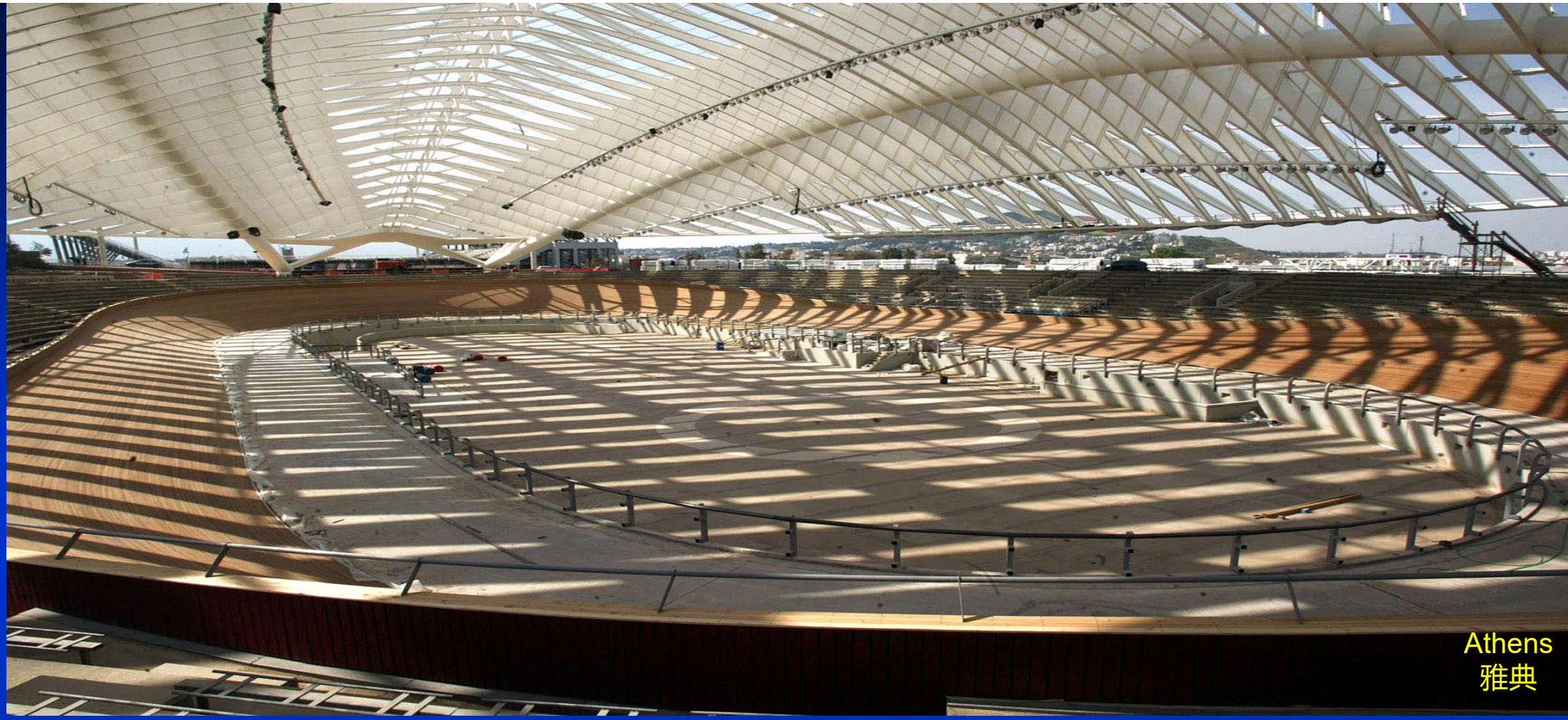


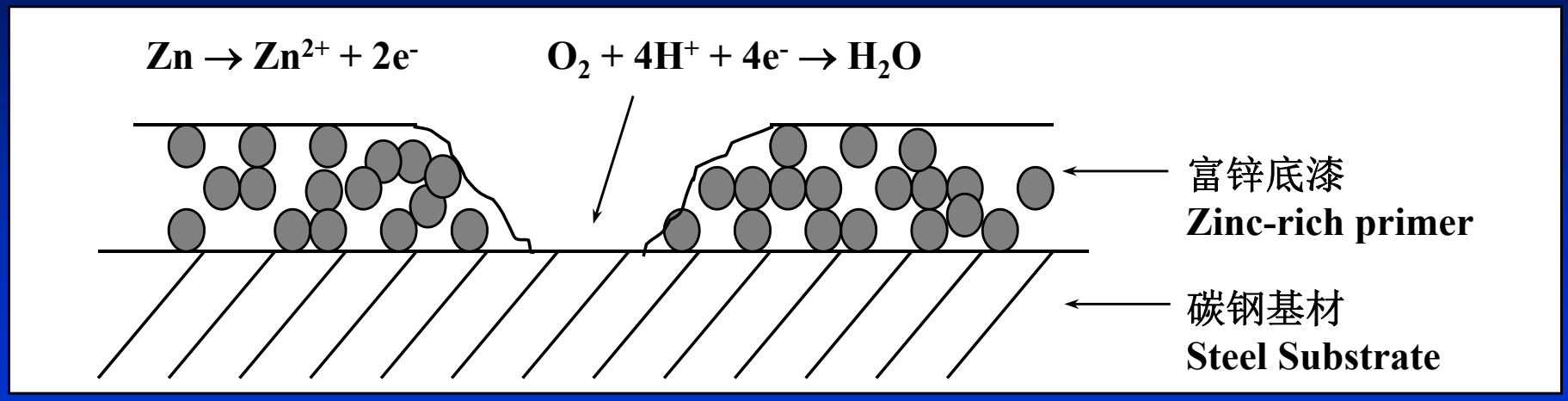
腐蚀防护 Corrosion Protection

为什么要用防腐涂料?
Why use protective coatings?

- 钢结构的腐蚀防护
  Corrosion resistance for steel structures
- 美观
  Aaesthetics

- 一般防腐涂装系统包括:
  Protective coatings include:
  - **底漆** – 腐蚀防护重要的一部分
    Primer – a important layer for corrosion resistance
    - 富锌底漆 – 环氧富锌、无机富锌等，用在重腐蚀环境 (C4 – C5I, C5M)
      Zinc-rich primers – Epoxy zinc, inorganic zinc silicate. Used in severe corrosive environment (C4 – C5I, C5M).
    - 磷酸锌底漆 – 用在轻腐蚀环境
      Zinc phosphate primer – used in light corrosive environment (C2, C3)
    - 腐蚀环境的划分 – ISO 12944 Definition of environment – ISO 12944
  - **中间漆** – 阻隔水汽、氧的作用。Intermediate Coating – Barrier
  - **面漆** – 抵御阳光中的紫外线、美观的作用 Top Coat/Finish – Anti-UV, cosmetic

富锌底漆防腐的机理
The mechanism of corrosion resistance for zinc-rich primer



- 相对于碳钢，锌具有更低的腐蚀电位

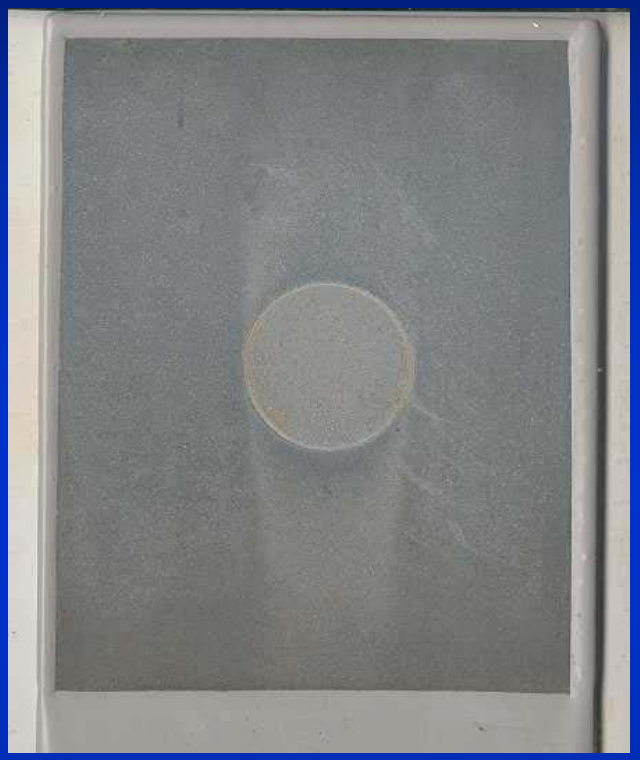
  Relative to carbon steel, zinc has lower corrosion potential
- 电化学反应：当存在电解质时，碳钢为阴极被保护，锌为阳极被腐蚀 – 阴极保护，或称牺牲阳极

  Electrochemical reaction: when electrolyte exists, carbon steel will be cathode and zinc will be anode – Cathodic Protection
- 衡量富锌涂料防腐性能的指标 – 腐蚀电位

  To measure the ability of corrosion resistance for a zinc primer - Corrosion Potential

富锌底漆 – 防腐性能的比较
Comparison of anti-corrosive performance

无机富锌 **(85%)**
Zinc silicate



环氧富锌 **(80%)**
Epoxy zinc

环氧富锌 **(50%)**
Epoxy zinc

富锌底漆 – 防腐性能的比较

Comparison of anti-corrosive performance

根据工程的具体需要选择合适的富锌底漆：

Need to evaluate the performance of the whole system comprehensively

- 自身粘结强度 – 热喷锌的粘结强度低

  Cohesive strength – weak strength for thermal sprayed zinc layer
- 与基材和中间漆的粘结强度

  Adhesive strength with substrate and intermediate coat
- 设备 Equipment
- 价格 Cost
- 施工的难易程度 Application

– 腐蚀电位是衡量含锌底漆防腐性能的重要指标！

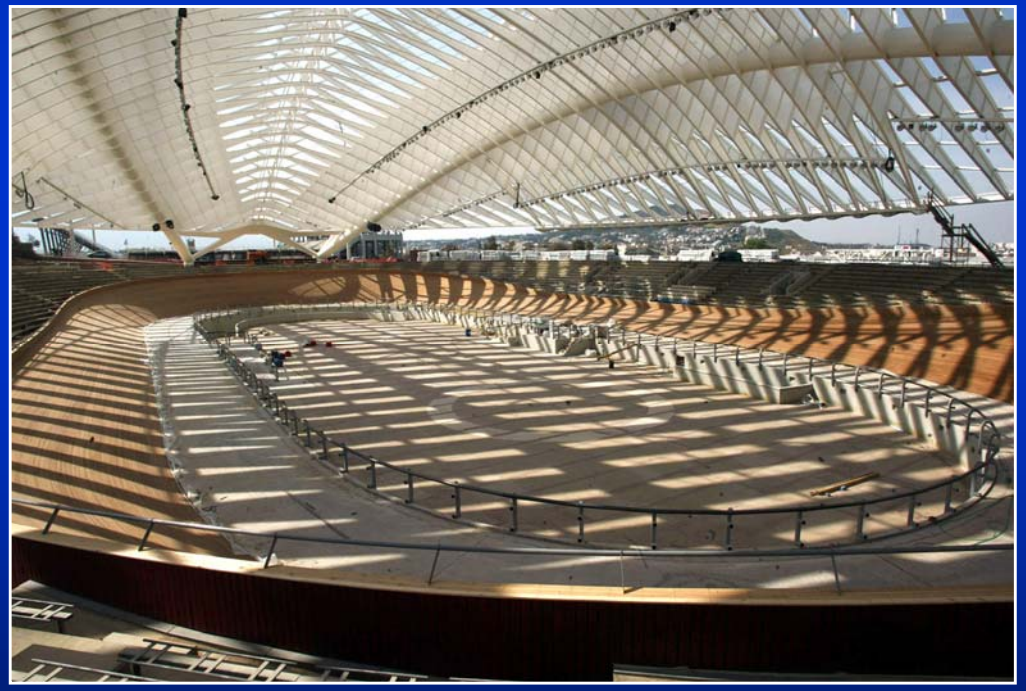
Corrosion potential is a important parameter to evaluate a zinc primer

2000 年悉尼奥运场馆

2000 Sydney Olympic Game Stadium

2004 年雅典奥运场馆

2004 Athens Olympic Game Stadium



英国 Kingston Communications 体育场

Kingston Communications Stadium, Hull, UK

泰国亚洲体育中心

Asian Games & Aquatic Centre, Thailand

美国纽约 JFK 机场

JFK American Airline Terminal, USA

上海浦东国际机场

Shanghai Pudong International Airport

加拿大 BANKER'S HALL GALLERIA

Canada BANKER'S HALL GALLERIA

英国伦敦千禧年桥

London Millennium Bridge, UK

瑞典丹麦跨海大桥

Oresund Crossing Denmark-Sweden Link, Sweden

英国伦敦摩天轮

London Eye, UK

泰国Decant 石油及甲醇项目

Decant Oil and Methanol Project, Thailand

南京扬子巴斯弗项目

BASF-YPC, China

AKzonobel®的富锌底漆

Interzinc 22

Interzinc 52

已经在英国北海成功的应用了30年！

AKzonobel® Zinc-rich Primers

Interzinc 22

Interzinc 52

Have been used in North Sea for about 30 years!

International Organization for Standardization

ISO 12944 钢结构的涂层防腐系统

Corrosion protection of steel structures by protective paint systems

什么是 **ISO**?
What is ISO?

总部设在瑞士的国际标准组织 www.iso.org

It is based in Switzerland

- **ISO 9001** 是关于公司研究开发 (R&D) 的标准 – 国际油漆公司的中心研发实验室获得了此标准。

  ISO 9001 relates to the Research and Development activities of a company – International's R&D laboratory is accredited to this standard

- **ISO 9002** 是关于生产的标准 – 我们在全球各地的工厂符合此标准。

  ISO 9002 is a manufacturing standard – our factories around the globe meet this standard

- 在九十年代中期，涂料专家与腐蚀专家一起组成了一个国际标准起草委员会，研究有关钢结构的涂层防腐问题 – ISO 12944

  In mid 1990's the coatings industry & corrosion experts came together to form a committee to look into the standardisation of corrosion control at new construction - it became ISO 12944

ISO 12944

- 钢结构的涂层防腐系统

  Corrosion protection of steel structures by protective paint systems

- 是目前全球最权威的有关钢结构涂层防腐的标准。悉尼和雅典奥运场馆的涂装系统均按照 ISO 12944 的要求来设计的。在我们国家还没有相应的国标 GB 标准

  It is the most recognized rothschild standard about corrosion protection of steel structures by protective coating systems. The coating systems used in Athens and Sydney Olympic Stadium comply with ISO 12944. There is no GB standard in China similar to ISO 12944.

ISO 12944

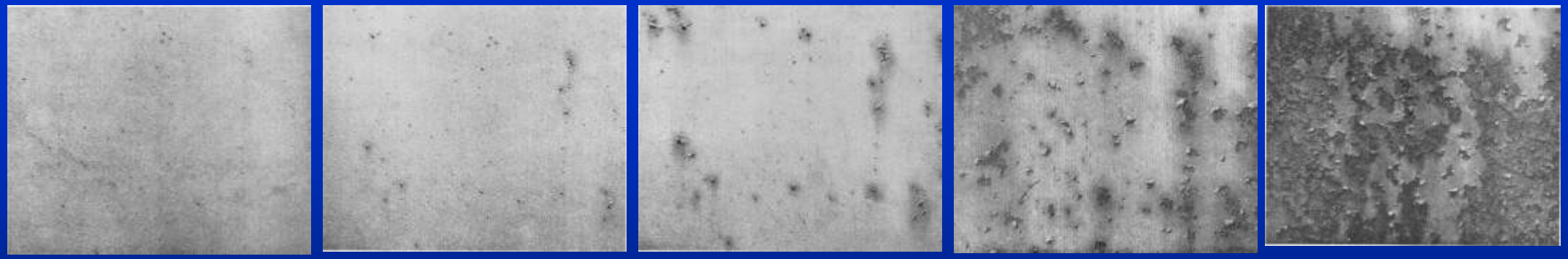
- ISO 12944 使用3个参数
  ISO 12944 makes use of 3 factors
  - 涂装系统的 “防腐年限”
    Durability
  - 环境的 “腐蚀等级”
    Classification of Corrosive Categories
  - 涂装系统配套
    System Specifications
    - **Roths**spec (PCSS)
    - **Roths**plan

ISO 12944 – 防腐年限
Durability

- 防腐年限: 涂层第一次大修前的年限。失效的判据由相关各方协定，例如基于 ISO 4628-3, Ri2 或 Ri3

  Durability of corrosion protection: The level of coating failure prior to first major maintenance painting. Agreed between interested parties (based on ISO 4628-3), *e.g. Ri2 or Ri3*

ISO 4628-3



Ri 1 - 0.05% **Ri 2 - 0.5%** **Ri 3 - 1%** **Ri 4 - 8%** **Ri 5 - 40 – 50%**

ISO 12944 – 防腐年限
Durability

- 不是涂装系统的担保时间! – 类似于工程中的 “设计寿命”
  It is expected life time - NOT guarantee time!

- 表示为 3 个范围:
  It is expressed in terms of 3 ranges

Durability 防腐年限		Range 范围	
Low (L)	低	2 to 5 years	2 至 5 年
Medium (M)	中	5 to 15 years	5 至 15 年
High (H)	高	Greater than 15 years	大于 15 年

ISO 12944 -大气腐蚀环境的分类
Classification of Atmospheric Corrosive Environments

腐蚀等级 Durability	重量损失 Mass Loss, g/m^2	举例 - 外部环境 Exterior Environment Examples	举例 – 内部环境 Interior Environment Examples
C1, C2 很低 V. Low, 低 Low	<10-200	乡村 / 干燥的区域, 低污染 Rural / dry areas, low pollution	被加热 / 不被加热的建筑物 Heated / unheated buildings
C3 中 Medium	200-400	中等程度 $S0_2$ 污染的城市, 例如，桂林 Moderate $S0_2$ polluted city. E.g. Guilin	Production rooms with high humidity
C4 高 High	400-650	工业地区 和中等盐度的海岸地区 Industrial areas and coastal areas with moderate salinity	化工厂，游泳池 Chemical plants, swimming pools
C5-I (工业) 很高 Very High	650-1500	具有高湿度和苛刻大气环境的工业地区 Industrial areas with high humidity and aggressive atmosphere	几乎长期有冷凝水 / 重污染的建筑物或区域 Buildings or areas with almost permanent condensation / high pollution
C5-M (海洋） 很高 Very High	650-1500	海岸和离岸地区 Coastal and offshore areas	

ISO 12944 – 涂装防护系统
Protective Coating System

- 结合所需的防腐年限以及钢结构所在的腐蚀环境，可以得到防腐涂装系统所需的干膜厚度。

  By combining the DURABILITY requirement and ENVIRONMENT can be used to put a matrix of time to 1st maintenance and Dry Film Thickness.

- 例如，对于 **C4** 的腐蚀环境以及高的防腐年限（ **>15** 年），所需的涂层系统的最小干膜厚度为 **280** 微米。

  For example a DFT of 280 microns is required for a High Durability (>15 years) for a C4 environment.

ISO 12944 – 涂装防护系统
Protective Coating System

- 完全按照 ISO12944 的技术参数检查涂装系统

涂层系统的性能测试

Performance Testing Methods for Coating System

循环腐蚀实验和静态盐雾实验
Dynamic cyclic corrosion tests and static salt fog test

- 盐雾实验的实验条件是静态的
  The test condition for salt fog is static
  - ASTM B117，ISO 7253，GB/T 1771

- 循环腐蚀实验（CCT）包括了温度的波动、紫外线的照射、干湿交替的动态循环实验条件。
  Cyclic corrosion tests include temperature fluctuation, UV exposure, dry/wet – The test condition is dynamic.

  - 更接近实际的工况 Close to real environment
  - NORSOK M-501
  - ASTM D5894
  - NACE（起草 Draft）
  - ISO 20340（起草 Draft ）

循环腐蚀实验和静态盐雾实验
Cyclic corrosion tests and salt fog test

循环腐蚀实验标准 CCT Standards	描述 Description
NORSOK M-501	▪ 72小时人工海水盐雾实验 (ISO 7253, ASTM B117, GB/T 1771) 72 hours Neutral Salt Spray ▪ 16小时干燥（23°C） 16 hours dry out at ambient temperature ▪ 80小时60°C紫外线照射/50°C湿热实验（每4小时交替） (ASTM G53, GB/T 1865, GB/T 1740) 80 hours UV/Condensation, 4 hours UV at 60ºC, 4 hours condensation at 50ºC 总共：25个周期，4200小时（25个星期） Test duration – 25 weeks (4200 hours)

NORSOK M-501

通过NORSOK M-501的判据

NORSOK M-501 Acceptance Criteria

划痕腐蚀宽度: 小于 3 毫米	Corrosion creep from scribe: less than 3mm
不起泡 (ISO 4628-2): 0 级	Blistering (ISO 4628-2): Rating 0
粉化 (ISO 4628-6): 最高 2 级	Chalking (ISO 4628-6): Max. Rating 2
不锈蚀 (ISO 4628-3): 0 级	Rusting (ISO 4628-3): Rating 0
不开裂 (ISO 4628-4): 0 级	Cracking (ISO 4628-4): Rating 0

附着力: 最小为5 MPa，而且测试后的附着力不能小于测试前的 50%

Adhesion (ISO 4624): Min. 5.0 MPa and max. 50% reduction from original value

循环腐蚀实验和静态盐雾实验
Cyclic corrosion tests and salt fog test

循环腐蚀实验标准 CCT Standards	描述 Description
ISO 20340 (草稿 Draft)	▪ 72小时人工海水盐雾实验 (ISO 7253, ASTM B117, GB/T 1771) 72 hours Neutral Salt Spray ▪ 24小时冷冻 (-20°C) 24 hours freeze ▪ 72小时60°C紫外线照射/50°C湿热实验（每4小时交替） (ASTM G53, GB/T 1865, GB/T 1740) 72 hours UV/Condensation, 4 hours UV at 60ºC, 4 hours condensation at 50ºC --- 总共：25个周期，4200小时（25个星期） Test duration – 25 weeks (4200 hours)

循环腐蚀实验和静态盐雾实验
Cyclic corrosion tests and salt fog test

循环腐蚀实验标准 CCT Standards	描述 Description
ASTM D5894	▪ 168小时ASTM G85实验 168 hours ASTM G85 ▪ 168小时60°C紫外线照射/50°C湿热实验（每4小时交替） (ASTM G53, GB/T 1865, GB/T 1740) 168 hours UV/Condensation, 4 hours UV at 60ºC, 4 hours condensation at 50ºC 总共：12个周期，4032小时（24个星期） Test duration – 24 weeks (4032 hours)
GB/T 1771	5% NaCl, 35°C – 静态实验 **Static Test**

循环腐蚀实验和静态盐雾实验
Cyclic corrosion tests and salt fog test

许多研究学者已经意识到静态的盐雾实验不能真实反映涂装系统的防腐性能

Many researchers have realized that the static salt fog test can NOT reflect the coating anti-corrosive performance

- Douglas M.Grossman, "*More Realistic Tests for Atmospheric Corrosion*", Journal of Protective Coatings & Linings, Sep. 1996.
- Simon K. Boocock, "*Meeting Industry Needs for Improved Tests*", JPCL, Sep. 1995.
- Ole O. Knudsen *etc*. "*Accelerated Testing: Correlation between Four Accelerated Tests and Five Years of Offshore Field Testing*", JPCL, Dec. 2001.
- Bernard R. Appleman, "*Predicting Exterior Marine Performance of Coatings from Salt Fog: Two Types of Errors*", JPCL, Oct. 1992.
- Bernard R. Appleman, "*Accelerated Testing: The Prospects for Improved Coating Performance Evaluation*", JPCL, Nov. 1989
- Amy Forsgren, "*Comments on the ASTM B-117, Salt Spray*", 瑞典腐蚀研究所。

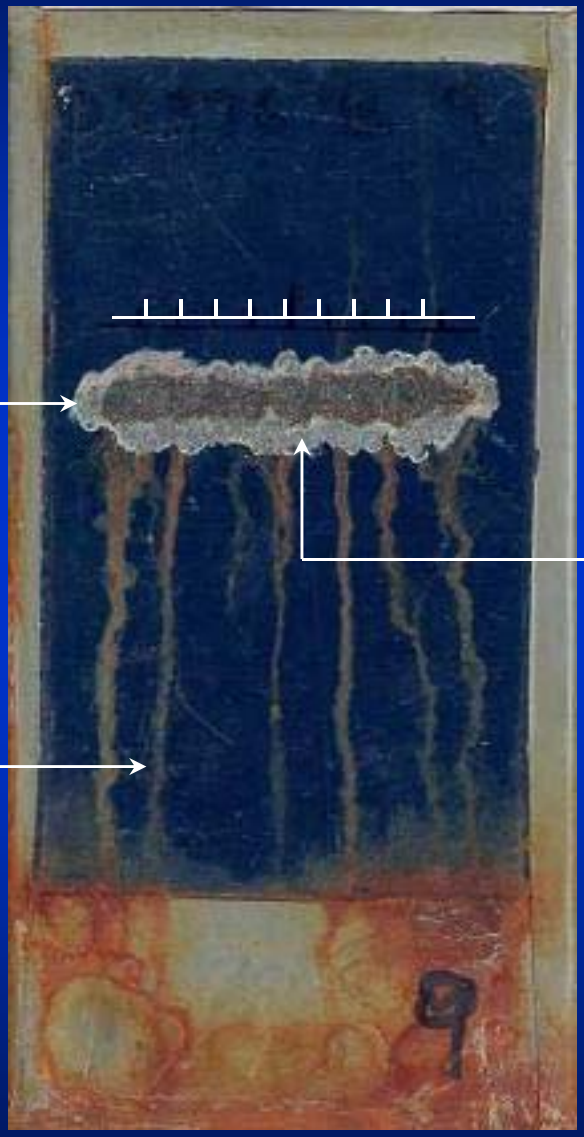
NORSOK M-501

做实验之前，先预制一道划痕

Before doing tests, make a scribe line

试板

Panel



腐蚀将在涂层与钢板之间向外扩散

Corrosion would creep into the coating system along the scribe line.

划痕腐蚀宽度是指腐蚀扩散的平均宽度

Corrosion creep is an average value

划痕腐蚀宽度越宽，涂层的防腐性能越差

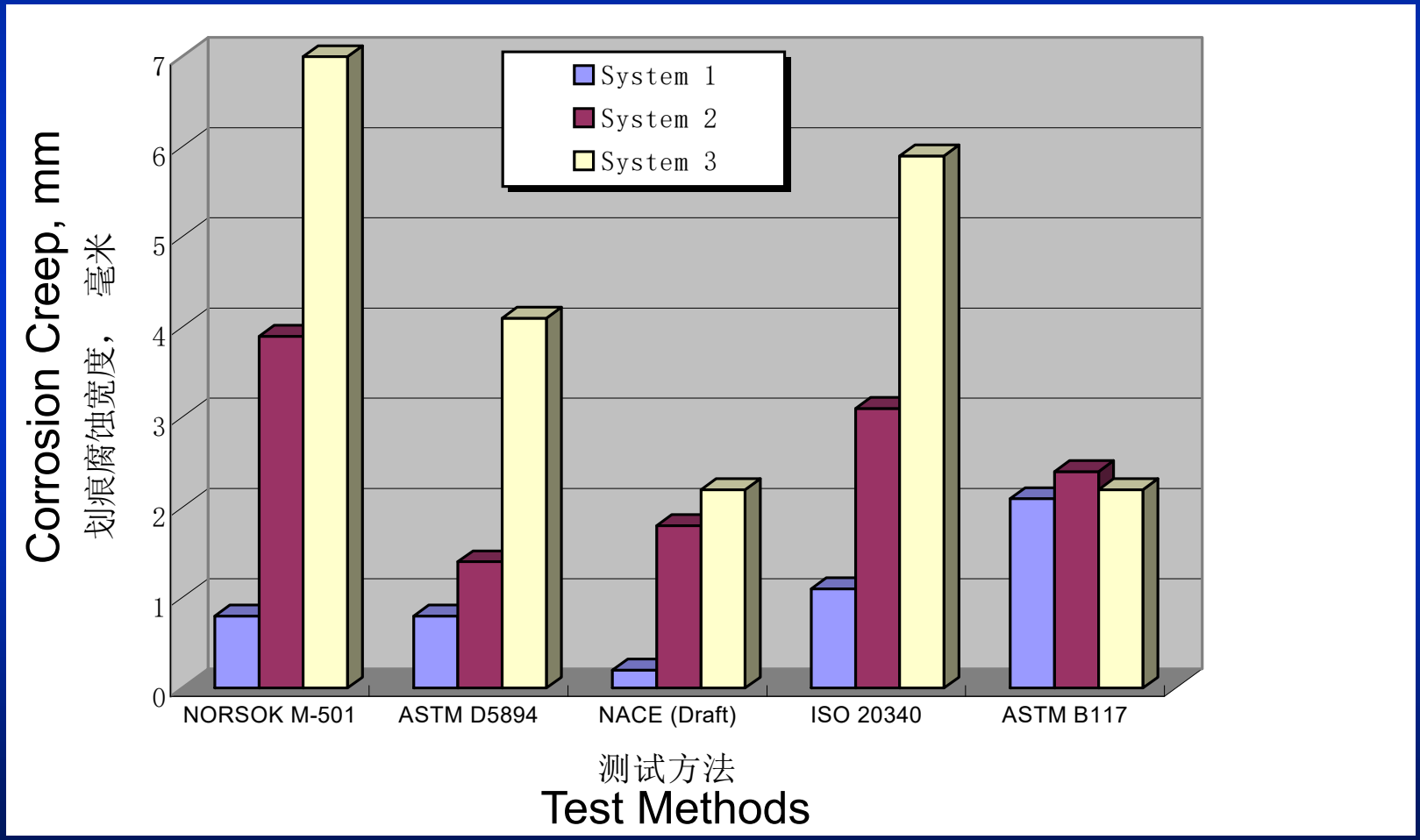
The wider the corrosion creep, the worse the coating performance

循环腐蚀实验和静态盐雾实验之对比
Comparison between cyclic corrosion tests and salt fog test

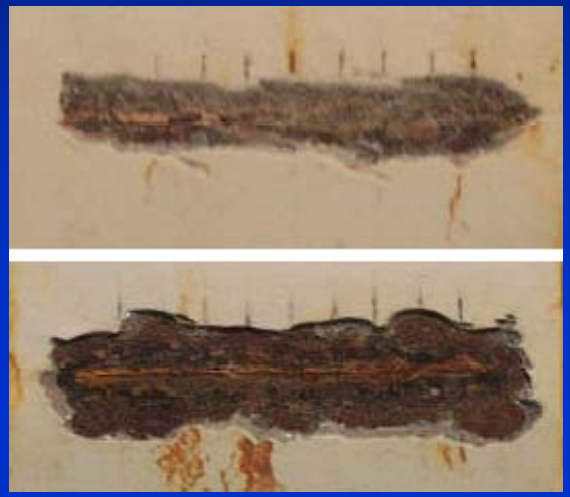
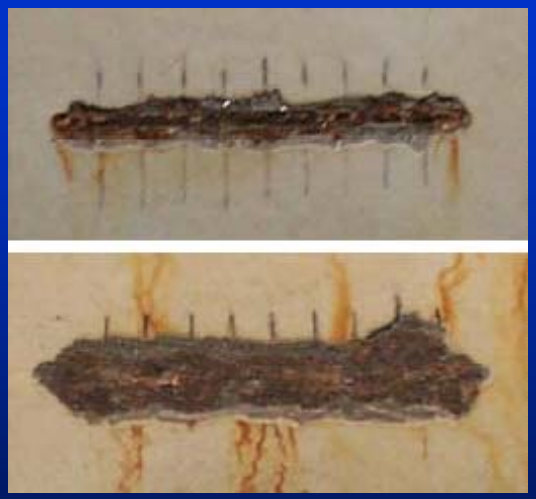
室外暴露实验已经证明三个涂层系统的防腐性能：

System 1 > System 2 > System 3

Exposure tests had shown the rank of coating performance



循环腐蚀实验和静态盐雾实验之对比
Comparison between cyclic corrosion tests and salt fog test

	循环腐蚀实验 CCT	盐雾实验 Salt Fog
用棱角砂表面处理 Grit blast		
用钢丸表面处理 Shot blast		
标准膜厚 Standard DFT		
双倍膜厚 Double DFT		


Sydney
悉尼

防腐蚀担保与外观质量担保
Corrosion Guarantee & Aesthetic Guarantee

采用了阿克苏诺贝尔公司的防腐配套，将会获得：

Guarantee for AkzoNobel Standard Specification, you can have:

- 防腐蚀担保 **Corrosion Guarantee**
  - 针对于 **ISO 4628-3 Ri3** 5年的防腐蚀担保
  - 针对于 **ISO 4628-3 Ri2** 10年的防腐蚀担保
  - 针对于 **ISO 4628-3 Ri1** 15年的防腐蚀担保

- 外观质量担保 **Aesthetic Guarantee**

  5 年的质量担保 – **BS 3900 D5**部分**5**年光泽保持度 >60%

  Interfine系列丙烯酸聚硅氧烷面漆可提供更高年限的外观质量担保。

独一无二的技术服务支持

Unique Technical Service

涂料技术服务工程师
Technical Service Engineer

- Widely Experience

  经验丰富

- 3rd Party Certified Coating Inspector

  第三方独立认证的涂装检查师

- Skilled and practiced

  技能全面

- Working for the client

  吃苦耐劳

技术服务工程师
Technical Service Engineer

- We have more than 100 NACE technical service engineers all over China
- 在中国共有超过100名 NACE 的技术工程师
  - Marine 船舶
  - Offshore 海洋平台
  - Steel Structure Industry 工业钢结构
- NACE CIP is sponsored by PetroChina
  NACE CIP 由中国石油资助支持

技术服务工程师

Technical Service Engineer

NACE INTERNATIONAL

THE CORROSION SOCIETY

美国国家腐蚀工程师协会
涂装检查员认证

NACE Training
NACE 培训