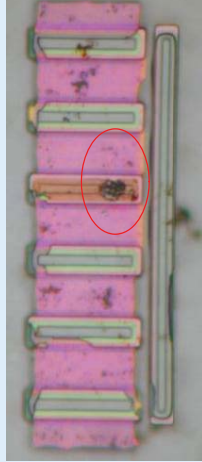
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2.3 Failure Location and Analysis of Damaged Samples

- Substrate Damage
 - 
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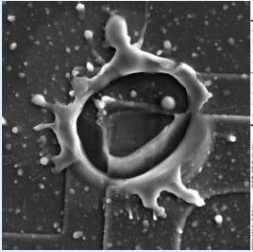
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2.3 损伤样品失效定位及分析

- 当器件所受的ESD脉冲的电压很高或能量很大时，ESD损伤的表现也可能出现与EOS一样的现象如金属化或半导体材料熔融，损伤面积大等。



SEM image showing a large, irregular crater with a central hole and surrounding spiky protrusions, characteristic of ESD damage.

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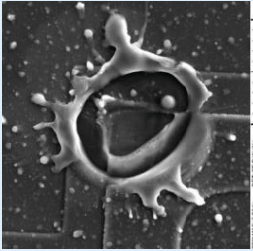
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2.3 Failure Location and Analysis of Damaged Samples

- When a component has been suffered to high ESD pulse voltage or energy, ESD damage may also present the same phenomenon of EOS damage, such as metallization, or melting of semiconductor materials, and large damage area, etc..



SEM image showing a large, irregular crater with a central hole and surrounding spiky protrusions, characteristic of ESD damage.

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2.4 失效验证试验和分析

- 失效验证试验是确定失效原因非常有效的手段。
 - ESD或EOS试验
 - 确定敏感等级;
 - 再现失效模式;
 - 失效形貌观察对比

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2.4 Failure Verification Test and Analysis

- Failure Verification Test is a very effective means to determine the cause of failure.
- ESD or EOS Test
- Determine Sensitivity Level;
- Reproduce Failure Mode;
- Observe and Compare Failure Morphology

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2.5 静电来源追溯

- 在确认静电损伤后应根据样品信息追溯静电来源。
 - 敏感的工序有：
 - 手工装配、传送带、老化试验等



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2.5 Trace ESD Source

- It shall trace the source of ESD after the confirmation of ESD damage in accordance with the sample information.
- Sensitive processes include:
 - manual assembly, conveyor belts, aging test, etc.



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3 结论

元器件的损伤是否是ESD造成的是产品制造和使用者最为关心的问题；

- 但要明确损伤是ESD造成的而不是其他电过应力或缺陷造成的并不是一件容易的事；
- 通过采取合适的技术定位，分析失效样品的敏感度、经历的环境、开展对比试验等，我们有可能明确一些元器件的失效是由ESD造成的；
- 但，不是全部！



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3. Conclusions

- Whether the damage of parts and components is caused by ESD is most concerned issue by the product manufacturers and users;
- However, it is indeed not an easy task to confirm that the damage is caused by ESD rather than other electrical overstress or defects;
- By virtue of adopting the appropriate locating technologies, analyzing the sensitivity, experienced environment of failure samples, and carrying out comparative tests, etc., we are likely to ascertain that the failure of certain parts and components are caused by ESD;
- However, not all!



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Packaging Materials for Static Sensitive Items

选择包装静电敏感元件器件材料的标准规范
-屏蔽袋、屏蔽防潮袋-

美商卫利有限公司
郭先正

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Outline 纲要

- ▶ I. Introduction简介
- ▶ II. Related Standards相关标准
- ▶ III. Bag Manufacturing and QA Processes
制袋生产工艺和品管过程
- ▶ IV. Other Requirements 行业内其它要求
- ▶ V. Summary 结论

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2

I. Introduction 简介

► Functions of Packaging Materials for ESD and contaminations sensitive Items

静电敏感电器组件包装材料的作用

- Provide physical protection– 物理性能的保护
- Provide environmental protection–moisture, contamination free–环境（如湿气、污染）的保护
- Provide security–安全性
- Provide ESD and EMI protections–静电放电, 静电场的保护 (Direct discharge, Static field, Tribogeneration)
- Prevent secondary contaminations –避免交叉污染
- Cost vs. value – 价性比

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ESD Packaging And Material Types

静电防护包装及材料类型

- Adhesive Tape 胶带
- **Bags（屏蔽袋、屏蔽防潮袋）**
- Boxes 盒子
- Cushioning Materials 缓冲材料（空气、泡沫、充填）
- Shrink Wrap 收缩包装
- Stretch Wrap 拉伸包装
- Tape and Reel 胶带与卷轴
- Thermoformed Trays 热成型托盘
- Injection Molded Trays 注塑托盘
- Tubes 料管

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II. Related standards 相关标准

▶ International Standards:国际标准:

- MIL-81705D
- ANSI/ESD S541
- ANSI/ESD S11.4
- J-STD-033
- IEST 61340
- Cleanliness Standards

• China National Standards: 中国国家标准:

- GJB2605-96: 可热封柔软性防静电阻隔材料性规范

II.1. International Standards: MIL- 81705D, 2004

- BARRIER MATERIALS,FLEXIBLE, ELECTROSTATIC
PROTECTIVE HEAT-SEABLE
可热封柔性防静电阻隔材料规范
- GJB-2605（中国军标），其内容与MIL-81705D基本相似。

II.2. International Standards: ANSI/ESD S541-2008

- ▶ Packaging Materials for ESD Sensitive Items, 静电放电敏感物品的防护包装材料
- ▶ 是电子工业协会EIA-541 标准的主要改进。
- ▶ ANSI/ESD S20.20定义了完整的ESD控制方案，需要使用ESD保护的妥善包装，以制造，运输，和储存ESD敏感设备。
- ▶ EPA, inside and outside
- ▶ ESD properties
- ▶ ESD Protective symbols, per ANSI/ESD S8.1
- ▶ Traceability

II.2. International Standards: ANSI/ESD S541-2008

Provide ESD and EMI protections 静电放电, 电磁场的保护:

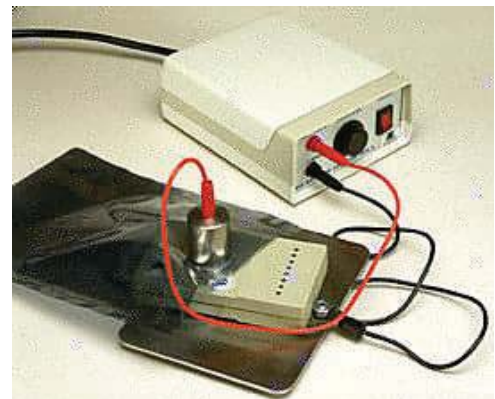
- ▶ A. Triboelectric Charge Accumulation Testing (ESD ADV 11.2) – inside and outside 摩擦起电电压 – “User defined”
- ▶ B. Surface and volume resistance (ANSI/ESD STM11.11) 表面, 体积电阻 – “Conductive” or “Dissipative”
- ▶ C. Static shielding (ANSI/ESD STM11.31, 2006) 屏蔽 – 穿透能量 –

II.2. International Standards: ANSI/ESD S541-2008

- B. Electrical resistance: ANSI/ESD STM11.11- SP11.14 etc. 电阻分类:
 - Shielding: $< 1 \times 10^3 \text{ ohms}$
 - Conductive: $< 1 \times 10^4 \text{ ohms}$
 - Static dissipative: $\geq 1 \times 10^4$ to $< 1 \times 10^{11} \text{ ohms}$
 - Insulative: $\geq 1 \times 10^{11} \text{ ohms}$

International Standards: ANSI/ESD S541-2008

- ▶ C. Static shielding (ANSI/ESD STM11.31, 2006)
屏蔽 - 穿透能量 -
 - For Evaluating the Performance of Electrostatic Discharge Shielding Materials
 - Replace EIA 541, capacitance probe method, volts - $< 30 \text{ volts}$
 - Energy $< 50 \text{ nanojoules}$



II.3. International Standards: ANSI/ESD S11.4-2012

- ▶ **ANSI/ESD S11.4 起源:**
- ▶ MIL-81705D和ANSI/ESD S541，没有对包装袋进行定义规范。
- ▶ 2012年9月由3M、Seagate、NASA、Flextronics、Ovation等公司编制发布了ANSI/ESD S11.4。首次对ESD包装袋做了全面的规范。
- ▶ 确立适用于普通电子工业的制造和包装应用，包装袋的物理性能、电性能、防潮性能标准限定

II.3. International Standards: ANSI/ESD S11.4-2012

- ▶ This standard defines five levels of static control bags:
- ▶ S11.4 定义了防静电袋子的五个等级。
- ▶ **Level 1:** moisture barrier bag for device packaging
- ▶ Level 1 设计特定的防潮袋，铝箔复合材料
- ▶ **Level 2:** moisture barrier bag for general packaging
- ▶ Level 2 普通的防潮袋
- ▶ **Level 3:** static shielding bag
- ▶ Level 3 屏蔽袋
- ▶ **Level 4:** conductive bag
- ▶ Level 4 导电袋
- ▶ **Level 5:** static dissipative bag
- ▶ Level 5 静电耗散袋

II.3. International Standards: ANSI/ESD S11.4-2012

Bag Markings and Traceability:

- ▶ Level 1~Level 5 需要标识静电防护标识以及等级编号
- ▶ Level 1和Level 2 同时也需要标识防潮标识以及等级编号
- ▶ 所有等级的袋子，需要标识供应商和可追溯信息



ESD Protective Symbol

Level 1~Level 5
防静电标识



Moisture Warning Symbol

Level 1~Level 2
防潮标识

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II.3. International Standards: ANSI/ESD S11.4-2012

▶ Physical Properties 物理性能列表

Technical Requirements

Properties	Technical Requirement	Level 1	Level 2	Level 3	Level 4	Level 5	Units	Test Method and Instructions
		Moisture Barrier Bag	Moisture Barrier Bag	Static Shielding Bag	Cond. Bag	Static Dissipative Bag		
Physical	Moisture Vapor Transmission Rate (MVTR)	≤ 0.002	≤ 0.02	NA	NA	NA	grams/100 in ² /day	ASTM F1249
	Puncture Resistance	> 15	> 15	> 8	> 5	> 5	pounds	MIL-STD-3010 Method 2065
	Seal Strength	> 12	> 12	> 8	> 5	> 5	pounds per inch	ASTM D882
	Thickness	≥ 0.004	≥ 0.003	≥ 0.002	≥ 0.002	≥ 0.002	inches	MIL-STD-3010 Method 1003
	Marking Adhesion	Marking Legible	Marking Legible	Marking Legible	Marking Legible	Marking Legible	visual	IPC-TM-650 2.4.1
	Transparency	NA	NA	30 to 50	NA	70 to 100	percent	EMA Optical Density

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II.3. International Standards: ANSI/ESD S11.4-2012

Moisture Vapor Transmission Rate (MVTR) 水蒸气透过率

▶测试方法及标准值:

Level 1 ≤ 0.002 grams/100 in²/day材料经过揉折20次后测试

ASTM F1249 ASTM F392 条件E 37.7°C (100F) 100%RH

ASTM F392 Flex Durability of Flexible Barrier Materials

Level 2 ≤ 0.02 grams/100 in²/day

ASTM F1249 ASTM F392 条件E 37.7°C (100F) 100%RH

Level 3~Level 5 不适用

▶Puncture Resistance 穿刺力, from PE side out

▶测试方法及主要参数:

MIL-STD-3010 Method 2065

刺针运动速度20inch/min 刺针球半径1/8inch

II. 3. International Standards: ANSI/ESD S11.4-2012



揉折试验机



穿刺力测试仪

II.3. International Standards: ANSI/ESD S11.4-2012

- ▶ Electrical Properties and Cleanliness 电性能与洁净要求

Technical Requirements

Properties	Technical Requirement	Level 1	Level 2	Level 3	Level 4	Level 5	Units	Test Method and Instructions
		Moisture Barrier Bag	Moisture Barrier Bag	Static Shielding Bag	Cond. Bag	Static Dissipative Bag		
Electrical	ESD Shielding	< 20	< 20	< 20	NA	NA	Nano Joule	ANSI/ESD STM11.31
	S/R Interior	< 1.0×10^{11} and $\geq 1.0 \times 10^4$	< 1.0×10^{11} and $\geq 1.0 \times 10^4$	< 1.0×10^{11} and $\geq 1.0 \times 10^4$	< 1.0×10^4	< 1.0×10^{11} and $\geq 1.0 \times 10^4$	ohms	ANSI/ESD STM11.11
	S/R Exterior	< 1.0×10^{11}	< 1.0×10^{11}	< 1.0×10^{11}	< 1.0×10^4	< 1.0×10^{11} and $\geq 1.0 \times 10^4$	ohms	ANSI/ESD STM11.11
Cleanliness	Sillcone	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	—	ASTM E168

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III. Bag Manufacturing and QA Processes

防静电包装袋工艺,品管过程

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III. 防静电包装袋工艺过程 - 吹膜前混料



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III. 防静电包装袋工艺过程 - 吹膜



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III. 防静电包装袋工艺过程 - 干式复合



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III. 防静电包装袋工艺过程 - 机器制袋



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III. 产品质量检测 – 物理性能测试



电子拉力机



密封测试仪



摆锤冲击测试仪



透光率测定仪



热封仪



摩擦系数测试仪

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VI. Other Requirements: Cleanliness Standards

- ▶ Industrial standards, .e.g. RoHS
- ▶ Lead & Halogen free ink
- ▶ ISO 14644—9
- ▶ IEST-1246D, NASA

Inspection Items 检测项目

- ▶ FTIR, 不含硅油, 氨基化合物和DOP
- ▶ IC, 离子含量
- ▶ LPC, 液体粒子计数
- ▶ NVR, 非挥发性残留
- ▶ Outgassing, 动态挥发性测试



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E.g. Problems caused by amine and amide: 氨基化合物的危害

- ▶ Greasy surface– 油面
- ▶ Delaminate metalized film– 分离屏蔽袋的金属膜
- ▶ Fatty acid (N-Octanoic Acid) residue–corrosion/solder ability on PC board– 腐蚀焊接点
- ▶ Fogging– 起雾
- ▶ Cause craze or crack on Polycarbonate– 对聚碳酸酯造成裂纹或断裂
- ▶ Outgas – Great concern to the disk drive industry–R/W processes
- ▶ Water soluble–contaminate cleaning bath

V. Summary, 结论

- ▶ *Packaging is the last defense line for customers' products and that is the first impression from their customers!*
- ▶ 包装袋不仅是您客户对其产品的最后防线, 也是他们客户在收到产品时的第一印象!

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61	卫利国际科贸（上海）有限公司	包丽娟	工程师	Tel: 18019120819

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62	苏州百思博防静电净化用品有限公司	梁世平	总经理	Tel: 13073311744
63	上海佰洁静电检测技术中心	徐明	主任	Tel: 13817094329
64	苏州亨达洋静电技术有限公司	刘清平	总经理	Tel: 13814820918
65	苏州市苏信净化设备厂	惠旅峰	总经理	Tel: 13962510772
66	苏州华瑞塑胶电子有限公司	王卫国	总经理	Tel: 13962159515
67	迈思德防静电有限公司	叶建平	总经理	Tel: 13812693035
68	华东理工大学华昌聚合物有限公司	王晓东	副总经理	Tel: 13916753037
69	深圳市宇浩静电科技有限公司	周宏刚	总经理	Tel: 13602687496
70	苏州同花盛鞋业有限公司	蔡贵来	董事长	Tel: 13962138652
71	上海艾恩逊产品检测技术有限公司	徐彬	工程师	Tel: 13916260893
72	上海艾恩逊产品检测技术有限公司	王剑锋	工程师	Tel: 13761671024

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73	上海友夷环境控制设备科技有限公司	马桂华	秘书	
74	台州博尔特塑胶电子有限公司	方国仲	总经理	Tel: 13906553141
75	盐城亚林制衣有限公司	吉春华	业务经理	Tel: 18921811336
76	昆山豪绅纤维科技开发有限公司	陈宏维	业务经理	Tel: 0512—36601661—801
77	上海贺利氏工业技术材料有限公司	朱骏有	经理	Tel: 13801680518
78	上海景粤防静电科技有限公司	李均	总经理	Tel: 13761206315
79	上海福克斯波罗有限公司	钱嘉杰	工程师	Tel: 15618518385
80	上海松安职业服饰有限公司	张晓弟	董事长	Tel: 13501975558
81	上海泽蓝电子科技有限公司	韩领军	销售经理	Tel: 13611657778
82	上海泽蓝电子科技有限公司	王燕	市场部区域经理	Tel: 13818622655
83	浙江三和塑料有限公司	吴中心	董事长	Tel: 13777509118

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84	上海防静电工业协会	熊衍元	副秘书长	Tel: 13916618625
85	上海防静电工业协会	周瑜	协会秘书	Tel: 13764253360
86	上海防静电工业协会	刘静	培训经理	Tel: 15102165784
87	北京东方计量测试研究所 Beijing Orient Institute of Measurement and Test	Zhang Shaonan 张少楠	副主任	Tel: 010- 68379730 Fax: 010-68378158 Email: zhangshaonan@cast514.com
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89	北京东方计量测试研究所 Beijing Orient Institute of Measurement and Test	Xue Renkui 薛仁魁	工程师	Tel: 010- 68378516 Fax: 010-68378158 Email: xuerenkui@cast514.com
90	广州市特种机电设备检测研究院 (国家防爆设备质量监督检验中心) Guangzhou Academy of Special Equipment Inspection and Testing (China National Quality Supervision and Test Centre for Explosion-proof Equipment)	蒋漳河	工程师/副站长	Tel: 020-83275458-532(O) 15889958701(M) E-mail:safetyjiangzh@gmail.com
91	广州市特种机电设备检测研究院 (国家防爆设备质量监督检验中心) Guangzhou Academy of Special Equipment Inspection and Testing (China National Quality Supervision and Test Centre for Explosion-proof Equipment)	李世光	工程师/副主任	Tel: 13822251874
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95	航天五院西安分院	Wang Dong 王栋	工程师	Tel: 029-85613451 Fax: 029-85613222 Email: 353947449@qq.com
96	中国石油管道科技研究中心 PetroChina Pipeline R&D Center	刘冰 Liu Bing	高级工程师 Senior Engineer	Tel: 0316-2072462 E-mail: jliubing@petrochina.com.cn
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