IALA

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PAINTING AIDS TO NAVIGATION BUOYS

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DOCUMENT REVISION

Revisions to this document are to be noted in the table prior to the issue of a revised document.

Date	Details	Approval
December 2005	Entire document reformatted to reflect IALA documentation hierarchy.	Council 37
December 2013	Section 5 Additional information on antifouling coatings.	Council 56
July 2022	Edition 2.2 Editorial corrections.	

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1. INTRODUCTION

This Guideline incorporates information from members of the IALA Engineering Committee who have experience operating steel, glass reinforced plastic (GRP) and moulded polyethylene buoys.

Paint systems have two functions:

- To provide protection from corrosion, in the case of steel buoys and oxidation and ultraviolet degradation, in the case of plastic buoys.
- To provide the signal colour to be seen by the mariner.

The quality of the finished paint system will define the effective working life of the buoy. The high cost of surface preparation and complex application systems associated with modern high performance paint systems may be justifiable when the operating life of a buoy can be extended from two years to five years.

2. PAINTING OF STEEL BUOYS

Information has been received from Sweden, Germany, Canada, England and the USA regarding their paint systems designed to provide in excess of five years of working life for steel buoys.

2.1. PREPARATION

In order to obtain the full life and hence realize the value of a modern high performance paint system, the surface to which the paint is to be applied must be correctly prepared, and the paint application conditions must meet all of the paint manufacturer's requirements.

If the buoy has been in service, it is usually water jetted with high pressure fresh water to remove marine growth, salt products and loose paint. This can be carried out on the servicing vessel, at the marine depot, or possibly by a specialist contractor, depending on the operating practice of the particular service.

The next process is abrasive blasting to remove old paint systems and/or clean the surface of the steel to make this surface suitable for paint application. The standard usually used is SA2½ which means blast cleaning to a uniform near white surface. Abrasive blast cleaning also produces an essentially rough surface which helps the adhesion of the paint system. There are various types of abrasives in use which may be cast iron, steel or a mineral grit. Abrasives containing copper slag should not be used, and health and safety regulations prevent the use of silica (sand) based abrasives.

After blast cleaning, the buoy must be maintained at a sufficiently high temperature and low humidity so that corrosion does not start before paint is applied. The paint manufacturer will specify minimum painting temperature and temperature level above the dew point. In cold and damp climates this will require the buoy to be kept in a heated building.

Variations on this process include abrasive water jetting, when abrasive particles are carried in a high-pressure water jet, and very high-pressure water blasting. Both have the advantage of containing all waste products in a water mixture, thus reducing environmental hazards. Specially formulated paint systems are required to prime the water blasted steel and specific environmental conditions must be provided.

2.2. PAINT

2.2.1. PRIMING SYSTEM

Most authorities use a high build epoxy paint system to provide the required corrosion protection. This is applied by a high-pressure airless spray system. With two coats of paint, a final film thickness of 250 or 300 microns will be achieved which can provide corrosion protection for at least 5 years. There are many formulations of high build epoxy developed for marine use. The epoxy may be "filled" with iron oxide, mica or zinc.

Recent developments include glass flake epoxy, which has very high abrasion resistance and can be applied in one coat to achieve a 300 - 400 micron dry film thickness.

The epoxy high build system provides the corrosion protection to the steelwork and must be applied in conditions strictly in accordance with the manufacturer's recommendations.

2.2.2. COLOUR COAT

The high build system is followed by a colour coating to provide the signal colour for the buoy.

The trend is towards two-component polyurethane colour coatings because of their excellent gloss retention properties. There are, however, serious concerns regarding the safety of the isocyanate components of these paints and there have been developments in high gloss, modified epoxy systems which have gloss retention performances similar to polyurethane.

An antifouling coating may be applied on the buoy sides and below the waterline. This can be in the required signal colour if this is available as an antifouling paint. See section 5.

2.2.3. PAINT SYSTEMS

It is generally preferred to use all products from one manufacturer when painting a buoy, to ensure that the various coatings will be compatible and will adhere well to each other.

2.3. INTERNAL COATINGS

A wide variety of coatings have been used on the inside surfaces of steel buoys. These range from vegetable oil systems applied hot to untreated steelwork, to complete internal blasting and the application of a single coat of epoxy paint. Provided that the inside of the buoy remains completely sealed, there should be little chance of corrosion. One of the oil or wax based products designed to protect hollow structural steelwork or steel tanks should be adequate for buoys although some authorities prefer a conventional oil-based paint which dries to a hard surface and allows subsequent internal working in the buoy body.

The health and safety aspects of the coating application inside the buoy will be an important factor when specifying internal coating products.

2.4. APPLICATION

The high-performance paints discussed above, that is high build epoxies and polyurethane, are all two component systems where the base and curing agents are mixed together when they will react to provide a tough, long lasting paint film. The long-term performance of the paint is entirely dependent on the paint being applied and allowed to cure in the conditions specified by the paint manufacturer. The cost, particularly in cold countries, of providing suitable heated facilities with ventilation systems that meet local health and safety regulations may be prohibitive. It may be more economical to have the painting carried out by a specialist contractor who will already have such facilities.

3. PAINTING OF GLASS REINFORCED PLASTIC (GRP) BUOYS

3.1. COSMETIC REPAIR

When a GRP buoy has been in service for any length of time, the surface of the GRP, the gelcoat, will begin to fade. This is a result of the attack by ultraviolet (UV) light present in sunlight. Conditions can occur which cause loss of gloss and “chalking”, where the surface gradually breaks down to a powder. Polishing with marine grade wax polish may delay this, but eventually, a paint system will be needed to protect the gelcoat surface and provide the required glossy colour finish.

3.2. PREPARING GRP SURFACE FOR PAINTING

Special releasing agents are used during the manufacturing process to allow the removal of the buoy from its mould. It is essential that these agents are removed from the surface before painting. The buoy must be cleaned with a de-greasing agent which can be obtained from paint manufacturers. This is usually left on the buoy for 10-20 minutes before washing off. This should ensure that all grease and release agents are removed.

Wash again with fresh water. If the surface is completely clear of grease, the water will spread out evenly on the surface. If grease is still present, the water will form small droplets which will indicate more cleaning is necessary with the de-greasing agent.

Any minor cracks and blemishes can be filled with an epoxy filler. Only epoxy-based fillers should be used to ensure long term adhesion and water resistance.

To ensure good adhesion of the paint, the surface must be abraded with a fine grade abrasive paper. Wet and dry abrasive paper may be used if a high gloss finish is required.

All sanding dust should be removed before painting proceeds.

3.3. PRIMING

The purpose of priming is to provide protection to the substrate and to promote good adhesion of the paint system. For the best long-term protection, a coat of an epoxy primer should be applied prior to the selected finishing coating.

If the surface is in very good condition, it may not be necessary to apply a separate primer as the undercoat for the paint will provide the necessary adhesion. If the surface has become “chalked” it can absorb solvents from the paint system, which can cause micro blistering problems later. To avoid this, an epoxy primer system should be applied to the surface. This will seal the surface and provide a stable base for the paint system.

3.4. FINISHING COATS

Two component polyurethane paint is the usual choice for the undercoat and topcoat of the required colour in order to achieve the longest possible life and gloss retention.

3.5. APPLICATION

Both epoxy and polyurethane paints can be applied by brush, roller or spray depending on the surface area involved and the facilities available. The paint manufacturer’s advice must be strictly followed concerning the application conditions (temperature and humidity) and over-coating times. These factors are most critical with these sophisticated paint systems.

Suitable safety equipment must be provided for those applying the paint, particularly if spray systems are used. The site must meet the national health and safety regulations for the types of paint to be used.

3.6. UNDERWATER AREAS

Submerged areas of the buoy which do not form part of the colour daymark may be painted with at least three coats of an underwater epoxy system to provide a water barrier for the GRP structure. This may be followed by a coat of antifouling paint, where this is used. Ensure that the antifouling is compatible with the epoxy.

It is suggested that all the paints used on a buoy should by supplied by one manufacturer who should guarantee that they are compatible and form a recommended paint system.

3.7. MAJOR SURFACE DETERIORATION

If the gelcoat is extensively grazed, flaking, blistering or contains many bubbles, then the gelcoat should be removed by power sanding or grit blasting. This must be undertaken by experienced personnel to ensure that the glass fibre structure of the buoy is not damaged. The buoy should then be pressure washed with fresh water and allowed to thoroughly dry in conditions of controlled temperature and humidity. Coatings of solvent free epoxy are then applied, again in controlled climatic conditions, to form an impermeable barrier on the surface of the GRP moulding. Four or five coats are usually necessary, and these may be followed by coats of polyurethane paint in areas where the signal colour of the buoy is required.

The directions of the epoxy supplier should be carefully followed and advice sought on all stages of this process.

4. PAINTING OF MOULDED POLYETHYLENE BUOYS

4.1. SURFACE PREPARATION AND PAINTING

Polyethylene buoys are usually rotationally moulded in steel moulds. The moulded surface is smooth and naturally “slippery”, upon which it is very difficult to achieve paint adhesion. Some success has been obtained by abrading the surface of the plastic with a medium grade abrasive paper and then painting with a two-component polyurethane paint system. The effectiveness of this process may vary depending on the grade of polyethylene used in the manufacture of the buoy.

4.2. FLAME SPRAYING

A substantial new surface can be formed by flame spraying new plastic onto the surface of the original moulding. This involves using a proprietary spraying system which projects plastic powder through a gas flame to deposit a molten layer of new plastic. Materials of any colour can be sprayed on and a considerable thickness can be built up if this is required.

5. ANTIFOULING COATING

There are various opinions regarding the use and efficacy of antifouling paint. National regulations may restrict the type of antifouling that can be used.

The conventionally available antifouling coatings will achieve up to three years of antifouling performance, although modern developments with non-toxic formulas claim to offer longer performance life significantly.

Alternative coatings and antifouling systems include:

- Biocide coatings - this is usually copper.
- Non-toxic coatings (slippery):
  - Silicon based coating
  - Fluoropolymer based coating
- Impressed electrical current systems

Each of these will delay the formation of a weed coating on the buoy to a lesser or greater extent and will probably make it easier to remove any weed that does adhere by water jetting or scrubbing.

The slippery types of coating will make the removal of any marine fouling considerably easier than would be the case with conventional antifouling coatings.

Figure 1 Spar buoy painted with fluoropolymer paint

Figure 1 shows a spar buoy being lifted from the water following one year in service. The lower floatation section has been painted with a fluoropolymer antifouling coating compared to the spar and ladder section which has been painted with traditional epoxy-based paint.

The paint scheme in the illustration, consists firstly of a layer of anti-corrosion epoxy, followed by a tie coat, and a final coating with a fluoropolymer-based paint which gives an elastic, soft and rubbery surface texture.

The environmental condition for the application of the fluoropolymer paint are particularly critical as is the over coating time. Once the paint components have been mixed, they must be utilized within a very specific time frame. It is essential therefore, to plan the time and material necessary to complete the application of the paint system.

6. SAFETY

6.1. PERSONNEL SAFETY

Most paints are in some way hazardous to personnel using them. Suitable protective clothing and respiratory protection must be provided and its use monitored to ensure that no personnel are at risk from paint particles or solvent fumes. Paint manufacturers will provide advice, as will local health and safety specialists.

6.2. TRAINING

Operators must be fully trained in the use of all equipment and in the mixing and application of all the types of paint, they will use. The paint manufacturers are usually helpful in arranging operator training. It is important that operator training is reviewed if paint types are changed.

6.3. ENVIRONMENTAL LEGISLATION

Many of the processes described previously fall within areas of health and safety and environmental legislation. The following is a list of the types of legislation that should be studied:

1 Grit blasting:

- a Emission of dust
- b Type of abrasive
- c Disposal of waste products, particularly dust from old lead paint or antifouling paint
- d Protective clothing and breathing equipment
- e Personal safety equipment for operators

2 Painting:

- a Volatile solvent content of paints
- b Solvent emission in working areas
- c Allowable emissions to atmosphere
- d Working conditions in painting area
- e Protective clothing and breathing equipment for operators
- f Safety of, particularly, airless spray equipment

7. BUOY HANDLING

The methods of handling newly painted buoys must be carefully considered. There is little point in providing a high-quality paint coating and then damaging this by careless handling before the buoy is in the water. This is a particular problem with heavy steel buoys. Pallets can be designed which allow buoys to be moved by forklift trucks, otherwise, extreme care must be taken to prevent crane hooks from damaging new paint. Chocks must be carefully padded if the buoy has to be laid on its side, as must lashings used aboard ship.

During servicing, weed should not be removed from painted buoys with mechanical scrapers. These will cause serious damage to the paint film and shorten the life of the paint system. The hard surface of both epoxy and polyurethane paint systems allows relatively easy weed removal by water jetting or scrubbing and these should be the only methods used.

8. DEFINITIONS

The definitions of terms used in this Guideline can be found in the *International Dictionary of Marine Aids to Navigation* (IALA Dictionary) at http://www.iala-aism.org/wiki/dictionary and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

9. ABBREVIATIONS

GRP	Glass reinforced plastic (fibreglass)
nm	Nanometre
UV	Ultraviolet (light) (10 – 380 nm)