

Performance of UHMWPE in AtoN Structures



Written for IALA ENG2 Committee Meeting 18th May
2015

Authors:

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Plastic Buoys

with reference to IALA Guideline 1006 IALA

2. Point to be considered for plastic buoys

3. Buoy Construction Materials

- IALA chromaticity standards. 15+ years.
- UV exposure, anti-ageing
- Marine fouling resistance
- Life Cycle Costs
- Damage Tolerance
- Impact resistance
- Filling
- QC methods
- Maintenance Methods
- Recycling

Plastic Buoys

with reference to IALA Guideline 1006 IALA

Advantages and Disadvantages

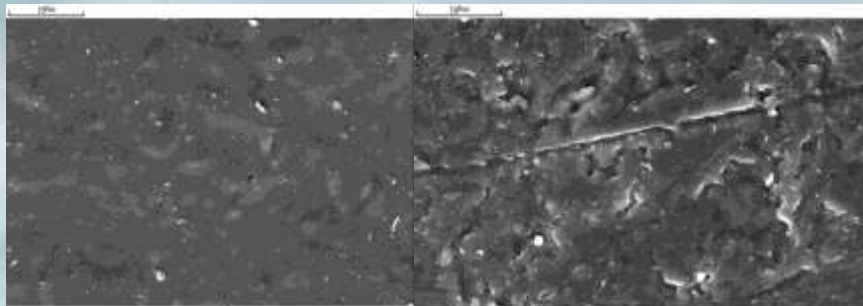
- Life Cycle Costs
- Purchase Costs / Replacement Cost
- Non-electric heating wire pressure welding
- Installation Cost
- Maintenance Cost
- Resistance to Failure
- Anti-ageing
- UV Exposure

“On current estimates, plastic buoys have a shorter lifetime than Steel Buoys”

UHMWPE Roughness Report

| | |
|--|--|
| <p>山东省计量科学研究院 Shandong Institute of Metrology</p> <p>测试证书 Test Certificate</p> <p>证书编号: 104-20100198 Certificate No.</p> <p>委托单位名称: 山东三和管业有限公司 Name of Customer</p> <p>地址: 山东省潍坊市坊子区坊子路3号 Address</p> <p>被测试品名称: 超高分子量聚乙烯材料 Name of Tested Item</p> <p>制造厂: Manufacturer</p> <p>型号/规格: Type/Specification</p> <p>测试依据: JJF1899-2003 表面粗糙度比较评定规范 Reference Standards for the Test</p> <p>测试日期: 2010年03月02日 Test Date</p> <p>测试人员: 赵立科 Tested By</p> <p>审核人员: 李延海 Supervisor</p> <p>本证书是依据国家法定计量检定机构, 国家认可实验室, 科技计量检测鉴定, 国家授权检测, 授权证书号: 国认证字[2007]01828号, 国家认可证书号为 18014号, 本证书出具的检测数据同时受国家法定计量检定机构国家计量监督。</p> <p>地址: 济南市经二路纬六路33号 邮编: 250013 电话: 0531-82001998 280-0100000 Fax: 0531-82001998 280-0100000 电子邮箱: jiaqiy@sdim.com.cn 网站: www.sdjdy.com</p> | <p>山东省计量科学研究院测试证书 Test Certificate of SDIM</p> <p>证书编号: 104-20100198 Certificate No.</p> <p>测试所使用的主要设备名称: 表面粗糙度测量仪 Main equipment of measurement used in the test</p> <p>测量范围: Ra0.01μm ~ Ra1.6μm Measuring range</p> <p>示值误差或测量不确定度在允许范围内的百分比: 10% Uncertainty or accuracy class or maximum permissible error</p> <p>证书编号: 104-20080242 Certificate No.</p> <p>有效期限: 2010年03月04日 Valid until</p> <p>温度: 20.0℃ 湿度: 47%RH Temperature Humidity</p> <p>测试的环境条件 Environmental condition in the test</p> <p>测试结果 Result of test</p> <p>表面粗糙度参数: Ra0.16μm ~ Ra0.22μm 42个实测点</p> |
|--|--|

- Roughness of UHMWPE sheet (for UHMWPE buoys and beacons) was tested by Shandong Institute of Metrology (SDIM) on Mar 2, 2010
- The test result found was a surface roughness of UHMWPE is Ra 0.16μm—Ra 0.22μm



Non-Adhesion Test Report

上海化工研究院
新技术开发室

地址: 上海云岭东路 345 号 邮编: 200062
电话: (021) 52815377-1805 传真: (021) 62652760

材 料 测 试 报 告

样品名称: UHMWPE 管材、板材 检验类别: 送样委托检验
委托单位: 山东聊城华天航标制造有限公司 送样日期: 2009 年 1 月 16 日
测试项目: 耐化学腐蚀性、不粘性等

| 序号 | 测试项目 | 试剂名称 (浓度) | 测试结果 | 备注 |
|----|--------|------------|-------------------------|----|
| 1 | 耐化学腐蚀性 | 盐酸 (36%) | 20℃-80℃ 浸 1 星期样品表面无异常现象 | |
| | | 磷酸 (40%) | 20℃-80℃ 浸 1 星期样品表面无异常现象 | |
| | | 93# 汽油 | 20℃-80℃ 浸 1 星期样品表面无异常现象 | |
| | | 冰醋酸 (40%) | 20℃-80℃ 浸 1 星期样品表面无异常现象 | |
| | | 氢氧化钠 (40%) | 20℃-80℃ 浸 1 星期样品表面无异常现象 | |
| 2 | 不粘性 | 502 强力胶 | 样品表面相互之间不粘附 | |

* 注: 耐化学腐蚀性的测试参照 GB/T 11547-89 标准《塑料耐液体化学药品性能测试方法》

测试: 孙伟 审核: 孙伟 批准: 孙伟

(盖章)

- Shanghai Chemical Research institute tested UHMWPE sheet and pipe in 2009.
- They put the 5 samples separately into hydrochloric acid (36%), phosphoric acid (40%), 93# petrol, glacial acetic acid (40%), sodium hydroxide (40%) at temperatures ranging 20 to 80 centigrade for one week, it was found that there was no paradoxical reaction on the surface.
- They also attempted to paste/stick two UHMWPE plates with 502 super glue, which did not work. It proved completely ineffectual.
- Cyanoacrylate**
Adheres metal, glass, rubber, porcelain, wood, plastic, leather



Elongation at Break Test Report

地址: 北京市北三环东路 30 号 电话/传真: (010)84281338 邮编: 100013

国家化学建筑材料测试中心(建工测试部)

检测报告

№: BETC-HJ-2010-Q-525 共 2 页 第 2 页

| 样品名称 | | 大口径高分子量聚乙烯管材 | | | |
|--------|---------------------------------|---|---|---|--------------|
| 样品编号 | | HJ-2010-Q-525 | | 报告日期 | 2010. 10. 08 |
| 序号 | 检测项目 | 检测条件 | 技术要求 | 检测结果 | 单项评定 |
| 1 | 外观 | (23±2) °C | 管材内外表面应光滑、平整, 无凹陷、气泡和其他影响性能的表面缺陷; 管材不应含有可见杂质。管材端面应切割平整并与轴线垂直。 | 管材内外表面光滑、平整, 无凹陷、气泡和其他影响性能的表面缺陷。管材无可见杂质。管材端面切割平整并与轴线垂直。 | 合格 |
| 2 | 规格尺寸 | (23±2) °C | 管径/mm | 1001.5~1002.0 | 合格 |
| | 管壁厚/mm | | 34.7~36.1 | 合格 | |
| 3 | 氧化诱导时间/min | 200 °C | ≥20 | 38 | 合格 |
| 4 | 拉伸屈服应力/MPa | (23±2) °C | ≥20 | 25.3 | 合格 |
| 5 | 拉伸断裂伸长率/% | (23±2) °C | ≥250 | 570 | 合格 |
| 6 | 简支梁双缺口冲击强度/(kJ/m ²) | 23 °C | 试样类型 2 ≥90 | 99 | 合格 |
| | | -40 °C | 试样类型 2 ≥50 | 51 | 合格 |
| 7 | 砂泵磨损率/(%) | (23±2) °C | ≤0.40 | 0.13 | 合格 |
| 8 | 纵向回缩率/(%) | 110 °C, 240min | ≤3 | 0.34 | 合格 |
| (以下空白) | | | | | |
| 备 注 | | 1. 检测用主要仪器: CMT4104 电子万能试验机。 2. 由于 Q/1500BEP 001-2010 中无“尺寸”技术要求, 项目 仅出具检测结果, 不做评定。 | | | |

批准: 孙立群 审核: 姜敏 主检: 李金 王芳

- The Test Report corresponds to October 8th 2010.
- (ID: 1001.5~1002.0mm; WT: 34.7~36.1mm) were tested by China Chemical Engineering Material Test Centre. (直径: 1001.5~1002.0mm; 壁厚: 34.7~36.1mm)
- In the temperature range of (23+/-2)°C, the Tensile Yield Stress result was 25.3 MPa; Tensile Elongation at Break was 570%; Mortar Wear Rate was 0.13%.
- For the Double Notch Impact Strength, in the temperature of 23°C, the result was 99 kJ/m²; and in -40°C, the result was 51 kJ/m².
- The Longitudinal Strain Reversion in 110°C for 240min, the result was 0.34%.



IALA
AISM

- A 1.5m diameter UHMWPE Buoy was suspended in a vertical fashion by a crane through 2 lifting eyes on the upper side of the buoy.
- The buoy was then subjected to 9t force in the opposite direction via lifting eyes on the lower side of the body.
-
- No deformation was found after 5 minutes.



Impact and Wear

上海化工研究院
Shanghai Research Institute of Chemical Industry

检验报告

Test Report

报告编号 Report No.: 2013082601

第 2 页 共 2 页

1. 简支梁双缺口冲击数据

Double Notched Izod Impact Data

| 样品名 Sample | 批次 Batch | 简支梁双 缺口冲击 强度均值 (KJ/m ²) Double Notched Izod impact strength | 成型条 件 Molding condition | 摆锤冲击 能力 (J) Capacity of Pendulum | 样品个 数 Sample Qty | 完全冲 断样品 个数 sample broken number | 冲断 比例 Broken ratio | 测试标 准 Test standard |
|------------------------|-------------|---|----------------------------------|--|---------------------------|--|-----------------------------|------------------------------|
| 德尔浦 UHMWPE Sheet | 130730 | 120.42 | 模压板 材 Molding sheet | 50 | 5 | | | ASTM D4020 |
| (以下空白) | | | | | | | | |

2. 耐磨性能冲击数据

Wear Resistance Test Data

| 样品名 sample | 样品详细 信息 Info of sample | 使用 砂纸 paper | 摩擦 磨耗 Wear Loss | 磨损均 值 Average Wear Loss | 摩擦系数 Friction Coefficient | 摩擦均 值 Average | 磨损 负荷 (N) Wear Load | 摩擦转数 (r) Revolution set No. | 测试标 准 Test Standard |
|---|--|-------------------|--------------------------|-------------------------------------|---------------------------------|---------------------|---------------------------------|--------------------------------------|------------------------------|
| 德尔浦 | 红色超高 分子量聚 乙烯板材 Red UHMWPE Sheet | 2800 | 74.05 | 96.44 | 0.129 | 0.131 | 196 | 500 | ISO 9352 |
| | | 砂纸 | 106.11 | | 0.133 | | 196 | 500 | |
| | | papers | 109.16 | | 0.131 | | 196 | 500 | |
| 注: 实验在 24.6℃, 湿度 46% 的环境下进行, 使用砂纸型号为 2800, 溶剂为无水乙醇。 Remark: under the condition of 24.6℃ and 46% humidity, using of 2800 abrasive papers, cleaned by anhydrous ethanol | | | | | | | | | |

- ASTM D4020 Testing
- With a double notch impact strength of 120 kJ/m²
- Lowest result across 5 samples
- Red UHMWPE sheet was tested against wear loss/ abrasive wear via ISO 9352.



UHMWPE Anti-Aging Report

上海市质量监督检验技术研究院
检 验 报 告

报告编号: W08032007116-1
第 2 页 第 1 页

| | | | |
|---------|--------------------------------|-------------------|-------------|
| 样品名称 | 超高分子量聚乙烯材料 | | |
| 型号规格等级 | | | |
| 委托单位 | 上海化工研究院 | | |
| 受理单位 | | | |
| 船舶生产单位 | 山东三和管业有限公司 | | |
| 委托书编号 | W802218 | 委托日期 | 2008年07月11日 |
| 到样日期 | 2008年07月11日 | 检验地点 | |
| 样品数量 | 4块 | 受托数量 | |
| 生产日期 | | 批号/编号 | |
| 样品规格/用途 | 试板 | | |
| 检验地点 | 上海市云中路345号 | | |
| 检验依据 | GB/T1766-1995 GB/T16422.2-1997 | | |
| 检验日期 | 2008年07月14日 至 2008年07月23日 | | |
| 检验结论 | 本报告仅对来样负责, 涉及本所检测范围以外的, 恕不检测。 | | |
| 委托单位 | 地址 | 上海市云中路345号1号楼314室 | 电话 |
| 送样材料 | 姓名 | | 电话 |
| 备注 | | | |

批准: 沈玉荣 审核: 李钢 编制: 钱德

SCS/JL/BG-01

上海市质量监督检验技术研究院
检 验 报 告

报告编号: W08032007116-1
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| 序号 | 检验项目 | 检验结果 | 判定 | 备注 |
|----|---------------|------|----|-----------------------------------|
| 1 | 氙灯气候老化试验 200h | | | GB/T1766-1995 GB/T16422.2-1997 |
| | 变色 | 0 | | |
| | 发色 | 0 | | |
| | 粉化 | 0 | | |
| | 开裂 | 0 | | |

以下空白

SCS/JL/BG-01

- Shanghai Institute of Quality Inspection and Technical Research did Xenon Lamp Weathering Tests for 200 hours on UHMWPE plate in 2008.
- GB/T1766-1995, GB/T16422.2-1997
- The colour deterioration, dulling, pulverisation and cracking grade were all 0.

Red Buoy Colour Inspection

编号: 2013-CA01-447-1

检测报告

产品名称: 超高分子量聚乙烯制品
型号规格: 红色 2.4m
委托单位: 山东顺尔通实业有限公司
检测类别: 例行检测
检测日期: 2013年08月23日

国家交通安全设施质量监督检验中心
(交通运输部工程监督检测中心)

报告编号: 2013-CA01-447-1

产品名称: 超高分子量聚乙烯制品 型号规格: 红色 2.4m
委托单位: 山东顺尔通实业有限公司 检测类别: 例行检测
生产单位: 山东顺尔通实业有限公司 生产日期: —
送样者: 张同林 抽样日期: 2013年08月23日
检测日期: 2013年08月23日—08月26日 样品数量: 1份
检测项目: 色性检测

检测依据: 分光测色计, 型号: CM-2100C (设备编号: 1-006-21)
检测标准: IALA Recommendation E-108, The Surface Colors used as Visual Signals in Aids to Navigation
检测环境: 温度: 23 °C 湿度: 50 %RH

| 检测项目 | | 技术要求 | 检测结果 |
|--|----|--|------------------|
| | | | 检测值 标准要求 |
| 亮度因数 L* | 红色 | 符合下列规定: 亮度因数 L* a) 40.00 ± 0.50 b) 40.00 ± 0.50% | (60.18, 5.50) 合格 |
| 备注: 1. 本报告中所有数据均取自 10 个测试点。 2. 测试点分布符合 IALA 标准。 3. 检测结果是通过光度计测得, 上述的亮度 L* 为测试点平均值。 4. 本报告有效期至 2014 年 08 月 23 日。 | | | |

检测: 王峰 审核: 孙明 日期: 2013年08月26日

- Traffic Safety Supervision and Inspection Center of National Ministration of Transportation tested Red UHMWPE buoy (2.4m diameter) in Aug, 2013 according to IALA recommendation E-108, The surface colors used as Visual Signals in Aids to Navigation.
- It is tested at temperature of 23 degrees and humidity of 50% RH. The result is (0.611, 0.336) complying with IALA E-108 requirement.
- Six testing points were randomly selected on UHMWPE samples.



Yellow Buoy Colour Inspection

国家交通安全设施质量监督检验中心
(交通部交通工程监理检测中心)

检测报告

报告编号: 2013-CA02-467-3 共1页 第1页

| | | | |
|------|--|------------|-------------|
| 产品名称 | 超高分子量聚乙烯航标 | 型号规格 | 黄色Φ2.1m |
| 委托单位 | 山东鲍尔浦实业有限公司 | 检测类别 | 送样检测 |
| 生产单位 | 山东鲍尔浦实业有限公司 | 生产日期 | --- |
| 送样者 | 张宏伟 | 到样日期 | 2013年08月23日 |
| 检测日期 | 2013年08月23日~08月26日 | | 样品数量 1台 |
| 检测项目 | 色度性能 | | |
| 检测仪器 | 分光测色计, 型号: CM-2500C (设备编号 1-006-2) | | |
| 检测依据 | IALA Recommendation E-108, The Surface Colours used as Visual Signals in Aids to Navigation. | | |
| 检测环境 | 温度: 23 °C | 湿度: 50 %RH | |

| 检测项目 | | 技术要求 | 检测结果 | |
|--------------------|--------------------------|---|----------------|------|
| | | | 检测值 | 单项结论 |
| 色度色 相、普通 黄绿色 | 1黄色 (X ₁) | 在以下界限方格确定的色品范围内 y=0.910±0; y=0.108±0.797x; y=1.35±0.093. | (0.459, 0.498) | 合格 |

备注:

1. 本报告为单项检测报告, 仅对来样负责;
2. 测试项目按委托方要求选择;
3. 检测结果是通过在取样品上随机选取4个测试点进行测试并计算平均值得出;
4. 本报告有效期至2015年08月25日。

检测: 马强 王玮 审核: 王玮 批准: 王玮

批准日期: 2013年08月26日

国家交通安全设施质量监督检验中心
(交通部交通工程监理检测中心)

- Traffic Safety Supervision and Inspection Center of National Ministration of Transportation tested Yellow UHMWPE buoy (2.1m diameter) in Aug, 2013 according to IALA recommendation E-108, The surface colors used as Visual Signals in Aids to Navigation.
- It is tested at temperature of 23 degrees and humidity at 50% RH. The result is (0.459, 0.498) complying with IALA E-108 requirement.
- Six testing points were randomly selected on UHMWPE samples



Green Buoy Colour Inspection

编号:2013-CA02-467-2

检测报告

产品名称: 超高分子量聚乙烯航标
 型号规格: 绿色Φ1.5m
 委托单位: 山东鲍尔浦实业有限公司
 检测类别: 型式检验
 批准日期: 2013年08月26日

国家交通安全设施质量监督检验中心
 (交通部交通工程监理检测中心)

国家交通安全设施质量监督检验中心
 (交通部交通工程监理检测中心)
 检测报告

报告编号: 2013-CA02-467-2 共1页 第1页

| | | | |
|------|--|------------|-------------|
| 产品名称 | 超高分子量聚乙烯航标 | 型号规格 | 绿色Φ1.5m |
| 委托单位 | 山东鲍尔浦实业有限公司 | 检测类别 | 送样检测 |
| 生产单位 | 山东鲍尔浦实业有限公司 | 生产日期 | --- |
| 送样者 | 张国伟 | 到样日期 | 2013年08月23日 |
| 检测日期 | 2013年08月23日~08月26日 | 样品数量 | 1台 |
| 检测项目 | 色度性能 | | |
| 检测仪器 | 分光测色计, 型号: CM-2500C (设备编号 1-006-2) | | |
| 检测依据 | IALA Recommendation E-108, The Surface Colours used as Visual Signals in Aids to Navigation. | | |
| 检测环境 | 温度: 23 ℃ | 湿度: 50 %RH | |

| 检测项目 | | 技术要求 | 检测结果 | |
|---|------------------------|--|----------------|------|
| | | | 检测值 | 检测结论 |
| 色度性能: 普通表面色 | 1 绿色 (G ₂) | 在以下界限方格确定的色品范围内: $y=0.243 \pm 0.079x$ $y=0.211x$ $y=0.636-0.982x$ | (0.233, 0.520) | 合格 |
| 备注: 1. 本报告为单项送样检测报告, 仅对来样负责; 2. 测试项目按委托方要求选择; 3. 检测结果是通过在制样品上随机选取6个测试点进行测试并计算平均值获得; 4. 本报告有效期至2015年08月25日。 | | | | |

检测: 王涛 审核: 王涛 批准: 王涛
 批准日期: 2013年08月26日

- Traffic Safety Supervision and Inspection Center of National Ministration of Transportation tested Green UHMWPE buoy (1.5m diameter) in Aug, 2013 according to IALA recommendation E-108, The surface colors used as Visual Signals in Aids to Navigation.
- It is tested at temperature of 23 degrees and humidity at 50% RH. The result is (0.233, 0.520) complying with IALA E-108 requirement.
- Six testing points were randomly selected on UHMWPE samples.



Ship Collision Test



船只以 12 海里/小时速度撞击浮标瞬间
The moment that a ship impact on a buoy at speed of 12 nautical miles per hour.



撞击后灯器完好，未发现损坏
The light was found to be in good condition after impact.



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Nº 12000817



撞击后灯器护圈未发现变形
The anti-collision protector were found undeformed after impact.

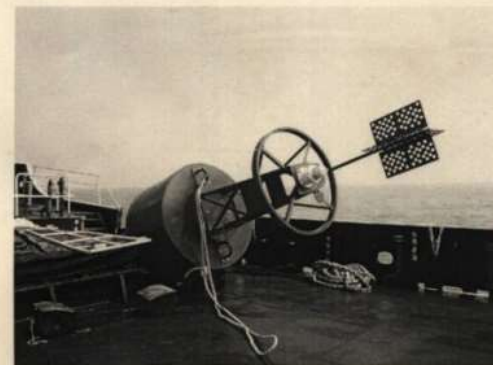


撞击后浮标本体略有划痕，但未发现破裂
A few scratches were found on the buoy but no cracking found after impact.



第 5 页, 共 5 页 / Page 5 of 5

Nº 12000818



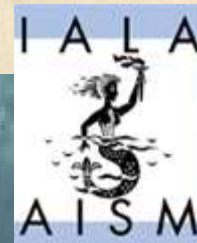
浮标整体外观
Overall appearance of buoy



撞击前浮标护圈及灯器
The anti-collision protector and light of buoy.



Nº 12000818



Ship Collision Test Report

China Classification Society Inspection

- 1.8m Buoy was impacted by a ship.
- No cracking of buoy body or ballast was found post collision
- No deformation found of UHMWPE guiding ring.
- No damage found to lanterns.

The image shows two pages of a Ship Collision Test Report from China Classification Society (CCS). The left page is the 'Inspection Report' (检验报告) and the right page is the 'Inspection Certificate' (检验证书).

Left Page: Inspection Report (检验报告)

Header: 中国船级社 CHINA CLASSIFICATION SOCIETY

Section: 检验报告 INSPECTION REPORT

Form Fields:

- Client: 山东烟台海洋工程机械有限公司
- Product: 1.8m Buoy
- Inspection Date: 2014.11.11
- Inspection Location: 山东烟台
- Inspection Result: 合格

Table: 检验结果 (Inspection Results)

| 检验项目 (Inspection Item) | 检验结果 (Inspection Result) | 备注 (Remarks) |
|------------------------|--------------------------|--------------|
| 外观检查 (外观检查) | 合格 | |
| 尺寸检查 (尺寸检查) | 合格 | |
| 材料检查 (材料检查) | 合格 | |
| 性能检查 (性能检查) | 合格 | |

Inspector: 张明 (Zhang Ming)

Date: 2014.11.11

Page 1 of 1

Right Page: Inspection Certificate (检验证书)

Header: 中国船级社 CHINA CLASSIFICATION SOCIETY

Section: 检验证书 INSPECTION CERTIFICATE

Form Fields:

- Client: 山东烟台海洋工程机械有限公司
- Product: 1.8m Buoy
- Inspection Date: 2014.11.11
- Inspection Location: 山东烟台
- Inspection Result: 合格

Inspector: 张明 (Zhang Ming)

Date: 2014.11.11

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Secondary Collision Test



- In January 2008, China Shanghai Maritime Bureau, Ningbo Beacon Department organized the ship impact test on the UHMWPE buoy, after front impact by the 500 tons sea patrol ship at 10 knots, UHMWPE buoy emerged from the stern, no damage happened to the ship or the buoy.

Maintenance of AtoN Structures

Maintaining UHMWPE

The true maintenance benefit of UHMWPE is a non-requirement to maintain or repair within the same time periods.

Due to the smooth surface and self-lubricating properties, UHMWPE is superior in deflecting marine growth. Similarly, due to high flexibility and impact resistance, UHMWPE is good at deflecting objects that would damage other plastics, or steel.

If undertaken, repairs are difficult to perform at sea. Current welding methods are both variations of compression welding, one where the heating is conducted via hot oil, the other electricity – similar to socket fusion.



Maintenance of AtoN Structures

The super structure is carbon steel, which is easy to be damaged due to collision and should be maintained every 2 years. The damaged super structure need to be repaired or replaced. There is abrasion between connection part of the lifting lug with the anchor shackle, so regular inspection is necessary, at least once each year . If serious abrasion occurs , it must be welded.

During the welding process, the lifting eyes must be cooled to prevent high temperature damaging to UHMWPE float.

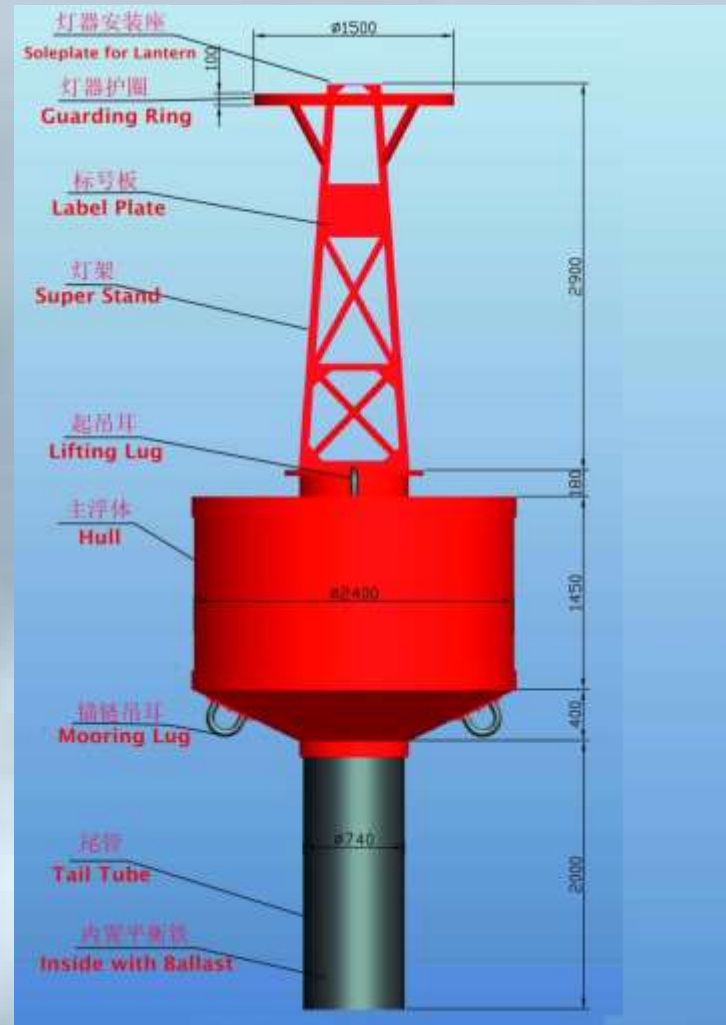


Extreme Environment AtoN Engineering

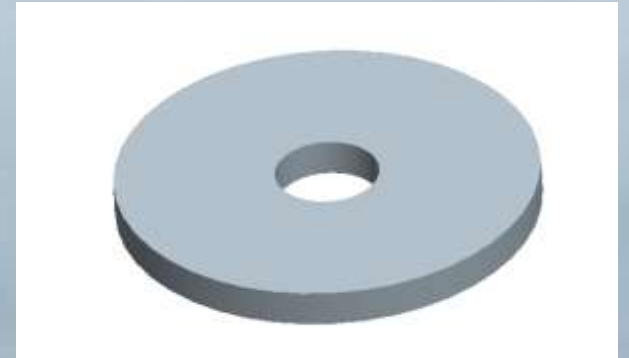
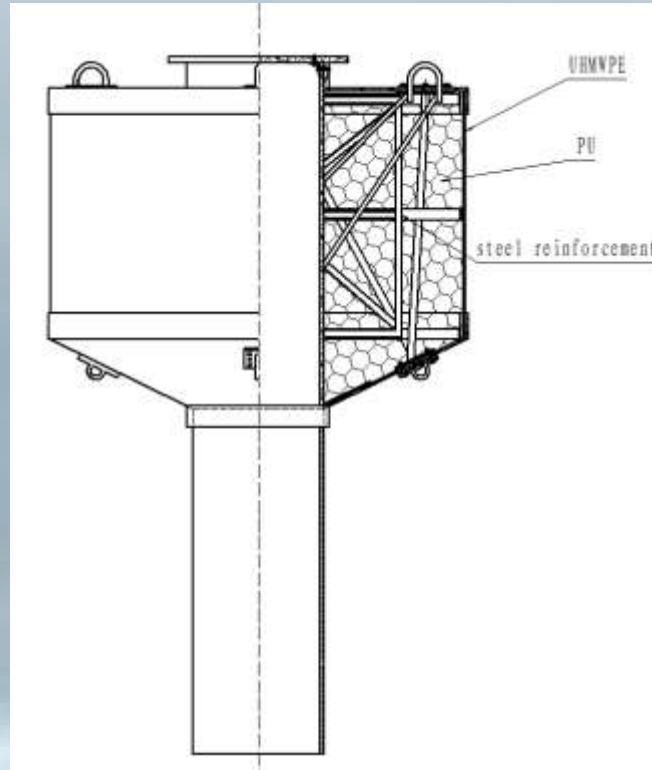
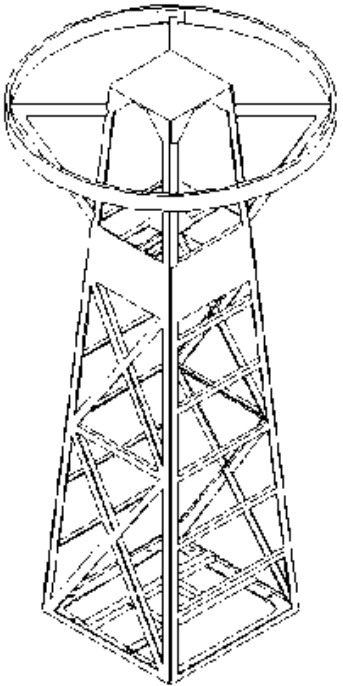
- Ice Buoys
- High Salinity
- Impact Resistance
- Marine growth reduction
- Fantastic under cold temperatures.
- Can handle high salinity or volatile chemical interaction.
- Impact Resistance far superior to other polyethylenes.
- Perfect for areas with high marine growth rates.



Navigation Buoy Design



Navigation Buoy Design

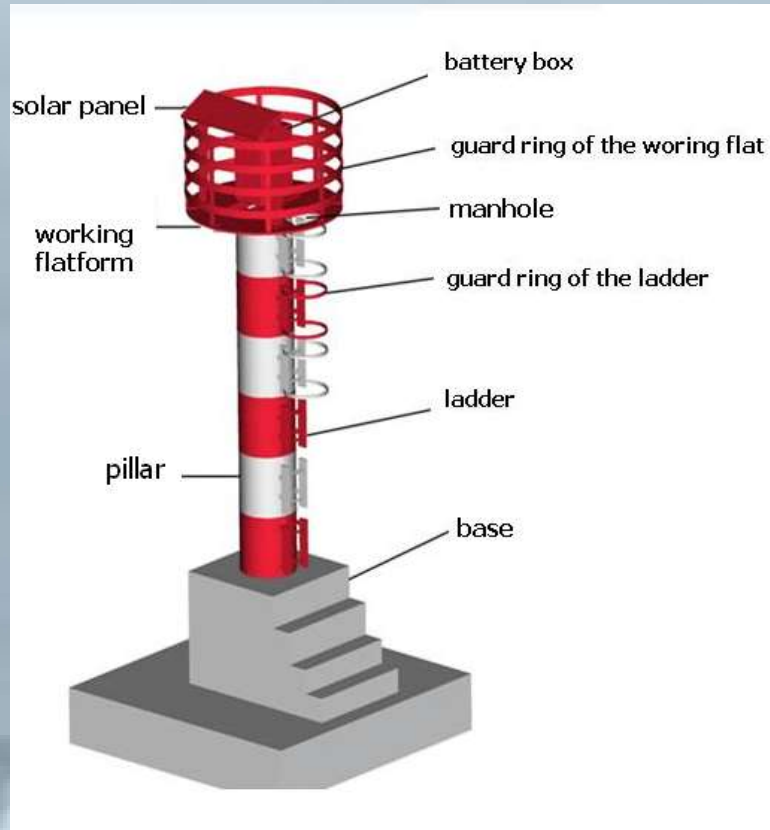


Other Navigation Buoy Designs





Light Beacon Design



- Parameter Design
- Connection Bolts, Foundation Bolts
- Pillar Strength
- Guarding / Rails
- Anti-Slip

Light Beacon Design

Maintenance Reduction

The UHMWPE light beacon can be installed quickly at the working site, and it (lantern excluded) is maintenance free without frequent painting.

Reduced lifting devices

With modular structure, the UHMWPE light beacon has unit height of 0.75-1.0m and weight of 65-150kg. Making the final structure more convenient to transport and install.

Wind and wave resistance

In local testing, the light beacon modules connection are designed to withstand waves and wind grades. In excess of 4 and Grade 12 respectively

Long service life

The service life of UHMWPE light beacon could reach more than 30 years.





Summary of UHMWPE potential in AtoN Structures

- Use of UHMWPE in Buoys and Beacons of any variation
- Impact Resistance
- Colour adherence to IALA chromaticity expectations
- UV anti-ageing
- Marine fouling resistance due to self-lubrication and smooth surface
- PU foam filled, steel superstructure modular design
- Factory specific QC requirements
- Can be recycled
- Excellent Elongation properties and flexible failure mode
- Superior Abrasion and Impact resistance
- Withstands ship collision without mooring difficulties
- Can be used in extreme environments
- Already adapted to Navigation Buoys, Environmental Buoys, Mooring Buoys, Marker Buoys, Special Marker Buoys, Cardinal Buoys, Ice Buoys, Power Generating/Tidal Buoys
- Compartmentalised Beacon structure already in use

